MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY (MIST)



<u>SYLLABUS OF</u> BACHELOR OF SCIENCE IN BIOMEDICAL ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING (BME)

March 2024

COMMITTEE FOR SYLLABUS REVIEW – BME DEPT, MIST

The undergraduate course curriculum of the Department of Biomedical Engineering (BME), Military Institute of Science and Technology (MIST) has been reviewed by the committee as mentioned below and will be implemented from academic session 2024-2025 (Batch BME-10) and onwards.

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CHAPTER 1 GENERAL INFORMATION

1.1 Introduction to MIST

The necessity of establishing a technical institute for the Bangladesh Armed Forces was felt in the late eighties. In the absence of such an institution, officers of Bangladesh Armed Forces had been graduating from Bangladesh University of Engineering and Technology (BUET), Bangladesh Institute of Technology (BIT) and other foreign institutions of science and technology. Intending to meet the increasing demand for the development and dissemination of engineering and technological knowledge, Bangladesh Armed Forces established the Military Institute of Science and Technology (MIST) that promises to provide facilities for higher technical education both for the officers of Bangladesh Armed Forces as well as for civil students from home and abroad. The motto of MIST is -Technology for Advancement. Founded on 19 April 1998, MIST started its journey on 31 January 1999 by offering a four-year bachelor's degree in Civil Engineering. Bachelor degree in Computer Science Engineering course started in 2001. Bachelor courses in Electrical, Electronic & Communication Engineering and Mechanical Engineering started its journey from 2003. Bachelor of Science program on Aeronautical Engineering (AE) and Naval Architecture and Marine Engineering (NAME) program were started from 2008-2009 and 2012-2013 respectively. Besides, four new departments started their academic session from 2014-2015, i.e. Nuclear Science & Engineering (NSE), Biomedical Engineering (BME), Architecture (Arch) and Environmental, Water Resources & Coastal Engineering (EWCE).

1.2 Vision and Mission of MIST

Vision: To be a centre of excellence for providing advanced quality education in the field of science, engineering, and technology advanced to create diverse quality leaders and professionals and conduct innovative research to meet the national and global needs and challenges.

Mission: MIST is working on the following missions:

- a. To develop as a Centre of Excellence for providing comprehensive education and conducting creative and innovative research in diverse disciplines of engineering, technology, science, management and related fields.
- b. To produce technologically advanced intellectual leaders and professionals with high moral and ethical values to meet the national and global needs for sustainable socioeconomic development.

- c. To provide consultancy, advisory and testing services to government, industrial, educational and other organizations to render technical support for widening practical knowledge and to contribute to sustainable socio-economic advancement.
- d. To extend collaborative and research activities with national and international communities for life-long learning and long term interaction with the academician and industry.

1.3 <u>Motto and Values of MIST</u>

Motto: As an Institution without gender biasness, MIST is steadily upholding its motto "Technology for Advancement" and remains committed to contributing to the wider spectrum of national educational arena, play a significant role in the development of human resources and gradually pursuing its goal to grow into a 'Centre of 'Excellence'.

Values:

- a. Integrity and Respect-We embrace honesty, inclusivity, and equity in all that we do.
- **b.** Honesty and Accountability-Our actions reflect our values, and we are accountable for both.
- **c.** Dedication to Quality and Intellectual Rigour-We strive for excellence with energy, commitment, and passion.
- **d. Pursuit of Innovation**-We cultivate creativity, adaptability, and flexibility in our student, faculty, and staff.

1.4 Eligibility of Students for Admission in MIST

The students must fulfill the following requirements:

- a. **Bangladeshi Students.** Minimum qualifications to take part in the admission test are as follows:
 - 1) **SSC Examination (or Equivalent).** The applicant must have passed the examination in Science Group obtaining a minimum GPA of 4.00 (without fourth subject) on the scale of 5.0. Only the applicants who passed SSC or Equivalent Examination in Corresponding current and previous one year can apply.
 - 2) **HSC Examination (or Equivalent).** The applicants passed in current and previous one year must obtain minimum total grade point 17 in four subjects (Mathematics, Physics, Chemistry and English).

- 3) GCE ('O' and 'A' Levels or Equivalent) who have passed HSC or equivalent examination in the current year or one year before the notification for admission can apply.
 - a) The applicant who passed in current and previous one year must have qualified with minimum 'B' grade in five subjects including Mathematics, Physics, Chemistry, and English in GCE 'O' Level.
 - b) The applicant who passed in current and previous one year must have minimum two 'B' grades and one 'C' grade in Mathematics, Physics, and Chemistry in GCE 'A' Level.
- 4) Applicants interested in Biomedical Engineering must have Biology at HSC or equivalent level with a minimum grade point of 'A-' / GCE 'A' or equivalent level with a minimum grade point of 'C'.
- b. **Foreign Students.** Maximum 3% of overall vacancies available will be kept reserved for the foreign students and will be offered to foreign countries through AFD of the Government of the People's Republic of Bangladesh. Applicants must fulfill the following requirements:
 - 1) Educational qualifications as applicable for Bangladeshi civil students or equivalent.
 - 2) Must have security clearance from respective Embassy/High Commission in Bangladesh.
 - 3) Sex: Male and Female.

* In the event of non-availability of foreign students, Bangladeshi civil candidates will fill up the vacancies.

1.5 <u>Number of Seats</u>

The highest number of seats for 04 (Four) years Bachelor Degree in Engineering programs (Unit -A) and 5 (Five) years Bachelor Degree of Architecture programs are as follows:

Allocation of Seats

Ser	Unit	Department	Seats
1	•	Civil Engineering (CE)	120
2	Α	Computer Science and Engineering (CSE)	120

General Information

		Total=	860
12	В	Architecture (Arch)	25
11		Petroleum and Mining Engineering (PME	25
10		Industrial and Production Engineering (IPE)	50
9		Environmental, Water Resources and Coastal Engineering (EWCE)	60
8		Nuclear Science and Engineering (NSE)	40
7		Biomedical Engineering (BME)	40
6		Naval Architecture and Marine Engineering (NAME)	40
5		Aeronautical Engineering (AE)	100
4		Mechanical Engineering (ME)	120
3		Electrical, Electronic & Communication Engineering (EECE)	120

The total number is 860. In general, about 50% seats will be allocated to military officers. However, in case of the requirement of military students vacancy is less in any particular year, the deficient vacancy will be filled up by civil students. MIST also maintains quota as mentioned below:

Ser	Quota Allocation	Seats
1	General Candidates	54%
2	Children of Military Personnel	40%
3	Children of Freedom Fighters	2%
4	Tribal Citizen	1%
5	International Students	3%
	Total=	100%

1.6 Admission Procedure

1.6.1 Syllabus for Admission Test.

Admission test will be conducted on the basis of the syllabus of Mathematics, Physics, Chemistry and English (comprehension and functional) subjects of HSC examinations of all boards of secondary and higher secondary school certificates. Admission test will be conducted out of 200 marks and the distribution of marks is given below:

Ser.	Subjects	Marks
a.	Mathematics	90
b.	Physics	70
c.	Chemistry	30
d.	English	10
	Total=	200

1.6.2 Final Selection

Students will be selected on the basis of results of the admission test. The individual choice for selection of departments will be given preference as far as possible. In case of tie in the result of admission test, the difference will be judged on the basis of marks obtained in Mathematics, Physics, Chemistry and English respectively in admission test.

1.6.3 Medical Checkup

Civil candidates selected through admission test will go for medical checkup in MIST/CMH. If the medical authority considers any candidate unfit for study in MIST due to critical/contagious/mental diseases as shown in medical policy of MIST will be declared unsuitable for admission.

1.7 <u>Students Withdrawal Policy</u>

1.7.1 For Poor Academic Performance

The undergraduate (B.Sc.) Engineering programs for all engineering disciplines are planned for 04 regular levels, comprising of 08 regular terms for Architecture program, it is planned for 3 & regular levels, comprising of 10 regular terms. It is expected that all students will

earn degree by clearing all the offered courses in the stipulated time. In case of failure, the following policies will be adopted:

- a. Students failing in any course/subject will have to clear/pass the said course/subject by appearing it in supplementary/self-study (for graduating student) examination as per examination policy.
- b. Students may also retake the failed subject/course in regular term/short term as per Examination policy.
- c. Maximum grading for supplementary/self-study examination etc. of failed subjects will be B+ as per examination policy.
- d. One student can retake/reappear in a failed subject/course only twice. However, with the Permission of Academic Council of MIST, a student may be allowed for third time as last chance.
- e. In case of sickness, which leads to missing of more than 40% classes or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw temporarily from that term and repeat the whole level with the regular level in the next academic session, subject to the approval of Academic Council, MIST. However, he/she has to complete the whole undergraduate program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.
- f. Minimum credit requirement for the award of bachelor's degree in Engineering (B.Sc. Engg) and Architecture (B. Arch) will be decided by the respective department as per existing rules. However, the minimum CGPA requirement for obtaining a bachelor degree in engineering and Architecture is 2.20.
- g. Whatever may be the cases, students have to complete the whole undergraduate Program within 06 (six) academic years from the date of registration.
- h. All other terms and condition of MIST Examination Policy remain valid.

1.7.2 Withdrawal on Disciplinary Ground

- **a.** Unfair Means. Adoption of unfair means may result in expulsion of a student from the programme and so from the Institution. The Academic Council will authorize such expulsion on the basis of recommendation of the Disciplinary Committee, MIST and as per policy approved by the affiliating university. Following would be considered as unfair means adopted during examinations and other contexts:
 - > Communicating with fellow students for obtaining help in the examination

- Copying from another student's script/ report /paper
- > Copying from desk or palm of a hand or other incrimination documents
- Possession of any incriminating document whether used or not
- **b.** Influencing Grades. Academic Council may expel/withdraw any student for approaching directly or indirectly in any form to influence a teacher or MIST authority for grades.
- c. Other Indiscipline Behaviors. Academic Council may withdraw/expel any student on disciplinary ground if any form of indiscipline or unruly behavior is seen in him/her which may disrupt the academic environment/program or is considered detrimental to ' 'MIST's image.
- **d. Immediate Action by the Disciplinary Committee of MIST.** The Disciplinary Committee, MIST may take immediate disciplinary action against any student of the institution. But later the approval of BUP has to be taken. In case of withdrawal/expulsion, the matter will have to be referred later to the next academic Council, MIST.

1.7.3 Withdrawal on Own Accord.

- **a. Permanent Withdrawal.** A student who has already completed some courses and has not performed satisfactorily may apply for a withdrawal.
- **b.** Temporary Withdrawal. A student, if he/she applies, may be allowed to withdraw temporarily from the program, subject to approval of Academic Council of MIST, but he/she has to complete the whole program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.
- **c. Permanent Expulsion** The term 'Permanent Expulsion' means expulsion permanently from the institution on disciplinary ground. A student, if expelled permanently will never be allowed to re-enter the course or similar program in MIST and be subjected to other terms and conditions as set by the authority while approving the permanent expulsion order.
- **d. Temporary Expulsion** The term 'Temporary Expulsion' means expulsion from an academic course/program for a certain period on disciplinary ground. A student, if expelled temporarily, may be allowed to re-enter the course/program on expiry of the punishment period and on fulfilment of other terms and conditions (if any) as set by the authority while approving the temporary expulsion order.

CHAPTER 2

RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAMS AT MIST

2.1 <u>Introduction</u>

MIST has introduced course system for undergraduate studies from the academic session 2017-18. Therefore, the rules and regulations mentioned in this paper will be applicable to students for administering undergraduate curriculum through the Course System. This will be introduced with an aim of creating a continuous, even and consistent workload throughout the term for the students.

2.2 <u>The Course System</u>

a. The salient features of the Course System are as follows:

Number of theory courses will be generally 5 in each term. However, with the recommendation of course coordinator and Head of the Department, Commandant MIST may allow relaxation in this regard. This relaxation is to be reported to Academic Council of MIST.

- 1) Students will not face any level repeat for failing
- 2) Students will get scope to improve their grading
- 3) Introduction of more optional courses to enable the students to select courses according to their individual needs and preferences
- 4) Continuous evaluation of 'students' performance
- 5) Promotion of student-teacher interaction and contact
- **b.** Beside the professional courses pertaining to each discipline, the undergraduate curriculum gives a strong emphasis on acquiring thorough knowledge in the basic sciences of mathematics, physics and chemistry. Due importance is also given on the study of several subjects in humanities and social sciences.
- **c.** The first two years of ' 'bachelor's degree programs generally consist of courses on basic engineering, general science and humanities subjects; while the third and subsequent years focus on specific disciplines.

2.3 <u>Number of Terms in a Year</u>

There will be two terms Spring Term (Jan-Jun) and Fall Term (Jul-Dec) in an academic year.

2.4 **Duration of Terms**

The duration of each of Spring Term and Fall Term (maximum 22 weeks) may be as under:

Ser	Events	Duration
1.	Classes before Midterm	7 weeks
2.	Midterm Vacation	1 week
3.	Classes after Midterm	7 weeks
4.	Makeup Classes and Preparatory leave	2/3 weeks
5.	Term Final Examination	2/3 weeks
6.	Term End Vacation	1/2 weeks

2.5 <u>Course Pattern and Credit Structure</u>

The undergraduate program is covered by a set of theoretical courses along with a set of laboratories (sessional) courses to support them.

2.6 <u>Course Designation System</u>

Each course is designated by a maximum of four-letter code identifying the department offering the course followed by a three-digit number having the following interpretation:

- a. The first digit corresponds to the year/level in which the course is normally taken by the students.
- b. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.
- c. The last digit is an odd number for theoretical courses and an even number for sessional courses.

The course designation system is illustrated as follows:



2.7 Assignment of Credits

The assignment of credits to a theoretical course follows a different rule from that of a sessional course.

- a. Theoretical Courses: One lecture per week per term is equivalent to one credit.
- **b.** Sessional Courses: Credits for sessional courses is half of the class hours per week per term.

c. Credits are also assigned to project and thesis work taken by the students. The amount of credits assigned to such work varies from one discipline to another.

2.8 <u>Types of Courses</u>

The types of courses included in the undergraduate curricula are divided into the following groups:

- **a.** Core Courses: In each discipline, a number of courses are identified as core courses, which form the nucleus of the respective bachelor's degree program. A student has to complete all designated core courses of his/her discipline.
- **b. Prerequisite Courses:** Some of the core courses are identified as prerequisite courses for a specific subject.
- **c. Optional Courses:** Apart from the core courses, the students can choose from the set of optional courses. A required number of optional courses from a specified group have to be chosen.

2.9 <u>Course Offering and Instruction</u>

- **a.** The courses to be offered in a particular term are announced and published in the Course Catalog along with the tentative Term Schedule before the end of the previous term. The courses to be offered in any term will be decided by Board of Undergraduate Studies (BUGS) of the respective department.
- **b.** Each course is conducted by a course teacher who is responsible for maintaining the expected standard of the course and for the assessment of 'students' performance. Depending on the strength of registered students (i.e. on the number of students) enrolled for the course, the teacher concerned might have course associates and Teaching Assistants (TA) to aid in teaching and assessment.

2.10 <u>Teacher Student Interaction</u>

The new course system encourages students to come in close contact with the teachers. For promotion of a high level of teacher-student interaction, each student is assigned to an adviser and the student is free to discuss all academic matters with his/her adviser. Students are also encouraged to meet any time with other teachers for help and guidance in academic matters. However, students are not allowed to interact with teachers after the moderation of questions.

2.11 <u>Student's Adviser</u>

- a. One adviser is normally appointed for a group of students by the BUGS of the concerned department. The adviser advises each student about the courses to be taken in each term by discussing the academic program of that particular term with the student.
- b. However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the ' 'student's specific plan of study and monitor subsequent progress of the student.
- c. For a student of second and subsequent terms, the number and nature of courses for which he/she can register are decided on the basis of academic performance during the previous term. The adviser may permit the student to drop one or more courses based on previous academic performance.

2.12 Course Registration

Any student who uses classroom, laboratory facilities or faculty-time is required to register formally. Upon admission to the MIST, students are assigned to advisers. These advisers guide the students in choosing and registering courses.

2.12.1 Registration Procedure

At the commencement of each term, each student has to register for courses in consultation with and under the guidance of his/her adviser. The date, time and venue of registration are announced in advance by the ' 'Registrar's Office. Counseling and advising are accomplished at this time. It is absolutely essential that all the students be present for registration at the specified time.

2.12.2 **Pre-conditions for Registration**

- a. For first year students, department-wise enrollment/admission is mandatory prior to registration. At the beginning of the first term, an orientation program will be conducted for them where they are handed over with the registration package on submission of the enrolment slip.
- b. Any student, other than the new batch, with outstanding dues to the MIST or a hall of residence is not permitted to register. Each student must clear their dues and obtain a clearance certificate, upon production of which, he/she will be given necessary Course Registration Forms to perform course registration.

c. A student is allowed to register in a particular course subject to the class capacity constraints and satisfaction of prerequisite courses. However, even if a student fails in a prerequisite course in any term, the concerned department (BUGS) may allow him/her to register for a course which depends upon the prerequisite course provided that his/her attendance and performance in the continuous assessment of the mentioned prerequisite course is found to be satisfactory.

2.12.3 Registration Deadline.

Each student must register for the courses to be taken before the commencement of each term. Late registration is permitted only during the first week of classes. Late registration after this date will not be accepted unless the student submits a written application to the registrar through the concerned Head of the department explaining the reasons for delay. Acceptable reasons may be medical problems with supporting documents from the Medical Officer of MIST or some other academic commitments that prohibit enrollment prior to the last date of registration.

2.12.4 Penalty for Late Registration

Students who fail to register during the designated dates for registration are charged a late registration fee of Tk. 100.00 (One hundred only) per credit hours. Penalty for late registration will not be waived.

2.12.5 Limits on the Credit Hours to be taken

- **a.** A student should be enrolled for at least 15 credit hours and is allowed to take a maximum of 24 credit hours. Relaxation on minimum credit hours may be allowed. A student must enroll for the sessional courses prescribed in a particular term within the allowable credit hour limits.
- **b.** In special cases where it is not possible to allot the minimum required 15 credit hours to a student, the concerned department (BUGS) may permit with the approval of the Comdt, a lesser number of credit hours to suit individual requirements. Such cases are also applicable to students of Level 4 requiring less than 15 credit hours for graduation.

2.12.6 Course Add/Drop

a. A student has some limited options to add or drop courses from the registration list. Addition of courses is allowed only within the first two weeks of a regular term and only during the first week of a short term. Dropping a course is permitted within the first four weeks of a regular term and two weeks of a short term.

- b. Any student willing to add or drop courses has to fill up a Course Adjustment Form. This also has to be done in consultation with and under the guidance of the 'student's respective adviser. The original copy of the Course Adjustment Form has to be submitted to the 'Registrar's Office, where the required numbers of photocopies are made for distribution to the concerned adviser, Head, Dean, Controller of Examinations and the student.
- **c.** All changes must be approved by the adviser and the Head of the concerned department. The Course Adjustment Form has to be submitted after being signed by the concerned persons.

2.12.7 Withdrawal from a Term

If a student is unable to complete the Term Final Examination due to serious illness or serious accident, he/she may apply to the Head of the degree-awarding department for total withdrawal from the term before commencement of term final examination. However, application may be considered during term final examination in special case. The application must be supported by a medical certificate from the Medical Officer of MIST. The concerned student may opt for retaining the sessional courses of the term. The Academic Council will take the final decision about such applications. However, the total duration for graduation will not exceed 6 academic years.

2.13 <u>The Grading System</u>

The total performance of a student in a given course is based on a scheme of continuous assessment, for theory courses this continuous assessment is made through a set of quizzes, class tests, class evaluation, class participation, homework assignment and a term final examination. The assessments for sessional courses are made by evaluating performance of the student at work during the class, viva-voce during laboratory hours and quizzes. Besides that, at the end there will be a final lab test. Each course has a certain number of credits, which describes its corresponding weightages. A student's performance is measured by the number of credits completed satisfactorily and by the weighted average of the grade points earned. A minimum grade point average (GPA) is essential for satisfactory progress. A minimum number of earned credits also have to be acquired in order to qualify for the degree. Letter grades and corresponding grade points will be given as follows:

Numerical Markings	Grade	Grade Points
80% and above	A+	4.00
75% to below 80%	A	3.75
70% to below 75%	A-	3.50
65% to below 70%	B+	3.25
60% to below 65%	В	3.00
55% to below 60%	B-	2.75
50% to below 55%	C+	2.50
45% to below 50%	С	2.25
40% to below 45%	D	2.00
below 40%	F*	0.00
Incomplete	I	-
Withdrawal	W	-
Capstone Project/Thesis Continuation	X	-

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*Subject in which the student gets F grade shall not be regarded as earned credit hours for the calculation of Grade Point Average (GPA).

2.14 **Distribution of Marks**

2.14.1 Theory

Forty percent (40%) of marks of a theoretical course shall be allotted for continuous assessment, i.e. quizzes, home assignments, class tests, observations/ class participation and class attendance. This mark must be submitted to Office of the Controller of Examinations before commencement of final exam. The rest of the marks will be allotted to the Term Final Examination. The duration of final examination will be three (03) hours. The scheme of continuous assessment that a particular teacher would follow for a course will be announced on the first day of the classes.

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Distribution of marks for a given course per credit is as follows	Marks
Class Performance	5%
Class Attendance	5%
Class Test/ Assignment	20%
Midterm Assessment (Exam/Project)	10%
Final Examination (Section A & B)	60%
Total =	100%

Note:

- a. In final exam, each section can be used for achieving not more than two course outcomes (COs). The remaining COs should be attained from mid-term assessment or class tests. Course teacher has to inform the student the beginning of the terms.
- b. Course teacher of a particular course has to inform the department whether he/she wants to assess mid-term through exam or project within first two weeks of beginning of a term. The duration of mid-term examination should not be more than 50 minutes which has to be conducted in between 6th to 9th week of a semester. If mid-term assessment is done through project, then there should be project report and presentation.
- c. The weightage of class performance can be assessed through checking attentiveness during classes or arranging unnoticed pop quizzes.
- d. The number of class tests shall be n for 3.0 and above credit courses and (n-1) shall be considered for grading where n is the number of credits of the course. However, for courses having credits below 3.0, the considered class tests shall be 2 out of 3.
- e. All class test will carry 20 marks each. Exam software system will finally convert these achieved marks into total class test marks as per credit hour. i.e for n=1(20), n=2 (40), n=3 (60), n=4(80), etc.
- f. Irrespective of the result of the continuous assessment (class performance, class test, mid-term assessment), a student has to appear in the final examination (where applicable) for qualifying/passing the concern course/ subject.

2.14.2 Laboratory/Sessional/Practical Examinations

Laboratory/ Sessional courses are designed and conducted by the concerned departments. Examination on sessional/practical subjects will be conducted by the respective department before the commencement of term final examination. The date of practical examination will be fixed by the respective department. Students will be evaluated in the laboratory/ sessional courses on the basis of the followings:

a.	Conduct of Lab Tests/Class Performance	25%
b.	Report Writing/ Programming	15%
с.	Mid-Term Evaluation (exam/project/assignment)	20%
d.	Final Evaluation (exam/project/assignment)	
e.	Viva Voce/ Presentation	10%
	Total Percentage=	100%

Note: the above distribution of percentage is a general guideline. Department can rearrange to some extent if required.

2.14.3 Sessional Course in English

The distribution will be as under:

a.	Class performance/observation	10
b.	Written Assignment	15
c.	Oral Performance	25
d.	Listening Skill	10
e.	Group Presentation	30
f.	Viva Voce	10
	Total Percentage=	100%

2.14.4 Class Attendance

Class attendance may be considered as a part of continuous assessment. No mark should be allotted for attending classes.

Collegiate and Non-collegiate

Students having class attendance of 85% or above in individual subject will be treated as collegiate, and less than 85% and up to 70% will be treated as non-collegiate in that subject. The non-collegiate student(s) may be allowed to appear at the examination subject to payment of non-

collegiate fee/fine of an amount fixed by MIST/BUP. Students having class attendance below 70% will be treated as dis-collegiate and will not be allowed to appear at the examination and treated as fail. But in a special case such students may be allowed to appear in the examination with the permission of Commandant and it must be approved by the Academic Council.

2.14.5 Calculation of GPA

Grade Point Average (GPA) is the weighted average of the grade points obtained of all the courses passed/completed by a student. For example, if a student passes/completes n courses in a term having credits of $C_1, C_2, ..., C_n$ and his grade points in these courses are $G_1, G_2, ..., G_n$, respectively, then

 $GPA = \frac{Grade \ points \ earned \ in \ the \ semester}{Credits \ completed \ in \ the \ semester}$

= Summation of (Credit hours in a course * Grade point earned in that course) Total number of credit hours completed

$$=\frac{\sum_{i=1}^{n}Ci*Gi}{\sum_{i=1}^{n}Ci}$$

The Cumulative Grade Point Average (CGPA) is the weighted average of the GPA obtained in all the terms passed/completed by a student. For example, if a student passes/ completes n terms having total credits of TC_1 , TC_2 , ..., TC_n and his GPA in these terms are GPA₁, GPA_2 ,..., GPA_n , respectively then

$$CGPA = \frac{\sum_{i=1}^{n} TCi * GPAi}{\sum_{i=1}^{n} TCi}$$

Numerical Example

Suppose a student has completed eight courses in a term and obtained the following grades:

Course	Credits, C _i	Grade	Grade, Gi	Points, $C_i G_i$
BME 101	2.0	A-	3.50	7.00
PHY 125	3.0	A+	4.00	12.00

PHY 128	1.5	А	3.75	5.625
CHEM 103	3.0	В	3.00	9.00
CHEM 104	1.5	B-	2.75	4.125
MATH 101	3.0	A+	4.00	12.00
LANG 102	1.5	А	3.75	5.625
GES 101	2.0	A+	4.00	8.00
GEBS 101	2.0	A-	3.50	7.00
Total	19.50			70.375

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GPA = 70.375/19.50 = 3.60

Suppose a student has completed four terms and obtained the following GPA.

Level	Term	Credit Earned,	Hours GPA Earned,	$GPA_i \times TC_i$
		TCi	GP A _i	
1	1	19.50	3.73	72.73
1	2	22.50	3.93	88.42
2	1	21.50	3.96	85.14
2	2	20.50	4.00	82.00
ſ	fotal	84.00		328.30

CGPA = 328.30/84.00 = 3.90

2.14.6 Impacts of Grade Earned

- d. The courses in which a student has earned a "D' or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained an "F' grade will not be counted towards his/her earned credits or GPA calculation. However, the "F' grade will remain permanently on the Grade Sheet and the Transcript.
- e. A student who obtains an "'F' grade in a core course will have to repeat that particular course. However, if a student gets an "'F' in an optional course, he/she may choose to repeat that course or take a substitute course if available. When a student will repeat a course in which he/she has previously obtained an "F', he/she will not be eligible to get a grade better than 'B+"" in that repeated course.
- f. If a student obtains a grade lower than 'B+"" in a particular course he/she will be allowed to repeat the course only once for the purpose of grade improvement. However, he/she will not be eligible to get a grade better than 'B+"" for an improvement course.

- g. A student will be permitted to repeat for grade improvement purposes a maximum of 6 courses in BSc. Engineering programs and a maximum of 7 courses in B. Arch. program.
- h. If a student obtains a 'B+"" or a better grade in any course he/she will not be allowed to repeat the course for the purpose of grade improvement.

2.15 <u>Classification of Students</u>

At MIST, regular students are classified according to the number of credit hours completed/ earned towards a degree. The following classification applies to all the students:

Land	Credit Hours Earned		
Level	Engineering	Architecture	
Level 1	0.0 to 36.0	0.0 to 34.0	
Level 2	More than 36.0 to 72.0	More than 34.0 to 72.0	
Level 3	More than 72.0 to 108.0	More than 72.0 to 110.0	
Level 4	More than 108.0	More than 110.0 to 147.0	
Level 5		More than 147.0	

However, before the commencement of each term all students other than new batch are classified into three categories:

- **a.** Category 1: This category consists of students who have passed all the courses described for the term. A student belonging to this category will be eligible to register for all courses prescribed for the upcoming term.
- **b.** Category 2: This category consists of students who have earned a minimum of15 credits but do not belong to category 1. A student belonging to this category is advised to take at least one course less since he might have to register for one or more backlog courses as prescribed by his/her adviser.
- **c.** Category 3: This category consists of students who have failed to earn the minimum required 15 credits in the previous term. A student belonging to this category is advised to take at least two courses less than a category 1 student subject to the constraint of registering at least 15 credits. However, he will also be required to register for backlog courses as prescribed by the adviser.

2.15.1 Definition of Graduating Student

Graduating students are those students who will have ≤ 24 credit hour for completing the degree requirement.

2.16 <u>Performance Evaluation</u>

- **a.** The performance of a student will be evaluated in terms of two indices, viz. Term Grade Point Average and Cumulative Grade Point Average which is the grade average for all the terms completed.
- **b.** Students will be considered to be making normal progress toward a degree if their Cumulative Grade Point Average (CGPA) for all work attempted is 2.20 or higher. Students who regularly maintain a term GPA of 2.20 or better are making good progress toward the degrees and are in good standing with MIST. Students who fail to maintain this minimum rate of progress will not be in good standing. This can happen when any one of the following conditions exists:
 - 1) The term GPA falls below 2.20.
 - 2) The Cumulative Grade Point Average (CGPA) falls below 2.20.
 - 3) The earned number of credits falls below 15 times the number of terms attended.
- **c.** All such students can make up their deficiencies in GPA and credit requirements by completing courses in the subsequent term(s) and backlog courses, if there are any, with better grades. When the minimum GPA and credit requirements are achieved the student is again returned to good standing.

2.17 Application for Graduation and Award of Degree

A student who has fulfilled all the academic requirements for 'Bachelor's degree will have to apply to the Controller of Examinations through his/her Adviser for graduation. Provisional Degree will be awarded by BUP on completion of credit and GPA requirements.

2.17.1 Minimum Earned Credit and GPA Requirement for Obtaining Degree

a. Minimum credit hour requirements for the award of Bachelor's degree in engineering (BSc Engg) and architecture (B Arch) will be decided by the respective department (BUGS). However, the syllabus of all BSc engineering prog must be of minimum 157 credit hours or more and for architecture prog minimum 189 credit hours or more. A student must earnsearn minimum credit hour set in the syllabus by the concerned

department for qualifying Bachelor's Degree. The minimum CGPA requirement for obtaining a Bachelor's degree in engineering and architecture is 2.20.

b. A student may take additional courses with the consent of his/her Adviser in order to raise CGPA, but he/she may take a maximum of 15 such additional credits in engineering and 18 such additional credits in architecture beyond respective credit-hour requirements for Bachelor's degree during his/her entire period of study.

2.17.2 Minimum Earned Credit and GPA Requirement for Obtaining Degree

Minimum credit hour requirements for the award of bachelor's degree in engineering (B.Sc. Engineering) and other discipline will be decided as per existing rules. The minimum GPA requirement for obtaining a Bachelor's degree in Engineering and Architecture is 2.20.

2.18 <u>Time Limits for Completion of Bachelor's Degree</u>

A student must complete his studies within a maximum period of six years for engineering and seven years for architecture.

2.19 Attendance, Conduct and Discipline

MIST has strict rules regarding the issues of attendance in class and discipline.

- a. Attendance: All students are expected to attend classes regularly. The university believes that attendance is necessary for effective learning. The first responsibility of a student is to attend classes regularly and one is required to attend the classes as per MIST rules.
- b. **Conduct and Discipline:** During their stay in MIST all students are required to abide by the existing rules, regulations and code of conduct. Students are strictly forbidden to form or be members of student organization or political party, club, society etc., other than those set up by MIST authority in order to enhance ' 'student's physical, intellectual, moral and ethical development. Zero tolerance in regards of sexual abuse and harassment in any forms and drug abuse and addiction are strictly observed in the campus.

2.20 <u>Teacher-Student Interaction</u>

The academic system in MIST encourages students to come in close contact with the teachers. For promotion of high level of teacher-student's interaction, a course coordinator is assigned to each course. Students are free to discuss with CC about all academic matters. Students are also encouraged to meet other teachers any time for help and guidance for academic matters. Heads of

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the departments, Director of Administration, Director of Students Welfare (DSW), Dean and Commandant address the students at some intervals. More so, monthly Commandant's Parade is organized in MIST where all faculty members, staff and students are formed up, thereby increasing teacher-student interaction.

2.21 Absence During a Term

A student should not be absent from quizzes, tests, etc. during the term. Such absence will naturally lead to reduction in points/marks, which count towards the final grade. Absence in the Term Final Examination will result in an F grade in the corresponding course. A student who has been absent for short periods, up to a maximum of three weeks due to illness, should approach the course teacher(s) or the course coordinator(s) for make-up quizzes or assignments immediately upon return to classes. Such request has to be supported by medical certificate from competent authority (e.g. CMH/MIST Medical Officer).

2.22 <u>Recognition of Performance</u>

As recognition of performance and ensure continued studies MIST awards medals, scholarships and stipends will be given as per existing rules and practices.

2.23 <u>Types of Different Examination</u>

Following different types of final Examinations will be conducted in MIST to evaluate the students of Undergraduate Programs:

- **a.** Term Final Examination: At the end of each normal term (after 22week or so), Term Final Examination will be held. Students will appear in the Term Final Examination for all the theory courses they have taken in the Term.
- **b.** Supplementary Examination: It will take place twice in a year. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun)/Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec)/ Spring Term (Jan-Jun) end break, respectively. Students will be allowed to register for a maximum of two theory courses (Failed/ Improvement) in Supplementary-II and maximum of one theory course (Failed/ Improvement) in Supplementary-II.
- **c. Improvement Examination:** It will be taken during Supplementary-I and Supplementary-II Examination. Questions will be same as the question of the regular examination of that Supplementary Examination (if any). Student can take maximum two subjects at a time (two subjects in Supplementary-I and one subject in Supplementary-II) and maximum 6 subjects in the whole academic duration. If a student obtains a grade lower than 'B+' in a course, he/she will be allowed to repeat the course only once for grade improvement.
However, he/she will not be eligible to get a grade better than 'B+' for an improvement course. Among the previous result and improvement examination result, best one will be considered as final result for an individual student. However, performance of all examination i.e. previous to improvement examination shall be reflected in the transcript.

2.24 <u>Rules of Different Examinations</u>

2.24.1 Term Final Examination

Following rules to be followed:

- **a.** Registration to be completed before commencement of the class. A student has to register his desired courses paying registration, examination fee and other related fees.
- **b.** Late registration will be allowed without penalty within first one week of the term.
- **c.** Within 1st two weeks of a term a student can Add/Drop course/courses. To add a course, in the 3rd week, one has to register the course by paying additional fees. To drop a course, one has to apply within three weeks and paid fees will be adjusted/ refunded. If anyone wants to drop a course after three weeks and within 4 weeks, that will be permitted but paid fees will not be refunded in that case.
- **d.** Registrar office will finalize registration of all courses within 7 (seven) weeks, issue registration slip and that will be followed by issuing Admit Card.
- e. Term Final Examination to be conducted in the 18-20th week of the term as per approved Academic Calendar.

2.24.2 Supplementary Examination

Following rules to be followed:

- a. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun) /Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec) / Spring Term (Jan-Jun) end break, respectively.
- b. Students will be allowed to register for a maximum of two theory courses (Failed/ Improvement) in Supplementary-I and maximum of one theory course (Failed/ Improvement) in Supplementary-II.
- c. No class will be conducted.

- d. 40% marks will be considered from the previous exams.
- e. Maximum grading in Supplementary Exam will be 'B+'.
- f. No Sessional Exam will be conducted.
- g. Examination will be taken on 60% marks like Term Final Examination.
- h. If a student fails in a course more than once in regular terms, then for calculating 40% marks, the best one of all continuous assessment marks will be counted.
- i. If anyone fails in the Laboratory/ Sessional course, that course cannot be taken in the supplementary examination.
- j. If any student fails in a course, he can clear the course retaking it second time or, he can clear the examination appearing at the Supplementary Examination as well. Anyone fails twice in a course, can only retake it in the regular term for appearing third time. But anyone fails even after appearing third time, he/she has to take approval of Academic Council of MIST for appearing 4th (last) time in a course and need to pay extra financial penalty. If any student fails even 4th time in a course, will not be allowed to appear anymore in this same course.
- k. Registration of Supplementary-I Exam to be done within 5th week after completion of fall Term (Jul-Dec) and registration of Supplementary-II Exam to be done within the mid-term break of Spring Term (Jan-Jun), paying all the required fees.
- 1. There will be no provision for add/drop courses after registration.
- m. **Thesis:** if a student cannot complete thesis in two consecutive terms, with the recommendation of the supervisor, he/she may continue for next one/two term within six academic years.

2.24.3 Improvement Examination

Following rules to be followed:

- a. Improvement Examination is to be taken during the Supplementary-I and II examinations.
- b. For Improvement Examination, registration is to be done during the registration of Supplementary-I and Supplementary-II Examinations by paying all the fees.
- c. Question Setting, Moderation and Result Publication to be done with courses of Supplementary-I and Supplementary-II Examinations.

- d. Any student gets a grading below 'B+' and desires to improve that course, he will be allowed to appear the Improvement Examination for that particular course.
- e. Highest grade of Improvement Examination will be 'B+'.
- f. One student is allowed to appear at Improvement Exam in 6 (six) courses in his whole graduation period taking maximum two courses at a time (two courses at Supplementary-I and one course at Supplementary-II).

2.25 <u>Irregular Graduation</u>

If any graduating student clears his/her failed course in Term-1 (Spring) and his graduation requirements are fulfilled, his graduation will be effective from the result publication date of Term-1 (Spring) and that student will be allowed to apply for provisional certificate.

2.26 <u>Minimum Earned Credit and CGPA Requirement for Obtaining Degree</u>

The requirements for award of engineering degree are as follows:

- a. Completion of the courses for the minimum required credits of 157 (or as specified in a particular department) in a maximum period of six academic years.
- b. Appearing at the final examination in all the required courses as per syllabus of the program.
- c. Scoring a CGPA of 2.2 or above.

2.27 <u>Consequences of Failing in Sessional Courses</u>

Any student failing in any sessional course must re-take that sessional course when offered by the department in any next Regular Term. No Supplementary exam is allowed for sessional course.

2.28 <u>Withdrawal for Poor Performance</u>

A student to remain in reasonable standing must maintain a minimum CGPA of 2.20. Failure to secure/achieve minimum CGPA of 2.20 in two consecutive levels will also lead to withdrawal of the student. A student who fails to maintain a CGPA of 2.20 at the end of a level, but obtains 2.00 or more, will be placed on probation. Failure by a student placed on probation to raise the CGPA to 2.20 in the next level will lead to his withdrawal from the Program. A student failing to maintain a CGPA of 2.20 at the end of the level-4 shall be allowed to repeat courses of the level-4 in which he earned 'C' grades or below. This opportunity will be given only once. Such a student failing to raise CGPA to 2.2 after repeating the courses will be withdrawn from the Program (For further detail 'MIST Withdrawal Policy' may be consulted).

- a. <u>Voluntary withdrawal for Sickness.</u> In case of sickness which leads to missing of more than 40% class or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw from that term subject to the approval of the Academic Council of MIST. Students may retain sessional courses of that term if applies and approved by Academic council. 'VW' as grading of each course to be reflected in concerned tabulation sheet, grade sheet and transcript.
- b. <u>Class Tests.</u> The number of class tests shall be n for 3.0 and above credit courses and (n-1 shall be considered for grading where n is the number of credits of the course. However, for courses having credits below 3.0, the considered class tests shall be 2 out of 3. Class test will be conducted by the subject teacher. Duration of class test should not be more than 30 minutes. Course teacher must announce results within 10 days of holding the examination. Checked script will be shown to the students. If a student misses the class test for acceptable reason the course teacher my take the test of the student.
- c. MIST is committed in conferring degrees to the students in time which plays a very vital role in steering all the academic activities in any university/ institute. At the beginning MIST conducted all its examinations under the examination section of the University of Dhaka. In June 2008, MIST got affiliation with BUP. Since then MIST has been conducting all its examinations under the control and authority of BUP. For the need of time, former MIST examination policy was reviewed several times. Present review committee has made necessary amendment/ addition/ deletion to suit the proposed course system. This policy may be reviewed every after 05 (five) years or as and when felt necessary by the authority of MIST.

Serial	Examination Type	Session	Number of Theory Courses	Maximum Grading	Assessment Percentage	Examination Schedule	Courses	Registration Schedule
1	Regular	Spring Term (Jan- Jun) and Fall Term (Jul- Dec)	Maximum	A+	Assessment	Regular	Regular	Regular
2	Retake	Spring Term (Jan- Jun) and Fall Term (Jul- Dec)	6 Theory Courses	В+	on 100%	Examination		
3	Supplementary-I (Fail/Improvement)	Spring Term (Jan- Jun)	Maximum 2 Theory	В+	Assessment on 60%	1 st week of Spring Term (Jan-Jun)/ Fall Term (Jul-Dec) End Break	Courses of immediate past terms included	5th week after completion of Fall Term (Previous Year)
4	Supplementary-II (Fail/Improvement)	Fall Term (Jul- Dec)	Maximum 1 Theory	В+	Assessment on 60%	1 st week of Fall Term (Jul-Dec)/ Spring Term (Jan- Jun) End Break	Courses of immediate past terms not included	Mid-Term Break of Spring (Jan-Jun) Term (March)

2.29 SUMMARY OF MIST EXAMINATION POLICY-2020

- 1. Maximum 24 credit hour in one regular term (excluding Supplementary Exams).
- 2. Students may register maximum upto 7 (seven) theory courses in exceptional case, if department can accommodate within 24 credit hour.
- 3. Students can register maximum 6 (six) theory courses for improvement in his whole academic period.
- 4. Supplementary-I Exam to be considered as part of previous Academic Year.
- 5. Student appearing in Supplementary-I shall not be included in current graduation ceremony.

CHAPTER 3

DEPARTMENT OF BIOMEDICAL ENGINEERING (BME)

3.1 Introduction to the Program

The Department of Biomedical Engineering, MIST, was founded in 2014 and started the academic program of the pioneer batch of Undergraduate Biomedical Engineers in the country. The B.Sc Program commenced on 1st February, 2015 with 41 students. The M.Sc Program commenced on 4th November 2015 with 5 students. Currently, there are a total of 161 students in the B.Sc Program and a total of 37 students in the M.Sc Program. Biomedical Engineering (BME) is an interdisciplinary field that combines the design and problem-solving skills of engineering with medical and biological sciences to advance healthcare treatment. Deeply interdisciplinary, biomedical engineering applies modern approaches from the experimental life sciences in conjunction with theoretical and computational methods from engineering, mathematics, and computer science to the solution of biomedical problems of fundamental importance, such as human health. This field seeks to close the gap between engineering and medicine, combining the design and problem-solving skills of engineering with medical and biological sciences to advance healthcare treatment, including diagnosis, monitoring, and therapy. The current focus of the BME Department includes the development of biocompatible implants and prostheses, various diagnostic and therapeutic medical devices ranging from clinical equipment, common biomedical imaging equipment, cell & tissue engineering, regenerative tissue growth, pharmaceutical drugs, and therapeutics.

3.2 <u>Vision and Mission of the Program</u>

Vision:

To become a locally reputed and globally recognized Biomedical Engineering Department through nurturing excellence in teaching, research, and industrial partnership towards advanced cuttingedge healthcare technologies.

Mission:

- **a.** To provide quality education in the emerging and extremely interdisciplinary field of Biomedical Engineering, utilizing up-to-date teaching and learning facilities contributing to advanced healthcare technologies.
- **b.** To formulate and implement a modern academic curriculum to develop professionally sound and ethically strong Biomedical Engineers to provide dedicated services in the healthcare sector of the nation.

- **c.** To facilitate innovative and industry-linked research platforms to foster the development of cutting-edge technologies and their proficient applications.
- **d.** To improve the quality of common peoples' life in Bangladesh using knowledge and skills of modern science and technology.

3.3 **Program Educational Objective (PEOs)**

No	PEO Statement
PEO-1	Provide graduates mathematical, scientific, and engineering fundamentals and advanced knowledge of understanding in the sector of Biomedical Engineering including analysis techniques, design, developments, and implementation methodologies
PEO-2	Integrate technical and communicative knowledge with professional and industry- based education to build up successful professional careers in industry, government, and academia
PEO-3	Expose graduate's problem-solving skills and research-based education for life- long learning to adapt the innovation and changes.
PEO-4	Make the graduates capable of working in the broader area of technology, having the capability and responsibility of leadership and teamwork.
PEO-5	Enable the graduates to establish and run sustainable business enterprises along diverse career paths by creating, selecting, applying appropriate and modern technologies and tools.
PEO-6	Contribute the educational, cultural, social, technological and economic development of society through the ethical application of their knowledge and skills.

3.4 **Program Outcomes**

Based on the suggestion of the Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh, the Bachelor in Biomedical Engineering (BME) program will have the following learning outcomes:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

- 2. Problem analysis: Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using the first principles of mathematics, the natural sciences, and the engineering sciences.
- **3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal, and environmental concerns.
- 4. Investigation: Conduct investigations of complex problems, considering the design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.
- **5. Modern tool usage:** Create, select, and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to professional engineering practice.
- 7. Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate sustainable development knowledge.
- **8.** Ethics: Apply ethical principles and commit to professional ethics, responsibilities, and the norms of the engineering practice.
- **9. Individual work and teamwork:** Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.
- **10. Communication:** Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations, and give and receive clear instructions.
- **11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multi-disciplinary environments.
- **12. Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

Department of Biomedical Engineering (BME)

In addition to incorporating the above-listed POs, MIST also included the following Knowledge Profile (K1-K8) as an educational institution: may include additional outcomes in its learning programs. The ranges of Complex Problem Solving (P1 – P7) and Complex Engineering Activities (A1 – A5) that should be addressed in the program are summarized in the tables below.

	Attribute
K1	A systematic, theory-based understanding of the natural sciences applicable to the discipline
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline
К3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
K5	Knowledge that supports engineering design in a practice area
K6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability
K8	Engagement with selected knowledge in the research literature of the discipline

Knowledge Profile (KP)

Attribute	Complex Engineering Problems have characteristic P1 and some or all of P2 to P7:
Depth of knowledge required	P1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach

Range of Complex Engineering Problem Solving

Range of conflicting requirements	P2: Involve wide-ranging or conflicting technical, engineering and other issues
Depth of analysis required	P3: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
Familiarity of issues	P4: Involve infrequently encountered issues
Extent of applicable codes	P5: Are outside problems encompassed by standards and codes of practice for professional engineering
Extent of stakeholder involvement and conflicting requirements	r P6: Involve diverse groups of stakeholders with widely varying needs
Interdependence	P7: Are high level problems including many component parts or sub-problems

Range of Complex Engineering Activities

Attribute	Complex activities means (engineering) activities or projects that have some or all of the following characteristics:
Range of resources	A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	A2: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	A3: Involve creative use of engineering principles and research based knowledge in novel ways
Consequences for society and the environment	A4: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	A5: Can extend beyond previous experiences by applying principles- based approaches

3.5 <u>Generic Skills</u>

- 1. Apply the principles and theory of biomedical engineering knowledge to the requirements, design and development of different biomedical equipment and devices with appropriate understanding.
- 2. Define and use appropriate research methods and modern tools to conduct a specific project.
- 3. Learn independently, be self- aware, and self- manage their time and workload.
- 4. Apply critical thinking to solve complex engineering problems
- 5. Analyze real time problems and justify the appropriate use of technology
- 6. Work effectively with others and exhibit social responsibility

3.6 <u>Curriculum/ Skill Mapping</u>



CHAPTER 4

COURSE CURRICULUM FOR BACHELOR DEGREE IN BME

4.1 <u>Course Schedule</u>

Keeping the above mentioned program outcome, the course schedule for the undergraduate students of the Biomedical Engineering (BME) is given below:

	Basic Science		G		General		Engineering Courses				
Level/ Term			Math	Education		Dept.		Non-Dept.		Elective Course	Total
	Т	S	Т	Т	S	Т	S	Т	S	Т	
L-1 (Spring)	6.00	1.50	3.00	2.00	-	2.00	-	3.00	1.50	-	19.00
L-1 (Fall)	6.00	1.50	3.00	2.00	1.50	3.00	1.50	-	-	-	18.50
L-2 (Spring)	-	-	3.00	2.00	1.50	3.00	-	6.00	3.00	-	18.50
L-2 (Fall)	-	-	3.00	-	-	9.00	4.50	3.00	-	-	19.50
L-3 (Spring)	-	-	-	-	-	12.00	4.50	3.00	1.50	-	21.00
L-3 (Fall)	-	-	-	-	2.00	12.00	7.50	-	-	-	21.50
L-4 (Spring)	-	-	-	4.00	-	6.00	6.00	-	-	6.00	22.00
L-4 (Fall)	-	-	-	2.00	-	9.00	3.00	-	-	6.00	20.00
% of Total Course	9.3	75	7.50	10.	625	51.8	875	13.	125	7.50	100.00
Total Credit Hr	15.		12.00	17	.00	83.	00	21	.00	12.00	160.00

T=Theory; S=Sessional

Table: Summary of Course Curriculum

Course Curriculum for Bachelor Degree in BME

Level/Term	Theory Contact Hours	Sessional Contact Hours	Theory Credit Hours	Sessional Credit Hours	Total Contact Hours	Total Credit Hours
L-1 (Spring)	16.00	6.00	16.00	3.00	22.00	19.00
L-1 (Fall)	14.00	9.00	14.00	4.50	23.00	18.50
L-2 (Spring)	14.00	9.00	14.00	4.50	23.00	18.50
L-2 (Fall)	15.00	9.00	15.00	4.50	24.00	19.50
L-3 (Spring)	15.00	12.00	15.00	6.00	27.00	21.00
L-3 (Fall)	12.00	16.00+4 Weeks	12.00	9.50	28.00+4 Weeks	21.50
L-4 (Spring)	16.00	12.00	16.00	6.00	28.00	22.00
L-4 (Fall)	17.00	6.00	17.00	3.00	23.00	20.00
Total	119.00	79.00+4 Weeks	119.00	41.00	198.00+4 Weeks	160.00

4.2 <u>Contact Hours and Credit Hours Distribution in Eight Terms</u>

4.3 <u>Final Year</u>

Final Year Design and Research Project

Final year design and research project will have to be undertaken by students under separate supervisors in partial fulfillment of the requirement of his/her degree. Credits allotted to the final year design and research project will be 6.00 corresponding to 12.00 contact hours. Topic and advisor selection of final year design and research project must be finalized within level-3, term-2.

4.4 <u>BME Courses</u>

The students have to complete all the core courses listed below:

4.4.1 List of Core Courses – BME

Ser	Course Code	Course Name			
1	BME 101	Introduction to Biomedical Engineering	2.0		
2	BME 104	CAD in Biomedical Engineering Sessional	1.5		
3	BME 105	Human Anatomy	3.0		
4	BME 201	Human Physiology	3.0		
5	BME 203	Biochemistry	3.0		
6	BME 204	Biochemistry Sessional	1.5		
7	BME 205	Biofluid Mechanics and Heat Transfer	3.0		
8	BME 206	Biofluid Mechanics and Heat Transfer Sessional	1.5		
9	BME 207	Biomedical Instrumentation and Measurements	3.0		
10	BME 208	Biomedical Instrumentation and Measurements Sessional	1.5		
11	BME 301	Statistics and Numerical Methods for Biomedical Engineers	3.0		
12	BME 302	Statistics and Numerical Methods for Biomedical Engineers Sessional	1.5		
13	BME 303	Biomechanics	3.0		
14	BME 304	Biomechanics Sessional	1.5		
15	BME 305	Biomedical Signal Processing	3.0		
16	BME 306	Biomedical Signal Processing Sessional	1.5		
17	BME 307	Medical Imaging	3.0		
18	BME 309	Biomedical Transport Phenomenon	3.0		
19	BME 311	Embedded Systems and Interfacing	1.5		
20	BME 312	Embedded Systems and Interfacing Sessional	3.0		
21	BME 313	Biomedical Image Processing	1.5		
22	BME 314	Biomedical Image Processing Sessional	3.0		

23	BME 315	Biomaterials	3.0
24	BME 316	Biomaterials Sessional	1.5
25	BME 318	Biomedical Engineering Design Sessional I	1.5
26	BME 300	Industrial Training	1.5
27	BME 401	Diagnostic and Therapeutic Equipment	3.0
28	BME 403	Molecular Biology for Engineers	3.0
29	BME 404	Molecular Biology for Engineers Sessional	1.5
30	BME 405	Healthcare Technology Management	3.0
31	BME 407	Rehabilitation Engineering	3.0
32	BME 409	Tissue Engineering	3.0
33	BME 412	Biomedical Engineering Design Sessional II	1.5
33	BME 400	Final Year Design and Research Project	6.0
Total			83.0

Course Curriculum for Bachelor Degree in BME

4.4.2 List of Courses – Basic Science and Mathematics

Ser	Course Code	Course Name	Credit Hour
1	PHY 125	Waves and Oscillations, Optics and Modern physics	3.0
2	PHY 127	Structure of matter, Electricity, Magnetism, and Mechanics	3.0
3	PHY 128	Physics Sessional	1.5
4	CHEM 103	General Chemistry	3.0
5	CHEM 104	Chemistry Sessional	1.5
6	CHEM 125	Physical and Bio-organic Chemistry	3.0
7	MATH 101	Differential and Integral Calculus	3.0
8	MATH 105	Vector Analysis, Matrix and Coordinate Geometry	3.0
9	MATH 205	Differential Equation, Laplace transform and Fourier Transform	3.0
10	MATH 231	Complex Variables and Linear Algebra	3.0
Tota	l		27.0

2.0

2.0 **17.0**

Communicative Language						
Ser	Course Code	Course Name	Credit Hour			
1	LANG 102	Communicative English I	1.5			
2	GES 101	Fundamentals of Sociology	2.0			
3	GEBS 101	Bangladesh Studies	2.0			
4	GELM 271	Leadership and Management	2.0			
5	LANG 202/LANG 204	Communicative English II/Bangla Language and Literature	1.5			
6	GERM 352	Fundamentals of Research Methodology (Sessional)	2.0			
7	GEPM 481	Project Management and Finance	2.0			

Environment, Sustainability and Law

Engineering Ethics and Moral Philosophy

4.4.3 List of Courses – General Education or Non-Skill and Language/ Communicative Language

4.4.4 List of Core Courses – Interdisciplinary

8

9

Total

GESL 421

GEEM 451

Ser	Course Code	Course Name	Credit Hour
1	EECE 191	Principles of Electrical Engineering	3.0
2	EECE 192	Principles of Electrical Engineering Sessional	1.5
3	EECE 291	Electronic Circuits and Devices	3.0
4	EECE 292	Electronic Circuits and Devices Sessional	1.5
5	EECE 391	Digital Electronics	3.0
6	EECE 392	Digital Electronics Sessional	1.5
7	ME 291	Principles of Mechanical Engineering	3.0
8	CSE 291	Computer Programming	3.0
9	CSE 292	Computer Programming Sessional	1.5
Total			21.0

4.4.5 **BME Elective Courses**

At least TWO elective courses must be taken from each group.

4.4.5.1 Group-I (Instrumentation)

Ser	Course Code	Course Name	Credit Hour
1.	BME 411	Physiological Control System	3.0
2.	BME 413	Virtual Bioinstrumentation	3.0
3.	BME 415	Biophotonics	3.0
4.	BME 417	Equipment in Radiology and Radiotherapy	3.0

4.4.5.2 Group-II (Regenerative Medicine)

Ser	Course Code	Course Name	Credit
			Hour
1.	BME 419	Drug Development and Delivery System	3.0
2.	BME 421	Nanotechnology in Biomedicine	3.0
3.	BME 423	Artificial Organ Development	3.0
4.	BME 425	Bioinformatics	3.0

4.4.5.3 Group-III (Imaging)

Ser	Course Code	Course Name	Credit
			Hour
1.	BME 427	Advanced Biomedical Signal Processing	3.0
2.	BME 429	Nuclear Medicine	3.0
3.	BME 431	Biomedical Data Science	3.0

4.4.5.4 Group-IV (Biomechanics and Rehabilitation Engineering)

Ser	Course Code	Course Name	Credit
			Hour
1.	BME 433	Advanced Biofluid Mechanics	3.0
2.	BME 435	Biomedical Implants and Braces	3.0
3.	BME 437	Neuroscience and Neural Engineering	3.0
4.	BME 439	Biofabrication	3.0

4.5 <u>Term-wise Distribution of Courses</u>

4.5.1 LEVEL 1, SPRING

Ser	Course Code	Course Name	Contact	Credit
			Hour	Hour
1.	BME 101	Introduction to Biomedical Engineering	2.0	2.0
2.	PHY 125	Waves and Oscillations, Optics and Modern	3.0	3.0
2.	1111 125	physics	5.0	5.0
3.	GES 101	Fundamentals of Sociology	2.0	2.0
4.	CHEM 103	General Chemistry	3.0	3.0
5.	CHEM 104	Chemistry Sessional	3.0	1.5
6.	MATH 101	Differential and Integral Calculus	3.0	3.0
7.	EECE 191	Principles of Electrical Engineering	3.0	3.0
8.	EECE 192	Principles of Electrical Engineering	3.0	1.5
0.		Sessional	5.0	1.5
	•	Total	22.0	19.0

4.5.2 LEVEL 1, FALL

Ser	Course Code	Course Name	Contact	Credit
			Hour	Hour
1.	BME 104	CAD in Biomedical Engineering Sessional	3.0	1.5
2.	BME 105	Human Anatomy	3.0	3.0
3.	PHY 127	Structure of matter, Electricity and Magnetism, and Mechanics	3.0	3.0
4.	CHEM 125	Physical and Bio-organic Chemistry	3.0	3.0
5.	MATH 105	Vector Analysis, Matrix and Coordinate Geometry	3.0	3.0
6.	PHY 128	Physics Sessional	3.0	1.5
7.	GEBS 101	Bangladesh Studies	2.0	2.0
8.	LANG 102	Communicative English I	3.0	1.5
	Total			18.5

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 201	Human Physiology	3.0	3.0
2.	MATH 205	Differential Equation, Laplace transform	3.0	3.0
		and Fourier Transform		
3.	EECE 291	Electronic Circuits and Devices	3.0	3.0
4.	EECE 292	Electronic Circuits and Devices Sessional	3.0	1.5
5.	CSE 291	Computer Programming	3.0	3.0
6.	CSE 292	Computer Programming Sessional	3.0	1.5
7.	GELM 271	Leadership and Management	2.0	2.0
8.	LANG	Communicative English II/Bangla	3.0	1.5
	202/LANG 204	Language and Literature		
	Total			18.5

4.5.3 LEVEL 2, SPRING

4.5.4 LEVEL 2, FALL

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 203	Biochemistry	3.0	3.0
2.	BME 204	Biochemistry Sessional	3.0	1.5
3.	BME 205	Biofluid Mechanics and Heat Transfer	3.0	3.0
4.	BME 206	Biofluid Mechanics and Heat Transfer	3.0	1.5
		Sessional		
5.	BME 207	Biomedical Instrumentation and	3.0	3.0
		Measurements		
6.	BME 208	Biomedical Instrumentation and	3.0	1.5
		Measurements Sessional		
7.	ME 291	Principles of Mechanical Engineering	3.0	3.0
8.	MATH 231	Complex Variables and Linear Algebra	3.0	3.0
	Total			19.5

4.5.5 LEVEL 3, SPRING

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 301	Statistics and Numerical Methods for	3.0	3.0
		Biomedical Engineers		
2.	BME 302	Statistics and Numerical Methods for	3.0	1.5
		Biomedical Engineers Sessional		
3.	BME 303	Biomechanics	3.0	3.0
4.	BME 304	Biomechanics Sessional	3.0	1.5
5.	BME 305	Biomedical Signal Processing	3.0	3.0
6.	BME 306	Biomedical Signal Processing Sessional	3.0	1.5
7.	BME 307	Medical Imaging	3.0	3.0
8.	EECE 391	Digital Electronics	3.0	3.0
9.	EECE 392	Digital Electronics Sessional	3.0	1.5
	Total			21.0

4.5.6 LEVEL 3, FALL

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 309	Biomedical Transport Phenomenon	3.0	3.0
2.	BME 311	Embedded Systems and Interfacing	3.0	3.0
3.	BME 312	Embedded Systems and Interfacing Sessional	3.0	1.5
4.	BME 313	Biomedical Image Processing	3.0	3.0
5.	BME 314	Biomedical Image Processing Sessional	3.0	1.5
6.	BME 315	Biomaterials	3.0	3.0
7.	BME 316	Biomaterials Sessional	3.0	1.5
8.	BME 318	Biomedical Engineering Design Sessional I	3.0	1.5
9.	GERM 352	Fundamentals of Research Methodology (Sessional)	4.0	2.0
10.	BME 300	Industrial Training	4 weeks	1.5
	Total			21.5

Contact Credit **Course Name** Ser **Course Code** Hour Hour BME 401 Diagnostic and Therapeutic Equipment 3.0 3.0 1. Molecular Biology for Engineers BME 403 3.0 2. 3.0 Molecular Biology for Engineers Sessional 3. BME 404 3.0 1.5 BME 4** 4. Elective 1 3.0 3.0 BME 4** 5. Elective 2 3.0 3.0 6. **GESL 421** Environment, Sustainability and Law 2.0 2.0 GEPM 481 Project Management and Finance 2.0 2.0 7. Biomedical Engineering Design Sessional II 1.5 8. BME 412 3.0 9. BME 400 Final Year Design and Research Project 3.0 6.0 28.0 22.0 Total

4.5.7 LEVEL 4, SPRING

4.5.8 LEVEL 4, FALL

Ser	Course Code	Course Name	Contact Hour	Credit Hour
1.	BME 405	Healthcare Technology Management	3.0	3.0
2.	BME 407	Rehabilitation Engineering	3.0	3.0
3.	BME 409	Tissue Engineering	3.0	3.0
4.	BME 4**	Elective 3	3.0	3.0
5.	BME 4**	Elective 4	3.0	3.0
7.	GEEM 451	Engineering Ethics and Moral Philosophy	2.0	2.0
8.	BME 400	Final Year Design and Research Project	6.0	3.0
	Total			20.0

4.5.9 List of Elective Courses

At least TWO elective courses must be taken from each group.

Group-I (Instrumentation)

Ser	Course Code	Course Name	Credit Hour
1.	BME 411	Physiological Control System	3.0
2.	BME 413	Virtual Bioinstrumentation	3.0
3.	BME 415	Biophotonics	3.0
4.	BME 417	Equipment in Radiology and Radiotherapy	3.0

Group-II (Regenerative Medicine)

Ser	Course Code	Course Name	Credit
			Hour
1.	BME 419	Drug Development and Delivery System	3.0
2.	BME 421	Nanotechnology in Biomedicine	3.0
3.	BME 423	Artificial Organ Development	3.0
4.	BME 425	Bioinformatics	3.0

Group-III (Imaging)

Ser	Course Code	Course Name	Credit Hour
1.	BME 427	Advanced Biomedical Signal Processing	3.0
2.	BME 429	Nuclear Medicine	3.0
3.	BME 431	Biomedical Data Science	3.0

Group-IV (Biomechanics and Rehabilitation Engineering)

Ser	Course Code	Course Name	Credit
			Hour
1.	BME 433	Advanced Biofluid Mechanics	3.0
2.	BME 435	Biomedical Implants and Braces	3.0
3.	BME 437	Neuroscience and Neural Engineering	3.0
4.	BME 439	Biofabrication	3.0

CHAPTER 5

COURSES OFFERED BY OTHER DEPARTMENTS

5.1 Department of Science and Humanities

5.1.1 Level-1, Spring

5.1.1.1 PHY 125 Waves and Oscillations, Optics and Modern Physics

COU	RSE INFORMATION								
	Course Title :Waves and Oscillations, Optics and Modern Physics C		Lecture Contact Hours Credit Hours		: 3.00 : 3.00				
PRE-	REQUISITE			i					
None									
CURI	RICULUM STRUCTURE								
Outco	me-Based Education (OBE)								
	DPSIS/RATIONALE								
empha engine	course is the basic physics in the field of wav asized the basic concepts, theories and solve q cering disciplines.		-			· ·			
OBJE	CCTIVE								
osc 2. To 3. To s	define the different parameters, concepts, log sillations, optics and modern physics. explain the basic theories and laws of waves a solve numerical and analytical problems regar RSE OUTCOMES & GENERIC SKILLS	and oscillat	tions, optics an	d mode	rn phys	sics.	-		
No.	Course Outcome								
	At the end of the course, a student should be	e able to	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods	
CO1	Be able to define different basic laws and pa in the field of waves and oscillations, op modern physics such as simple harmonic damped oscillations, interference, dif polarization, relativity, photoelectric Compton effect, radioactivity, etc.	otics and	C1	1	-	-	1	T, MT, F	
CO2	Be able to explain different basic theories in of waves and oscillations, optics and modern such as the SHM, damped motion, wave interference, diffraction, polarization, specia of relativity, Compton theory, transformation, nuclear reaction etc.	n physics motion, al theory nuclear	C2	1	_	-	1	T, MT, F	
CO3	Be able to solve quantitative problems in the waves and oscillations, optics and modern such as SHM, damped motion, wave interference, diffraction, polarization, r photoelectric effect, Compton shift, radio etc.	n physics motion, elativity,	C3, C4	1	-	-	2	T, F, MT, ASG	

Course Offered by Other Departments

(CP - Complex Problems, CA - Complex Activities, KP - Knowledge Profile, T - Test, PR - Project, Q - Quiz, ASG							
– Assignment, Pr –	- Assignment, Pr - Presentation, R - Report, CS - Case study, MT- Mid Term Exam, F - Final Exam)						
C1 - Remember C2 – Understand C3 - Apply C4 - Analyze C5 – Evaluate C6 – Create							

COURSE CONTENT

Waves and Oscillations: Simple Harmonic Motion (SHM) and its properties, differential equation of a SHM and its solution, total energy and average energy of a body executing SHM, simple pendulum, torsional pendulum, spring-mass system, LC oscillatory circuit, two body oscillation and reduced mass, Composition of SHM, Damped oscillations, and its different condition, forced oscillations and its different condition, resonance, Wave motion : expression for a plane progressive wave, differential equation of wave motion, energy density of wave motion, average kinetic and potential energy of wave motion, Stationary wave.

Optics: Combination of lens, equivalent lens and power, Defects of images and different aberrations, Interference of light, Young's double slit experiment, interference in thin films, Newton's ring, Diffraction of light, Fraunhofer and Fresnel diffraction, diffraction by single slit and double slit, diffraction grating, Fraunhofer diffraction at a circular aperture, resolving power of optical instrument, Polarization of light, Brewster's law, Malus law, polarization by double refraction, Nicole prism, optical activity and polarimeters, Laser: spontaneous and stimulated emission.

Modern physics: Relativity : Frame of reference, postulates of special theory of relativity, Galilean transformation, Lorentz transformation, length contraction, time dilation, velocity addition, relativity of mass, mass energy relation, momentum energy relation, Photoelectric effect, Compton effect, de Broglie matter wave, Bohr atom model and explanation, atomic orbital and energy equation, classification of nuclei, nuclear mass and binding energy, Radioactivity, radioactive decay law, half-life, mean life, nuclear reaction, introduction to nuclear reactor

SKILL MAPPING

No.	Course Outcome		PROGRAM OUTCOMES (PO)										
INO.		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to define different basic parameters in the field of Waves and Oscillations, Optics and Modern physics such as periodic motion, simple harmonic motion, undamped oscillations, interference, diffraction, polarization and prism, photoelectric effect, Compton effect, matter wave, atomic model, radioactive decay, fusion, fission etc.												
CO2	Be capable to explain different basic theories in the field of Waves and Oscillations, Optics and Modern physics such as the wave motion for different systems along with energy, different formula for interference, diffraction, polarization special theory of relativity, Compton theory, nuclear transformation, and nuclear reaction etc.												
CO3	Be skilled to solve quantitative problems in the field of Waves and Oscillations, Optics and Modern physics such as energy of wave motion, wavelength, diffraction pattern, relativistic energy, photon energy, Compton shift, nuclear binding energy etc.												
(Numer	ical method used for mapping which indicates	3 as	high,	2 as	med	ium,	, and	1 as	low le	evel o	f matcl	ning)	
JUSTI	FICATION FOR CO-PO MAPPING												

Mapping	Level of	Justification	
	Matching		
CO1-PO1	3	The conceptual knowledge of the natural sciences applicable to	o the engineering discipline
CO2-PO1	3	The theory-based knowledge of the natural sciences appl discipline	icable to the engineering
CO3-PO1	3	The numerical analysis based knowledge of the natural s engineering	ciences applicable to the
TEACHING	G LEARNING	STRATEGY	
Teaching and	d Learning Activ	vities	Engagement (hours)
Face-to-Face	e Learning		
Lec	cture		42
Pra	ctical / Tutorial	/ Studio	-
Stu	dent-Centered L	earning	-
Self-Directed	d Learning		
	n-face-to-face le	-	42
	-	vious and (or) subsequent lecture at home	21
	paration for fina	l examination	21
Formal Asse			
	ntinuous Assessi	ment	3
	al Examination		3
Total			132
TEACHING	G METHODOL	JOGY	
Lecture and	discussion, Co-c	pperative and collaborative method, Problem based method	
COURSE S	CHEDIII E		
	CHEDULE		
Wee		Content	Assessment
Wee Week-1	ek To	ppic	Assessment
	ek To Int		Assessment
Week-1	ek To Int rec Pe (SI sol	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM	Assessment CT – 1 and Midterm, Final
Week-1 Class-1	ek To Int rec (SI sol Ve	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM elocity, acceleration, phase and epoch, time period, frequency	CT – 1 and Midterm,
Week-1 Class-1 Class-2	ek To Int rec (SI sol Ve	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3 Week-2	ek To To Int rec Pe (SI sol Ve an	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM elocity, acceleration, phase and epoch, time period, frequency	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3	ek To To Int rec Pe (SI sol Ve an	ppic rroductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM clocity, acceleration, phase and epoch, time period, frequency d angular frequency of SHM	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3 Week-2 Class-4	ek To To Int rec Pe (Sl sol Ve an To Si	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM elocity, acceleration, phase and epoch, time period, frequency d angular frequency of SHM tal energy and average energy of SHM, problems	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3 Week-2 Class-4 Class-5	ek To To Int rec Pe (Sl sol Ve an To Si	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM clocity, acceleration, phase and epoch, time period, frequency d angular frequency of SHM tal energy and average energy of SHM, problems mple pendulum, torsional pendulum, spring-mass system	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3 Week-2 Class-4 Class-5 Class-6	ek To To Int rec Pe (SI sol Ve an To Sin LC	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM clocity, acceleration, phase and epoch, time period, frequency d angular frequency of SHM tal energy and average energy of SHM, problems mple pendulum, torsional pendulum, spring-mass system	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3 Week-2 Class-4 Class-5 Class-6 Week-3	ek To To Int rec Pe (SI sol Ve an To Sii LC	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM elocity, acceleration, phase and epoch, time period, frequency d angular frequency of SHM tal energy and average energy of SHM, problems mple pendulum, torsional pendulum, spring-mass system C oscillatory circuit, two body oscillations, reduced mass	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3 Week-2 Class-4 Class-5 Class-6 Week-3 Class-7	ek To To Int rec Pe (Sl sol Ve an To Sii LC Cc	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM elocity, acceleration, phase and epoch, time period, frequency d angular frequency of SHM tal energy and average energy of SHM, problems mple pendulum, torsional pendulum, spring-mass system C oscillatory circuit, two body oscillations, reduced mass omposition of SHM	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3 Week-2 Class-4 Class-5 Class-6 Week-3 Class-7 Class-8	ek To To Int rec Pe (Sl sol Ve an To Sii LC Cc	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM clocity, acceleration, phase and epoch, time period, frequency d angular frequency of SHM tal energy and average energy of SHM, problems mple pendulum, torsional pendulum, spring-mass system C oscillatory circuit, two body oscillations, reduced mass pmposition of SHM problems	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3 Week-2 Class-4 Class-5 Class-6 Week-3 Class-7 Class-8 Class-9	ek To To Int rec Pe (SI sol Ve an To Sin LC Cc Cc Cc	ppic productory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM elocity, acceleration, phase and epoch, time period, frequency d angular frequency of SHM multiple pendulum, torsional pendulum, spring-mass system C oscillatory circuit, two body oscillations, reduced mass pomposition of SHM problems muped oscillations and its differential equation	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3 Week-2 Class-4 Class-5 Class-6 Week-3 Class-7 Class-8 Class-9 Week-4	ek To To Int rec Pe (SI sol Ve an To Sii LC Sii LC Cc Cc Da	ppic troductory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM clocity, acceleration, phase and epoch, time period, frequency d angular frequency of SHM tal energy and average energy of SHM, problems mple pendulum, torsional pendulum, spring-mass system C oscillatory circuit, two body oscillations, reduced mass pmposition of SHM problems	CT – 1 and Midterm,
Week-1 Class-1 Class-2 Class-3 Week-2 Class-4 Class-5 Class-6 Week-3 Class-7 Class-8 Class-9 Week-4	ek To To Int rec Pe (SI sol Ve an To Sin LC Co Co Co Da	ppic productory class: Brief discussion on total syllabus, basic quirements of the course, assessment of the course riodic motion, oscillatory motion, simple harmonic motion HM), properties of SHM, differential equations, general lution of SHM, graphical representation of SHM elocity, acceleration, phase and epoch, time period, frequency d angular frequency of SHM ptal energy and average energy of SHM, problems mple pendulum, torsional pendulum, spring-mass system C oscillatory circuit, two body oscillations, reduced mass pomposition of SHM problems mped oscillations and its differential equation splacement equation of damped oscillations and its different	CT – 1 and Midterm,

Course Offered by Other Departments

	Course Offered by Ot	ner Departments
Class-12	Wave motion : expression for a plane progressive wave, differential equation of wave motion, particle velocity, wave velocity	
Week-5		Midterm, Final
Class-13	Energy density of a plane progressive wave, average energy in a	
	plane progressive wave, problems	
Class-14	Stationary wave : node, anti-node, problems	
Class-15	Lens and combination of lenses, equivalent lens, power of lens,	
	cardinal points	
Week-6		
Class-16	Defects of images and different aberrations	
Class-17	Defects of images and different aberrations	
Class-18	Interference of light, young's double slit experiment	
Week-7		
Class-19	Analytical treatment of interference, energy distribution	
Class-20	Interference fringes, interference in thin films	
Class-21	Newton's ring, Interferometer	
	MIDTERM	
Week-8		
Class-22	Diffraction : Fresnel & Fraunhofer diffraction, diffraction by single slit	
Class-23	Diffraction by double slit, diffraction gratings	
Class-24	Fraunhofer diffraction at a circular aperture, resolving power of	
	optical instrument	
Week-9		CT – 2, FINAL
Class-25	Polarization of light, Brewster's law, Malus' law	
Class-26	Polarization by double refraction, Nicol prism: Polarizer and	
	analyzer	
Class-27	Optical activity: specific rotation, polarimeters	
Week-10		
Class-28	Laser: spontaneous and stimulated emission, applications of laser	
Class-29	Theory of relativity: Frame of reference, postulates of special relativity, Galilean relativity, Galilean transformation	
Class-30	Lorentz transformations, length contraction, time dilation	
Week-11	, , ,,	
Class-31	Velocity addition, relativistic mass and its expression,	
Class-32	Mass and energy equivalence equation and concept of massless	
	particles and its expression, momentum energy relation,	
	problems	
Class-33	Photoelectric effect, photocurrent and work function, kinetic	
	energy, stopping potential	
Week-12		CT – 3, FINAL
Class-34	Photoelectric equation, characteristics of photoelectric effect	
Class-35	Compton effect: definition, Compton wavelength shift, limitation	
Class-36	De Broglie concept, condition for wave and particle behavior,	
	Bohr atomic model	
Week-13		
Class-37	Expression for Bohr radii and orbital energy for hydrogen atom	
Class-38	Classification of nuclei, nuclear mass and nuclear binding energy	FINAL
Class-39	Radioactivity : Radioactive decay law, half- life	

Week-14	
Class-40	Mean life, nuclear reaction : concept of Fusion, Fission and
	nuclear chain reaction
Class-41	General idea on nuclear reactor and nuclear power plant
Class-42	Review of the syllabus

ASSESSMENT STRATEGY

Comp	Components		СО	Blooms Taxonomy
	Class Test/ Assignment	Grading 20%	CO1, CO2	C1, C2
Continuous Assessment	Class Participation	5%		
(40%)	Class Attendance	5%		
	Midterm	10%	CO2, CO3	C2, C3
			CO 1	C1
Final	Final Exam		CO 2	C1, C2
		-	CO 3	C2
Total	Marks	100%		·

(CO = Course Outcome, C = Cognitive Domain)

TEXT BOOKS

- 1. Fundamentals of Physics : Halliday, Resnick and Walker
- 2. Physics for Scientists and Engineers: Serway and Jewett

REFERENCE BOOKS

- 1. Physics for Engineers : Part-I and Part-II : Dr Giasuddin Ahmad
- 2. Physics, Volume I and Volume II : Resnick and Halliday
- 3. Fundamentals of Physics : Halliday, Resnick and Walker
- 4. Physics for Scientists and Engineers: Serway and Jewett
- 5. Waves and Oscillations : Brij Lal and Subramannyam
- 6. The Physics of Vibrations and Waves: H. J. Pain
- 7. Concept of Modern Physics: Arthur Beiser
- 8. University Physics with Modern Physics: Hugh D. Young and Roger A. Freedman
- 9. Modern Physics for Science and Engineering: Marshall L. Burns
- 10. Modern Physics : B.L. Theraja
- 11. Fundamental of Optics: Francis A. Jenkins and Harvey E. White
- 12. Introduction to Modern Optics: Grant R. Fowles
- 13. Fundamental Optical Design: Michael J. Kidger
- 14. A Text Book of Optics : Brijlal and N. Subrahmanyam Fundamental Optical Design: Michael J. Kidger

REFERENCE SITE

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5.1.1.2 MATH 101 Differential and Integral Calculus

COURSE INFOR	RMATION					
Course Code : Math 101		Lecture Contact Hours	: 3.00			
Course Title	: Differential and Integral Calculus	Credit Hours	: 3.00			
PRE-REQUISITE						
None						
CURRICULUM STRUCTURE						

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Purpose of this course is to introduce basic knowledge of Differential Calculus and use it in engineering study.

OBJECTIVE

1. Be able to impart basic knowledge on differential and Integral Calculus to solve engineering problems and other applied problems.

2. Developing understanding some of the important aspects of rate of change, area, tangent, normal and volume.

3. Be expert in imparting in depth knowledge of functional analysis such as increasing, decreasing, maximum and minimum values of a function

COURS	E OUTCOMES & GENERIC SKILLS						
No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Define the limit, continuity and differentiability of functions, identify the rate of change of a function with respect to independent variables and describe the different techniques of evaluating indefinite and definite integrals.	C1-C2	1	1		3	T, F, ASG
CO2	Apply the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	C3	1	1		3	T, Midterm Exam, F
CO3	Calculate the length, area, volume, center of gravity and average value related to engineering study	C3	1	1		3	Midterm Exam, F, ASG

(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)

COURSE CONTENT

Differential Calculus: Introduction, Differential Calculus for Engineering, Function and Limit, Continuity and Differentiability, Cartesian differentiation, Successive Differentiation, Leibnittz's Theorem, Rolle's Theorem, Mean Value Theorem, Taylor's theorem, Expansion of Finite and Infinite forms, Indeterminate form, Partial differentiation. Euler's theorem, Tangent, sub tangent and Normal, sub normal, Maxima and Minima, Curvature, Asymptotes,

Integral Calculus: Definition of Integration, Importance of Integration in Eng., Integration by substitution, Integration by parts, Standard integrals, Integration by successive reduction, Definite integrals and its properties, Integration as a limit of sum, summing series, Walli's formula, Improper Integrals, beta and gamma function, multiple integral and its application, Area, volume of solid revolution, Area under a plain curve, Area of the region enclosed by two curves, Arc lengths of curves.

SKILL MAPPING

Course Offered by Other Departments

No.]	PROC	GRAN	M O	UT	CO	ME	S (PC	C)	
110.		Course Outcome		1	2	3	4	5	6	7	8	9	10	11	12
CO 1	Define the limit, continuity and differentiability of functions, identify the rate of change of a function with respect to independent variables and describe the different techniques of evaluating														
CO 2	differentiation and integration to solve the														
CO 3	gravity study	ate the length, area, volu and average value related ethod used for mapping whi	to engineering	3				1				1 - 6		1	
		for CO-PO mapping:	cn indicates 5 as	nign, 2		mean	um a)w 1	eve	-1 01	mau	(ming)	
Mapp	oing	Corresponding Level of matching					Justi	ificat	ions						
	PO1(a)	3	The knowledge describe the co	mplete	con	icept	of di	fferer	ntial	and	l int	tegr	al cal	lculus	
	PO1(a)	3	To apply prope knowledge of r	nathem	natic	s, sci	ience	and e	engi	neei	ring	g is 1	requi	red.	-
CO3	PO1(a)	3	In order to calc revolution obje												
		LEARNING STRATEGY Learning Activities								Er	nga	gem	nent (hours)
	to-Face I Lectu	Learning										-	42	<u> </u>	
		ical / Tutorial / Studio											-		
Self-I		ent-Centred Learning Learning													
Self-I	Directed Non- Revis	ent-Centred Learning											42 21 21		
	Directed I Non- Revis Prepa al Assess Cont	ent-Centred Learning Learning face-to-face learning sion of the previous lecture aration for final examination sment inuous Assessment											21 21 2		
	Directed I Non- Revis Prepa al Assess Cont	ent-Centred Learning Learning face-to-face learning sion of the previous lecture aration for final examination sment											21 21		
Forma	Directed Non- Revis Prepa al Assess Cont Final	ent-Centred Learning Learning face-to-face learning sion of the previous lecture aration for final examination sment inuous Assessment											21 21 2 3		
Forma Total TEA	Directed Non- Revis Prepa al Assess Cont Final	ent-Centred Learning Learning face-to-face learning sion of the previous lecture aration for final examination sment inuous Assessment Examination	1	lethod,	Pro	blem	Base	ed Me	etho	d			21 21 2 3		

-	Course Offered by Other De	
Week 1		
Class 1	Introduction to Differential Calculus for Engineering study, Limit of a function and its properties.	
Class 2	Basic limit theorems with proofs, Limit of infinity and infinite limit, Sandwich (Squeezing) theorem with problems.	
Class 3	Concept of Differentiation, definition, classification of discontinuity and solving	CT 1
	problems	
Week 2		
Class 4	Basic concept of Differentiability, definition, derivative of a function, differentiable function.	
Class 5	Differentiability - one sided derivatives (R.H.D and L.H.D), solving problems	
Class 6	Successive differentiation – Concept and problem solving	
Week 3		
Class 7	Leibnitz's theorem and its applications	
Class 8	Determination of $(y_n)_0$	
Class 9	Mean Value theorem, Taylor theorem	
Week 4		
Class 10	Expansion of finite and infinite forms, Lagrange's and Cauchy's form of remainder.	CT 2
Class 11	Indeterminate forms – concept and problem solving,	
Class 12	L'Hospital's rul s with application	
Week 5		
Class 13	Partial differentiation - partial derivatives of a function of two variables and problems	
Class 14	Partial differentiation - partial derivatives of a homogeneous function of two variables, Euler's theorem for two variables and problems	
Class 15	Partial differentiation - partial derivatives of a homogeneous function of several variables, Euler's theorem for several (three and m) variables and problem solving	
Week 6		
Class 16	Tangents and Normals – Tangents and Normals in Cartesian, equation of tangent at the origin, equation of normal of functions of explicit and implicit forms, Angle between two intersection of two curves; problem solving	
Class 17	Tangents and Normals – Tangents and Normals in polar, Angle between two intersection of two curves; problem solving	
Class 18	Tangents and Normals – Subtangent and subnormals in Cartesian and polar coordinate; problem solving	
Week 7		
Class 19	Maxima and minima of functions of single variables – concept, Increasing and decreasing function, Concave up and down with problems	
Class 20	Curvature	
Class 21	Asymptotes	Mid
Week 8		Term
Class 22	Introduction to integral calculus	
Class 23	Standard integrals – concept of definite and indefinite integrals, applications.	
Class 24	Indefinite integrals – Method of substitution, Techniques of integration	
Week 9		

		1
Class 25	Indefinite integrals - Integration by parts, Special types of integration, integration by	
	partial fraction	
Class 26	Integration by the method of successive reduction	
Class 27	Definite integrals – definite integrals with properties and problems	
Week 10		
Class 28	Definite integrals – Reduction formula, Walli's formula	
Class 29	Definite integrals – definite integral as the limit of the sum	
Class 30	Beta function – concept and problem solving	
Week 11		CT 4
Class 31	Gamma function - concept and problem solving	
Class 32	Relation between beta and gamma function, Legendre duplication formula, problems and	
	applications	
Class 33	Multiple integrals – double integrals	
Week 12		
Class 34	Multiple integrals – triple integrals	
Class 35	Multiple integrals – successive integration for two and three variables	
Class 36	Area in Cartesian	
Week 13		
Class 37	Area in polar	
Class 38	Volume of solid revolution	
Class 39	Area under a plain curve in Cartesian and polar coordinates	
Week 14		
Class 40	Area of a region enclosed by two curves in Cartesian and polar coordinates	
Class 41	Arc lengths of curves in Cartesian coordinates	
Class 42	Arc lengths of curves in polar coordinates	
	- •	

ASSESSMENT STRATEGY

			СО	Blooms Taxonomy
Compor	Grading	00	Dicomb Taxonomy	
	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2
	Class Test Assignment 1-5	2070	CO 2	C3
Continuous Assessment (40%)	Class Participation	5%	CO 3	C3
	Midterm	15%	CO 2, CO3	C3
			CO 1	CO 1
Final E	60%	CO 2	CO 2	
			CO 3	CO 3
Total M	larks	100%		
(CO = Course Outcom	e, C = Cognitive Domain, P =	= Psychom	otor Domain,	A = Affective Domain)
TEXT BOOKS				
1. Calculus (9th Edition) by Ho	ward Anton (Author), Irl C. B	ivens (Auth	nor), Stephen I	Davis.
REFERENCE BOOKS				

1. Calculus: An Intuitive and Physical Approach By Morris Kline.

REFERENCE SITES

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5.1.1.3 CHEM 103 General Chemistry

COUR	SE INFORMATION									
Course	Course Code: CHEM 103Lecture Contact Hours: 3.00									
Course	Course Title: General ChemistryCredit Hours: 3.00									
PRE-R	REQUISITE		1							
None										
CURR	ICULUM STRUCTURE									
Outcon	ne Based Education (OBE)									
SYNO	PSIS/RATIONALE									
To lear	n the basic concepts of inorganic	chemistry, physical c	chemistry and sp	ectrosc	opic tec	hniques				
OBJEC	CTIVE									
	o define the different parameter a	· · ·	•							
	o apply different chemical theory		of molecules.							
	o explain the basic concepts of ph	• •								
	o describe basic principles of spec		5.							
COUR	SE OUTCOMES AND GENER	IC SKILLS Corresponding	Bloom's				Assessment			
No.	Course Outcomes	PO	Taxonomy	СР	CA	KP	Methods			
	Be able to define/identify the									
	different parameters and fundamental concepts	1								
CO1	fundamental concepts regarding inorganic and		C1			1	T, F, Mid Term			
	physical chemistry,									
	spectroscopic techniques.									
	Be able to apply different									
CO2	theories on chemical bonding	1	C3			1,2	T, F, Mid Term,			
	and hybridization to determine	1	0.5			1,2	ASG			
	structure of molecules.									
	Be able to explain/illustrate									
	/derive different theories based on colligative									
	properties, chemical						T, F, Mid Term,			
CO3	equilibrium, chemical	1	C2			1,2	ASG			
	kinetics, thermochemistry and									
	electrochemistry,									
	spectroscopic techniques									
	Solve/Analyze different						ASC MITTE			
CO4	problems related to inorganic	2	C4			1,2	ASG ,Mid Term Exam, F			
	and physical chemistry						Exaili, F			

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Atomic Structure: Concepts of atomic structure, Different atom models, Quantum theory and electronic configurations, Heisenberg's uncertainty principle

Periodic Table: Periodic classification of elements, Periodic properties of elements, Properties and uses of noble gases **Chemical Bonding:** Types and properties, Lewis theory, VBT, MOT, Hybridization and shapes of molecules

Introduction to spectroscopic techniques: interaction of electromagnetic radiation with matter, IR spectroscopy, UV-Vis spectroscopy, Beer-Lambert law

Fundamentals of chromatography: Basic principle, classification

Acids-Bases/Buffer Solution: Different concepts of acids-bases, Buffer solution, Mechanism of buffer solution, Henderson-Hasselbalch equation, Water chemistry and pH of water. Theories of Acid-Base Indicators.

Solutions: Solutions and their classification, Unit expressing concentration, Colligative properties and dilute solutions, Raoult's law, Van't Hoff's law of osmotic pressure

Thermochemistry: Laws of thermochemistry, Enthalpy, Heat of reaction, Heat of formation, Heat of neutralization, Kirchoff's equations, Hess's law

Electrochemistry: Conductors and nonconductors, Difference between electrolytic and metallic conduction, Electrolytic conductance, Factors influencing the conductivity of electrolytes, Kohlrausch Law and conductometric titrations

 $\label{eq:chemical Equilibria: Equilibrium law/constant, K_p and K_c, Homogeneous and heterogeneous equilibrium, Van't Hoff's reaction isotherm, Le Chatelier's principle$

Phase Rule: Basic terms and phase rule derivation, Phase diagram of water

Chemical Kinetics: Order and rate of reaction, Pseudo and zero order reaction, Half-life, Determination and factors affecting the rate of a reaction, First order reaction, Second order reaction, Collision theory, Transition state theory

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
INO.	Course Outcome	1	2	3	4	5	6	7	8	9 1	10	11	12
CO1	Be able to define/identify the different parameters and fundamental concepts regarding inorganic and	3											
	physical chemistry, spectroscopic techniques.												
CO2	Be able to apply different theories on chemical bonding and hybridization to determine the structure of molecules.	2											
CO3	Be able to explain/illustrate /derive different theories based on colligative properties, chemical equilibrium, chemical kinetics, thermochemistry and electrochemistry, spectroscopic techniques	2											
CO4	Solve/Analyze different problems related to inorganic and physical chemistry		1										
-	erical method used for mapping which indicates 3 as h CHING LEARNING STRATIGY	igh, i	2 as	med	ium	and	1 as	low	leve	l of n	natchi	ng)	
Teach	ing and Learning Activities				Engagement (hours)								
Face-to-Face Learning Lecture				42									
	Class Performance									-			

CO-PO MAPPING

Self-Directed Learning Assignments	42
Revision of the previous lecture at home Preparation for final examination	21 21
Formal Assessment Continuous Assessment Final Examination	2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week	Content	Assessment
Week 1	General Introduction/Atomic Structure	СТ
Class 1	General introduction on the importance of chemistry for BME students, Concepts of	
	atomic structure, Different atom models	
Class 2	Concepts of atomic structure, Different atom models	
Class 3	Quantum numbers, Electronic configuration	
Week 2	Atomic Structure/Periodic Table	
Class 4	Hydrogen spectral lines, Heisenberg's uncertainty principle	CT-1
Class 5	Classification of elements according to electronic configurations	C1-1
Class 6	Periodic classification of elements	
Week 3	Periodic Table/Chemical Bonding	
Class 7	Periodic properties of elements, Properties and uses of noble gases	
Class 8	Alkali metals: Chemical properties and uses	
Class 9	Chemical bonding (types, properties, Lewis theory, VBT)	
Week 4	Chemical Bonding	
Class 10	Molecular orbital theory (MOT)	
Class 11	Molecular orbital theory (MOT)	
Class 12	Hybridization and shapes of molecules	
Week 5	Chemical Bonding/ Spectroscopic Techniques	
Class 13	Hybridization and shapes of molecules	
Class 14	Hybridization and shapes of molecules	CT-2
Class 15	Interaction of electromagnetic radiation with matter, IR spectroscopy	
Week 6	Spectroscopic Techniques	
Class 16	IR spectroscopy	
Class 17	UV-Vis spectroscopy	
Class 18	UV-Vis spectroscopy, Beer-Lambert law	
Week 7	Acids-Bases	
Class 19	Different concepts of acids-bases	
Class 20	Buffer solution, Mechanism of buffer solution	
Class 21	Henderson-Hasselbalch equation, Theories of Acid-Base Indicators	
Week 8	Acids-Bases/Solutions	CT-3/Mid Term
Class 22	Water chemistry and pH of water	
Class 23	Solutions and their classification, Unit expressing concentration	
Class 24	Effect of temperature and pressure on solubility, Validity and limitations of Henry's	
	law	

Week 9		Solutions/Thermochemis	try		1					
Class 25	Colligative properties	and dilute solutions, Raoult's law	v, deviation fro	om Raoult	's law,					
	Elevation of boiling point									
Class 26										
Class 27	Laws of thermochemi									
Week 10		Thermochemistry/Electroche	emistry							
Class 28	Heat of reaction, Heat	of formation, Heat of neutralizat	ion							
Class 29	Hess's law, Kirchoff's	equations								
Class 30	Electrolytic conductio	n and its mechanism								
Week 11		Electrochemistry								
Class 31	Faraday's law, Kohlra	Faraday's law, Kohlrausch Law, Debye-Huckel-Onsagar theory								
Class 32	Conductrometric titrat	tions								
Class 33	Different types of cell	s								
Week 12		Chemical Equilibrium	l							
Class 34	Reversible reactions,	Characteristics of chemical equili		mass act	ion,					
	Equilibrium constant,	Units of equilibrium constant								
Class 35	-	and K _c ,Van't Hoff's reaction isoth	nerm			CT-4				
Class 36	-	gnificance Heterogeneous equilibr		elier's prir	nciple					
Week 13		cal Equilibrium /Phase rule/ Ch		_						
Class 37	Temperature depender	nce on equilibrium constant								
Class 38	Definitions related to	phase rule, Phase diagram of wate	er							
Class 39		r of reaction, Molecularity of read		and zero	order					
	reaction,									
Week 14		Chemical Kinetics								
Class 40	First order reaction, S	econd order reaction, Half-life								
Class 41	Determination of orde	er of reaction								
Class 42	Collision theory, Tran	sition state theory								
ASSESSMEN	T STRATEGY									
	Compor	nents	Grading	CO	Bloc	om's Taxonomy				
	^			CO1		Cl				
				CO2		C3				
		Class Test/ Assignment	20%	CO3		C2				
				CO4		C4				
Continuous	Assessment (40%)			0.04						
continuous	1135035110111 (1070)	Class Performance	5%	-		-				
				-		-				
			1.50/	CO1,	C					
		Mid term	15%	CO3,	C	1, C3, C4, C4				
				CO4		<u>C1</u>				
				CO1		C1				
	Final E	xam	60%	CO2		СЗ,				
				CO3		C2				
				CO4		C4				
	Total M	arks	100%							
(CO =	= Course Outcome, C =	= Cognitive Domain, P = Psycho	omotor Doma	in, A = A	ffective	Domain)				
TEXT BOOK	KS									
	Inorganic Chemistry – Inorganic Chemistry –									
REFERENCI										
- 1. Modern Inorganic Chemistry S. Z. Haider
- 2. Analytical Chemistry- G.D. Christian
- 3. Essentials of Physical Chemistry Bahl and Tuli
- 4. Physical Chemistry Atkins

REFERENCE SITES

5.1.1.4 CHEM 104 Chemistry Sessional

COURSE INFORMATION

Course Code	: CHEM 104	Lecture Contact Hours	: 3.00
Course Title	: Chemistry Sessional	Credit Hours	: 1.50

PRE-REQUISITE

CHEM 103: General Chemistry

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn the basic concepts of inorganic, organic and physical chemistry.

OBJECTIVE

1. To familiarize the students with experimentation of acid and base neutralization, titration and quantitative analysis of metals etc.

2. To make students proficient in iodimetric and iodometric analysis and complexometric titration etc.

3. To develop students' ability in estimating zinc, ferrous content in water sample by using various titrimetric methods, and UV-Vis spectrophotometric method.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Be able to define the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on.	Cl	1	-	-	1	T, Q, R, ASG
CO2	Be able to describe the different phenomena regarding iodimetric and iodometric method, complexometric titration, UV- Vis spectrophotometric method, etc.	C2	1	-	-	1	T, Q, R,ASG
CO3	Be able to estimate zinc, ferrous content in water sample by using various titrimetric, spectrophotometric methods and report writing	Р3	РО5, РО9	-	-	1	T, Q, R, ASG

Course	Offered	hv	Other	Departments
0000000	0,,0.000	~,	011101	Depen interio

_	emember	Presentation; R - Repor	C3 - Apply		C4 Ana	- alyze		C5	5 - E'	valua	ate		C6	- Crea	te
		•			•										
COUR	RSE CONTI	ENT													
Ouanti	tative chemi	cal analysis in the field	l of inorganic	and p	hvsio	al ch	emis	trv s	uch	as:					
-		, Redox titration, Iodor	-	-	-			-			titrat	tion.			
SKILI	L MAPPIN	Ç.													
SIGILI				PR	DGR	AMO			IFS						
No.	Course L	earning Outcome		1	2	3	4	5	6	$\frac{(10)}{7}$	8	9	10	11	12
	Be able to	o define the different p	arameters	-	_							-	10		
		g acid and base neutrali													
		and quantitative analysis													
CO1		others key words like p		3											
		substances, secondary													
		es, molarity, normality,													
		it weights and so on.	,												
		o describe the differen	t												
		na regarding iodimetri													
CO2		ic method, complexom		3											
	titration,	*													
		rophotometric method	etc.												
	_	o estimate zinc, ferrou													
CO3		nple by using various t													
005		notometric methods and						3				2			
	writing		1												
													ļ	1	
(Nume	rical method	l used for mapping wh	ich indicates 3	3 as hi	igh, 2	as m	ediu	m, a	nd 1	as lo	ow le	vel of	match	ing)	
TEAC	CHING LEA	ARNING STRATEGY	<i>I</i>												
Teachi	ing and Lear	ning Activities										Engag	gemen	t (hour	s)
Face-to	o-Face Learn	ning													
	Lecture											7			
		/ Tutorial / Studio										35			
		Centered Learning										-			
Self-D	irected Lear														
		-to-face learning										-			
		of the previous and (or		lectur	e at h	ome						15			
	_	on for final examinatio	n									10			
Forma	l Assessmen														
		us Assessment										1			
	Lab Test											1			
	Quiz											0.75			
	Viva											0.25			
Total												70			

Lecture and discussion, Co-operative and collaborative method, Problem based method

Class/ Week	Intended topics to be covered	Remarks
Class 1	Introduction	
Class 2	Standardization of Sodium Hydroxide (NaOH) Solution with Standard Oxalic Acid dihydrate (C2H2O4.2H2O) Solution.	
Class 3	Standardization of Hydrochloric Acid (HCl) Solution with standard Sodium Hydroxide (NaOH) Solution.	
Class 4	Standardization of Hydrochloric Acid (HCl) Solution with standard Sodium Carbonate (Na ₂ CO ₃) Solution.	
Class 5	Determination of Calcium (Ca) Content in a calcium chloride dihydrate (CaCl2.2H2O) Solution with Standard Di-Sodium Ethylene Diamine Tetra Acetic Acid (Na ₂ -EDTA) Solution.	
Class 6	Standardization of Sodium ThiosulphatePentahydrate (Na2S2O3.5H2O) Solution with Standard Potassium Dichromate (K2Cr2O7) Solution.	
Class 7	Estimation of Copper (Cu) Content in a Copper Sulphate Pentahydrate (CuSO4.5H2O) (Blue Vitriol) Solutions by Iodometric Method with standard Sodium Thiosulphate Pentahydrate (Na2S2O3.5H2O) Solution.	
Class 8	Standardization of Potassium Permanganate (KMnO4) Solution with Standard Oxalic Acid dihydrate (C2H2O4.2H2O) Solution.	
Class 9	Determination of Ferrous (Fe) Content in an Ammonium Ferrous Sulphate (Mohr's Salt) [FeSO4.(NH4)2SO4.6H2O] Solution with Standard Potassium Permanganate (KMnO4) solution.	
Class 10	Spectroscopic determination of iron (II) by complexing with 1,10- phenanthroline	
Class 11	Practice Lab	
Class 12	Lab Test	
Class 13	Quiz Test	
Class 14	Viva	

Companyata		Grading	СО	Blooms Taxonomy
Components	Components			
Continuous	Report	20%	CO1, CO2, CO3	C1, C2, P3
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3	C1, C2, P3
Final Exam	Lab Test	20%	CO1, CO2, CO3	C1, C2, P3
(60%)	Quiz	30%	CO1, CO2, CO3	C1, C2, P3
(0070)	Viva	10%	CO1, CO2, CO3	C1, C2, P3
Total Marks		100%		
(CO = Course	e Outcome, C =	Cognitive Doma	in)	
TEXT BOOK	KS			
1. G.H. Jeff	ery, J. Bassett, J.	Mendham, R.C.	Denney, Vogel's Textbook of Q	uantitative Chemical Analysis, 5th
Edition,	Longman Scient	ific & Technical	, 1989	
REFERENC	E BOOKS			
1. G. D. Chi	ristian., Analytic	al Chemistry, 6th	n Edition, Wiley India Pvt. Limi	ted, 2007
2. A. Jabbar	Mian and M. M	ahbubul Haque-	Practical Chemistry	
REFERENC	E SITE			

5.1.1.5 GES 101 Fundamentals of Sociology

COU	RSE INFO	RMATION						
	e Code e Title		Lecture Contact H Credit Hours	lours	: 2.00			
PRE-	REQUISIT	È						
-								
CURI	RICULUM	STRUCTURE						
Outco	me Based E	ducation (OBE)						
SYNC	OPSIS/RAT	IONALE						
-								
OBJE	CTIVE							
1.	. Understa	nding social phenomena						
COU	RSE OUTC	COMES & GENERIC SKILLS						
No.		Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1		o understand the basic nature, sco ectives of sociology.	C2	1,2,6	-	-	1	T, F
CO2		apply sociological imagination to social problems of BD society	the C3	3	-	-	1	T, MID, F
CO3		to understand the stages of soc processes and methodologies	cial C2	6,7	-	-	1	T, F

						55	~		1
CO4	civilizations	to analyze differe s and different social j tions for those		C4	11	-	-	1	T, MID, F
CO5	stratification	understand and ar n, different socia capitalism and relate	l systems,	C2	6,7	-	-	1	T, F
CO6	CO6 Be able to apply contextual knowledge to assess coietal and cultural issues in environmental context for sustainable development			C3	7	-	-	1	T, F
	(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASC								Q – Quiz; ASG
– Assignment; Pr – Presentation; R - Report; F – Final Exam)							-		
C1 - R	C1 - Remember C2 - Understand C3 - Apply				C4 - Analyze C5 - Evaluate		te	C6 – Create	

COURSE CONTENT

Nature and scope; Sociological imagination, Perspectives of sociology, Stages of social research and research method, Culture and civilization, Socialization and self -development, Globalization and social changes, Media and individual, Social organizations and social problems, social stratification; industrial revolution, Capitalism and socialism, Work and economic life, Environment and human activities, Climate change and global risk, Population and human society, Urbanization and city development, Social changes and technology.

SKILL MAPPING

No.	Course Looming Outcome	PROGRAM OUTCOMES (PO)											
NO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to understand the basic nature, scope and perspectives of sociology.	3	3				3						
CO2	Be able to apply sociological imagination to the context of social problems of BD society			3									
CO3	Be able to understand the stages of social research processes and methodologies						3	3					
CO4	Be able to analyze different cultures, civilizations and different social problems and design solutions for those											3	
CO5	Be able to understand and analyze social stratification, different social systems, socialism, capitalism and relate them to BD society						3	3					
CO6	Be able to apply contextual knowledge to assess societal and cultural issues in environmental context for sustainable development							3					
(Nume	rical method used for mapping which indicat	tes 3	as hi	gh, 2	as n	nedi	um,	and	1 as 1	low l	evel c	of mate	hing)
FACI	HING LEARNING STRATEGY												
	and Learning Activities									En	gager	nent (h	ours)
	-Face Learning											(/
	Lecture											28	

	Course	e Offerea by Other Departments
	tical / Tutorial / Studio	-
	ent-Centred Learning	-
Self-Directed	Learning face-to-face learning	28
	sion of the previous and (or) subsequent lecture at home	14
	aration for final examination	14
Formal Asses		
Cont	inuous Assessment	2
Fina	Examination	3
Total		89
TEACHING	METHODOLOGY	
Lecture and o	liscussion, Co-operative and collaborative method, Problem based	method
COURSE SO	CHEDULE	
Weeks	Topics	Assessment
1		
Lecture 1	Definition, nature and scope of sociology	
Lecture 2	Sociological imagination	
2		
Lecture 3	Perspectives of sociology	
Lecture 4	Orientation of sociological theories	CT – 1 and Midterm,
3		Final
Lecture 5	Social research and its process	
Lecture 6	Research designs and techniques.	
4		
Lecture 7	Introducing culture and its variations	
Lecture 8	Civilization	
5		
Lecture 9	Defining family and its changes	
Lecture 10	Socialization process and development of self	
6		
Lecture 11	Introducing globalization and its impact on human life	 Midterm, Final
Lecture 12	Factors responsible to globalization	
7	1 0	
Lecture 13	Media and its impact in modern society	
Lecture 14	Addressing social problems of Bangladesh	
	MIDTERM	
8		
Lecture 15	Introducing social groups and organizations	
Lecture 16	Introducing bureaucracy and good governance	
9		CT – 2, FINAL
Lecture 17	Introducing social stratifications and social inequality	,
Lecture 18	Poverty and its types and dimensions	

Lecture 19	Industrial revolution and aftermath	
Lecture 20	Urbanization and city development	
11		
Lecture 21	Capitalism: features and influence	
Lecture 22	Socialism: features and influence	
12		
Lecture 23	Environment and human activities	CT – 3, FINAL
Lecture 24	Climate change and global risk	
13		
Lecture 25	Population of Bangladesh: problem or prospect	
Lecture 26	Crime and deviance: a brief analysis	
14		
Lecture 27	Review 1	
Lecture 28	Review 2	
ASSESSME	NT STRATEGY	

Compone		~ *	CO	Blooms Taxonomy
	ents	Grading		2
	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3, CO4, CO5, CO6	C2, C3, C4
(40%)	Class articipation	5%	CO3	C2
]	Mid term	15%	CO2, CO4	C3, C4
i			CO 1	C2
			CO 2	C3
Final Exa		60%	CO 3	C2
Fillal Exa	alli	0070	CO 4	C4
			CO 5	C2
			CO 6	C3
Total Ma	rks	100%		
CO = Course O	utcome, C =	Cognitive Dor	nain)	
FEXT BOOKS				
	•		aefer, 2 nd edition, 2013	
2. Sociology -	Primary Prince	ciples: by CN	Shankar Rao	

1. Anthony Giddens- 5th edition

2. Relevant journal

REFERENCE SITE

-

5.1.2 Level-1, Fall

5.1.2.1 PHY 127 Structure of matter, Electricity, Magnetism, and Mechanics

COURSE INFORMATION Course Code : PHY 127 Lecture Contact Hours : 3.00 Course Title Credit Hours : Structure of Matter, Electricity, Magnetism and Mechanics : 3.00 **PRE-REQUISITE CURRICULUM STRUCTURE** Outcome Based Education (OBE) SYNOPSIS/RATIONALE This course is one of the basic physics in the field of structure of matter, electricity and magnetism and mechanics. The course will be emphasized the basic concepts, theories and solve quantitative problems which can be applicable in a wide spectrum of engineering disciplines. **OBJECTIVE** 1. To define the different parameter and concepts of structure of matter, electricity and magnetism and mechanics. 2. To explain the basic theories of structure of matter, electricity and magnetism and mechanics. 3. To solve numerical problems regarding structure of matter, electricity and magnetism and mechanics. **COURSE OUTCOMES & GENERIC SKILLS**

		Course Outcome							
No.	At the end	d of the course, a studer able to	nt should be	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	the field of magnetism structure, o	define different basic p 'structure of matter, el and mechanics such crystal defects, charge nomentum, wave function	lectricity and n as crystal e, Coulombs	C1	1	-	-	1	MT, T, F
CO2	Be able to explain different basic theories in the field of structure of matter, electricity and magnetism and mechanics such as such as the Bragg's law, bonding energy, electric field, dipole moment, Faraday's law, Schrödinger equation etc			C2	1	-	-	1	MT, T, F
CO3	Be able to solve quantitative problems in the field of structure of matter, electricity and		C3, C4	1	-	-	2	MT, T, F, ASG	
	-	blems, CA – Complex Presentation, R – Repo		-				-	9 – Quiz, ASG
C1 - R	emember	C2 – Understand	C3 - Apply	C4 - Ana	lyze	C5 – Evaluate		Ce	6 – Create
COU	COURSE CONTENT								

Structure of matter : States of matter, plasticity and elasticity, crystalline and non-crystalline solids, single crystal and poly-crystal solids, unit cell, crystal systems, co-ordinations number, crystal planes and directions, NaCl and CsCl structure, packing factor, Miller indices, relation between inter-planar spacing and Miller indices, Bragg's law, methods of determination of inter-planar spacing from diffraction patterns; defects in solids: point defects, line defects, surface defects, bonds in solids, band theory of solids: distinction between metal, semiconductor and insulator, inter-atomic distances, calculation of cohesive and bonding energy.

Electricity and Magnetism : Electric charges and Coulomb's law, quantization of charge, electric field, electric field due to : point charge, dipole, charged rod and charged ring, electric flux and calculation of flux, Gauss' law, application of Gauss' law, electric potential, calculation of electric potential, equipotential surfaces, energy and electric potential, Capacitors, capacitance for different capacitors, energy store in a capacitor, dielectrics and atomic view of dielectrics and Gauss' law with dielectrics, Current density, drift speed, resistances, ohm's law and resistivity-an atomic view, Biot-Savart law and Ampere's law and their applications, Laws of electromagnetic induction, self-inductance and mutual Magnetic conductor, inductance, force on current carrying а Torque on a current carrying loop, Hall effect, solenoid and toroid, Maxwell's equations, Magnetic field intensity, susceptibility, permeability, magnetization; classification of magnetic materials, soft and hard magnetic materials, superparamagnetic materials and their applications.

Mechanics: Linear momentum of a system of particles, conservation of linear momentum, elastic and inelastic, collisions, angular kinematics, torque, rigid bodies, moment of inertia, angular momentum of a system of particles, conservation of angular momentum. Introduction to Quantum Mechanics, wave function, uncertainty principle, postulates of quantum mechanics, Schrödinger time independent and time dependent equation, eigen value, expectation value, probability, particle in a potential box, calculation of energy.

SKILL	MAPPI	ING													
No.		Course Learning Ou	taoma				PR	OG	RAN	1 O I	JTCC	MES	(PO)		
INO.		Course Learning Ou	teome	1	2	3	4	5	6	7	8	9	10	11	12
	Be abl	e to define different ba	sic parameters												
		field of structure of ma	•												
CO1		nagnetism and mecha													
01	-	structure, crystal de													
	Coulor	mbs law, flux, mon	nentum, wave												
	functio	on etc.													
	Be abl	e to explain different	basic theories												
	in the f	field of structure of ma	tter, electricity												
CO2	and ma	agnetism and mechanic	es such as such												
02	as the	Bragg's law, bonding e	energy, electric												
	-	dipole moment, Fa	araday's law,												
	Schröd	linger equation etc													
	Be able	e to solve quantitative p	problems in the												
	field o	f structure of matter,	electricity and												
CO3	magne	tism and mechanics st	uch as such as												
005	packin	g factor, Miller indic	es, electricity,												
	magne	tism, classical	& quantum												
	mecha	nics, etc.													
(Numer	ical met	hod used for mapping	which indicates	3 as l	high,	2 as 1	medi	um,	and	1 as	low l	evel o	of mat	tching)	
JUSTIFICATION FOR CO-PO MAPPING															
Mapping Level of Matching							J	ustif	ficat	ion					

SKILL MADDING

		Course Offered b	by Other Departments
CO1-PO1	3	The conceptual knowledge of the natural sciences discipline	applicable to the engineering
CO2-PO1	3	The theory-based knowledge of the natural engineering discipline	sciences applicable to the
CO3-PO1	3	The numerical analysis based knowledge of the n the engineering	natural sciences applicable to
TEACHING LEA		ATEGY	
Teaching and Lear			Engagement (hours)
Face-to-Face Learn	ning		
Lecture			42
	/ Tutorial / Stud		-
	Centred Learnin	g	-
Self-Directed Lear	e		
	-to-face learnin	-	42
	-	and (or) subsequent lecture at home	21
<u>^</u>	on for final exa	mination	21
Formal Assessmen			
	us Assessment		3
Final Exa	mination		3
Total			132
TEACHING MET	THODOLOGY	ł	
Lecture and discus	sion, Co-operat	tive and collaborative method, Problem based method	
COURSE SCHEE	DULE		
Week		Content	Assessment
1			
Lecture 1	Introduc	tory class: Brief discussion on total syllabus, basi	c

Week	Content	Assessment
1		
Lecture 1	Introductory class: Brief discussion on total syllabus, basic	
	requirements of the course, assessment of the course.	
Lecture 2	States of matter, classification of solids, plasticity and elasticity,	
	types of crystalline solids, crystal, lattice, basis, crystal structure,	CT – 1 and Midterm,
	plane lattice, space lattice, Bravais and non-Bravais lattices	Final
Lecture 3	Unit cell, lattice parameters, primitive and non-primitive cells and	
	their distinctions, lattice symbols, crystal structure of NaCl and	
	CsCl	
2		
Lecture 4	Unit face, axial units: linear and numerical parameters and, Miller	
	indices	
Lecture 5	Atomic radius, packing factor and coordination number for	
	different structures	
Lecture 6	Relation between lattice constant and density of solids and related	
	numerical problems.	
3		

	Course Ojjerea by C	tiller Departments		
Lecture 7	Inter-planer spacing, relation between inter-planar spacing and Miller indices, problems			
Lecture 8	X-ray diffraction, Bragg's law, methods of determination of inter- planar spacing from diffraction patterns, problems			
Lecture 9	Defects in solids: point defects, line defects, surface defects			
4				
Lecture 10	Defects in solids: point defects, line defects, surface defects			
Lecture 11	Atomic arrangement in solid: different types of bonds in solids			
Lecture 12	Band theory of solids : valence band, conduction band, energy gap, distinction between metal, semiconductor and insulator			
5				
Lecture 13	Potential, cohesive energy, binding energy, Madelung constant, inter-atomic distance, calculation of total potential energy of a pair of atoms	Midterm, Final		
Lecture 14	Calculation of total potential energy at the equilibrium separation of an ionic crystal, problems			
Lecture 15	Electric charges and Coulomb's law, quantization of charge, electric field, electric field due to : point charge, uniformly charged wire, charged ring, charged disk			
6				
Lecture 16	e 16 Electric field due to dipole, dipole in an electric field, electric flux and calculation of flux, Gauss' law			
Lecture 17	Gauss' law and Coulomb's law for a point charge, application of Gauss' law for : charged sphere, line of charge, sheet of chare, parallel charged plates			
Lecture 18	Electric potential, potential and electric field strength, calculation of electric potential : due to a point charge, dipole			
7				
Lecture 19	Calculation of electric potential : charged ring, charged disk, electric potential energy, equipotential surfaces, calculation of electric field from the potential			
Lecture 20	Capacitors, capacitance for different capacitors			
Lecture 21	Energy store in a charged capacitor, energy density, dielectrics and atomic view of dielectrics and Gauss' law with dielectrics			
	MIDTERM			
8				
Lecture 22	Concept of electric current, current density, drift velocity, resistances, ohm's law and resistivity-an atomic view,			
Lecture 23	Magnetic force on a current carrying conductor, torque on a current carrying loop, Hall effect			
Lecture 24	Biot-Savart law and Ampere's law and their applications, solenoid and toroid	CT – 2, FINAL		
9				
Lecture 25	Laws of electromagnetic induction, self-inductance and mutual inductance			
Lecture 26	Maxwell's equations			
Lecture 27	Magnetization; magnetic field intensity, susceptibility, permeability			

10								
Lecture 28		Classification of m	agnetic materials, magnetizat	ion curves.				
			M-H hysteresis loop, soft and ha					
Lecture 29			aterials and their applications					
Lecture 30			, quantum and statistical mecha	anics, centre				
		of mass, centre of gra						
11								
Lecture 31		Coincidence of centre	of mass and centre of gravity, n	notion of the				
		centre of mass, probl	ems					
Lecture 32			a particle, linear momentum of n of linear momentum	a system of				
Lecture 33		Elastic and inelastic, bodies	collisions, angular kinematics, t	torque, rigid				
12]	Mechanics			CT – 3, FINAL			
Lecture 34	1	Moment of inertia of	different objects, problems		01 0,110,112			
Lecture 35	;	angular momentum o	f a particle, angular momentum	of a system				
			of conservation of angular mon					
Lecture 36		Introduction to Quant principle	tum Mechanics, wave function,	uncertainty				
13]	principie						
Lecture 37]	Fundamental postula	ve function,					
	1	uncertainty principle						
Lecture 38	,	Time dependent Schr	ödinger's equation					
Lecture 39	,	Time independent Scl	hrödinger's equation		FINAL			
14								
Lecture 40			ion value, probability					
Lecture 41		Particle in a potential						
Lecture 42		Calculation of energy						
		F	FINAL EXAMINATION					
ASSESSME	NT STRAT	EGY						
			СО	Bloo	ms Taxonomy			
Comp	oonents	Grading	0	DIOO	ins raxonomy			
	Class Tes	20%	CO1, CO3		C1, C2			
	Assignme	ent	,		,			
Continuous	3%							
(40%) Class								
(4070)	Participati	on 5%			A2			
	Midterm		CO2, CO3		C1, C2			
			CO 1		C1			
Final	Exam	60%	CO 2	(C1, C2, C4			
			CO 3		C3, C4			
Total	Marks	100%						

REFERENCE BOOKS

- 1. Physics for Engineers : Part-I and Part-II : Dr Giasuddin Ahmad
- 2. Physics, Volume I and Volume II : Resnick and Halliday
- 3. Fundamentals of Physics : Halliday, Resnick and Walker
- 4. Physics for Scientists and Engineers: Serway and Jewett
- 5. Introduction to Solid State Physics: Charles Kittle
- 6. Solid State Physics: S. O. Pillai
- 7. Solid State Physics: Ali Oma
- 8. Fundamentals of Solid State Physics : B.S. Saxena, R.C. Gupta, P.N. Saxena
- 9. B.Sc Physics: C. L. Arora.
- 10. Concept of Electricity and Magnetism : Rafiqullah, Roy, Huq
- 11. Electricity and Magnetism : K. K. Tewari
- 12. Elements of Quantum Mechanics : Kamal Singh, S.P. Singh
- 13. Concepts of Modern Physics : Arthur Beiser
- 14. Quantum Mechanics : Gupta, Kumar & Sharma

REFERENCE SITE

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5.1.2.2 PHY 128 Physics Sessional

COURSE INFORMATION Course Code : PHY 128 Lecture Contact Hours : 3.00 Course Title : Physics Sessional Credit Hours : 1.50 **PRE-REQUISITE** N/A **CURRICULUM STRUCTURE** Outcome Based Education (OBE) SYNOPSIS/RATIONALE This course is a laboratory course for the basic physics in the field of waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics. The course will be emphasized the fundamental experiments on different fields of physics which can be applicable in a wide spectrum of engineering disciplines. This laboratory course will enable students to understand basic physics practically as well as do work with team or individual. **OBJECTIVE** 1. To develop basic physics knowledge practically 2. To practice use of basic scientific instrument. **LEARNING OUTCOMES & GENERIC SKILLS** CP CA KP No. Course Outcomes

_			Course Offered	by Other Dep	partme	nts
	At the end of the course, a student should be able to	Correspondin g POs	Bloom's Taxonomy			Assessm ent Methods
CO1	Be able to define the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	PO1	C1		K1	R, Q, F
CO2	Be able to describe the different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	PO1	Cl		K1	R, Q, T, F
CO3	Be able to construct Experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	PO9	C2		K2	R, Q, T, F
CO4	Be able to prepare a report for an experimental work.	PO10	C2		K2	R

(CP – Complex Problems, CA – Complex Activities, KP – Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, CS – Case study, MT- Mid Term Exam, F – Final Exam)

COURSE CONTENT

Quantitative measurement of different parameters in the field of waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics such as:

Specific resistance of materials, high resistance, resistance of a galvanometer, Electrochemical equivalent (ECE) of copper, comparison of the E.M.F's of two cells, radius of curvature, wavelength of light, focal length of lens, specific rotation of sugar, refractive index of a liquid, thermal conductivity of a bad conductor, temperature co-efficient of resistance, pressure co-efficient of a gas, specific heat of a liquid, acceleration due to gravity, spring constant, rigidity modulus, young's modulus, moment of inertia, conservation of linear momentum, frequency of a tuning fork, surface tension, Planck's constant.

СО-РО	MAPPING												
No.			PROGRAM OUTCOMES (PO)										
INO.	Course Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to define the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	3											
CO2	Be able to describe the different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	3											

-		Course Offered by Other Departments
CO3	Be able to construct Experiments by an individual or by a group to determine different phenomena regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	2
CO4	Be able to define the different parameters regarding waves and oscillations, optics, mechanics, electricity, modern physics and thermal physics etc.	

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level of Matching	Justification
CO1-PO1	3	The conceptual knowledge of the natural sciences applicable to the engineering discipline
CO2-PO1	3	The descriptive knowledge of the natural sciences applicable to the engineering discipline
CO3-PO9	2	Able to do work or complete a task as an individual and as a team
CO4-PO10	1	Capable to write a report on an experimental work

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Experiment	35
Self-Directed Learning	
Preparation of Lab Reports	21
Preparation for the Lab Test	13
Preparation of Quiz	9
Preparation of viva	9
Formal Assessment	
Continuous Assessment	14
Final Quiz	1
Final viva	1

Fin	al lab exam		3				
	Total		112				
TEACHIN	G METHODOLOGY						
Lecture foll Method	lowed by practical experiments and discussion, Co-operative	and Collaborative M	1ethod, Pro	ject Based			
COURSE S	CHEDULE						
Weeks	Topics			Remarks			
Week-1	Introductory class: Brief discussion on total syllabus, bas evaluation system of the course, grouping, visit differe introduction to different basic equipment						
Week-2	Determination of the specific resistance of a wire using meter length of a concave lens by auxiliary lens method	bridge / Determinatio	on of focal	Perform any one			
Week-3	Veek-3 Determination of high resistance by the method of deflection / Determination of resistance of a galvanometer by half deflection method / Determination of specific heat of a liquid by the method of cooling						
Week-4	Determination of ECE of copper by using copper voltameter / Determination of the Young's modulus of bar by bending method. / Determination of the Young's modulus for the material of a wire by Searle's apparatus						
Week-5	Determination of the wavelength of sodium light by a spectrometer using a plane diffraction grating/ Determination of the moment of inertia of a Fly-wheel about its axis of rotation						
Week-6	Determination of the radius of curvature of a plano-convex Determination of the temperature co-efficient of resistance of meter-bridge			Perform any one			
Week-7	Determination of the specific rotation of sugar by polarimeter/ index of a liquid by plane mirror and pin method using a conv		refractive	Perform any one			
Week-8	Determination of the thermal conductivity of a bad conductor of the law of conservation of linear momentum / Determination by capillary tube method and hence to verify Jurin's law			Perform any one			
Week-9	Determination of the value of g acceleration due to grav pendulum / Comparison of the E.M.F's of two cells by a pote		compound	Perform any one			
Week-10	Determination of the spring constant, effective mass and the Determination of the pressure co-efficient of a gas at constant thermometer			Perform any one			
Week-11	Determination of the Planck's constant using photoelectric frequency of a tuning fork by Melde's experiment	effect / Determinati	on of the	Perform any one			
Week-12	Viva & lab final experimental exam						
Week-13	Viva & lab final experimental exam						
Week-14	Quiz exam						
ASSESSMI	ENT STRATEGY						
		СО	Blooms	Гахопоту			

	Components	Grading		
Continuous Assessment	Class performance/ Assignment	10%	CO1	C1
(40%)	Report Writing/ Assignment	30%	CO1, CO4	C1, C2
	Lab test	30%		
Final Exam (60%)	Viva	10%	CO1, CO2, CO3	C1, C2
	Quiz	20%		
	Total Marks			

(CO = Course Outcome, C = Cognitive Domain, A = Affective Domain, P = Psychomotor Domain)

REFERENCE BOOKS

- 1. Practical physics for degree students : Dr Giasuddin and Md. Sahabuddin
- 2. Practical Physics: G. L. Squires
- 3. B.Sc. Practical Physics: C. L Arora
- 4. Practical Physics: S.L. Gupta and V. Kumar

5.1.2.3 MATH 105 Vector Analysis, Matrix and Coordinate Geometry

COURSE INFORMATION

Course Code	: Math 105	Lecture Contact Hours	: 3.00	
Course Title	: Vector Analysis, Matrix and Coordinate Geometry	Credit Hours	: 3 .00	

PRE-REQUISITE

Course Code: Math 105

Course Title: Vector Analysis, Matrix and Coordinate Geometry

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To teach the students the basic Concepts, Principles and operations of Vector, Matrices and Application of Geometry. The aim of this course is to develop the analytical capability of Vector, Matrices and Geometry. Finally this course is designed to develop a capability of students to solve practical problems.

OBJECTIVE

- 1. Be able to impart basic knowledge on the Vector Analysis, Matrix and Geometry.
- 2. Achieving ability to familiarize the students with the working principle of calculating differentiation and integration of vector valued functions in Cartesian, cylindrical and spherical geometry.
- 3. Be able to provide knowledge on using concept of vector, matrix and Geometry in engineering area and solve other applied problems.
- 4. Be expert in imparting the depth knowledge on the vector analysis, matrix and co-ordinate geometry.

No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Define and identify the physical explanation of different vector notation, explain the basic concept of matrix, 2D and 3D geometry.	C1-C2	1	1		1, 3	T, F
CO2	Interpret mathematics, science and engineering such as calculating volume and area of any object in vector field.	C2	1	1		3	T, Mid Term Exam, F
CO3	Be proficient to analyses and demonstrate the technique in engineering problems which is taught in vector, matrix and Geometry.	C1,C3	1	1,3		3	Mid Term Exam, F, ASG

(C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create; CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam)

COURSE CONTENT

Vector Analysis: Definition of Vector, Scalars and Vectors, Equality of direction ratios and vectors, Addition and Subtraction of Vectors, Multiplication of vectors by scalars, Position Vector of a point, Scalar and vector products of two vectors and their geometrical interpretation, Triple products and multiple products, Differentiation of vectors, Gradient of scalar functions, Divergence and curl of point functions, physical significance of gradient, divergence and curl, Definition of line, surface and volume integral, Integration of Vectors, Green's, stroke's and Gauss theorem and their application.

Matrix: Definition of Matrix, different types of matrices, Algebra of Matrices, Multiplication of matrices, Transpose and adjoint of a matrix, inverse of a matrix, rank and elementary transformation, solution of linear equation or System of Linear Equation, linear dependence and independence of vectors, quadratic forms, matrix polynomials, determination characteristic roots and vectors, null space and nullity of matrix, characteristic subspace of matrix, Eigen values and Eigen Vectors, Caley-Hamilton theorem.

Coordinate Geometry: Introduction to geometry, Rectangular co-ordinates, Angle between two lines, Transformation of co-ordinates, changes of axes, The plane-angle between two planes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties, circles (tangents, normal, chord of contact, pole and polar), equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points), Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid.

SKILL MAPPING

No.	Course Outcome			I	PRO	GR/	٩M	OUT	ГСО	MES	5 (PO))	
INO.	Course Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to define and identify the physical explanation of different vector notation, explain the complete concept about matrix, 2D and 3D geometry.	3											
CO2	Be able to interpret mathematics, science and engineering such as calculating volume and area of any object in vector field.	3											
CO3	Be proficient to determine and find the technique to obtain the inverse matrix and calculate length, volume and area of objects related to engineering study by using vector, solve the system of linear equations using matrix and the problems related to the pair of straight lines, circles, system of circles, parabola, ellipse etc.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

Justification	for CO-PO mapping:							
Mapping	Corresponding	Justific	ations					
	Level of matching							
CO1-PO1(a)	3	The knowledge of mathematics, science	ence and engineering has to be applied to					
		describe the operation of being able to	be the operation of being able to identify the physical explanation of					
		different vector notation, explain the com geometry.	plete concept about matrix, 2D and 3D					
CO2-PO1(a)	3	In order to interpret mathematics, science	ce and engineering such as calculating					
		inverse matrix and volume and area of an	y object in vector field.					
CO3-PO1(a)	3	In order to construct and calculate the area of objects related to engineering stu						
		by using vector, solve the system of linear equations using matrix and geometr related problems.						
TEACHING	LEARNING STRAT	EGY						
Teaching and	Learning Activities		Engagement (hours)					
Face-to-Face	Learning							
Lectu			42					
	tical / Tutorial / Studio ent-Centred Learning		-					
Self-Directed								
	-face-to-face learning		42					
	sion of the previous led		21					
	ration for final examination	ation	21					
Formal Assess								
	inuous Assessment		2					
	Examination		3					
Total			131					

Justification for CO-PO mapping:

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1		
Class 1	Definition of vector, Scalars and Vectors, Equality of direction ratios and vectors, Addition,	
	Subtraction and multiplication of vectors,	
Class 2	Position vector of a point, Scalar and vector products of two vectors and their geometrical	
	interpretation, Triple products and multiple products,	
Class 3	Linear dependence and independence of vectors, Differentiation of vectors,	CT 1
Week 2		
Class 4	Gradient of scalar functions, Divergence and curl of point functions,	
Class 5	Physical significance of gradient, divergence and curl	
Class 6	Physical significance of gradient, divergence and curl	
Week 3		
Class 7	Integration of vectors (line, surface and volume integrals)	
Class 8	Integration of vectors (line, surface and volume integrals)	
Class 9	Integration of vectors (line, surface and volume integrals)	
Week 4		
Class 10	Green's, Stoke's and Gauss's theorem and their application	CT 2
Class 11	Green's, Stoke's and Gauss's theorem and their application	
Class 12	Green's, Stoke's and Gauss's theorem and their application	
Week 5		
Class 13	Definition of Matrix, different types of matrices, Algebra of Matrices, Multiplication of matrices,	
Class 14	Transpose and adjoint of a matrix, inverse of a matrix,	
Class 15	Rank and elementary transformation.	
Week 6		
Class 16	Solution of linear equation or System of Linear Equation,	
Class 17	Solution of linear equation or System of Linear Equation,	
Class 18	Quadratic forms, matrix polynomials, determination characteristic roots and vectors	
Week 7		
Class 19	Null space and nullity of matrix, characteristic subspace of matrix,	
Class 20	Eigen values and Eigen Vectors	
Class 21	Caley-Hamilton theorem - concepts and problems	

Week 8					Other Departments	_
Class 22	Introduction to ge	ometry, Rectangular co-ordinat	es, Angle be	tween two line:	5,	
Class 23		f co-ordinates, changes of axes,				Mid
Class 24		between two planes, pair of stra	ight lines			Term
Week 9		1 / 1	0			Term
Class 25	Pair of straight lin	nes, general equation of second	degree and	reduction to its	standard forms	
	and properties,					
Class 26	Circles (tangents,	normal, chord of contact, pole a	ind polar),			
Class 27	Circles (tangents,	normal, chord of contact, pole a	ind polar),			
Week 10						
Class 28	Equation of conic	s,				
Class 29	Equation of conic					
Class 30	- -	uations of second degree,				
Week 11		6 /				CT 4
Class 31	Angle between st	raight lines, pair of lines joining	the origin to	the point of in	tersection of two	
	-	ations of parabola, ellipse in Ca	-	-		
Class 32		ng the origin to the point of int	-			
		n Cartesian and polar coordinate		8		
Class 33	· ·	ng the origin to the point of int		two given curv	ves, equations of	
		n Cartesian and polar coordinate		8		
Week 12						
Class 34	System of circles	(radical axes, coaxial circles, lin	niting points	5),		
Class 35	System of circles	(radical axes, coaxial circles, lin	niting points	s),		
Class 36	Three dimensiona	Il co-ordinate system,				
Week 13						
Class 37	Direction cosines	, projections,				
Class 38	The plane (angle	between two planes, parallel & p	erpendicula	r plane, distanc	e of a point from	
	a plane).					
Class 39	The plane (angle a plane).	between two planes, parallel & p	perpendicula	r plane, distanc	e of a point from	
Week 14						
Class 40		(coplanar lines, shortest distant of sphere, ellipsoid, hyperboloi		two given str	aight lines),	
Class 41	The straight line (coplanar lines, shortest distance	between tw	o given straigh	t lines), standard	
	-	e, ellipsoid, hyperboloid)		-		
Class 42	The straight line (coplanar lines, shortest distance	between tw	o given straigh	t lines), standard	
	equation of spher	e, ellipsoid, hyperboloid)				
ASSESSMEN	NT STRATEGY					
	Compo	nents	Grading	СО	Blooms Taxor	nomy
Cantin 1	ssessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2, C	3
	ssessment (40%)	1 Inco Loct/ Accommont 1 2	1 ///-			

		Сои	urse Offered by C	Other Departments
	Class Participation	5%	CO3	C2,C3
	Mid term	15%	CO 2, CO3	C2,C3
			CO 1	C1, C2
Final E	xam	60%	CO 2	C1, C2, C3
			CO 3	C3
Total M	arks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT BOOKS

- 1. Vector Analysis Seymour Lipschutz, Dennis Spellman and Murray R. Spiegel, Schaum's outlines.
- 2. Vector Analysis M. D. Raisinghania.

REFERENCE BOOKS

- 1. Elementary Linear algebra Wiely, Howard Anton and Chris Rorres.
- 2. A Text Book on Co-ordinate Geometry with Vector Analysis Rahman & Bhattacharjee.
- 3. Analytic Geometry -Abdur Rahman.
- 4. Analytical Solid Geometry- Shanti Narayan.

REFERENCE SITES

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5.1.2.4 CHEM 125 Physical and Bio-organic Chemistry

COURS	E INFORMAT	ION					
Course (Code : CHE	EM 125	Lecture Contact Hours	: 3.0	0		
Course 7	itle : Phys	ical and Bio-organic	Credit Hours	: 3.0	0		
	Chem	istry					
PRE-RE	QUISITE						
CHEM 1	03 – General C	Chemistry					
CURRI	CULUM STRU	CTURE					
Outcome	Based Educatio	n (OBE)					
	SIS/RATIONA						
This cou	rse introduces st	udents to the theories and	d structures of chemicals i	n thermod	ynamic	s and eq	uilibrium,
hydrocar	bons, and biomo	lecules. Principles of the	ermodynamics and free en	ergy, chen	nical eq	uilibriur	n, reaction
mechani	sms and rates, hy	drocarbon structures and	d reactions, structures and	mechanis	ms of si	ugars, po	olvsaccharides.
		es are covered in depth.	,			8 1	, ,
OBJEC'							
1. To a	equire sufficient	knowledge of the concep	ots and parameters of ther	nodynami	cs, entr	opy, equ	
	• ,						illibrium, and
	ion rates.						illibrium, and
react		ates and chemical equili	_				illibrium, and
react 2. To a	nalyze reaction r	*	_	ıs hydroca	urbons a		
react 2. To a 3. To d	nalyze reaction r escribe the struct	ures, synthesis, and read	orium	•		and orga	nic compounds
react 2. To a 3. To d 4. To b	nalyze reaction r escribe the struct	tures, synthesis, and react the chemistry behind difference	orium tion mechanisms of variou	•		and orga	nic compounds
react 2. To a 3. To d 4. To b lipid	nalyze reaction r escribe the struct e able to explain s, and biological	tures, synthesis, and react the chemistry behind difference	orium tion mechanisms of variou fferent bioconjugate techn	•		and orga	nic compounds
react 2. To a 3. To d 4. To b lipid	nalyze reaction r escribe the struct e able to explain s, and biological	the chemistry behind dir molecules	orium tion mechanisms of variou fferent bioconjugate techn	iques, bior		and orga	nic compounds

					Cours	e Offer	ed by (Other De	epartments
CO1	Be able to	o understand concepts	of	C2	1	1	-	1, 2	T, F
	thermody	namics, kinetics, and en	ntropy						,
~~~	Be able to	o apply the concepts of	•	~					
CO2	thermody	namics and kinetics to	calculating	C3	2	1	-	1, 2	T, F
	reaction r	ates and energy							
<b>a</b> a <b>a</b>	Be able to	o <b>remember/classify</b> th	e structure,	C1	1		-	1	
CO3	reactions,	, and functions of carbo	hydrates,	C1		-			MID, F
	proteins a	and lipids							
<b>GO</b> 4	Be able to	o understand bioconju	gate						<b>T D</b>
CO4	technique	es, and structure and che	emistry of	C2	1	-	-	1	T, F
	biomolec	ules found in the body							
(CP-Co	omplex Prob	olems, CA-Complex Ac	tivities, KP-K	nowledge Prof	ile,T – T	Fest; PI	R – Pro	ject; Q -	– Quiz; ASG –
Assign	ment; Pr – P	resentation; R - Report;	; F – Final Exa	m)					
C1 - Re	member	C2 – Understand	C3 - Apply	C4 - Ana	lyze	C5 –	Evalua	ite	C6 - Create

#### COURSE CONTENT

Thermodynamics and Kinetics: Overview of thermodynamics and kinetics, First law of thermodynamics, second law of thermodynamics and entropy, Free energy, 3rd law of thermodynamics, Gibbs Free energy, equilibrium and free energy, reaction mechanism, Arrhenius equation and catalysis, rates of reaction, Kinetic theory of gases, ideal gas law Organic chemistry: Chemistry of hydrocarbons, Synthetic methods of common organic compounds, Reaction mechanism of typical organic reactions, Structure determination of organic compounds, alkenes, aromatics, ether, aldehyde, esters, amide, amine.

Biomolecules: Basic chemistry of biomolecules and bio-conjugation techniques. Molecular logic of living system, Biomolecules and cells, Sugars, polysaccharides, lipids-triglycerides, phospholipids, amino acids, amino acid sequences, primary, secondary, tertiary and quaternary structure; classification of proteins, biological membranes, chemistry of antibody, protein synthesis.

#### SKILL MAPPING

Na	Course Looming Outcome	PR	OGR.	AM (	DUT	CON	ЛES	(PO	)				
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to <b>understand</b> concepts of	3											
	thermodynamics, kinetics, and entropy	5											
	Be able to <b>apply</b> the concepts of												
CO2	thermodynamics and kinetics to calculating		3										
	reaction rates and energy												
~~~	Be able to <b>remember/classify</b> the												
CO3	structure, reactions, and functions of	3											
	carbohydrates, proteins and lipids												
CO4 t	Be able to understand bioconjugate												
	techniques, and structure and chemistry of	3											
	biological molecules found in the body												
(Numer	rical method used for mapping which indicates	3 as h	igh, i	2 as r	nediı	um, a	and	l as	low l	evel o	of mate	ching)	
TEAC	HING LEARNING STRATEGY												
Teachi	ng and Learning Activities									Eng	ageme	ent (ho	urs)
Face-to	-Face Learning												
	Lecture									42			
	Practical / Tutorial / Studio									-			
	Student-Centred Learning									-			
Self-Di	irected Learning												
	Non-face-to-face learning									42			
	Revision of the previous and (or) subsequent	lectu	re at l	nome						21			

Preparati	on for final examination	21
Formal Assessmen	t	
Continuo	us Assessment	2
Final Exa	mination	3
Total		131
TEACHING ME	THODOLOGY	
Lecture and discus	sion, Co-operative and collaborative method, Problem based method	
COURSE SCHEI	DULE	
Week	Content	Assessment
1	Course introduction	
Lecture 1	Course Introduction	-
Lecture 2	Introduction to Thermodynamics and Kinetics: Overview of	
	thermodynamics and kinetics from chemistry I	
Lecture 3	Heat and enthalpy	CT - 1 and Midterm,
2	Thermodynamics and Free Energy, First law of thermodynamics	Final
Lecture 4	Second law of thermodynamics and entropy, Free energy	
Lecture 5	3 rd law of thermodynamics	
Lecture 6	Gibbs Free energy]
3	Equilibrium and Reaction mechanisms]
Lecture 7	Equilibrium and free energy	
Lecture 8	Reaction mechanism	
Lecture 9	Arrhenius equation and catalysis	
4	Rates of reaction and gas law	
Lecture 10	rates of reaction	-
Lecture 11	Kinetic theory of gases, ideal gas law	
Lecture 12	Review Class	
5	Chemistry of hydrocarbons	
Lecture 13	Organic chemistry: Chemistry of hydrocarbons	
Lecture 14	Organic chemistry: Chemistry of hydrocarbons,	
Lecture 15	Synthetic methods of common organic compounds	
6	Reaction mechanisms and structure of organic compounds	
Lecture 16	Reaction mechanism of typical organic reactions	
Lecture 17	Reaction mechanism of typical organic reactions	Midterm, Final
Lecture 18	Structure determination of organic compounds, alkenes,	
	aromatics	
7	Structure of organic compounds	
Lecture 19	ether, aldehyde, esters	
Lecture 20	amide, amine	
Lecture 21	Basic chemistry of biomolecules	
MIDTERM		
8	Sugars	
Lecture 22	Sugars and their types, sugar derivatives and biologically	
	relevant sugars	
Lecture 23	structure and isomerism	
Lecture 24	Reactions of sugars	
9	Polysaccharides	
Lecture 25	polysaccharides and glycosidic bonds, amylose and amylopectin	CT – 2, FINAL

Lecture 26	Starch, glycogen, and cellulose	
Lecture 27	heteropolysaccharides	
10	Lipids	
Lecture 28	lipids-triglycerides	
Lecture 29	Phospholipids	
Lecture 30	Lipid membranes and structures	
11	Proteins and their structure	
Lecture 31	amino acids, amino acid sequences	
Lecture 32	primary, secondary, tertiary and quaternary structure	
Lecture 33	classification of proteins	
12	Chemistry of biological molecules	CT – 3, FINAL
Lecture 34	biological membranes	
Lecture 35	chemistry of antibody	
Lecture 36	Protein Synthesis	
13	Bioconjugate techniques	
Lecture 37	Introduction to bioconjugation techniques	
Lecture 38	EDC-NHS chemistry, Imidoester, Carbodiimide chemistry	
Lecture 39	DCC chemistry, maleimide chemistry	
14	Bioconjugation techniques continued	
Lecture 40	Carbonyl group reactive chemistry, photoreactive chemistry	FINAL
Lecture 41	PEGylation and surface modification, protein cross-linkers with	- TINAL
	implications in biology	
Lecture 42	Review Class	1

ASSESSMENT STRATEGY

			со	Blooms Taxonomy	
Components		Grading		Dioonis Taxonomy	
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO2, CO4	C2, C3	
Assessment (40%)	Class Participation	5%	CO3	C1	
	Mid term	15%	CO1, CO2, CO3	C1, C2, C3	
	•		CO 1	C2	
Final Exam		60%	CO 2	C3	
		0070	CO 3	C1	
			CO 4	C2	
Total Marks		100%			
(CO = Course	e Outcome, $C = 0$	Cognitive Doma	in)		

TEXT BOOKS

- 1. Physical Chemistry P. W. Atkins; Oxford University Press.
- 2. Essentials of Physical Chemistry- B.S. Bahl & G.D. Tuli; S. Chand and Company Ltd.

REFERENCE BOOKS

- 1. Lehninger Principles of Biochemistry- 4th Edition, by Albert L. Lehninger, David L. Nelson, and Michael M. Cox.
- Harper's Illustrated Biochemistry- 28th Edition by Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil.
- 3. Morrison and Boyd, Organic Chemistry, 6th Edition, Prentice Hall, 1998

REFERENCE SITE

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5.1.2.5 LANG 102 Communicative English I

	RSE INFO	ORMATION					
Course	e Code	: LANG – 102	Lecture Contact Hours	: 3	.00		
Course	e Title	: Communicative English I	Credit Hours	: 1	.50		
PRE-F	REQUISI	TE	l				
-							
		M STRUCTURE					
		Education (OBE)					
		TIONALE					
		mainly been designed to impro	1 0				
		instructions and experience in		<u> </u>	-		
		al and informal. Emphasis will b					-
		course will help students prog	-		-		
		stand class lectures and can co		Engineer	ing course	e, and a	lso to compete
		market and increase career ski	lls.				
OBJE	CTIVE						
3. To and	improve l listening give the s	students exposure to different ty	r to improve their level o	of compre	ehensibili	ty in bo	th speaking
5. To and	gain an u l revise th RSE OUT Listen,	nniques of reading. nderstanding of the underlying eir own as well as peer's writin COMES & GENERIC SKIL Course Outcome understand, and learn the tes of note taking and	ng. LS Bloom's	PO C		KP	ch how to edit Assessment Methods T, ASG, Pr
5. To and COUR No. CO1	gain an u I revise th RSE OUT Listen, techniqu answerin Underst	nderstanding of the underlying eir own as well as peer's writin COMES & GENERIC SKIL Course Outcome understand, and learn the les of note taking and ng questions. cand and speak English	ng. LS Bloom's Taxonomy C1	PO C			Assessment Methods T, ASG, Pr
5. To and COUR No. CO1 CO2	gain an u d revise th RSE OUT Listen, techniqu answerin Underst quickly techniqu	nderstanding of the underlying eir own as well as peer's writin COMES & GENERIC SKIL Course Outcome understand, and learn the les of note taking and ing questions. Cand and speak English and smartly using the les learnt in the class.	g. LS Bloom's Taxonomy	20 C			Assessment Methods
5. To and COUR No. CO1 CO2 CO3	gain an u I revise th RSE OUT Listen, techniqu answerin Underst quickly techniqu commu shortest j ideas and	nderstanding of the underlying eir own as well as peer's writin COMES & GENERIC SKIL Course Outcome understand, and learn the les of note taking and ing questions. Cand and speak English and smartly using the les learnt in the class. nicate effectively within the possible time to present their lopinions.	g. LS Bloom's I Taxonomy C1 C2	PO C			Assessment Methods T, ASG, Pr
5. To and COUR No. CO1 CO2 CO3	gain an u I revise th RSE OUT Listen, techniqu answerin Underst quickly techniqu commu shortest ideas and Develop	nderstanding of the underlying eir own as well as peer's writin COMES & GENERIC SKIL Course Outcome understand, and learn the tes of note taking and ing questions. cand and speak English and smartly using the tes learnt in the class. micate effectively within the possible time to present their	g. LS Bloom's Taxonomy C1 C2 C2 C2	PO C			Assessment Methods T, ASG, Pr T, ASG, Pr
5. To and COUR No. CO1 CO2 CO3 CO4	gain an u I revise th RSE OUT Listen, techniqu answerin Underst quickly techniqu shortest j ideas and Develop commun	nderstanding of the underlying eir own as well as peer's writin COMES & GENERIC SKIL Course Outcome understand, and learn the less of note taking and ing questions. and and speak English and smartly using the less learnt in the class. nicate effectively within the possible time to present their lopinions. competency in oral, written	g. LS Bloom's I Taxonomy C1 C2 C2 C2 C4	PO C 1 - 1 - 10 - 10 -	P CA - - - -	KP - - -	Assessment Methods T, ASG, Pr T, ASG, Pr T, ASG, Pr T, ASG, Pr
5. To and COUR No. CO1 CO2 CO3 CO4 (CP- C	gain an u I revise th RSE OUT Listen, techniqu answerin Underst quickly techniqu shortest p ideas and Develop commun	nderstanding of the underlying eir own as well as peer's writin COMES & GENERIC SKIL Course Outcome understand, and learn the tes of note taking and ing questions. Eand and speak English and smartly using the tes learnt in the class. nicate effectively within the possible time to present their opinions. competency in oral, written ication/presentation	IS Bloom's Taxonomy C1 C2 C2 C2 C2 C4 Ees, KP-Knowledge Profi	PO C 1 - 1 - 10 - 10 -	P CA - - - -	KP - - -	Assessment Methods T, ASG, Pr T, ASG, Pr T, ASG, Pr T, ASG, Pr

COURSE CONTENT

Speaking: Introduction to Language: Introducing basic skills of language.

English for Science and Technology. Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd.

Name, family background, education, experience, any special quality/interest, likings/disliking, etc. Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions.

Discussing everyday routines and habits, Making requests/offers/invitations/excuses/apologies/complaints. Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event. Practicing storytelling, Narrating personal experiences/Anecdotes. Telephone conversations (role play in group or pair). Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation).

Listening: Listening and understanding: Listening, note taking and answering questions;

Students will listen to recorded text, note down important information and later on will answer to some questions. Difference between different accents: British and American accents;

Documentaries from BBC and CNN will be shown and students will try to understand. Listening to short conversations between two persons/more than two.

Reading: Reading techniques: scanning, skimming, predicting, inference; Reading Techniques: analysis, summarizing and interpretation of texts.

Writing: Introductory discussion on writing, prewriting, drafting; Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event; Paragraph writing, Compare-contrast and cause- effect paragraph.

SKILL MAPPING

No.	Course Learning Outcome				PRO	OGR	RAM	OU	TCO	MES	(PO))	
NO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Listen, understand, and learn the												
CO1	techniques of note taking and answering	3											
	questions.												
	Understand and speak English quickly												
CO2	and smartly using the techniques learnt	3											
	in the class.												
	Communicate effectively within the												
CO3	shortest possible time to present their										3		
	ideas and opinions.												
CO4	Develop competency in oral, written										3		
0.04	communication/presentation										5		

(Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Practical / Tutorial / Studio	35
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	-
Revision of the previous and (or) subsequent lecture at home	15
Preparation for final examination	10
Formal Assessment	
Continuous Assessment	1
Lab Test	1
Quiz	0.75
Viva	0.25
Total	70
TEACHING METHODOLOGY	

Lecture and discussion, Co-operative and collaborative method, Problem based method

Week	Торіс	Assessment
1		
Lecture 1	Introduction to Language: Introducing basic skills of language. English for Science and Technology	
Lecture 2	Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any	
Lecture 3	 special quality/interest, likings/disliking, etc. Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any special quality/interest, likings/disliking, etc. 	Test, Assignment Presentation
2		
Lecture 4	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions	
Lecture 5	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions	
Lecture 6	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions	
3		
Lecture 7	Discussing everyday routines and habits, Making requests/offers/invitations/excuses/apologies/complaints	
Lecture 8	Discussing everyday routines and habits, Making requests/offers/invitations/excuses/apologies/complaints	
Lecture 9	Discussing everyday routines and habits, Making requests/offers/invitations/excuses/apologies/complaints	
4		
Lecture 10	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event	
Lecture 11	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event	
Lecture 12	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event	
5		
Lecture 13	Practicing storytelling, Narrating personal experiences/Anecdotes	
Lecture 14	Practicing storytelling, Narrating personal experiences/Anecdotes	
Lecture 15	Practicing storytelling, Narrating personal experiences/Anecdotes	

(
6 L 16		
Lecture 16	Telephone conversations (role play in group or pair)	
	Situational talks / dialogues: Practicing different	
	professional conversation (role play of doctor-patient	
	conversation, teacherstudent conversation)	
Lecture 17	Telephone conversations (role play in group or pair)	
	Situational talks / dialogues: Practicing different	
	professional conversation (role play of doctor-patient	
	conversation, teacherstudent conversation)	
Lecture 18	Telephone conversations (role play in group or pair)	
	Situational talks / dialogues: Practicing different	
	professional conversation (role play of doctor-patient	
	conversation, teacherstudent conversation)	
7		
Lecture 19	Listening and understanding: Listening, note taking and	
	answering questions;	
	Students will listen to recorded text, note down important	
	information and later on will answer to some questions	
Lecture 20	Listening and understanding: Listening, note taking and	
Lecture 20	answering questions;	
	Students will listen to recorded text, note down important	
	information and later on will answer to some questions	
L		
Lecture 21	Listening and understanding: Listening, note taking and	
	answering questions;	
	Students will listen to recorded text, note down important	
	information and later on will answer to some questions	
	Midterm Break	
8		
Lecture 22	Difference between different accents: British and American	
	accents;	
	Documentaries from BBC and CNN will be shown and	
	students will try to understand	
Lecture 23	Difference between different accents: British and American	
	accents;	Test, Assignment,
	Documentaries from BBC and CNN will be shown and	Presentation
	students will try to understand	
Lecture 24	Difference between different accents: British and American	
	accents;	
	Documentaries from BBC and CNN will be shown and	
	students will try to understand	
9		
Lecture 25	Listening to short conversations between two persons/more	
	than two	
Lecture 26	Listening to short conversations between two persons/more	
Lociale 20	than two	
Lecture 27	Listening to short conversations between two persons/more	
Lecture 27		
10	than two	
10		
Lecture 28	Reading techniques: scanning, skimming, predicting,	
	inference;	

				Course Offer	red by Other Departm
Lecture 29		eading techniqu nference;	ues: scanning, skimming,	predicting,	
Lecture 30		eading techniqu nference	ues: scanning, skimming,	predicting,	
11					
Lecture 31		eading Techni terpretation of te		rizing and	
Lecture 32		eading Techni nterpretation of te	exts	rizing and	
Lecture 33		eading Techni nterpretation of te		rizing and	
12					
Lecture 34	Ir	ntroductory discu	ssion on writing, prewriting,	drafting;	
Lecture 35	Ir	ntroductory discu	ssion on writing, prewriting,	drafting;	
Lecture 36	Ir	ntroductory discu	ssion on writing, prewriting,	drafting	
13					
Lecture 37	st	opic sentence, ructure, describi vent	paragraph development, ing a person/scene/picture,		
Lecture 38	st	-	paragraph development, ing a person/scene/picture,		
Lecture 39	st	•	paragraph development, ing a person/scene/picture,	· · ·	
14					
Lecture 40		aragraph writing aragraph	g, Compare-contrast and c	ause- effect	
Lecture 41	P		g, Compare-contrast and c	ause- effect	
Lecture 42	P		g, Compare-contrast and c	ause- effect	
ASSESSME	ENT STRAT	EGY			
Comp	oonents	Grading	СО	В	looms Taxonomy
	Listening Test	15%	CO1, CO2, CO3, CO4		C1, C2, C4
Continuous Assessment	Descriptive writing	25%	CO1, CO2, CO3, CO4		C1, C2, C4
(40%)	Public Speaking	30%	CO1, CO2, CO3, CO4		C1, C2, C4
	Presentation	n 30%	CO1, CO2, CO3, CO4		C1, C2, C4
	Marks rse Outcome	$\frac{100\%}{0}$, C = Cognitive	Domain)		
TEXT BOO	NKS				
1. Langar	n, J. (2005). C		kills with Readings (6 th Ed). n, Latest edition, McGraw-H		
	CE BOOKS	ing), John Langa	n, Latest cuttoll, McGlaw-H		L

- Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
- 2. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation)
- 3. From Paragraph to Essay Maurice Imhoof and Herman Hudson
- 4. Headway Series Advanced Level (2 parts with CDs): Oxford University Press Ltd.
- 5. Speak like Churchill stand like Lincoln James C. Humes
- 6. Cambridge IELTS Practice Book

7. Selected Sample Reports and Selected Research Articles

REFERENCE SITE

-

5.1.2.6 GEBS 101 Bangladesh Studies

COU	RSE INFOR	RMATION								
Cours	e Code	: GEBS 101	Lec	ture Contact H	ours	: 2.00)			
Cours	e Title	: Bangladesh Studies	Cree	dit Hours		: 2.00)			
PRE-	REQUISIT	Е								
-										
CURI	RICULUM	STRUCTURE								
Outco	me Based Eo	ducation (OBE)								
SYNC	OPSIS/RAT	IONALE								
This c	course has b	een designed for undergrad	luate eng	gineering stude	ents to	help tl	nem lea	irn the	rich	history of
-		provide them with basic kn	-					-		
	-	constitution of Bangladesh,			mic dev	elopme	ent, legi	slation,	citiz	zen charter,
		nich will make them response	ible citiz	zen.						
	ECTIVE									
	· ·	nts with factual knowledge t					•	-		
		storical roots of Bangladesh		•		1g on tl	ne socia	l, cultu	ral a	nd
		lopments that have taken pla		-						
	•	understanding of the develop	<u>^</u>	-						
		vareness among the students	about th	e Geography,	Econon	ıy, Pol	itics and	d Cultur	re of	
1	ingladesh.									
COU	RSE OUTC	OMES & GENERIC SKIL	LS	1		1	1 1			
				Bloom's		CD		IZD		Assessm
No.		Course Outcome		Taxonomy	PO	CP	CA	KP		ent
	D 11		6	-						Methods
		to identify specific stag	-							
COL	-	h's political history, throu	-	C1	6					T, MID,
CO1		edieval, colonial and post-c		C1	6	-	-	-		F
	^	d variety of cultural identi	ities of							
	Banglades		ttoma							
CO2		explain the economy and pa ic changes through qualitativ		C2	6					T, F
	quantitativ		ve allu		0	-	-	-		1,1
(CP- (-	blems, CA-Complex Activit	ies KP	Knowledge Pr	ofile T .	Test	$\mathbf{P}\mathbf{P} = \mathbf{P}$	roject: (γ_{-}	Quiz: ASG
	-	- Presentation; R - Report; F		-	5111 C , I -	rest,	1 K = 1		< - '	2ui2, A5U
1	Remember		- Apply	C4 - Ana	lvze	C5 -	Evaluat	te	Cf	6 – Create
		C2 Chaoistana C3	, .bbi		1920	105-	Louiudi	.~		Citate
COU	DEF CONT	ENT								
	RSE CONT									

Bangladesh Geography: Location, Area, Boundary, Physiography, River system, Forest and Climate, Demography of Bangladesh, Maritime zones.

History: Overview of the ancient Bengal; anthropological identity of the Bengali race; main trends in the history of medieval Bengal; Bengal under the East India Company; religious and social reform movements; nationalist movements, division of the Indian sub-continent; language movement 1948-1952; education movement of 1962; six-point movement of 1966; mass uprising of 1969; war of independence and emergence of Bangladesh in 1971, Constitution of Bangladesh, Pre and post liberation development in the field of engineering and technology, Bangladesh's contribution to world peace and its security, engineering developments in Bangladesh (Kaptai Dam, Padma bridge, power plants, Karnaphuli River Tunnel etc) and its impact on socio-economic aspect . Environment, Economy and Culture

Land, Characteristics of tropical monsoon climate, Forests and biomass, Fish, Minerals, Health,Education, Agriculture, Industries, NGOs, Population,Sociological and Cultural aspects of Bangladesh, Economy and National development, Development and Progress of the Millennium Development Goals (MDGs), Public Administration in Bangladesh, State of Good Governance in Bangladesh, Artand Literature, Main traditional cultural events, Vision-2021, Digitalization, Tourism and Natural Resources, Bangladesh and International Relations.

SKILL MAPPING

					PRO	GRA	MOL	JTCO	MES	(PO))		
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to identify specific stages of												
	Bangladesh's political history, through												
CO1	the ancient, medieval, colonial and post-						3						
	colonial periods and variety of cultural												
	identities of Bangladesh.												
	Be able to explain the economy and												
CO2	patterns of economic changes through						3						
	qualitative and quantitative analysis.												
	HING LEARNING STRATEGY								Em	~~~~	mont	hour	-)
Teachi	ng and Learning Activities								En	igagei	ment ((hours	s)
Face-to	o-Face Learning												
	Lecture										28		
											20		
	Practical / Tutorial / Studio										-		
	Student-Centred Learning										-		
Self-Di	Student-Centred Learning irected Learning										-		
Self-Di	Student-Centred Learning irected Learning Non-face-to-face learning										- 28		
Self-Di	Student-Centred Learning irected Learning Non-face-to-face learning Revision of the previous and (or) subseque	ent lec	ture a	at hor	ne						- - 28 14		
	Student-Centred Learning irected Learning Non-face-to-face learning Revision of the previous and (or) subseque Preparation for final examination	ent lec	ture a	at hor	ne						- 28		
	Student-Centred Learning irected Learning Non-face-to-face learning Revision of the previous and (or) subseque Preparation for final examination Assessment	ent lec	ture a	at hor	ne						- 28 14 14		
	Student-Centred Learning irected Learning Non-face-to-face learning Revision of the previous and (or) subseque Preparation for final examination Assessment Continuous Assessment	ent lec	ture a	at hor	ne						- 28 14 14 2		
Formal	Student-Centred Learning irected Learning Non-face-to-face learning Revision of the previous and (or) subseque Preparation for final examination Assessment	ent lec	eture a	at hor	ne						- 28 14 14 2 3		
	Student-Centred Learning irected Learning Non-face-to-face learning Revision of the previous and (or) subseque Preparation for final examination Assessment Continuous Assessment	ent lec	ture a	at hor	ne						- 28 14 14 2		
Formal Total	Student-Centred Learning irected Learning Non-face-to-face learning Revision of the previous and (or) subseque Preparation for final examination Assessment Continuous Assessment	ent lec	ture a	at hor	ne						- 28 14 14 2 3		

Weeks	Topics	Assessment
1		
Lecture 1	Definition, nature and scope of sociology	
Lecture 2	Sociological imagination	
2		
Lecture 3	Perspectives of sociology	
Lecture 4	Orientation of sociological theories	CT – 1 and Midter
3		Final
Lecture 5	Social research and its process	
Lecture 6	Research designs and techniques.	
1		
Lecture 7	Introducing culture and its variations	
Lecture 8	Civilization	
5		
Lecture 9	Defining family and its changes	
Lecture 10	Socialization process and development of self	
6		
Lecture 11	Introducing globalization and its impact on human life	Midterm, Final
Lecture 12	Factors responsible to globalization	
7		
Lecture 13	Media and its impact in modern society	
Lecture 14	Addressing social problems of Bangladesh	
	MIDTERM	
8		
Lecture 15	Introducing social groups and organizations	
Lecture 16	Introducing bureaucracy and good governance	
9		
Lecture 17	Introducing social stratifications and social inequality	CT – 2, FINAL
Lecture 18	Poverty and its types and dimensions	
10		
Lecture 19	Industrial revolution and aftermath	
Lecture 20	Urbanization and city development	
11		
Lecture 21	Capitalism: features and influence	
Lecture 22	Socialism: features and influence	
12		
Lecture 23	Environment and human activities	CT – 3, FINAL
Lecture 24	Climate change and global risk	
13		
Lecture 25	Population of Bangladesh: problem or prospect	
Lecture 26	Crime and deviance: a brief analysis	
14		
Lecture 27	Review 1	-
Lecture 28	Review 2	

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Final Exam 60% CO 1 C1 Total Marks 100% CO 2 C2 (CO = Course Outcome, C = Cognitive Domain) (CO = Course Outcome, C = Cognitive Domain) TEXT BOOKS . . 1. Bangladesh Studies: Md. Shamsul Kabir Khan and Daulatunnahar Khanam . . 2. The Constitution of the People's Republic of Bangladesh . . REFERENCE BOOKS . . . 1. Discovery of Bangladesh: Akbar Ali Khan . . . 2. History of Bangladesh: Akbar Ali Khan . . . 3. History of Modern Bengal, Vol, 1:R C Majumdar . . . 4. Dynastic History of Bengal: Dr. Abdul MuminChowdhury . . A History of Bangladesh: William Van Schendel 6. Geography of Bangladesh: HarunEr Rashid 7. Banglapedia: National Encyclopedia of Bangladesh, Vols, 1-10: Sirajul Islam . . . 8. History of Bengal: (Mughal Period 1526-1765): R. A. Chandra . . . 9. Land of Two Rivers: NiteshSengupta 10. A History of Bangladesh: Cambridge	Final Exam 60% CO 1 C1 CO 2 C2 C2 Total Marks 100% CO 2 C2 (CO = Course Outcome, C = Cognitive Domain) TEXT BOOKS 1. Bangladesh Studies: Md. Shamsul Kabir Khan and Daulatunnahar Khanam 2. The Constitution of the People's Republic of Bangladesh REFERENCE BOOKS 1. Discovery of Bangladesh: Akbar Ali Khan Efference Books 1. Discovery of Bangladesh, Vols, 1-3: Sirajul Islam History of Modern Bengal, Vol, 1:R C Majumdar 4. Dynastic History of Bengal: Dr. Abdul MuminChowdhury A History of Bangladesh: William Van Schendel 6. Geography of Bangladesh: HarunEr Rashid Banglapedia: National Encyclopedia of Bangladesh, Vols, 1-10: Sirajul Islam 8. History of Bengal: (Mughal Period 1526-1765): R. A. Chandra Jand of Two Rivers: NiteshSengupta 10. A History of Bangladesh: Cambridge University Press 11. Bengali Nationalism and the Emergence of Bangladesh : A.F Salahuddin Ahmed 12. Language Movement and The Making of Bangladesh: Safar Ali Akanda Co 1			5%	CO2	C2
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12. Language movement and the making of Dangiaucsii. Safat Ali Akanda		•		÷	6	
	REFERENCE SITE				Sangiauesii. Salat Ali Akaliua	

5.1.3 Level-2, Spring

5.1.3.1 MATH 205 Differential Equation, Laplace transform and Fourier Transform

COURSE INFORMATION

Course Code	: Math 205									
Course Title	: Differential Equations,	Lecture Contact Hours	: 3.00							
	Laplace Transform and	Credit Hours	: 3.00							
	Fourier Transform									
PRE-REQUISIT	Έ									
-										
CURRICULUM	CURRICULUM STRUCTURE									

Outcome Based Education (OBE) SYNOPSIS/RATIONALE

To teach the students the basic Concepts, Principles and operations of Differential Equation, Laplace Transform and Application of Fourier Analysis in Engineering problem. The aim of this course is to develop the analytical and practical capability of Differential equation, Laplace Transform and Fourier Analysis.

OBJECTIVE

- 1. To provide a physical interpretation of the Differential Equations and Laplace Transform.
- 2. Able to explain the characteristics of Ordinary Differential Equations and Laplace Transform.
- 3. To apply Laplace and Fourier Transform in solving complex problems.
- 4. To use differential operations for simplification of complexengineering expressions

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome			Bloom's	РО	СР	CA	KP	Assessment
				Taxonomy					Methods
	Identify di	Identify differential equations of various							T, F
CO1	types and r	ecognize the basic pro	perties of	C1, C2	1	1		1, 3	
	Laplace and	l Fourier transform.							
	Interpret t	he classifications of d	ifferential						T, Mid Term
CO2	equations a	and estimate the tech	nnique of	C2, C4	1	1		3	Exam, F
02	Laplace tran	nsform and Fourier tra	nsform of	02, 04		1		5	
	some eleme	ntary function.							
	Solve diff	ferent types of d	ifferential						Mid Term
	equations a	equations and apply Laplace transform to Ordinary Differential Equation and Fourier as well as Inverse Fourier transform to			1	1,3			Exam, F, ASG
CO3	Ordinary D							3	
COS	as well as							5	
	make use c	of boundary value pro	oblems in						
	Engineering	g fields							
(CP- C	omplex Proble	ems, CA-Complex Acti	ivities, KP-l	Knowledge Pro	file,T –	Test; Pl	R – Proj	ject; Q -	– Quiz; ASG –
Assign	ment; Pr – Pre	sentation; R - Report;	F – Final Ex	(am)					
C1 - Re	emember	C2 - Understand	C3 - App	ly C4 - Anal	yze	C5 - E	Evaluate	;	C6 - Create
		1	1	1		1		1	
COUP	SE CONTEN	1 T							
COUN		11							

Differential Equations (DE): Introduction to DE, Formulation of DE, Degree and order of Ordinary Differential Equation(ODE), Solution of first order DE by various methods, Solution of first order but higher degree DE, Solution of general LEs of second and higher order, Solution of Euler's homogeneous linear DEs, Solution of DEs by methods based on factorization, Application of ODE, Frobenious methods, Bessel's functions, Legendre's polynomial, Power series solution of DE and their application, Integral form of DE and its application to engineering problem, Formation of partial differential equations, Linear and Non-linear first order Partial Differential Equation(PDE), Standard form Linear Equations (LE) of higher order, Linear PDE with constant coefficients. Equation of second order with variable coefficients, wave equation, particular solutions with boundary and initial condition, Integral surface passing through given curve, Second order PDE and classification to canonical solution, Applications of PDE.

Laplace Transform (LT): Definition and properties of Laplace transform, Sufficient conditions for existence of Laplace transforms, Laplace transform of some basic functions, LT of derivatives, Unit step function, Periodic function, Some special theorems on LT, Inverse Laplace transform, Partial fraction, Heaviside expansion formula, Convolution theorem, Evaluation of improper integral, Solution of Differential Equations by LT, Application of LT.

Fourier Transform: Real and Complex form of Fourier Series, Definition and expansion of a function of x in a Fourier Series, Physical application of Fourier Series, Finite Fourier Transform, Fourier Integral, Inverse Fourier transform, Fourier transform and their uses in solving boundary value problems, Diffusion, wave, Laplace Equation

SKILL MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)												
110.	course oucome	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	Identify differential equations of various types and recognize the basic properties of Laplace and Fourier transform.	3												
CO2	Interpret the classifications of differential equations and estimate the technique of Laplace transform and Fourier transform of some elementary function.	3												
CO3	3 Solve different types of differential equations and apply Laplace transform to DE and Fourier and inverse Fourier transform to make use of boundary value problems in Engineering fields.													
(Num	erical method used for mapping which indicates 3 a	s hig	h, 2 a	is me	dium	, and	1 as	low	level	of r	natch	ing)		
TEAC	CHING LEARNING STRATEGY													
Teaching and Learning Activities							Engagement (hours)							
Face-t	o-Face Learning													
	Lecture							42						
	Practical / Tutorial / Studio							-						
Student-Centred Learning											-			
Salf D	virected Learning													
	Course Offered b	y Other Departments												
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Non-face-t	o-face learning	42												
Revision o	21													
Preparation	n for final examination	21												
Formal Assessment														
Continuous	s Assessment	2												
Final Exan	ination	3												
Total		131												
TEACHING MET	HODOLOGY													
Lecture and discuss	ion, Co-operative and collaborative method, Problem based method													
COURSE SCHED	ULE													
Week	Торіс	Assessment												
1	Differential Equations	Assessment												
Lecture 1	Introduction to DE, Formulation of DE, Degree and order of ODE	-												
Lecture 2	Solution of first order DE by various methods	-												
Lecture 3	Solution of first order DE by various methods	CT – 1, Final												
2		-												
Lecture 4	Solution of first order DE by various methods,	-												
Lecture 5	Solution of first order but higher degree DE, solution of general LEs of second and higher order													
Lecture 6	Solution of Euler's homogeneous linear DEs	-												
3		-												
Lecture 7	Solution of DEs by methods based on factorization,													
Lecture 8	Frobenious methods – concept	-												
Lecture 9	Frobenious methods – problems													
4														
Lecture 10	Solution of differential equations of the higher order when dependent and independent variables are absent													
Lecture 11	cture 11 Bessel's functions, Legendre's polynomial, Power series solution													
Lecture 12	of DE and their application, Integral form of DE and its application to engineering problem,													
5														
Lecture 13 Formation of partial differential equations, linear and non linear Midterm,														
	first order PDE,													
Lecture 14	Standard form LEs of higher order	1												
Lecture 15	Integral surface passing through given curve													
6		-												
Lecture 16	Non-linear PDE of order one, Charpit's method.	1												
Lecture 17	Linear PDE with constant coefficients	1												
Lecture 18	Linear PDE with constant coefficients	1												
7		1												

T 10	··· ·	Other Departments
Lecture 19	Equation of second order with variable coefficients, Second order	
	PDE and classification to canonical solution	
Lecture 20	wave equation, particular solutions with boundary and initial	
	condition	
Lecture 21	Application of ODE, Applications of PDE	
	Midterm Break	
8	Laplace Transform	
Lecture 22	Definition and properties of Laplace transform	
Lecture 23	Sufficient conditions for existence of Laplace transforms	
Lecture 24	Laplace transform of some basic functions, LT of derivatives	
9		
Lecture 25	Unit step function, Periodic function	
Lecture 26	Some special theorems on LT	CT – 2, Final
Lecture 27	Inverse Laplace transform	
10		
Lecture 28	Partial fraction,	
Lecture 29	Heaviside expansion formula	
Lecture 30	Convolution theorem	
11		
Lecture 31	Evaluation of improper integral,	
Lecture 32	Solution of Differential Equations by LT	
Lecture 33	Application of LT	
12	Fourier Transform	
Lecture 34	Real and Complex form of Fourier Series	
Lecture 35	Definition and expansion of a function of x in a Fourier Series	
Lecture 36	Physical application of Fourier Series	CT – 3, FINAL
13		
Lecture 37	Finite Fourier Transform	
Lecture 38	Fourier Integral	
Lecture 39	Inverse fourier transform	
14		
Lecture 40	Fourier transform and their uses in solving boundary value	FINAL
	problems	
Lecture 41	Fourier transform and their uses in solving boundary value	
	problems	
Lecture 42	Diffusion, wave, Laplace Equation	
ASSESSMENT		

$\begin{array}{c c c c c c c c c c c c c c c c c c c $			C I	СО	Blooms Taxonomy		
$\begin{array}{ c c c c c } \hline \text{Continuous} \\ \hline \text{Assignment} & 20\% & \text{CO1, CO2} & \text{C1, C2} \\ \hline 1-3 & & & & & & \\ \hline 1-3 & & & & & & \\ \hline 1-3 & & & & & & \\ \hline \hline 1-3 & & & & & & \\ \hline \hline 1-3 & & & & & & \\ \hline \hline \text{Class} & & & & & & \\ \hline \hline \text{Class} & & & & & & \\ \hline \hline \text{Class} & & & & & & \\ \hline \hline \text{Class} & & & & & & \\ \hline \text{Assignment} & & & & & \\ \hline 1-3 & & & & & & \\ \hline \hline \text{Class} & & & & & \\ \hline \hline \text{Class} & & & & & \\ \hline \hline \text{Class} & & & & & \\ \hline \text{Mid term} & & & & & & \\ \hline \text{Mid term} & & & & & & \\ \hline \hline \text{Mid term} & & & & & & \\ \hline \hline \text{Mid term} & & & & & & \\ \hline \text{Mid term} & & & & & & \\ \hline \hline \text{Mid term} & & & & & \\ \hline \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & & & \\ \hline \text{Mid term} & & & \\ \hline \text{Mid term} & & \\ \hline Mid $	Com		Grading				
$ \begin{array}{c c c c c c } \hline \mbox{Class} & 5\% & CO3 & C4 \\ \hline \mbox{Participation} & 15\% & CO2, CO3 & C2, C4 \\ \hline \mbox{Mid term} & 15\% & CO2, CO3 & C2, C4 \\ \hline \mbox{Mid term} & 15\% & CO2 & C2, C4 \\ \hline \mbox{CO 1} & C1, C2 \\ \hline \mbox{CO 2} & C2, C4 \\ \hline \mbox{CO 3} & C4 \\ \hline \mbox{CO 3} & C4 \\ \hline \mbox{CO 2} & C2, C4 \\ \hline \mbox{CO 3} & C$	0 011111100 00	Assignment	20%	CO1, CO2	C1, C2		
Final Exam 60% CO 1 C1, C2 60% CO 2 C2, C4 CO 3 C4 Total Marks 100% (CO = Course Outcome, C = Cognitive Domain) TEXT BOOKS 1. Ordinary and Partial Differential Equations by M.D.RAISINGHANIA. 2. Differential Equations by Shepley L. Ross. REFERENCE BOOKS 1. Differential Equations by Glen R. Hall. 2. Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel.			5%	CO3	C4		
Final Exam60%CO 2C2, C4CO 3C4Total Marks100%ICO = Course Outcome, C = Cognitive DomainTEXT BOOKS1.Ordinary and Partial Differential Equations by M.D.RAISINGHANIA.2.Differential Equations by Shepley L. Ross.REFERENCE BOOKS1.Differential Equations by Glen R. Hall.2.Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel.		Mid term	15%	CO2, CO3	C2, C4		
CO 3 C4 Total Marks 100% (CO = Course Outcome, C = Cognitive Domain) TEXT BOOKS 1. Ordinary and Partial Differential Equations by M.D.RAISINGHANIA. 2. Differential Equations by Shepley L. Ross. REFERENCE BOOKS 1. Differential Equations by Glen R. Hall. 2. Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel.				CO 1	C1, C2		
Total Marks 100% (CO = Course Outcome, C = Cognitive Domain) TEXT BOOKS 1. Ordinary and Partial Differential Equations by M.D.RAISINGHANIA. 2. Differential Equations by Shepley L. Ross. REFERENCE BOOKS 1. Differential Equations by Glen R. Hall. 2. Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel.	Fina	l Exam	60%	CO 2	C2, C4		
(CO = Course Outcome, C = Cognitive Domain) TEXT BOOKS 1. Ordinary and Partial Differential Equations by M.D.RAISINGHANIA. 2. Differential Equations by Shepley L. Ross. REFERENCE BOOKS 1. Differential Equations by Glen R. Hall. 2. Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel.				CO 3	C4		
TEXT BOOKS 1. Ordinary and Partial Differential Equations by M.D.RAISINGHANIA. 2. Differential Equations by Shepley L. Ross. REFERENCE BOOKS 1. Differential Equations by Glen R. Hall. 2. Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel.	Tota	Marks	100%				
 Ordinary and Partial Differential Equations by M.D.RAISINGHANIA. Differential Equations by Shepley L. Ross. REFERENCE BOOKS Differential Equations by Glen R. Hall. Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel. 	(CO = Cours	e Outcome, C = 0	Cognitive Domain	l)			
 Differential Equations by Shepley L. Ross. REFERENCE BOOKS Differential Equations by Glen R. Hall. Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel. 	TEXT BOO	KS					
REFERENCE BOOKS 1. Differential Equations by Glen R. Hall. 2. Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel.	1. Ordi	nary and Partial D	ifferential Equatio	ns by M.D.RAISINGHANIA	Α.		
 Differential Equations by Glen R. Hall. Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel. 	2. Diff	erential Equations	by Shepley L. Ros	SS.			
2. Theory and problems of Laplace Transform, Schaum's outlines series, Murray R. Spiegel.	REFERENC	E BOOKS					
	1. Diff	erential Equations	by Glen R. Hall.				
REFERENCE SITE	2. The	ory and problems of	of Laplace Transfo	rm, Schaum's outlines series	, Murray R. Spiegel.		
	REFERENC	E SITE					

5.1.3.2 GELM 271 Leadership and Management

COUF	RSE INFOI	RMATION							
Course	e Code	: GELM 271	Lecture Cont	tact Hours	: 2.0	0			
Course	e Title	: Leadership and Management	Credit Hours	5	: 2.0	0			
PRE-I	PRE-REQUISITE								
-									
CURF	RICULUM	STRUCTURE							
Outcon	me Based E	ducation (OBE)							
01110	PSIS/RAT								
		esigned to make students und							
		n organization through the stud	dy of varied m	nanagement j	oractio	ces and	l leader	rship traits as an	
engine									
	CTIVE								
		ifferent management functions a	* *						
	*	lents to different views and style							
		how an organization functions of	•	e		•	ers.		
		various personality traits and its	•	lership and m	anage	ement.			
		world management problems as a	e e						
COUF	RSE OUTC	OMES & GENERIC SKILLS							
No.		Course Outcome	Bloom's	РО	СР	CP CA KP	Assessment		
			Taxonomy					Methods	
	Be able	to familiarize with the							
CO1		tal concepts of leadership and	C1	9,10	-	-	1	T, R, F	
	manageme	ent skills							

						55			1
CO2		understand the role and of a leader in achiev nal goals		C2	9,10	-	-	1	T, ASG, R, F
CO3	of leadersh	understand the contribut hip traits and managem ision making and solving n ns	nent	C2	9,10	-	-	1	T, ASG, R, F
· ·	(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)								
	Remember		C3 - Appl		Analyze	C5 -	Evalua	ate	C6 – Create

COURSE CONTENT

Introduction to Leadership and Management: Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history.

Management Fundamentals: Definition of management & manager; levels of management; management functions and skills; Mintzberg's managerial roles; Henri Fayol's management principles; strategic management.

Leadership & Motivation: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory; Leadership styles; leadership trait theory; managerial grid; contemporary leadership; conflicts negotiation; leadership issues in 21st century; cross cultural leadership; engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning).

Organizational Management: Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration.

Planning and goal setting: Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal.

Control: Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback & concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence.

Change and Innovation: Change and innovation; internal and external for change; changing process; creativity vs innovation.

Attitude: Components of Attitude; behavior model and characteristics model; behavior vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction.

Personality: Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality).

Perception and Individual Decision Making: Factors influencing perception; attribution theory; errors/biases in attribution; Factors of individual decision making; rational decision making; bounded rationality; satisfice; common errors in decision making; creativity in decision making.

Understanding Work Team: Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team; team effectiveness; team challenges.

HR Management: Process of Human Resource Planning; forecasting demand for labor; staffing; internal supply of labor; performance appraisal.

Operations Management: Project managing basics; goals and boundary of project; WBS; scheduling a project; Demand and supply forecasting; inventory control.

Information Technology and Management: Management Information System (MIS); Enterprise Resource Planning (ERP) - For introductory knowledge.

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to familiarize with the												
CO1	fundamental concepts of leadership and									3	3		
	management skills												
	Be able to understand the role and												
CO2	contribution of a leader in achieving									3	3		
	organizational goals												
	Be able to understand the contribution												
CO3	of leadership traits and management									3	3		
005	skills in decision making and solving									5	5		
	real life problems												

(Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching)

Teaching and Learning Activities	Engagement (hours)
	Engagement (nours)
Face-to-Face Learning	
Lecture	28
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	28
Revision of the previous and (or) subsequent lecture at home	14
Preparation for final examination	14
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	89

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

Weeks	Topics	Assessment
1		
Lecture 1	Introduction to Leadership and Management: Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history.	
Lecture 2	Management Fundamentals:Definition of management & manager; levels of management & management & wills; Mintzberg's managerial roles; Henri Fayol's management principles; strategic management.	CT – 1 and Midterm, Final
2		
Lecture 3	Leadership & Motivation: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory	

Tasta 4		Other Departments
Lecture 4	Leadership & Motivation: Motivation, Maslow's hierarchy needs;	
	theory of X & Y; motivators and hygiene factors; goal setting	
	theory; reinforcement theory; equity theory; expectancy theory	
3		
Lecture 5	Leadership: Leadership styles; leadership trait theory; managerial	
	grid; contemporary leadership; conflicts negotiation; leadership	
	issues in 21st century; cross cultural leadership; engineer as a leader	
	and some simple case discussions on leadership (positive and toxic	
	leadership) in the class (Interactive Learning).	
Lecture 6	Leadership: Leadership styles; leadership trait theory; managerial	
Lecture o		
	grid; contemporary leadership; conflicts negotiation; leadership	
	issues in 21st century; cross cultural leadership; engineer as a leader	
	and some simple case discussions on leadership (positive and toxic	
	leadership) in the class (Interactive Learning).	
4		
Lecture 7	Case Study – I : Engineer as Great Leaders	
Lecture 8	Case Study – I : Engineer as Great Leaders	
5		
Lecture 9	Organizational Management: Organization; departmentalization;	
	chain of command; unity of command; cross functional area;	
	authority; centralization and decentralization; traditional &	
	contemporary organization; matrix project structure; learning	
	structure; organizing collaboration.	
Lecture 10	Planning and goal setting: Foundation of planning; goals of plan;	
	types of goal; types of goal & plan; goal setting; MBO; well written	
	goal.	
6		
Lecture 11	Control: Controlling process; controlling for organizational	
	performance; types of control: (feed-forward, feedback &	Midterm, Final
	concurrent); balanced scorecard; contemporary issues in control;	With the first fir
	workplace concern & workplace violence.	
T (10		
Lecture 12	Change and Innovation: Change and innovation; internal and	
	external for change; changing process; creativity vs innovation.	
7		
Lecture 13	Case Study – II : Planning and Goal Setting; A Managerial	
	Approach: Engineer as Great Managers (Interactive	
	Discussions in the Class)	
Lecture 14	Attitude: Components of Attitude; behavior model and	
	characteristics model; behavior vs. attitude; job attitude; job	
	involvement; job satisfaction and customer satisfaction.	
	MIDTERM	
	IVITU TEKIVI	
0		
8		
8 Lecture 15	Personality:Personality determinants: heredity and environment;	
-	Myers-Briggs Type Indicator; Big five personality model;	
-		CT 2 DINAL
-	Myers-Briggs Type Indicator; Big five personality model;	CT – 2, FINAL
-	Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality).	CT – 2, FINAL
Lecture 15	Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism,	CT – 2, FINAL

Lecture 17	Perception and Individual Decision Making: Factors of individual	
	decision making; rational decision making; bounded rationality;	
	satisfice; common errors in decision making; creativity in decision	
	making.	
Lecture 18	Case Study – III: A Case on Decision Making – Involves both	
	leadership and managerial skills (Interactive Discussion in the	
	Class)	
10		
Lecture 19	Understanding Work Team: Work group; work team; problem	
	solving team; self-managed work team; cross functional team;	
	virtual team; team effectiveness; team challenges.	
Lecture 20	HR Management: Process of Human Resource Planning; forecasting	
	demand for labor; staffing.	
11		
Lecture 21	HR Management: Internal supply of labor; performance appraisal.	
Lecture 22	Operations Management:Project managing basics; goals and	
	boundary of project; WBS; scheduling a project.	
12		
Lecture 23	Operations Management: Demand and supply forecasting;	
	inventory control.	
Lecture 24	Exercise – Use of Microsoft Project (MSP) for scheduling a	
	project at student level	
13		CT – 3, FINAL
Lecture 25	Case Study – IV: A case that covers all relevant theories taught	CI 3, III/IL
	throughout the course and involves both leadership and	
	management issues, e.g., Columbia's Final Mission. (This may be	
	given as group assignment followed by in class short	
	presentations/discussions)	
Lecture 26	Case Study – IV: A case that covers all relevant theories taught	
	throughout the course and involves both leadership and	
	management issues, e.g., Columbia's Final Mission. (This may be	
	given as group assignment followed by in class short	
	presentations/discussions)	
14		
Lecture 27	Information Technology and Management: Management	
	Information System (MIS); Enterprise Resource Planning (ERP) -	-
	For introductory knowledge.	
Lecture 28	Revision	

Compo Continuous Assessment (40%)	Onents Class Test/ Assignment 1-3 Class	Grading 20%	CO CO1, CO2	Blooms Taxonomy C1, C2, P1			
Assessment	Assignment 1-3	20%	CO1, CO2	C1, C2, P1			
Assessment	1-3	20%	CO1, CO2	C1, C2, P1			
Assessment							
	Class						
(4070)		5%	CO1, CO2	C1, C2, P1, P2, A1			
	Participation	370	001, 002	C1, C2, F1, F2, AI			
	Mid term	15%	CO1, CO2, CO3	C1, C2, P1, P2, A1, A2			
·			CO 1	C1, C2, P1, P2, A1, A2			
Final	Exam	60%	CO 2	C1, C2, P1, A1			
			CO 3	C1, C2, P1, P2, A1, A2			
Total	Marks	100%					
CO = Course Outcome, C = Cognitive Domain)							
TEXT BOOKS	5						
1. Engineerir	ng Management	(Revised Edition) – A.K. Gupta				
2. Industrial	Engineering and	Production Man	agement - Martand T. Telsan	g			

REFERENCE BOOKS

- **3.** Leadership in Organizations Gary Yukl
- 4. Developing Management Skills David A. Whetten and Kim S. Cameron

REFERENCE SITE

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5.1.3.3 LANG 202 Communicative English II

COURSE INFO	ORMATION					
Course Code	: LANG 202	Lecture Contact Hours	: 3.00			
Course Title	: Communicative English - II	Credit Hours	: 1.50			
PRE-REQUISI	TE	I	1			
LANG 102: Con	nmunicative English Sessional –1					
CURRICULUN	1 STRUCTURE					
Outcome Based	Education (OBE)					
SYNOPSIS/RA						
-		_	competence in communication skills for			
academic purpos	es especially in reading and write	ing. The approach will be	communicative and interactive and will			
involve individu	al, pair and group work. Student	ts will be exposed to diffe	erent types of texts to develop efficient			
reading skill. Rea	ading will also involve activities as	nd discussions leading to e	ffective writing. The course incorporates			
a wide range of	reading texts to develop studen	ts' critical thinking which	n is one of the most essential elements			
required to write	a good piece of academic writing	. Emphasis is particularly p	out on the various forms of essay writing			
such as description	ve, narrative, cause-effect, comp	are-contrast, and argumen	tative. Upon completion of this course,			
-		_	ticipate in group activities and prepare			
formal speech for academic, professional and social purposes. This course also incorporates classroom instructions						
-	-		on, the course emphasizes on providing			
constructive feed	lback on students' oral performan	ices.				
OBJECTIVE						
1. To develop I	English language skills to commu	nicate effectively and prof	essionally			

- 1. To develop English language skills to communicate effectively and professionally.
- 2. To strengthen students' presentation skills.
- 3. To develop competency in academic reading and writing.

COURSE OUTCOMES & GENERIC SKIL	LS
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	ASE OUTCO	JNIES & GENERIC S	DRILLS							
No.		Course Outcome		Bloom's	РО	СР	CA	КР	Assessment	
10.		Course Outcome	Taxonomy To Of Of			КГ	Methods			
	Be able to	o understand the teo	chniques of							
CO1	academic r	eading and become acqu	uainted with	C1	1	-	-	-	T, ASG, Pr	
	technical v	ocabularies								
	Be able to	o understand the tea	chniques of							
CO2	effective a	cademic writing such	as research	C2	1	-	-	-	T, ASG, Pr	
	article/report writing									
	Be able to communicate effectively within									
CO3	the shortest	t possible time to preser	nt any report	C2	10	-	-	-	T, ASG, Pr	
	and researc	ch work								
	Be able to	analyze any probler	n critically,							
CO4	analyze ar	analyze and interpret data and synthesize		C4	10	-	-	-	T, ASG, Pr	
	information	n to provide valid concl	lusions							
(CP- C	Complex Prob	olems, CA-Complex Ad	ctivities, KP-H	Knowledge Pro	ofile,T	– Test;	PR – F	roject;	Q – Quiz; ASG –	
Assign	nment; Pr – P	resentation; R - Report	; F – Final Ex	am)						
C1 - R	lemember	C2 - Understand	C3 - Apply	C4 - Ana	lyze	C5 - Evaluate			C6 - Create	
		•		•						

COURSE CONTENT

Speaking: Reading Comprehension: Practice using different techniques; Academic reading: comprehension from departmental or subject related passages; Vocabulary for Engineers (some common Engineering terms for both general and dept specific); Reading subject specific text to develop vocabulary.

Writing: Writing semi-formal, Formal/official letters, Official E-mail; Applying for a job: Writing Cover Letter and Curriculum Vitae; Statement of Purpose (SOP) writing, Proposal Writing: writing steps, principles and techniques, outlining, revising, editing, proofreading; Report writing, article writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing; Analyzing and describing graphs or charts; Practicing analytical and argumentative writing.

Speaking: Public Speaking: Basic elements and qualities of a good public speaker; Set Speech: How to get ready for any speech. Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation.

Listening: Listening to long lecture on some topics, Listening and understanding speeches/lectures of different accent.

					חחר		434	OU	TCO	UTC.	(\mathbf{DO})		
No.	Course Learning Outcome				PRC	JGR	AM	00		MES	(PO)		
1.00		1	2	3	4	5	6	7	8	9	10	11	12
	Be able to understand the techniques of												
CO1	academic reading and become acquainted	3											
	with technical vocabularies												
	Be able to understand the techniques of												
CO2	effective academic writing such as	3											
	research article/report writing												
	Be able to communicate effectively within												
CO3	the shortest possible time to present any										3		
	report and research work												
	Be able to analyze any problem critically,												
CO4	analyze and interpret data and synthesize										3		
	information to provide valid conclusions												
(Numeri	cal method used for mapping which indicates	3 as	high,	2 as	med	ium	, and	l 1 as	s low	level	of ma	atching)
TEACH	ING LEARNING STRATEGY												
Teaching	g and Learning Activities									Enga	ageme	ent (hou	ırs)

Face-to-Face Learnin		
	ng	
Lecture		7
	Futorial / Studio	35
	ntered Learning	-
Self-Directed Learni	C C	
	p-face learning	-
	The previous and (or) subsequent lecture at home	15
-	for final examination	10
Formal Assessment		
	Assessment	1
Lab Test		1
Quiz		0.75
Viva		0.25
Total		70
TEACHING METH	IODOLOGY	
Lecture and discussion	on, Co-operative and collaborative method, Problem based method	
COURSE SCHEDU	JLE	
Week	Торіс	Assessment
1	Торіс	Assessment
Lecture 1	Reading Comprehension: Practice using different techniques	
Lecture 2	Reading Comprehension: Practice using different techniques	
Lecture 3	Reading Comprehension: Practice using different techniques	
	Reading Comprehension: Practice using different techniques	
	A set i set i se a di se se se set i set i se france i se set i s	
2 Lecture 4	Academic reading: comprehension from departmental or	
Lecture 4	subject related passages	
	subject related passages Academic reading: comprehension from departmental or	Test. Assignment.
Lecture 4 Lecture 5	subject related passages Academic reading: comprehension from departmental or subject related passages	Test, Assignment, Presentation
Lecture 4	subject related passages Academic reading: comprehension from departmental or subject related passages Academic reading: comprehension from departmental or	Test, Assignment, Presentation
Lecture 4 Lecture 5 Lecture 6	subject related passages Academic reading: comprehension from departmental or subject related passages	
Lecture 4 Lecture 5 Lecture 6 3	subject related passages Academic reading: comprehension from departmental or subject related passages Academic reading: comprehension from departmental or subject related passages	
Lecture 4 Lecture 5 Lecture 6 3	subject related passages Academic reading: comprehension from departmental or subject related passages Academic reading: comprehension from departmental or subject related passages Vocabulary for Engineers (some common Engineering terms	
Lecture 4 Lecture 5 Lecture 6 3	subject related passages Academic reading: comprehension from departmental or subject related passages Academic reading: comprehension from departmental or subject related passages Vocabulary for Engineers (some common Engineering terms for both general and dept specific)	
Lecture 4 Lecture 5 Lecture 6 3 Lecture 7	subject related passages Academic reading: comprehension from departmental or subject related passages Academic reading: comprehension from departmental or subject related passages Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary	
Lecture 4 Lecture 5 Lecture 6 3 Lecture 7	subject related passages Academic reading: comprehension from departmental or subject related passages Academic reading: comprehension from departmental or subject related passages Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for both general and dept specific)	
Lecture 4 Lecture 5 Lecture 6 3 Lecture 7	subject related passages Academic reading: comprehension from departmental or subject related passages Academic reading: comprehension from departmental or subject related passages Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for both general and dept specific)	
Lecture 4 Lecture 5 Lecture 6 3 Lecture 7 Lecture 8	subject related passages Academic reading: comprehension from departmental or subject related passages Academic reading: comprehension from departmental or subject related passages Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary	
Lecture 4 Lecture 5 Lecture 6 3 Lecture 7 Lecture 8	subject related passages Academic reading: comprehension from departmental or subject related passages Academic reading: comprehension from departmental or subject related passages Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary Vocabulary for Engineers (some common Engineering terms for Engi	
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		v Other Departments
Lecture 16	Statement of Purpose (SOP) writing: writing steps, principles and techniques, outlining, revising, editing, proofreading;	
Lecture 17	Proposal writing: writing steps, principles and techniques, outlining, revising, editing, proofreading;	
Lecture 18	Proposal writing: writing steps, principles and techniques, outlining, revising, editing, proofreading;	
7		
Lecture 19	Report writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing;	
Lecture 20	Report writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing;	
Lecture 21	Report writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing;	
8		
Lecture 22	Analyzing and describing graphs or charts	
Lecture 23	Analyzing and describing graphs or charts	
Lecture 24	Analyzing and describing graphs or charts	
9		
Lecture 25	Practicing analytical and argumentative writing	Tost Assistment
Lecture 26	Practicing analytical and argumentative writing	Test, Assignment, Presentation
Lecture 27	Practicing analytical and argumentative writing	Presentation
10		
Lecture 28	Public Speaking: Basic elements and qualities of a good public speaker	
Lecture 29	Public Speaking: Basic elements and qualities of a good public speaker	
Lecture 30	Public Speaking: Basic elements and qualities of a good public speaker	
11		
Lecture 31	Set Speech: How to get ready for any speech.	
Lecture 32	Set Speech: How to get ready for any speech.	
Lecture 33	Set Speech: How to get ready for any speech.	
12		
Lecture 34	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation.	
Lecture 35	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation.	
Lecture 36	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation.	
13		
Lecture 37	Listening to long lecture on some topics	
Lecture 38	Listening to long lecture on some topics	
Lecture 39	Listening to long lecture on some topics	

14	
Lecture 40	Listening and understanding speeches/lectures of different
	accents
Lecture 41	Listening and understanding speeches/lectures of different
	accents
Lecture 42	Listening and understanding speeches/lectures of different
	accents

ASSESSMENT STRATEGY

	Components	Grading	СО	Blooms Taxonomy
	Testing vocabulary level	20%	CO1, CO2, CO3, CO4	C1, C2, C4
Continuous Assessment	Argumentative/analytical writing	25%	CO1, CO2, CO3, CO4	C1, C2, C4
(40%)	Individual Presentation	25%	CO1, CO2, CO3, CO4	C1, C2, C4
	Group Presentation	30%	CO1, CO2, CO3, CO4	C1, C2, C4
	Total Marks 100%			

(CO = Course Outcome, C = Cognitive Domain)

TEXT BOOKS

1. Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.

2. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation)

REFERENCE BOOKS

1. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication

2. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication

- 3. Headway Series Advanced Level (2 parts with CDs): Oxford University Press Ltd.
- 4. Speak like Churchill stand like Lincoln James C. Humes
- 5. Cambridge IELTS Practice Book

6. Selected Sample Reports and Selected Research Articles

REFERENCE SITE

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5.1.3.4 LANG 204 Bangla Language and Literature

COURSE INFORMATION									
Course Code	: LANG 204	Lecture Contact Hours	: 3.00						
Course Title	: Bangla Language and	Credit Hours	: 1.50						
	Literature								
PRE-REQUISI	ГЕ								
-									
CURRICULUM	I STRUCTURE								
-									
SYNOPSIS/RA	TIONALE								
বাংলা আমাদের ম	াতৃভাষা। বাংলা শুধু একটি ভাষাই	নয়, বরং এর সাথে বাংলাভাষী	া মানুষদের সংস্কৃতি, ইতিহাস এবং স্বকীয়তা						
ওতপ্রোতভাবে জড়ি	তৃত। এই ভাষা শেখার মাধ্যমে এ জ	মঞ্চলের মানুষদের ঐতিহ্য, মূল্য	বাধ এবং জীবনপ্রক্রিয়া সম্পর্কে সম্যক ধারণা						
লাভ করা যায়। স	লাভ করা যায়। সর্বোপরি 'বাংলা ভাষা ও সাহিত্য' বিষয়টি অধ্যয়নের মাধ্যমে স্নাতক (সম্মান) প্রোগ্রামের ছাত্রছাত্রীগণ এর তাত্ত্বিক								

বিষয়ে যেমন দক্ষতা অর্জন করবে তেমনি এই কোর্স হতে লব্ধ ধারণা তাদের জ্ঞানের পরিধি ও সংস্কৃতি সম্পর্কে ধারণা বৃদ্ধি এবং এর প্রায়োগিক কৌশলসমূহ আরও ভালোভাবে রপ্ত করতে সাহায্য করবে **OBJECTIVE** ১. বাংলা ভাষা, ব্যাকরণ ও সাহিত্যের মৌলিক বিষয়সম্পর্কেধারণা প্রদান। ২. মাতৃভাষার শুদ্ধ উচ্চারণ শিক্ষা। পঠিত বিষয়ের ভাব অনুধাবন করা এবং তা প্রকাশে দক্ষ করে তোলা। 8. বাংলা ভাষায় পেশাগত দাপ্তরিক পত্রালাপ (Official Correspondence) এবং সৃজনশীল রচনার জন্য প্রাতিষ্ঠানিক শিক্ষা প্রদান। প্রয়োগিক উদ্দেশ্য। সূজনশীল রচনায় বাংলা ভাষার দক্ষ প্রয়োগ। ২. মাতৃভাষায় শুদ্ধ উচ্চারণে বক্তব্য প্রদানে দক্ষতা অর্জন। ৩. লিখিত ও মৌখিক প্রয়োগে ভাষার সৌকর্য রক্ষা করা। মাতৃভাষায় দাপ্তরিক পত্রালাপে দক্ষতা অর্জন। <u>পাঠ্যসূচী</u>। সাহিত্য (প্রবন্ধ, গল্প ও কবিতা) – ৪০ নম্বর ২. ব্যাকরণ, ভাষা শিক্ষা ও বিরচন - ৬০ নম্বর (প্রবন্ধ, গল্প ও কবিতাসমূহ ঢাকা বিশ্ববিদ্যালয় এবং ইউজিসি'র সিলেবাস হতে সংগৃহীত) নির্বাচিত প্রবন্ধ - ১৫ নম্বর বাঙ্গালা ভাষা বঙ্কিমচন্দ্র চট্টোপাধ্যায় তৈল হরপ্রসাদ শাস্ত্রী নিৰ্বাচিত গল্প - ১৫ নম্বর পুঁইমাচা বিভূতিভূষণ বন্দোপাধ্যায় সৈয়দ ওয়ালীউল্লাহ নয়নচারা <u>নির্বাচিত ক</u>বিতা - ১০ নম্বর বিদ্রোহী কাজী নজরুল ইসলাম বঙ্গভাষা মাইকেল মধুসূদন দত্ত ব্যাকরণ ও ভাষা শিক্ষা - ২৫ নম্বর প্রমিত বাংলা বানানের নিয়ম। (ک) (২) অশুদ্ধি সংশোধন। (৩) বাগ্ধারা। (8) প্রবাদ প্রবচন। (৫) এক কথায় প্রকাশ। প্রশাসনিক পরিভাষা। (৬) প্রায় সমোচ্চারিত ভিন্নার্থক শব্দ। (٩) বিভিন্ন শব্দের বিশিষ্টার্থে প্রয়োগ। (৮) উচ্চারণবিধি - ০৫ নম্বর বিরচন - ৩০ নম্বর ইংরেজি থেকে বাংলা অনুবাদ/অনুচ্ছেদ রচনা। (ک) ভাব সম্প্রসারণ/সারাংশ/সারমর্ম। (২) পত্র/প্রতিবেদন রচনা। (৩) (8) প্রবন্ধ রচনা । <u>বিস্তারিত পাঠ্যসূচি।</u> মোট ক্রেডিট - ৩ (৪২পিরিয়ড):

ক্রু/নং	কোড নং	পাঠ্য বিষয়	পিরিয়ড সংখ্যা	মন্তব্য
		সাহিত্য (২০ পিরিয়ড)		
۲	বাংলা:১-৪	প্রবন্ধ: বাঙ্গালা ভাষা	8	
২৷	বাংলা:৫-৭	প্রবন্ধ: তৈল	٩	
৩।	বাংলা:৮-১১	গল্প: পুঁইমাচা	8	
81	বাংলা:১২-১৪	গল্প: নয়নচারা	٩	
¢۱	বাংলা:১৫-১৮	কবিতা: বিদ্রোহী	٩	
ঙা	বাংলা:১৯-২১	কবিতা: বঙ্গভাষা	Q	
	ব্যাকরণ, ভাষা শিক্ষা	ও মৌখিক প্রকাশ ক্ষমতার উন্নয়ন (:	১১ পিরিয়ড)	
٩١	বাংলা:২২-২৪	প্রমিত বাংলা বানানের নিয়ম	ર	
٦٩	বাংলা:২৫-২৬	অশুদ্ধি সংশোধন	2	
৯৷	বাংলা:২৭	বাগ্ধারা	2	
201	বাংলা:২৮	প্রবাদ প্রবচন	2	
اجر	বাংলা: ২৯	এক কথায় প্রকাশ	2	
১২৷	বাংলা: ৩০	প্রশাসনিক পরিভাষা	2	
১৩।	বাংলা: ৩১	প্রায় সমুচ্চারিত ভিন্নার্থক শব্দ	2	
ا 8ډ	বাংলা: ৩২	বিভিন্ন শব্দের বিশিষ্টার্থে প্রয়োগ	2	
۵৫।	বাংলা:৩৩-৩৪	উচ্চারণ বিধি	2	
		বিরচন (০৫ পিরিয়ড)		
১৬।	বাংলা: ৩৫-৩৬	ইংরেজি থেকে বাংলা অনুবাদ/অনুচ্ছেদ রচনা	2	
29।	বাংলা: ৩৭	ভাবসম্প্রসারণ/সারাংশ/সারমর্ম	٢	
261	বাংলা: ৩৮	পত্র/প্রতিবেদন রচনা	2	

১৯	ı	বাংলা: ৩৯	প্রবন্ধ রচনা			2			
	·		পরীক্ষা (০৬	পিরিয়ড)		·		
২০	I	বাংলা: ৪০-৪২		৬					
মোট পিরিয়ড = ৪২									
<u>পাঠদান কৌশল</u> । প্রশিক্ষণের ক্ষেত্রে নিম্নলিখিত পদ্ধতি/উপায়সমূহ অনুসরণ করা হবে: ক। বক্তৃতা। খ। দলগত আলোচনা। গ। মান্টিমিডিয়া প্রেজেন্টেশান। ঘ। নোট/সহায়কসামগ্রী প্রদান। ঙ। ল্যাংগুয়েজ ল্যাবে প্রশিক্ষণ। চ। স্পট/ক্লাস টেস্ট ইত্যাদি। মূ ল্যায়নপদ্ধতি। মূল্যায়ন পদ্ধতি নিম্নরপ:									
। ४ । च	ल्] ञ्ज	্যাংগুয়েজ ল্যাবে প্রশিক্ষণ। পট/ক্লাস টেস্ট ইত্যাদি।							
। छ । च	ल्] ञ्ज	্যাংগুয়েজ ল্যাবে প্রশিক্ষণ। পট/ক্লাস টেস্ট ইত্যাদি। <u>তি</u> । মূল্যায়ন পদ্ধতি নি		নস্বর	মন্তব্য				
ও। চ। মূল্যা	ল্য স্স য়নপৰ্দ্ধা বিষয়	্যাংগুয়েজ ল্যাবে প্রশিক্ষণ। পট/ক্লাস টেস্ট ইত্যাদি। <u>তি</u> । মূল্যায়ন পদ্ধতি নি		নম্বর ২০%	মন্তব্য ১ ঘণ্টা, ২০ ন	ম্ব			
ঙ। চ। মূল্যা ক্র. নং	ল্য স্প য়নপৰ্দ্ধা বিষয় ১×গি	্যাংশুয়েজ ল্যাবে প্রশিক্ষণ। পট/ক্লাস টেস্ট ইত্যাদি। <u>তি</u> । মূল্যায়ন পদ্ধতি নি য়			১ ঘণ্টা, ২০ ন		হবে, ৫%+৫%		
ঙ। চ। <u>মূল্য</u> া ক্র. নং ১।	ল্য স্ব য়নপৰ্জা বিষয় ১×ি ক্লাস অ্যাস	্যাংশুয়েজ ল্যাবে প্রশিক্ষণ। পট/ক্লাস টেস্ট ইত্যাদি। তি। মূল্যায়ন পদ্ধতি নি য় মড টার্ম পরীক্ষা	নমুরপ:	२०%	১ ঘণ্টা, ২০ ন		হবে, ৫%+৫৭		
ঙ। চ। <u>ম</u> ুল্যা ক. নং ১। ২।	ল্য স্ব য়নপৰ্জা বিষয় ১×ি ক্লাস অ্যাস	্যাংশুয়েজ ল্যাবে প্রশিক্ষণ। পট/ক্লাস টেস্ট ইত্যাদি। <u>ছি। মূল্যায়ন পদ্ধতি নি য় মড টার্ম পরীক্ষা । টেস্ট গাইনমেন্ট/ দলগত উ ফরমেন্স</u>	নমুরপ:	૨૦% ১০%	১ ঘণ্টা, ২০ ন		হবে, ৫%+৫৭		
ঙ। চ। <u>মূল্য</u> া ক্র. নং ১। ২। ২।	ল্য স্ব য়নপৰ্জা বিষয় ১×হি ক্লাস আ্যাস্ পারু	্যাংশুয়েজ ল্যাবে প্রশিক্ষণ। পট/ক্লাস টেস্ট ইত্যাদি। <u>ছি। মূল্যায়ন পদ্ধতি নি য় মড টার্ম পরীক্ষা । টেস্ট গাইনমেন্ট/ দলগত উ ফরমেন্স</u>	নমুরপ:	२०% ১०% ১०%	১ ঘণ্টা, ২০ ন	ম্বর জমা দেয়া	হবে, ৫%+৫৭		

REFERENCE BOOKS

সহায়ক গ্রন্থাবলি নিম্নুরূপ:

- বাংলা ব্যাকরণ ড. শাহজাহান মুনীর, স্টুডেন্টস পাবলিকেশনস।
- প্রবন্ধসংগ্রহ ঢাকা বিশ্ববিদ্যালয়।
- গল্পসংগ্রহ ঢাকা বিশ্ববিদ্যালয়।
- কবিতাসংগ্রহ ঢাকা বিশ্ববিদ্যালয়।

- ৫. বাংলা বানান অভিধান বাংলা একাডেমি কর্তৃক প্রকাশিত।
 ৬. বাংলা উচ্চারণ অভিধান বাংলা একাডেমি কর্তৃক প্রকাশিত।
 ৭. প্রমিত বাংলা ব্যাকরণ ও নির্মিতি (তৃতীয় খণ্ড) অধ্যাপক ড. হায়াৎ মামুদ ও অধ্যাপক ড. মোহাম্মদ আমীন।
- ৮. বাংলা ভাষার প্রয়োগ ও অপপ্রয়োগ⁻ বাংলা একাডেমি কর্তৃক প্রকাশিত।

REFERENCE SITE

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5.1.4 Level-2, Fall

5.1.4.1 MATH 231 Complex Variables and Linear Algebra

Cours							
Cours	se Code	: MATH IV	Le	cture Co	ontact]	Hours	: 3.00
Cours	se Title	: Complex Variable and Linear A	lgebra Cr	edit Ho	urs		: 3.00
PRE-	REQUISIT	E					
		TH 101, MATH 105					
		erential Calculus and Integral Calc	ulus, Vector A	nalysis	, Matri	x and C	Co-ordinate Geometry
CUR	RICULUM	STRUCTURE					
Dutco	ome Based E	ducation (OBE)					
SYNC	OPSIS/RAT	IONALE					
		nts the concepts, principles and wor	-	-			
· ·		foundation and applications of con	* *		· ·		•
	•	ons and contour integration. Finally		e			ate practical applications an
		the sectors surrounding Complex	Variable and	Linear a	lgebra.		
	ECTIVE						
		rt basic knowledge about Complex			•		
		iarize the students with the charac		•	•		
3. Be	proficient w	ith basic methods of complex diffe	erentiation, dif	ferent m	atrix d	ecomp	osition and their application
COU	RSE OUTC	OMES & GENERIC SKILLS					
No.		Course Outcome	Bloom's Taxonomy	СР	CA	KP	Assessment Methods
		e basic idea about Complex nd Linear algebra.	C1-C2	1		1	T, F
201	Explain t						
CO1	integrals,	he complex functions by line Cauchy's integral formulae and esidue theorem.	C2	1		2	T, Mid Term Exam, F
	integrals, Cauchy's r	· · ·	C2	1		2	T, Mid Term Exam, F
	integrals, Cauchy's r Apply decomposi	Cauchy's integral formulae and esidue theorem. various types of matrix tion to solve different	C2 C3	1		2	
CO2	integrals, Cauchy's r Apply decomposi engineerin	Cauchy's integral formulae and esidue theorem. various types of matrix tion to solve different g problems.	C3	1,3	uate, a	2	T, Mid Term Exam, F
CO2	integrals, Cauchy's r Apply decomposi engineerin Remember,	Cauchy's integral formulae and esidue theorem. various types of matrix tion to solve different	C3 – Analyze, C:	1,3 5 – Eval		2 nd C6	T, Mid Term Exam, F – Create; CP- Complex

COURSE CONTENT

Complex Variable: Complex number system, General functions of a complex variable, Limits and continuity of a function of complex variable and related theorems, Differentiation and the cauchy Riemann equations, Mapping by elementary functions, Line integral of a complex function, Cauchy's Integral formula, Complex function, Convergence and Uniform convergence, Liouville's theorem, Taylor's and Laurents theorem, Singular residues, Cauchy's residue theorem.

Linear Algebra:

Vector space and its basis and dimension. Linear Transformations; Kernel and range of linear transformations, Matrix Decomposition, LU Decomposition, QR decomposition, Eigen value decomposition, Singular Value Decomposition. Introduction to Principal Component Analysis (PCA), Independent Component Analysis (ICA), and Common Spatial Pattern (CSP).

				PROGRAM OUTCOMES (PO)							nis				
No.		Course Outcom	e							r			<u> </u>		
				1	2	3	4	5	6	7	8	9	10	11	12
CO1		I the basic idea ab le and Linear algebra	-	3											
CO2	integra	in the complex func ils, Cauchy's integral y's residue theorem.	•	3											
CO3	Apply various types of matrix decomposition to solve different engineering problems.														
		hod used for mapping r CO-PO mapping:	which indicate	es 3 as	s higł	n, 2 a	s me	diun	n an	11 a	s low	leve	l of ma	atching	;)
Mappin		Corresponding Level of matching					J	ustif	ficat	ions					
CO1-PC	D1(a)	3	The knowled has to be ap Biomedical E	oplied	l to	desci		-			-				-
CO2-PC	Engine				In order to explain the characteristics of various components of Biomedical Engineering, the knowledge of mathematics regarding Complex Variable is needed.										
CO3-PC	D1(a)	3	Matrix decomengineering s		ion is	s requ	uired	to	inter	pret	math	emati	cs, sci	ence a	nd
TEACH	HING L	EARNING STRATH	EGY												
Teachin	g and Le	earning Activities										E	ngagei	ment (ł	nours)
Face-to-	-Face Le	arning													
	Lecture	e										42			
	Practic	al / Tutorial / Studio												-	
	Studen	t-Centred Learning											-		
Self-Dir	ected Le	earning													
	Non-fa	ce-to-face learning												42	
	Revisio	on of the previous lect	ture at home											21	
	Prepar	ation for final examin	ation	21											
Formal	Assessm	nent													
	Contin	uous Assessment												2	
	Final E	Examination												3	
Total														131	

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE	SCHEDULE	
Week 1	COMPLEX VARIABLE	
Class-1	Complex number system	
Class-2	Complex number system	
Class-3	General functions of a complex variable	
Week 2	COMPLEX VARIABLE	
Class-4	Limits and continuity of a function of complex variable and related theorems	
Class-5	Limits and continuity of a function of complex variable and related theorems	CT-1
Class-6	Limits and continuity of a function of complex variable and related theorems	
Week 3	COMPLEX VARIABLE	
Class-7	Differentiation of complex function	
Class-8	Differentiation of complex function	
Class-9	The Cauchy Riemann equations - concepts	_
Week 4	COMPLEX VARIABLE	
Class-10	The Cauchy Riemann equations - problems	
Class-11	Mapping by elementary functions	
Class-12	Line integral of a complex function	
Week 5	COMPLEX VARIABLE	
Class-13	Cauchy's Integral formula,	СТ-2
Class-14	Complex function,	
Class-15	Convergence	
Week 6	COMPLEX VARIABLE	
Class-16	Uniform convergence	
Class-17	Liouville's theorem	
Class-18	Taylor's theorem	
Week 7	COMPLEX VARIABLE	
Class-19	Laurents theorem	
Class-20	Singular residues	
Class-21	Cauchy's residue theorem	
Week 8	LINEAR ALGEBRA	

Class-22	Vector space and its basis.	
Class-23	Vector space and its dimension.	-
Class-24	Linear Transformations	-
Week 9	LINEAR ALGEBRA	-
Class-25	Kernel of linear transformations	-
Class-26	Kernel of linear transformations	-
Class-27	Range of linear transformations	Mid Term
Week 10	LINEAR ALGEBRA	-
Class-28	Range of linear transformations	-
Class-29	Matrix Decomposition	-
Class-30	LU Decomposition	-
Week 11	LINEAR ALGEBRA	
Class-31	DU Decomposition	-
Class-32	QR decomposition	-
Class-33	QR decomposition	-
Week 12	LINEAR ALGEBRA	-
Class-34	Eigen value decomposition	-
Class-35	Singular Value Decomposition.	-
Class-36	Singular Value Decomposition.	-
Week 13	LINEAR ALGEBRA	-
Class-37	Introduction to Principal Component Analysis (PCA)	CT-4
Class-38	Introduction to Principal Component Analysis (PCA)	-
Class-39	Independent Component Analysis (ICA)	-
Week 14	LINEAR ALGEBRA	-
Class-40	Independent Component Analysis (ICA)	1
Class-41	Common Spatial Pattern (CSP).	-
Class-42	Common Spatial Pattern (CSP).	-
ASSESSN	IENT STRATEGY	

Com	ponents	Grading	СО	Blooms Taxonomy
	Class Test/		CO1, CO2	C1, C2
Continuous	Assignment 1- 3	20%	CO3	C3
Assessment (40%)	Class Participation	5%	CO3	C3
	Mid term	15%	CO2, CO3	C2,C3
			CO 1	C1, C2
Final	l Exam	60%	CO 2	C2
			CO 3	C3
Total	Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT BOOKS

1. Theory and functions of complex variables, Shanti Narayan.

REFERENCE BOOKS

1. Complex Variables by -Murray R. Spiegel, Schaum's Outline Series.

2. Elementary Linear algebra - Wiely, Howard Anton and Chris Rorres.

REFERENCE SITE

5.1.5 Level-3, Spring

5.1.5.1 GERM 352 Fundamentals of Research Methodology (Sessional)

COURSE INFOR	RMATION		
Course Code	: GERM 352	Lecture Contact Hours	: 4.00
Course Title	: Fundamentals of Research Methodology (Sessional)	Credit Hours	: 2.00
PRE-REQUISIT	E	I	1
None			

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The *Fundamentals of Research Methodology* is a hands-on course designed to impart education in the foundational methods and techniques of academic research in Science and Engineering context. UG students would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, time management, report writing, and presentation. Once equipped with this knowledge, participants would be well-placed to conduct disciplined research under supervision in an area of their choosing. In addition to their application in an academic setting, many of the methodologies discussed in this course would be similar to those deployed in professional research environments.

OBJECTIVES

- 1. To develop a research orientation among the UG students and to acquaint them with fundamentals of research methods.
- 2. To evaluate/review related extant literature, form a variety of sources, pertinent to the research objectives/questions.
- 3. To expose students to various research methodologies (design), relevant to the research problem needing to be addressed.
- 4. To explain and justify how researchers will collect and analyse research data.
- 5. To educate students in the common mistakes, research misconduct, and ethical considerations in the field of research methodology.

0001	SE OUTCOMES & GENERIC SKILLS						
No.	Course Outcome	Correspondin	Bloom's	СР	CA	KP	Assessment
INO.	Course Outcome	g PO	Taxonomy		CA	IXI	Methods
	Be able to understand the research						Assignment/
CO1	fundamentals and formulate problem	2	C2				Quiz
COI	statement and research	2	02	-			
	questions/objectives.						
	Be able to formulate and compose a						Report/Prese
CO2	research proposal considering research	4	C3	-			ntation/
02	activities/design, background studies, and	+					Assignment/
	following standard guidelines.						Quiz
	Be able to develop writing and						Report/Prese
CO3	presentation skill, and demonstrate ethical	10	C3	-			ntation/
	considerations in conducting research.						Assignment
(CP	(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG –						
Ì	Assignment, Pr – Presentation, R	•			•		~ .
C1 – F	Remember, C2 – Understand, C3 – Apply, C4	-					

COURSE OUTCOMES & GENERIC SKILLS

COURSE CONTENT

1. Foundations of Research: Meaning of Research; Definitions of Research; Objectives of Research; Motivation in Research; General Characteristics of Research; Criteria of Good Research; Types of Research; Concept of theory, empiricism, deductive and inductive theory; Characteristics of scientific method.

2. Problem Identification and Formulation: Meaning and need of Review of Literature; How to Conduct the Review of literature; Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

3. Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental/Computational Design: Concept of Independent & Dependent variables.

4. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

5. Research Misconduct and Ethics: Understand the research misconduct; type of research misconduct; Ethical issues in conducting research; Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

6. Use of Tools / Techniques for Research: Layout of a Research Paper; Methods to search required information effectively; Reference Management Software like Zotero/Mendeley; Software for paper formatting like LaTeX/MS Office; Software for detection of Plagiarism. Time management and developing Gantt Charts.

CO-PO MAPPING

	No. Course Learning Outcome				PRO	OGR	AM	OUT	ГСО	MES	S(PO)		
NO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Understand the research fundamentals and												
CO1	formulate problem statement and research		3										
	questions/objectives.												
	Formulate and compose a Research proposal												
CO2	considering research activities, background				3								
	studies, and following standard guidelines.												
	Develop writing and presentation skill, and												
CO3	demonstrate ethical considerations in										3		
	conducting research.												
(Numer	rical method used for mapping which indicates 3	as hi	gh, 2	as me	diun	n and	l 1 as	s low	leve	el of	matchi	ng)	
TEAC	HING LEARNING STRATEGY												
	ng and Learning Activities										Engage	ement (l	nours)
	-Face Learning										88-	(
Lecture	-											24	
Practica	al / Tutorial / Studio											12	
Student	t-Centred Learning												
												12	
	rected Learning											12	
Self-Di	-											12	
Self-Di Non-fa	rected Learning												
Self-Di Non-fae Report	rected Learning ce-to-face learning											12	
Self-Di Non-fao Report Formal	rected Learning ce-to-face learning Preparation											12	
Self-Di Non-fae Report Formal Continu	rected Learning ce-to-face learning Preparation Assessment											12 18	
Self-Di Non-fac Report Formal Continu Report	rected Learning ce-to-face learning Preparation Assessment uous Assessment											12 18	
Self-Di Non-fac Report Formal Continu Report	rected Learning ce-to-face learning Preparation Assessment uous Assessment Submission (2)											12 18 1.5	

Week	Lecture	Topics
1	Lec 1	Foundations of Research: Meaning of Research; Definitions of Research; Objectives of
	Lec 2	Research; Motivation in Research; General Characteristics of Research; Criteria of Goo
	Lec 3	Research; Types of Research; Concept of theory, empiricism, deductive and inductive theory
	Lec 4	Characteristics of scientific method.
2	Lec 5	Practice session on Foundations of Research
	Lec 6	
	Lec 7	
	Lec 8	
3	Lec 9	Problem Identification & Formulation: Meaning & need of Review of Literature; How
	Lec 10	Conduct the Review of literature; Research Question – Investigation Question – Measureme
	Lec 11	Issues - Hypothesis - Qualities of a good Hypothesis -Null Hypothesis & Alternativ
	Lec 12	Hypothesis. Hypothesis Testing – Logic & Importance.
4	Lec 13	Practice session on Problem Identification & Formulation
	Lec 14	
	Lec 15	
	Lec 16	
5	Lec 17	Research Design: Concept and Importance in Research – Features of a good research design
	Lec 18	- Exploratory Research Design - concept, types and uses, Descriptive Research Designs
	Lec 19	concept, types and uses. Experimental Design: Concept of Independent & Depende
	Lec 20	variables.
6	Lec 21	Practice session on Research Design
	Lec 22	
	Lec 23	
	Lec 24	
7	Lec 25	Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie char
	Lec 26	percentages), Bivariate analysis - Cross tabulations and Chi-square test including testin
	Lec 27	hypothesis of association.
	Lec 28	
8	Lec 29	Practice session on Data Analysis
	Lec 30	
	Lec 31	
	Lec 32	
9	Lec 33	Research Misconduct and Ethics: Understand the research misconduct; type of resear
	Lec 34	misconduct; Ethical issues in conducting research; Ethical issues related to publishin
	Lec 35	Plagiarism and Self-Plagiarism.
	Lec 36	
10	Lec 37	Practice session on Research misconduct and Ethics
	Lec 38	
	Lec 39	
	Lec 40	
11	Lec 41	Use of Tools / Techniques for Research: Layout of a Research Paper; Methods to search
	Lec 42	required information effectively; Reference Management Software like Zotero/Mendele
	Lec 43	Software for paper formatting like LaTeX/MS Office; Software for detection of Plagiarism
	Lec 44	Time management and developing Gantt Charts.
12	Lec 45	Practice session on Use of tools / techniques for Research
	Lec 46	
	Lec 47	

	Lec 48	
13	Lec 49	Review Session (Theory) – I
	Lec 50	/Final Presentation
	Lec 51	
	Lec 52	
14	Lec 53	Review Session (Practice) – II
	Lec 54	/Final Presentation
	Lec 55	
	Lec 56	

ASSESSMENT STRATEGY

Assessment Criteria		СО	Blooms Taxonomy		
Components	Grading	60	Bioonis Taxonomy		
Assignment I	20%	CO1 and CO3	C2, C3		
Assignment II	50%	CO2 and CO3	C3		
Continuous Assessment	30%	CO1 and CO2	C2, C3		
Total Marks	100%		•		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT BOOKS

- 1. Engineering Research Methodology: A Practical Insight for Researchers. Springer, by Deb, Dipankar, Dey, Rajeeb, Balas, Valentina E.
- 2. Research Methods for Engineers, 1st Edition, by David V. Thiel.

REFERENCE BOOKS

- 1. Handbook of Research Methodology by Talati, J.K.
- 2. Introducing Research Methodology: A Beginner's Guide to Doing a Research Project by Uwe Flick
- 3. DRM, a Design Research Methodology by Lucienne T.M. Blessing and Amaresh Chakrabarti
- 4. Research Methods: Information, Systems, and Contexts by Kirsty Williamson, Graeme Johanson
- Zelkowitz, M. V. and Wallace, D. R. (1998), Experimental models for validating technology, *Computer*, vol. 31, no. 5, pp. 23-31.
- 6. Internet, mail, and mixed-mode surveys : the tailored design method (3rd ed.) by Dillman, D. A., Smyth, J. D., & Christian, L. M.
- 7. Applied multiple regression/correlation analysis for the behavioral sciences (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates, by Cohen, J., Cohen, P., West, S., & Aiken, L.
- 8. Experimental and Quasi-Experimental Design for Generalized Causal Inference. Boston, Mass: Houghton Mifflin, by Shadish W.R., Cook T.D. & Campbell P.T.

REFERENCE SITES

5.1.6 Level-4, Spring

5.1.6.1 GEPM 481 Project Management and Finance

COURSE INFO	ORMATION		
Course Code		Lecture Contact Hours	: 3.00
Course Title	: GEPM 481 : Project Management and Finance	Credit Hours	: 3.00
PRE-REQUISI	ГЕ		

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course provides the students with the ability to predict as many dangers and problems as possible and to plan, organize and control activities so that one project can be completed as successfully as possible in spite of all the risks. Illustrates the principles to protect the environment by ensuring that a local planning authority when deciding whether to grant planning permission for a project which likely to have significant effects on environment.

OBJECTIVE

- Successful development of projects procedures of initiation, planning, execution, regulation and closure as we the guidance of the project team's operation towards achieving all the agreed upon goals within the set scope, time, quality and budget standards.
- 2. Develop, implement, monitor and maintain environmental strategies, policies, programs and systems that prosustainable development.

No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Be able to list and describe the selection and initiation of individual projects and of portfolios of projects in the enterprise.	C1, C2	1,11	1	-	1	T, F
CO2	Be able to prepare project planning activities that accurately forecast project costs, timelines and quality. Implement processes for successful resource, communication and risk and change management.	C3	1,3,12	1,2	-	1,3	T, F
CO3	Be able to demonstrate effective project execution & control techniques and conduct project closure activities to obtain formal project acceptance.	C2-C4	1,8	1	-	1	MID, F
CO4	Be able to demonstrate effective organizational leadership and change skills for financial management, managing projects, projects teams and stakeholders.	C2	4,10,11		-	1	T, F

COURSE OUTCOMES & GENERIC SKILLS

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Project Management: Definition of Project Management, Project Management Life Cycle, Economic Contexts of Project Management, Project Management in Healthcare Environment, Decision Making Tools for Choosing a Project, Estimating Time, Scheduling Tool, Estimating Cost, Cost Categories, Assessing Cost, Cost Estimation Tools, Project Quality Management, Project Quality Control, Project Quality Assurance, The Process of Communicating, Communication Management Plan, Dealing with Changes, Monitoring and Control Changes, Risk Definition, Identification, Responding and Monitoring, Contract Definition, Types and Organizing Contracts, Procurement Process: Pre-Purchase, Purchase, Post-Purchase, Contract Administration and Close Out, Project Close Out, Roles of Project Manager, Motivation, Teaming and Leadership, Negotiating and Conflict Management, Project Management in Pharmaceutical Industry, Project Management in Medical Device Manufacturing Industry, Sustainability and Green Efforts in Healthcare

Finance: Corporate Finance and Finance Manager, Forms of Business Organization, Goal of Financial Management, Cash Flow, Ratio Analysis, Financial Planning and Financial Planning Model, Percentage of Sales Approach, External Financing and Growth

N				PROGRAM OUTCOMES (PO)														
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12					
	Be able to list and describe the selection	n																
CO1	and initiation of individual projects and	of 3										3						
	portfolios of projects in the enterprise.																	
	Be able to prepare project planning	ıg																
	activities that accurately forecast proje	ct																
CO2	costs, timelines and quality. Implement	nt 3		3									3					
002	processes for successful resource	e, ³		5									5					
	communication and risk and chang	ge																
	management.																	
	Be able to demonstrate effective proje	et																
CO3	execution & control techniques an	14							2									
COS	conduct project closure activities	:0							2									
	obtain formal project acceptance.																	
	Be able to demonstrate effective																	
CO4	organizational leadership and chang				2						2	3						
004	skills for financial management, managin	-			2						2	5						
	projects, projects teams and stakeholder																	
-	rical method used for mapping which indic	ates 3 a	s higł	1, 2 a	s me	diun	ı, an	d 1 a	as lov	v leve	l of n	natching	g)					
TEAC	HING LEARNING STRATEGY																	
	ng and Learning Activities									Eng	gagen	nent (ho	ours)					
Face-to	-Face Learning																	
	Lecture											42						
	Practical / Tutorial / Studio											-						
	Student-Centred Learning											-						
Self-Di	rected Learning																	
	Non-face-to-face learning											42						
	Revision of the previous and (or) subseq	uent lec	ture a	it hor	ne							21						
	Preparation for final examination											21						
Formal	Assessment																	
	Continuous Assessment											2						
m 1	Final Examination								_			3						
Total												131						
TEAC	HING METHODOLOGY																	
Lecture	and discussion, Co-operative and collabor	ative m	ethod	l, Pro	blem	ı bas	ed n	netho	od									
COUR	SE SCHEDULE																	
	Week	To									As	sessme	nt					
1	Motivation and course i																	
Lecture	5	lanage	ment	and	Econ	nomi	$c \overline{C}$	onter	xt of									
	Project Management																	
Lecture	2 Decision Making Tools f	or choo	sing a	. Proj	ect													
2	Introductory Concents	of Proj	ect M	anao	omo	nt				1	Decision Making Tools for choosing a ProjectIntroductory Concepts of Project ManagementCT – 1, Final							

		Other Departments
Lecture 3	Strategy, Strategy Implementation and Project Management	
Lecture 4	Organizing Structure Influence on Project Choices and Project	
	Selection	
3	Time Management	
Lecture 5	Introductory Concepts of Time Management	
Lecture 6	Estimation and Scheduling Tool	
4	Cost Management	
Lecture 7	Introductory Concepts of Cost Management, Estimating Cost and	
	Cost Estimating Tools	
Lecture 8	Assessing Costs and Allocating Budget Costs	
5	Quality Management	
Lecture 9	Introductory Concepts of Quality Management	
Lecture 10	Project Quality Control, Quality Assurance and Quality	
	Assessment	
6	Communication, Adaptability and Risk Management	Midterm, Final
Lecture 11	Communication: The Process of Communication and	
	Communication Management Plan	
Lecture 12	Adaptability and Risk Management	
7	Contracting-Procurement and Project Close out	
Lecture 13	Contract Definition, Types and Organizing Contracts	
Lecture 14	Procurement Process, Project Close Out	
	Midterm Break	
8	Management Skills	
Lecture 15	Role of Project Manager: Motivation, Teaming and Leadership	
Lecture 16	Negotiating and Conflict Management	
9	Project Management in Healthcare - 1	
Lecture 17	Project Management in Pharmaceutical Industry	
Lecture 18	Project Management in Medical Device Manufacturing Industry	
10	Project Management in Healthcare - 2	CT – 2, Final
Lecture 19	Sustainability in Healthcare	
Lecture 20	Healthcare Agility	
<u>11</u>	Introduction to Corporate Finance	
Lecture 21	Corporate Finance and Finance Manager	
Lecture 22	Forms of Business Organization, Goal of Financial Management	
12		
Lecture 23	Financial Statements, Taxes and Cash Flow Balance Sheet	CT – 3, FINAL
		CI = 3, FINAL
Lecture 24	Income Statement, Taxes	
13 Leature 25	Cash Flow and Ratio Analysis	
Lecture 25	Cash Flow	
Lecture 26	Ratio Analysis	
14 Lecture 27	Financial Planning and Corporate Growth	FINAL
Looturo 77	Financial Planning and Financial Planning Model	
Lecture 28	Percentage of Sales Approach, External Financing and Growth	

Com	oonents	Grading	CO	Blooms Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO2	C1,C2,C3
Assessment (40%)	Class Participation	5%	CO1	C1,C2
	Midterm	15%	CO1,CO2	C1,C2,C3
I			CO 1	CO 1
Final	Exam	60%	CO 2	CO 2
гша		00%	CO 3	CO 3
			CO 4	CO 4
Total	Marks	100%		
(CO = Cours	e Outcome, C = O	Cognitive Domain)	
TEXT BOOF	KS			
1. David Sl	nirley, Project Ma	nagement for Heal	thcare, Second Edition, Tayl	or & Francis.
REFERENC	E BOOKS			
1. Larson,E	.W. andGray,C.F	.(2018),Project ma	nagement the managerial pro	ocess, Seventh Edition,McGraw-Hill
2. Fundame	entals of Corporat	e Finance 8th Cana	adian Edition	
REFERENC	E SITE			

5.1.7 Level-4, Fall

5.1.7.1 GESL 421 Environment, Sustainability and Law

Course Code	: GESL 421	Lecture Contact He	ours	: 2.00			
Course Title	: Environment, Sustainability and Law	, Credit Hours		: 2.00			
PRE-REQUI	SITE						
-							
CURRICUL	JM STRUCTURE						
Outcome Base	d Education (OBE)						
SYNOPSIS/F	ATIONALE						
development obligations to	international laws governing the and environmental protection, the wards the environment are cover- and medical waste management, b	e roles involved in adh ed. Biosafety principle	nering to s and pr	o environ ractices f	mental or facili	laws, s ities, s	and the ethica
OBJECTIVE							
. To be fan internation	iliar with the basic concepts of ally	environmental protection	on and	sustainab	ility rec	quired	to be followed
	uii j.						
	nowledge of the areas where rules		-				ination contro
 To correct depending To be awa industries 	nowledge of the areas where rules by identify biosafety concerns and on the scenario. The of the considerations for the envine in the safe treatment and disposal TCOMES & GENERIC SKILL	apply the principles for vironment and responsit of hazardous wastes in	biosafet bilities c	y protect	ion and	contarr	
 To correct depending To be awa industries 	y identify biosafety concerns and on the scenario. re of the considerations for the env in the safe treatment and disposal	apply the principles for vironment and responsit of hazardous wastes in	biosafet bilities c	y protect	ion and	contarr	ganizations and
 To correct depending To be awa industries COURSE OU No. Be a and 	y identify biosafety concerns and on the scenario. re of the considerations for the envi in the safe treatment and disposal TCOMES & GENERIC SKILL	apply the principles for vironment and responsil of hazardous wastes in S.S. Bloom's Taxonomy laws	biosafet bilities c hospital	y protect	uals, hea	contam alth org	ganizations an Assessment
 To correct depending To be awa industries COURSE OI No. CO1 Be a and they Be a and they 	y identify biosafety concerns and on the scenario. re of the considerations for the envi in the safe treatment and disposal TCOMES & GENERIC SKILL Course Outcome ble to remember environmental sustainability concepts and the in	Apply the principles for vironment and responsible of hazardous wastes in S Bloom's Taxonomy laws ssues C1 areas safety C2	biosafet bilities c hospital PO	y protect	uals, hea	contam alth org KP	ganizations and Assessment Methods
CO1 and they CO2 and prince CO2 COURSE OF C	ly identify biosafety concerns and on the scenario. re of the considerations for the envi in the safe treatment and disposal TCOMES & GENERIC SKILL Course Outcome ble to remember environmental sustainability concepts and the are designed to resolve. ble to understand the applicable methods for maintaining bios iples and hospital waste managem Problems, CA-Complex Activiti	apply the principles for vironment and responsible of hazardous wastes in S Bloom's Taxonomy laws ssues C1 areas safety C2 ent. es, KP-Knowledge Pro	biosafet bilities c hospital PO 7 7 7	cp protections.	CA -	KP 7 7	ganizations and Assessment Methods T, MID, F T, F
S. To correct depending industries COURSE OU No. Be a and they Be a cO2 and princ (CP- Complex	y identify biosafety concerns and on the scenario. re of the considerations for the envi in the safe treatment and disposal TCOMES & GENERIC SKILL Course Outcome ble to remember environmental sustainability concepts and the are designed to resolve. ble to understand the applicable methods for maintaining bios iples and hospital waste managem Problems, CA-Complex Activiti r – Presentation; R - Report; F – H	apply the principles for vironment and responsible of hazardous wastes in S Bloom's Taxonomy laws ssues C1 areas safety C2 ent. es, KP-Knowledge Provinal Exam) - C4 - Analyze	biosafet bilities c hospital PO 7 7 file,T –	cp protections.	CA - Proje	KP 7 7 cect; Q -	ganizations an Assessment Methods T, MID, F T, F
 To correct depending To be awa industries COURSE OU No. CO1 and they Be a and they CO2 and prince (CP- Complex Assignment; I C1 - Rememb 	ly identify biosafety concerns and on the scenario. re of the considerations for the envi in the safe treatment and disposal TCOMES & GENERIC SKILL Course Outcome ble to remember environmental sustainability concepts and the in are designed to resolve. ble to understand the applicable methods for maintaining bios iples and hospital waste managem Problems, CA-Complex Activiti r – Presentation; R - Report; F – F er C2 – Understand Appl	apply the principles for vironment and responsible of hazardous wastes in S Bloom's Taxonomy laws ssues C1 areas safety C2 ent. es, KP-Knowledge Provinal Exam) - C4 - Analyze	biosafet bilities c hospital PO 7 7 file,T –	cp - Test; PR	CA - Proje	KP 7 7 cect; Q -	Assessment Methods T, MID, F T, F – Quiz; ASG
COURSE COUR	ly identify biosafety concerns and on the scenario. re of the considerations for the envi in the safe treatment and disposal TCOMES & GENERIC SKILL Course Outcome ble to remember environmental sustainability concepts and the in are designed to resolve. ble to understand the applicable methods for maintaining bios iples and hospital waste managem Problems, CA-Complex Activiti r – Presentation; R - Report; F – F er C2 – Understand Appl	apply the principles for vironment and responsil of hazardous wastes in S Bloom's Taxonomy laws ssues C1 areas safety C2 ent. es, KP-Knowledge Pro Vinal Exam) - C4 - Analyze	biosafet bilities c hospital PO 7 7 file,T –	ry protection of individues. CP - Test; PR C5 – Eva	CA - Proje	KP 7 7 cect; Q - Ce	Assessment Methods T, MID, F T, F – Quiz; ASG

innovation; Liability in Trade and Business; The Atmosphere and the Climate; Climate Change and Greenhouse

effect; Ozone Layer Protection; Renewable Energy; Green Technology; The Link between Environment and Development; Preservation of Biodiversity and the Ecosystem; Marine Pollution and Biodiversity; Laws against Pollution.

Biosafety: Identifying Biological Safety Concerns; Biohazard Risk Assessment; Routes of Contamination; Methods for Hazard Control; Administrative Responsibilities in Contamination Control; Facility Design Considerations. Hospital Waste Management: Introduction to biomedical waste management in hospital; Responsibility of Staff and Visitors in Contamination Control; Treatment and Disposal Techniques; Water and Air Purification; Biosafety Consideration for Patients: Equipment Sterilization: Disinfection Techniques; Recycled Materials: Bedsheets, gowns, surgical equipment, etc.

						PR	ROG	RAN	лот	UTCO	OMES	S (PO)	
No.	0	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	, 11	12
CO1	laws an	e to remember environmental ad sustainability concepts and the hey are designed to resolve							3					
CO2	areas	le to understand the applicable and methods for maintaining ety principles and hospital waste ement.												
(Numer	ical metho	d used for mapping which indicate	s 3 as	s high	n, 2 as	s me	diun	n, an	d 1 a	as low	/ leve	l of m	atching	g)
TEACH	IING LEA	ARNING STRATEGY												
Teaching	Teaching and Learning Activities						En	gagen	nent (h	ours)				
Face-to-	Face Learn	ning												
	Lecture												28	
	Practical	/ Tutorial / Studio											-	
		Centred Learning											-	
Self-Dire	ected Lear	•												
		-to-face learning											28	
		of the previous and (or) subsequen	t lect	ure at	hom	e							14	
	Preparati	on for final examination											14	
Formal A	Assessmen	t												
	Continuo	us Assessment											2	
	Final Exa	mination											3	
Total													89	
TEACH	HING ME	THODOLOGY												
Lecture	and discus	ssion, Co-operative and collaborati	ve m	ethod	, Pro	blem	ı bas	ed n	netho	od				
COURS	SE SCHE	DULE												
We	eks	Т	opic	5								A	ssessm	ent
Weeks 1		Introduction to environment, su	-		ity aı	nd la	W							
Lecture		Principles of international environ			-									
Lecture 2	2	Sustainable development and the									C	T – 1		lidterm,
Weeks 2		Environment laws									1		Final	
Lecture 3		Environmental Politics and Econo	omics	5							1			
Lecture 4		Environmental Ethics												

Weeks 3	Environment laws	
Lecture 5	International organizations and common laws	
Lecture 6	Developed and Developing Countries Perspectives; Environmental Law in Bangladesh	
Weeks 4	Environment laws	
Lecture 7	Principles of Preventive Action and Precaution	
Lecture 8	International Environmental Problems	
Weeks 5	Sustainable Development	
Lecture 9	The role of regulation and innovation	
Lecture 10	Liability in Trade and Business	
Weeks 6	The Atmosphere	
Lecture 11	The Atmosphere and the Climate; Climate Change	Midterm, Final
Lecture 12	Greenhouse effect; Ozone Layer Protection	
Weeks 7	Development	
Lecture 13	Renewable Energy; Green Technology	
Lecture 14	The Link between Environment and Development	
	MIDTERM	
Weeks 8	Biodiversity	
Lecture 15	Preservation of Biodiversity and the Ecosystem	
Lecture 16	Marine Pollution and Biodiversity; Laws against Pollution	
Weeks 9	Biosafety	
Lecture 17	Identifying Biological Safety Concerns	CT – 2, FINAL
Lecture 18	Biohazard Risk Assessment	
Weeks 10	Contamination Control	
Lecture 19	Routes of Contamination & Methods for Hazard Control	
Lecture 19 Lecture 20	Routes of Contamination & Methods for Hazard Control Administrative Responsibilities & Facility Design Considerations	
Lecture 20	Administrative Responsibilities & Facility Design Considerations	
Lecture 20 Weeks 11	Administrative Responsibilities & Facility Design Considerations Hospital Biosafety	
Lecture 20 Weeks 11 Lecture 21	Administrative Responsibilities & Facility Design Considerations Hospital Biosafety Introduction to biomedical waste management in hospital	
Lecture 20 Weeks 11 Lecture 21 Lecture 22	Administrative Responsibilities & Facility Design Considerations Hospital Biosafety Introduction to biomedical waste management in hospital Responsibility of Staff and Visitors in Contamination Control	CT – 3, FINAL
Lecture 20 Weeks 11 Lecture 21 Lecture 22 Weeks 12	Administrative Responsibilities & Facility Design Considerations Hospital Biosafety Introduction to biomedical waste management in hospital Responsibility of Staff and Visitors in Contamination Control Maintaining Disease-free Environment	CT – 3, FINAL
Lecture 20 Weeks 11 Lecture 21 Lecture 22 Weeks 12 Lecture 23	Administrative Responsibilities & Facility Design Considerations Hospital Biosafety Introduction to biomedical waste management in hospital Responsibility of Staff and Visitors in Contamination Control Maintaining Disease-free Environment Treatment and Disposal Techniques	CT – 3, FINAL
Lecture 20 Weeks 11 Lecture 21 Lecture 22 Weeks 12 Lecture 23 Lecture 24	Administrative Responsibilities & Facility Design Considerations Hospital Biosafety Introduction to biomedical waste management in hospital Responsibility of Staff and Visitors in Contamination Control Maintaining Disease-free Environment Treatment and Disposal Techniques Water and Air Purification	CT – 3, FINAL
Lecture 20 Weeks 11 Lecture 21 Lecture 22 Weeks 12 Lecture 23 Lecture 24 Weeks 13	Administrative Responsibilities & Facility Design Considerations Hospital Biosafety Introduction to biomedical waste management in hospital Responsibility of Staff and Visitors in Contamination Control Maintaining Disease-free Environment Treatment and Disposal Techniques Water and Air Purification Biosafety Consideration for Patients	CT – 3, FINAL
Lecture 20 Weeks 11 Lecture 21 Lecture 22 Weeks 12 Lecture 23 Lecture 24 Weeks 13 Lecture 25	Administrative Responsibilities & Facility Design Considerations Hospital Biosafety Introduction to biomedical waste management in hospital Responsibility of Staff and Visitors in Contamination Control Maintaining Disease-free Environment Treatment and Disposal Techniques Water and Air Purification Biosafety Consideration for Patients Equipment Sterilization: Disinfection Techniques	CT – 3, FINAL
Lecture 20 Weeks 11 Lecture 21 Lecture 22 Weeks 12 Lecture 23 Lecture 24 Weeks 13 Lecture 25 Lecture 26	Administrative Responsibilities & Facility Design Considerations Hospital Biosafety Introduction to biomedical waste management in hospital Responsibility of Staff and Visitors in Contamination Control Maintaining Disease-free Environment Treatment and Disposal Techniques Water and Air Purification Biosafety Consideration for Patients Equipment Sterilization: Disinfection Techniques Recycled Materials: Bedsheets, gowns, surgical equipment, etc.	CT – 3, FINAL

Com	nononta	Grading	СО	Blooms Taxonomy
Com	ponents	Uraunig		
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2
Assessment (40%)	Class Participation	5%	CO2	C2
	Midterm	15%	CO1, CO2	C1, C2
Einel	Exam	60%	CO 1	C1
Fina	I Exam	00%	CO 2	C2
Total	Marks	100%		
(CO = Cours	e Outcome, C = C	Cognitive Domain)	
TEXT BOOK	KS			
	nas Schoenbaum a nd Edition.	nd Michael J. You	ng, International Environme	ntal Law: Cases, Materials, Problems,

1. Wooley, Dawn P., Byers, Karen B., Biological Safety Principles and Practices, Fifth Edition.

REFERENCE SITE

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5.1.7.2 GEEM 451 Engineering Ethics and Moral Philosophy

Course	e Code	: GEEM 351	Lect	ture Contact H	ours	: 2.00)			
Course	e Title	: Engineering Ethics an Moral Philosophy	d Cree	dit Hours		: 2.00)			
PRE-I	REQUISIT	E								
CURF	RICULUM	STRUCTURE								
Outcon	me Based E	ducation (OBE)								
SYNO	PSIS/RAT	IONALE								
manuf profes	acturing, m sional condu	principles and guidelines redicine, genetics, and act, responsibilities of er n sufficient details.	research are	taught. Cod	es of c	onduct	as est	ablishe	d by	institutions
OBJE	CTIVE									
2. To inte	recognize ellectual, an	the core principles, appl the responsibilities and d institutional rights acc elines of bioethics in hos	d expectation ording to the	as of an engination of an engination of an engine accepted code	neer in e of ethic	applyi cs for e	ng ethi engineer	cs to p s by in	orotect stituti	individual ons.
 To interference To of j 	recognize ellectual, an apply guide patients and	the responsibilities and d institutional rights acc	d expectation cording to the spital, device tusing harm o	ns of an engin accepted code development, or violating mo Bloom's	neer in e of ethic and bion	applyi cs for e medica	ng ethi engineer	cs to p s by in	orotect stitution stiring i	individual ons. involvemen Assessment
 To interact of the second secon	recognize ellectual, an apply guide patients and RSE OUTC Be able to	the responsibilities and d institutional rights acc elines of bioethics in hos live subjects without ca OMES & GENERIC S	d expectation cording to the spital, device using harm o	is of an engin accepted code development, r violating mo	neer in e of ethic and bion ral rules	applyi cs for e medica	ng ethiengineer	cs to p s by in ch requ	orotect stitution stiring i	individual ons.
 To int To of j COUF No. 	recognize ellectual, an apply guide patients and RSE OUTC Be able to moral obli Be able to abide by	the responsibilities and d institutional rights acc elines of bioethics in hos live subjects without ca OMES & GENERIC S Course Outcome	d expectation cording to the spital, device using harm of SKILLS s of ethics, al codes to	as of an enginate of an enginate of an enginate of a second code of the second	e of ethic and bio ral rules	applyi cs for e medica	ng ethiongineer	cs to p s by in ch requ KP	orotect stitution stiring i	individual ons. involvemen Assessment Methods
 To intervention To of provide the provided statement of the provided s	recognize ellectual, an apply guide patients and RSE OUTC Be able to abide by following Be able to areas of	the responsibilities and d institutional rights acc elines of bioethics in hos live subjects without ca OMES & GENERIC S Course Outcome o understand principles gations, and rights o understand the ethic in the industry and a established guidelines understand the bioethi research and applicatio genetic research, and ap	d expectation cording to the spital, device using harm of SKILLS s of ethics, cal codes to apply them ics in major on such as	s of an engin accepted code development, r violating mo Bloom's Taxonomy C2	PO 8	applyi cs for e medica s. CP	ng ethiongineer	cs to p s by in ch requ KP 7	orotect stitution stiring i	Assessment Methods T, MID, F
 To intra 3. To of [COUF No. CO1 CO2 CO3 (CP- C 	recognize ellectual, an apply guide patients and RSE OUTC Be able to moral obli Be able to abide by following Be able to areas of hospitals, a safe mar	the responsibilities and d institutional rights acc elines of bioethics in hos live subjects without ca OMES & GENERIC S Course Outcome o understand principles gations, and rights o understand the ethic in the industry and a established guidelines understand the bioethi research and applicatio genetic research, and ap	d expectation cording to the spital, device using harm of SKILLS s of ethics, al codes to apply them ics in major on such as oply them in ctivities, KP-	s of an engin accepted code development, r violating mo Bloom's Taxonomy C2 C2, C3 C2, C3 Knowledge Pt	PO 8 8,11 8,11	applyi cs for e medica c. CP - 5 5	CA - -	cs to p s by in ch requ KP 7 7 7 7		Assessment Methods T, MID, F T, MID, F

ETHICS AND MORAL PHILOSOPHY:

Introduction to Engineering Ethics and Moral Philosophy; Ethics, Values, and Reason

Interests and Consequences; Conflicts of Interests; Moral Obligations and Rights.

Moral Obligations and Moral Rules in Engineering

Negative and Positive, and Universal and Special, Obligations and Rules, Moral rights.

Rights of Privacy/Confidentiality and Intellectual Property

Rights of Privacy and Confidentiality, Intellectual Property Rights.

Institutionalization of Ethical Conduct

The Ethics of Engineering Organizations, Institutional Review Board Determination, Biomedical Engineering Society Code of Ethics.

Major Bioethical areas

Bioethics in Genetically modified organisms and Cloning, Bioethics in Neuronal engineering, Bioethics in Human research and Animal testing, Bioethics in Hospital service, Bioethics in Medical device development, Bioethics in Rehabilitation engineering, Bioethics in Organ transplantation and regenerative medicine, Public Health and Bioterrorism.

No.	Course Learning Outcorres				PR	OGF	RAM	OU	TCO	MES	(PO)		
NO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to understand principles of ethics, moral obligations, and rights								3				
CO2	Be able to understand the ethical codes to abide by in the industry and apply them following established guidelines								3			2	
CO3	Be able to understand the bioethics in major areas of research and application such as hospitals, genetic research, and apply them in a safe manner								3			2	
(Nume	erical method used for mapping which indicates	s 3 as	high	, 2 as	med	lium	, and	l 1 as	s low	level	of ma	tching)	
TEAC	HING LEARNING STRATEGY												
Teachi	ng and Learning Activities									Eng	ageme	ent (hou	rs)
Face-te	o-Face Learning												
	Lecture									42			
	Practical / Tutorial / Studio									-			
	Student-Centred Learning							-					
	Student-Centred Learning											-	
Self-D	Student-Centred Learning irected Learning											-	
Self-D	8										4		
Self-D	irected Learning	t lect	ure at	: hom	le						4	-	
Self-D	irected Learning Non-face-to-face learning	t lect	ure at	: hom	ie						2	-	
	irected Learning Non-face-to-face learning Revision of the previous and (or) subsequen	t lect	ure at	: hom	le						2	-	
	irected Learning Non-face-to-face learning Revision of the previous and (or) subsequen Preparation for final examination	t lect	ure at	: hom	ie						2	-	
	irected Learning Non-face-to-face learning Revision of the previous and (or) subsequen Preparation for final examination	t lect	ure at	: hom	ie						2 2 2	- 1 	

Lecture and di	scussion, Co-operative and collaborative method, Problem based method	d
COURSE SC	•	
COURSESC		
Weeks	Topics	Assessment
Weeks 1	Introduction to Ethics and Moral Philosophy	
Lecture 1	Ethics, Values, and Reason	-
Lecture 2	Ethics in Popular Culture and in Reality	-
Weeks 2	Interests and Consequences	-
Lecture 3	Interests and Conflicts of Interest	-
Lecture 4	Consequences: Harms, Benefits, and Risks	-
Weeks 3	Moral Obligations and Moral Rules in Engineering	CT – 1 and Midterm, Fina
Lecture 5	Negative and Positive, and Universal and Special, Obligations and Rules	-
Lecture 6	Moral rights	-
Weeks 4	Rights of Privacy/Confidentiality and Intellectual Property	-
Lecture 7	Rights of Privacy and Confidentiality	-
Lecture 8	Intellectual Property Rights	-
Weeks 5	Institutionalization of Ethical Conduct	
Lecture 9	The Ethics of Engineering Organizations	
Lecture 10	Institutional Review Board Determination	-
Weeks 6	The Bioethical Engineer	-
Lecture 11	Practice in Engineering; Code of Ethics for Engineers	Midterm, Final
Lecture 12	Biomedical Engineering Society Code of Ethics	-
Weeks 7	Bioethics in Genetically modified organisms and Cloning	
Lecture 13	Genetic modification of human and animal	-
Lecture 14	Ethical issues in Cloning	-
	MIDTERM	
Weeks 8	Bioethics in Neuronal engineering	
Lecture 15	Neuroethics	
Lecture 16	Ethical issues in Artificial intelligence	
Weeks 9	Bioethics in Human research and Animal testing	
Lecture 17	Clinical trials	
Lecture 18	Ethics of using animal models	CT – 2, FINAL
Weeks 10	Bioethics in Hospital service	
Lecture 19	General Medical ethics, The Patient-Physician Relationship, Autonomy and Privacy of Patients; (case study)	
Lecture 20	Ethics and data mining, Ethical consideration in Clinical engineering	
Weeks 11	Bioethics in Medical device development	
Lecture 21	Ethical Issues in Design and Manufacturing	CT – 3, FINAL
Lecture 22	FDA regulations for medical devices	
Weeks 12	Bioethics in Rehabilitation engineering	

Lecture 23	Ethical concern in rehabilitation engineering	
Lecture 24	Ethics of Biomaterials for implants	
Weeks 13	Bioethics in Organ transplantation and regenerative medicine	
Lecture 25	Ethical issues in organ donation and social taboo	
Lecture 26	Ethics in stem cell research and therapy	
Weeks 14	Bioethics in Biological Warfare	
Lecture 27	Understanding the biological warfare	FINAL
Lecture 28	Bioethics in biological warfare	
ASSESSMEN	TSTRATEGY	

			СО	Blooms Taxonomy		
Comp	oonents	Grading				
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO3	C2, C3		
(40%)	Class Participation	5%	CO3	C2, C3		
	Midterm	15%	CO2	C2, C3		
			CO 1	C2		
Final	Exam	60%	CO 2	C2, C3		
			CO 3	C2, C3		
Total	Marks	100%				
(CO = Course	e Outcome, C =	Cognitive Doma	in)			
TEXT BOOK	KS					
1. Ethics in	Engineering Prac	tice & Research,	Caroline Whitbeck, 2e, Camb	oridge University Press 2015.		
REFERENC	E BOOKS					
	al Ethics for Engi Vallero, Academ		l Decision Making in Biomed	ical and Biosystem Engineering by		

REFERENCE SITE

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5.2 Department of Electrical, Electronic and Communication Engineering

5.2.1 Level-1, Spring

5.2.1.1 EECE 191 Principles of Electrical Engineering

RSE INFO	RMATION							
e Code e Title	: EECE 191 : Principles of Electrical Engineering	2	Lect	Lecture Contact Hours Credit Hours			: 3.00	
REQUISIT	`E							
C								
RICULUM	STRUCTURE							
me-Based I	Education (OBE)							
	-	•						
	urse covers the following modules: D	C and AC cire	cuits, D	C Gene	erator, D	C M	otor, 4	AC Machines,
	Ide basic ACC IDC : '							
		ina voniova or		n a muak	lama			
		-	igineen	ng prot	orems.			
			ns effici	ently.				
		8 F						
	Course Outcome	Bloom's Taxonomy	РО	СР	CA	K	Р	Assessment Methods
DC circui	ts	C2	1	1	-	1,	3	T, F
theorems	for solving various engineering	C3	2	1,3	-	1,	3	T, F
		C2	1	1	-	1		MID, F
complex	engineering problems efficiently.	C4	2	1,3	-			T, F
-	-	-	rofile, 7	ſ-Test;	PR – Pı	roject	; Q –	Quiz; ASG –
					F 1 1			
		C4 – Ana	alyze	C5 -	Evaluate	•	Ce	- Create
sic concept ies-parallel works: Networes. Effe	on AC and DC circuits, RL, RC, RL circuits, Resonance in AC circuits, Tra vork analysis methods of branch and lo ctive current and voltage: Average va	C-based AC c ansient respons oop currents, N lues, Form fac	ircuit, I se of caj odal cir ctor, Cre	mpedar pacitor cuit ana est facto	nce in se and indu alysis, Tl or, Conc	eries, uctor hever ept o	paral circui nin's, s of real	lel branches, ts. Electrical and Norton's and reactive
	e Code e Title REQUISIT REQUISIT REQUISIT RICULUM me-Based F PSIS/RAT rm the basi nes. The co ransformer. CTIVE o understan o apply diff o explain th o analyze d RE OUTO Be able to DC circui Be able theorems problems. Be able different of Be able complex of Complex Pr ment; Pr – emember RE CONT damentals ic concept es-parallel ov orems. Effe	e Title : Principles of Electrical Engineering REQUISITE REQUISING AC and DC circuits. REQUISITE	e Code : EECE 191 : Principles of Electrical Engineering REQUISITE REQUISITE RICULUM STRUCTURE me-Based Education (OBE) PSIS/RATIONALE rn the basics of electrical circuit components, analysis of Denes. The course covers the following modules: DC and AC circurs ansformer. CTIVE o understand the basics of AC and DC circuits. o apply different laws of circuit theorems for solving various erfore analyze different electrical machines. o analyze different circuit-related complex engineering problem REQUITCOMES & GENERIC SKILLS Course Outcome Be able to understand the basics of AC and DC circuit theorems for solving various engineering problems. Be able to understand the behavior of different electrical machines. Be able to understand the behavior of complex engineering problems efficiently. Complex Problems, CA-Complex Activities, KP-Knowledge P unent; Pr – Presentation; R - Report; F – Final Exam) temember C2 - Understand C3 - Apply C4 – Ana RECONTENT damentals of electrical circuit: Ohm's Law, Kirchhoff's voltag ic concept on AC and DC circuits, Transient respon works: Network analysis methods of branch and loop currents, N orems. Effective current and voltage: Average values, Form face	e Code : EECE 191 : Principles of Electrical Engineering Lect e Title : Principles of Electrical Engineering Lect REQUISITE RECONES & GENERIC SKILLS RESEDUTONES & GENERIC SKILLS REDUISING REGUISING REGUISING RECOUTENT RECONTENT READING REGUISING REGUISING RECONTENT REMEMENT RECONTENT REMEMENT RECONTENT RECONTENT REMEMENT RECONTENT REMEMENT RECONTENT RECONTENT REMEMENT RECONTENT REMEMENT RECONTENT REMEMENT RECONTENT REMEMENT REMEMENT RECONTENT REMEMENT RECONTENT REMEMENT	e Code : EECE 191 : Principles of Electrical Engineering Lecture Co s Title : Principles of Electrical Engineering Lecture Co REQUISITE RECONTENT RET RET RET RET RET RET RET RE	e Code : EECE 191 : Principles of Electrical Engineering Lecture Contact Ho Credit Ho REQUISITE REPUTIENT CONSTRUCTURE methe basics of electrical circuit components, analysis of DC and AC circuits and nes. The course covers the following modules: DC and AC circuits, DC Generator, D ansformer. CTIVE o understand the basics of AC and DC circuits. o apply different laws of circuit theorems for solving various engineering problems. o explain the behavior of different electrical machines. o analyze different circuit-related complex engineering problems efficiently. REE OUTCOMES & GENERIC SKILLS Course Outcome Bloom's Taxonomy PO CP CA Be able to understand the basics of AC and C2 1 1 - Be able to understand the behavior of C2 1 1 - Be able to understand the behavior of C2 1 1 - Be able to understand the behavior of C2 1 1 - Be able to understand the behavior of C2 1 1 - Be able to understand the behavior of C2 1 1 - Be able to understand the behavior of C2 1 2 1,3 - Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Pr ment; Pr – Presentation; R - Report; F – Final Exam) complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Pr ment; Pr – Presentation; R - Report; F – Final Exam) cemember C2 - Understand C3 - Apply C4 – Analyze C5 - Evaluate RECONTENT damentals of electrical circuit: Ohm's Law, Kirchhoff's voltage and current laws, De ic concept on AC and DC circuits, RL, RC, RLC-based AC circuit, Impedance in s es-parallel circuits, Resonance in AC circuits, Transient response of capacitor and ind works: Network analysis methods of branch and loop currents, Nodal circuit analysis, To rems. Effective current and voltage: Average values, Form factor, Crest factor, Cond	e Code : EECE 191 : Principles of Electrical Engineering Lecture Contact Hours Credit Hours REQUISITE RECORES OF AC and DC circuits. Taxonomy PO CP CA K REQUISITE REQUISING Various engineering POOLENS. REQUISING Various engineering C3 2 1,3 - 1, READE to understand the behavior of C2 1 1 - 1, READE to understand the behavior of C2 1 1 - 1, READE to analyze different circuit-related C4 2 1,3 - 1, READE TO UNDERS. REQUISING VARIOUS ENGLISER REQUISING VARIOUS ENGLISER REVERT READER CONTENT REQUISING VARIOUS REPRIPERED REVERTED REMEMER C2-UNDERS ACTOMPLEX ACTIVITIES, RP-KNOWLED ProFile, T-TEST; PR - Project READER TO REVERST READER ADURE SECONTENT REMEMER C2-UNDERS ACTIVITIES, RL, RC, RLC-based AC circuit analysis, Thever RESE FORTENT REMEMER C2-UNDERS ACTIVITIS, RL, RC, RLC-BASED AC circuit analysis, Thever RESE FORTENT REMEMER C2-UNDER AND READER ACTIONS ACTIVITIS, REPORTED REMEMER C2-UNDERS ACTIVITIS, RU, RC, RLC-BASED AC circuit analysis, Thever REMEMER C2-UNDERS ACTIVITIS, RU, RC, RLC-BASED	e Code e Title: EECE 191 : Principles of Electrical EngineeringLecture Contact Hours Credit Hours: 3.0 : 3.0REQUISITERICULUM STRUCTURE me-Based Education (OBE)DPSIS/RATIONALE run the basics of electrical circuit components, analysis of DC and AC circuits and the basic enes. The course covers the following modules: DC and AC circuits, DC Generator, DC Motor, a ansformer.CTIVE o understand the basics of AC and DC circuits. o analyze different laws of circuit theorems for solving various engineering problems. o analyze different circuit-related complex engineering problems efficiently.REOUTCOMES & GENERIC SKILLSCourse OutcomeBloom's TaxonomyPO CPCAKPBe able to understand the basics of AC and DC circuitsC211-1,3Be able to understand the basics of AC and DC circuitsC211-1,3Be able to understand the behavior of different electrical machines.C211-1,3Be able to understand the behavior of different electrical machines.C211-1,3Be able to understand the behavior of different electrical machines.C211-1,3Be able to understand the behavior of different electrical machines.C421,3-1,3Be able to understand the behavior of complex engineering problems.C421,3-1,3Complex Problems.CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q –<

phase three-wire system of electrical load, balanced wye loads, balanced delta loads, power in balanced systems, power factor. Balanced three-phase circuit analysis, and power measurement.

DC Generator: Working principle, types, performances, and characteristics. DC Motor: Working principle, types, performances, speed control, starters and characteristics, AC Machines: Three-phase induction motor principles, equivalent circuit, single-phase induction motor principle, Principles of AC generator. Transformer: Principles of singe and three-phase transformer, Equivalent circuit of single-phase transformer, Different losses of transformers, Instrument Transformer, Applications of various machines in the Biomedical Engineering Field. Technical specifications of different electrical machines.

SKILL MAPPING

						PR	OGI	RAN	101	JTCC	OMES	(PO))	
No.	Course Le	arning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	e able to under nd DC circuits	stand the basics of AC	3											
co2 th		different laws of circuit ing various engineering		3										
CO3	e able to unde fferent electrical	rstand the behavior of machines.	3											
CO4 co	omplex engineer	different circuit-related ing problems efficiently.		3										
`		r mapping which indicate	s 3 as	s higł	n, 2 a	s me	diun	ı, an	d 1 a	as lov	v leve	l of n	natching	g)
	G LEARNING												6	
-	nd Learning Act	ivities									En	gagen	nent (ho	ours)
	ce Learning												40	
	ecture	/ C+ 1:										42		
	actical / Tutorial											-		
	udent-Centered I ed Learning	Learning											-	
	on-face-to-face l	earning											42	
		evious and (or) subsequer	nt lect	ure a	t hon	ne							21	
	reparation for fin			uic a	t non	ic						21		
Formal Ass	<u>`</u>												21	
	ontinuous Assess	sment											2	
	nal Examination												3	
Total													131	
TEACHIN	G METHODO	LOGY												
Lecture and	l discussion, Co-	operative and collaborati	ve me	ethod	, Pro	blem	n bas	ed n	netho	od				
COURSES	SCHEDULE													
We				opic								1	Assessr	nent
1		undamentals of Electric												
Lecture 1		hm's Law, Kirchhoff's v rcuits	voltag	ge an	d cui	rent	law	s, S	eries	-Para	allel			
Lecture 2		oltage and current divisio												
Lecture 3	B	asic concept on AC and I	DC c	ircuit	s, RI	., R0	C and	d RI	.C-b	ased	AC	C	CT – 1,	Final

Fundamentals of Electrical Circuits (Cont...)

circuit

2

Lecture 4	Impedance in series and parallel branches,	1
Lecture 5	Concept of resistance, reactance, inductance, capacitance,	
	susceptance, admittance, and impedance	
Lecture 6	Finding impedance of series-parallel AC circuits	
3	Fundamentals of Electrical Circuits (Cont)	
Lecture 7	Resonance in AC circuits	
Lecture 8	Transient response of capacitor and inductor circuits	
Lecture 9	Sinusoidal-steady-state response	
4	Electrical Network Analysis	
Lecture 10	Network analysis methods of branch and loop currents	
Lecture 11	Nodal circuit analysis, Mesh Circuit Analysis	
Lecture 12	Superposition Theorem	
5	Electrical Network Analysis and Effective Current and Voltage	
Lecture 13	Thevenin's and Norton's theorems	
Lecture 14	Features of AC signal, Average values, RMS value, Form factor,	
20000000000	Crest factor, and relevant mathematical problem	
Lecture 15	Concept of real and reactive power and relevant mathematical	CT – 2, Final
Lecture 15	problems	
6	Introduction to Phasor Algebra	
Lecture 16	Impedance in polar and Cartesian forms	
Lecture 17	Sinusoidal single-phase circuit analysis	
Lecture 18	Impedance measuring by vector diagram.	
7	Balanced Poly Phase Circuits	
Lecture 19	Three-phase four-wire and three-phase three-wire system of	
	electrical load	
Lecture 20	Balanced wye loads, balanced delta loads	
Lecture 21	Power in balanced systems	
	Midterm Break	
8	Balanced Poly Phase Circuits (Continue)	
Lecture 22	Power factor measurement of single and 3 phase systems,	
Lecture 23	Balanced three-phase circuit analysis and Power measurement	
Lecture 23	Some related mathematical problem solving	
9	DC Generator	
Lecture 25	Working principles of DC generator	
Lecture 26	Basic components and types of DC generator	Midterm, Final
	Performances and Characteristics, applications of DC generator	-
Lecture 27		
10 Lester 28	DC Motor	
Lecture 28	Working principle of DC motor	
Lecture 29	Basic components and types of DC motor	
Lecture 30	Performances and characteristics, speed control of DC motor	
11 Lecture 31	DC Motor (Cont) and AC Machines Different starters of DC motor	
Lecture 32	Applications of DC motor	
Lecture 33	Principles of three-phase induction motor and its equivalent circuit	
12	AC Machines	
Lecture 34	Principles of Single phase induction motor and its equivalent circuit	
Lecture 35	Principles of AC generator	CT – 3, Final
Lecture 36	Principles of Synchronous Motor and its application	$C_1 = 3$, Fillal
13	Transformer	FINAL
Lecture 37	Principles of singe and three-phase transformer	

Lecture 38	Equivalent circuit of single-phase transformer							
Lecture 39	Different loses and efficiencies of transformers and relevant							
	mathematical problems							
14	Transformer (Cont)							
Lecture 40	Instrument transformers							
Lecture 41	Applications of various machines in the Biomedical Engineering							
	Field							
Lecture 42	Familiarization with Technical specifications of different electrical							
	machines.							

ASSESSMENT STRATEGY

				1
Comp	oonents	Grading	СО	Blooms Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C4
(40%)	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C3
			CO 1	C2
Final	Enom	600/	CO 2	C3
Final	Exam	60%	CO 3	C2
			CO 4	C4
Total	Marks	100%		
(CO = Course	e Outcome, C =	Cognitive Doma	in)	
Text Books				
1. Fundame	entals of Electric	Circuits- Alexand	der & Sadiku.	
2. Alternati	ng Current Circu	its – Russell & G	eorge F. Corcoran; John Wiley	and Sons.
REFERENC	E BOOKS			
1. Introduct	tory Circuit Analy	ysis - R.L. Boyle	stad; Prentice Hall of India Priv	vate Ltd.
2. Electrica	l Machinery Fund	lamentals- Steph	en J Chapman	
3. A Textbo	ook of Electrical	Fechnology - B.I	_ Theraja	
DEFEDENCI	F SITE			

REFERENCE SITE

5.2.1.2 EECE 192 Principles of Electrical Engineering Sessional

COURSE INFO	COURSE INFORMATION									
Course Code Course Title	: EECE 192 : Principles of Electrical Engineering Sessional	Lecture Contact Hours Credit Hours	: 3.00 : 1.50							
PRE-REQUISI	TE		1							
EECE 191: Prin	ciples of Electrical Engineering									
CURRICULUM	A STRUCTURE									
Outcome-Based	Outcome-Based Education (OBE)									
SYNOPSIS/RA	TIONALE									

To learn the basics of electrical circuit components, analysis of DC and AC circuits and the basics of electrical machines. DC and AC circuits, DC Generator, DC Motor, AC Machines, and Transformer module will be covered by this course.

OBJECTIVE

This course aims to practically implement the concepts of AC and DC circuits and learn the principle and applications of different electrical machines.

COUI	RSE OUTC	OMES & GENERI	C SKILLS							
No.		Course Outcome	2	Bloom's Taxonomy	РО	СР	CA	KP		ssessment Methods
CO1		o apply different 1 for solving variou	C3	2	1	-	1, 3		T, Q, R	
CO2		to understand the electrical machines	C2	1	1, 3	-	1, 2, 3	3	T, Q, R	
CO3	Be able related co efficientl	C4	2	1	-	1, 3		T, Q, R		
1 °	-	blems, CA-Comple Presentation; R - Rep		-	rofile, T	-Test;	PR – I	Project; (Q – Qui	z; ASG –
C1 - R	Remember	C2 - Understand	C3 - Apply	C4 - Anal	C5 -	- Evalu	ate	C6 - C	reate	

COURSE CONTENT

Construction and operation of simple electrical circuits (Ohm's Law, Series-Parallel, Voltage Divider etc.), KVL and KCL, Superposition Theorem, Thevenin's theorem, alternating current (ac) waves and R-L-C series circuit, the principles and properties of DC Generator, principles and properties of DC Motor, principles and properties of Alternator, principles, and properties of Transformer. Familiarization with the technical specifications of various Electrical Machines

No.	Course Learning Outcome		PROGRAM OUTCOMES (PO)										
NO.		1	2	3	4	5	6	7	8	9	10 11	12	
CO1	Be able to apply different laws of circuit theorems for solving various engineering problems.		3										
CO2	Be able to understand the behavior of different electrical machines.	3											
CO3	Be able to analyze different circuit-related complex engineering problems efficiently.		3										

TT 1'	G LEARNING STRATEGY	
-	d Learning Activities	Engagement (hours)
Face-to-Face		
	cture	7
	actical / Tutorial / Studio	35
	Ident-Centered Learning	-
Self-Directe	-	
	n-face-to-face learning	-
	vision of the previous and (or) subsequent lecture at home	15
	eparation for the final examination	10
Formal Asse		
	ntinuous Assessment	1
2	b Test	1
Qu		0.75
Viv	va	0.25
Total		70
TEACHIN	G METHODOLOGY	
Lecture and	discussion, Co-operative and collaborative method, Problem based meth	d
2000010 0000		100
	CHEDULE	100
	*	Assessment
COURSE S Week	CHEDULE	
COURSE S Week	CHEDULE Lecture Topics	
COURSE S Week 1 2	CHEDULE Lecture Topics Construction and operation of simple electrical circuits	Assessment
COURSE S Week 1 2 3	CHEDULE Construction and operation of simple electrical circuits Verification of KVL	Assessment Report, Lab Test, Quiz,
COURSE S Week 1 2 3 4	CHEDULE Construction and operation of simple electrical circuits Verification of KVL Verification of KCL	Assessment
COURSE S Week 1 2 3 4 5	CHEDULE Construction and operation of simple electrical circuits Verification of KVL Verification of KCL Verification of Superposition Theorem	Assessment Report, Lab Test, Quiz,
COURSE S Week 1 2 3 4	CHEDULE Construction and operation of simple electrical circuits Verification of KVL Verification of KCL Verification of Superposition Theorem Verification of Thevenin's theorem	Assessment Report, Lab Test, Quiz,
COURSE S Week 1 2 3 4 5 6	CHEDULE Construction and operation of simple electrical circuits Verification of KVL Verification of KCL Verification of Superposition Theorem Verification of Thevenin's theorem Lab Test 1	Assessment Report, Lab Test, Quiz,
COURSE S Week 1 2 3 4 5 6 7	CHEDULE Construction and operation of simple electrical circuits Verification of KVL Verification of KCL Verification of Superposition Theorem Verification of Thevenin's theorem Lab Test 1 Familiarization with alternating current (ac) waves	Assessment Report, Lab Test, Quiz,
COURSE S Week 1 2 3 4 5 6 7 8	CHEDULE Construction and operation of simple electrical circuits Verification of KVL Verification of KCL Verification of Superposition Theorem Verification of Thevenin's theorem Lab Test 1 Familiarization with alternating current (ac) waves Midterm Break	Assessment Report, Lab Test, Quiz, Viva
COURSE S Week 1 2 3 4 5 6 7 8 9	CHEDULE Construction and operation of simple electrical circuits Verification of KVL Verification of KCL Verification of Superposition Theorem Verification of Thevenin's theorem Lab Test 1 Familiarization with alternating current (ac) waves Midterm Break Study of R-L-C series circuit	Assessment Report, Lab Test, Quiz,
COURSE S Week 1 2 3 4 5 6 7 8 9 10	CHEDULE Construction and operation of simple electrical circuits Verification of KVL Verification of KCL Verification of Superposition Theorem Verification of Thevenin's theorem Lab Test 1 Familiarization with alternating current (ac) waves Midterm Break Study of R-L-C series circuit Experiment on the principles and properties of DC Generator	Assessment Report, Lab Test, Quiz, Viva Report, Lab Test, Quiz,
COURSE S Week 1 2 3 4 5 6 7 8 9 10 11	CHEDULE CONSTRUCTION and operation of simple electrical circuits Verification of KVL Verification of KCL Verification of Superposition Theorem Verification of Thevenin's theorem Lab Test 1 Familiarization with alternating current (ac) waves Midterm Break Study of R-L-C series circuit Experiment on the principles and properties of DC Generator Experiment on the principles and properties of DC Motor	Assessment Report, Lab Test, Quiz, Viva Report, Lab Test, Quiz,
COURSE S Week 1 2 3 4 5 6	CHEDULE CONSTRUCTION and operation of simple electrical circuits Verification of KVL Verification of KCL Verification of Superposition Theorem Verification of Thevenin's theorem Lab Test 1 Familiarization with alternating current (ac) waves Midterm Break Study of R-L-C series circuit Experiment on the principles and properties of DC Generator Experiment on the principles and properties of DC Motor Experiment on the principles and properties of Alternator	Assessment Report, Lab Test, Quiz, Viva Report, Lab Test, Quiz,

Comj	Components		СО	Blooms Taxonomy
Continuous	Report	20%	CO1, CO2, CO3	C4, C5, C3
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3	C4, C5, C3
	Lab Test	20%	CO1, CO2, CO3	C4, C5, C3
Final Exam (60%)	Quiz	30%	CO1, CO2, CO3	C4, C5, C3
(****)	Viva	10%	CO1, CO2, CO3	C4, C5, C3
Total	Total Marks 10		L.	1

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT BOOKS

- 1. Fundamentals of Electric Circuits- Alexander & Sadiku.
- 2. Alternating Current Circuits Russell & George F. Corcoran; John Wiley and Sons.

REFERENCE BOOKS

- 1. Introductory Circuit Analysis R.L. Boylestad; Prentice Hall of India Private Ltd.
- 2. Electrical Machinery Fundamentals- Stephen J Chapman
- 3. A Textbook of Electrical Technology B.L Theraja

REFERENCE SITE

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5.2.2 Level-2, Spring

5.2.2.1 EECE 291 Electronic Circuits and Devices

COURSE INFORMATION

			: 3.00
Course Code	: EECE 291	Lecture Contact Hours	: 3.00
Course Title	: Electronic Circuits and Devices	Credit Hours	

PRE-REQUISITE

EECE 191: Principles of Electrical Engineering

CURRICULUM STRUCTURE Outcome-Based Education (OBE)

SYNOPSIS/RATIONALE

To teach the students about the concepts, principles, and working of basic electronic circuits. It is targeted to provide a basic foundation for technology areas like electronic devices, communication systems, industrial electronics, instrumentation, control systems, and various electronic circuit designs.

OBJECTIVE

- 1. To understand the basics of electronic devices like Diode, Transistor, MOSFET, Op-Amp, etc., and its applications.
- 2. To become skilled at designing different electronic circuits like rectifiers, amplifiers, active filters, etc. using electronic devices.

No.		Course Outcome		Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods	
CO1	devices' b	to understand ser asic operation and ch s, BJTs, and FETs.	niconductor aracteristics	C2	1	1	-	1,3	T, F	
CO2		apply the established find the important ac plifier.	C3	1	1,3	-	1,3	T, F		
CO3	response o	AC output vith BJT and amplifiers'	C4	2	1	-	1, 3	MID, F		
CO4	Be able to understand the characteristics of Op-Amps and its applications.			C2	2	1,3	-	1,3	T, F	
Assign	(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) C1 - Remember C2 - Understand C3 - Apply C4 - Analyze C5 - Evaluate C6 - Create									

COURSE OUTCOMES & GENERIC SKILLS

COURSE CONTENT

Introduction to Semiconductors; P-type and n-type semiconductors, p-n junction diode characteristics, Diode applications, half and full-wave rectifier, clipping and clamping circuits; regulated power supply using Zener diode. Bipolar junction transistor (BJT), principle of operation, I-V characteristics, Transistor circuits configurations (CB, CE and CC), BJT biasing, load lines, small-signal analysis of single and multi-stage amplifiers, frequency response of BJT amplifiers. Field effect transistors (FET), principle of operation of JFET and MOSFET, Depletion and Enhancement type NMOS and PMOS, biasing of FETs, Low and High frequency models of FETs, Switching circuit using FETs, Introduction to CMOS. Operational amplifier (OPAMP), linear application of OPAMPs, gain, input and

output impedances, differential amplifiers, common-mode rejection ratio, instrumentation amplifier, active filters, frequency response and noise, zero crossing, positive and negative level detectors, and application of Op-Amp.

N-	Camera	Learning Outserse				PR	.OG	RAN	101	JTCC	OMES	G (PO))	
No.	Course	E Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	devices' ł	inderstand semiconductor basic operation and	3											
	FETs.	s like diodes, BJTs, and												
CO2	equivalent m	o apply the established odels to find the important	3											
	_	s for an amplifier.												
CO3	response of a	alyze the DC and AC output network designed with BJT	3											
	amplifiers' de													
CO4	Be able	to understand the		3										
	applications.	s of Op-Amps and its												
(Numer	ical method used	for mapping which indicate	s 3 a	s higł	n, 2 a	s me	diun	n, an	d 1 a	as lov	v leve	el of n	natchin	g)
TEACI		NCSTDATECY												
TEACHING LEARNING STRATEGY Teaching and Learning Activities											En	gagen	nent (he	ours)
	Face Learning										Dil	0-0-1		
Lecture										42				
Practical / Tutorial / Studio										-				
	Student-Centre	d Learning											-	
Self-Dir	rected Learning													
	Non-face-to-fa	-									42			
		previous and (or) subsequer	nt lec	ture a	t hor	ne					21			
F 1	-	the final examination											21	
Formal	Assessment Continuous As	aagmant											2	
	Final Examinat												2 3	
Total													3 131	
	HING METHO	DOLOGY												
Lecture	and discussion,	Co-operative and collaborati	ve m	ethod	, Pro	blem	n bas	ed n	netho	od				
COURS	SE SCHEDULF	E												
	Week		Тор	oic								As	sessme	nt
1		Semiconductor devices												
Lecture	1	Basic idea about Electroni		-			ctro	nic c	levic	es,				
		and comparison with electr												
Lecture	2	Introduction to semicondu				nd its	s cla	ssifi	catio	ons,				
		P-type and N-type materia	als, a	nd do	ping							СТ	– 1, Fi	nal

	characteristics, output characteristics of depletion type	
Lecture 26	Introduction to MOSFET, construction, operation, input	
Lecture 25	Mathematical problems related to JFET	
9	FET	Midterm
Lecture 24	Pinch off voltage	
Lootuit 23	characteristics of JFET	
Lecture 23	Construction, operation, Drain characteristics, and Transfer	
Lecture 22	Introduction to FET and comparative studies between BJT and FET	
8 Lecture 22	FET	
0	Midterm Break	
Lecture 21	The frequency response of BJT amplifiers	
Lasture 21	common collector configurations	
Lecture 20	Voltage and current gain, input and output impedance of a	
T (00	common emitter configurations	
Lecture 19	Voltage and current gain, input and output impedance of a	
7	BJT	
	common base configurations	
Lecture 18	Voltage and current gain, input and output impedance of a	
Lecture 17	Small-signal analysis of single and multi-stage amplifiers	
	discrete circuits	
Lecture 16	BJT as an amplifier, BJT as a switch, and biasing the BJT for	
6	BJT	
Lecture 15	Mathematical problems related to BJT biasing	
Lecture 14	Mathematical problems related to BJT biasing	CT-2, Final
Lecture 13	BJT Biasing, Mathematical problems related to BJT biasing	
5	BJT	
	using BJT	
Lecture 12	Mathematical problems related to different configurations	
	CC configurations and characteristics curves	
Lecture 11	Working principle and operating regions of BJT, CB, CE, and	
Lecture 10	Introduction to BJT and construction	
4	BJT	
	related problems	
Lecture 9	Clipper circuit and related problems, Clamper circuit and	
Lecture 8	Ripple factor, and related mathematical problems.	
Lecture 7	Diode rectifiers	
3	Diodes	
Lecture 6	Applications of diode	
Lecture 5	Zener diode and related maths of Zener diode	
	Shockley's equation and related mathematical problems	
Lecture 4	I-V characteristics of the diode and equivalent circuit of diodes,	
2	semiconductor diodes Diodes	

Lecture 28	Biasing of JFET and related problems	o inter Departimentis
Lecture 29	Biasing of MOSFET and related problems	
	C 1	
Lecture 30	Biasing of MOSFET and related problems	
11	MOSFET	
Lecture 31	Threshold voltage, Body effect, current-voltage characteristics	
	of an enhancement MOSFET	
Lecture 32	Single-stage MOS amplifiers, MOSFET as a switch, CMOS	Final
	inverter	
Lecture 33	Mathematical Problems	
12	OP-AMP	
Lecture 34	Introduction to Op-amp, Characteristics, Gain, Input and	
	Output Impedances	
Lecture 35	Summing, Scaling, Averaging, and Subtractor Amplifiers	CT – 3, Final
Lecture 36	Differential Amplifiers, Differentiator, and Integrator	
13	OP-AMP	
Lecture 37	Common Mode Rejection Ratio (CMRR)	
Lecture 38	Active filters	
Lecture 39	Active filters	
14	OP-AMP	FINIA I
Lecture 40	Instrumentation Amplifiers	FINAL
Lecture 41	Zero-Crossing Detector, Positive and Negative Voltage level	
	detector	
Lecture 42	Other Applications of Op-Amp	

ASSESSMENT STRATEGY

			СО	Blooms Taxonomy				
Comp	ponents	Grading	20	Blooms Taxonomy				
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C4				
(40%)	Class Participation	5%	CO3	C2				
	Midterm	15%	CO2	C3				
			CO 1	C2				
Einel	Enom	60%	CO 2	C3				
Final	Exam	00%	CO 3	C2				
			CO 4	C4				
Total Marks 100%								

(CO = Course Outcome, C = Cognitive Domain)

TEXT BOOKS

- 1. Electronic Device and Circuit Theory by Robert L. Boylestad
- 2. Op-amps and linear integrated circuits by Ramakant A Gayakwad

REFERENCE BOOKS

- 1. Operational Amplifiers and Linear Integrated Circuit by Robert F. Coughlin and Frederic R. Driscoll.
- 2. Microelectronic Circuits Theory and Applications by Adel S. Sedra and Kenneth C. Smith
- 3. Electronic Devices Circuits by Millman and Halkias

REFERENCE SITE

5.2.2.2 **EECE 292 Electronic Circuits and Devices Sessional**

COURSE INFORMATION

Course	Code
Course	Title

: EECE 292 : Electronic Devices and Circuits Sessional Lecture Contact Hours Credit Hours

: 1.50

: 3.00

PRE-REQUISITE

EECE 291: Electronic Devices and Circuits

CURRICULUM STRUCTURE

Outcome-Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize with the basics of electronic circuits and utilize electronic devices for practical purposes.

OBJECTIVE

- 1. To learn about electronic circuits and to implement the basic electronic devices circuits.
- 2. To know and use of BJT, MOSFET and JFET devices for theoretical and practical purposes.
- 3. To learn about operational amplifier and filter circuits.
- To solve complex design problems regarding electronics based on realistic aspects. 4.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods		
CO1	Be able to understand practically the electronic devices such as Diode, MOSFET, FET, and special elec devices like operational amplifiers.	BJT, C2	2	1	-	1, 3	T, Q, R		
CO2	Be able to apply the basic circuit compo and know-how to connect them to filters and other devices with amplifier.	make C3	1	1, 3	-	1, 2, 3	T, Q, R		
CO3	Be able to analyze the concepts of elec devices, circuits, and uses.	tronic C4	2	1	-	1, 3	T, Q, R		
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)									
C1 - R	emember C2 - Understand C3 - Ap	ply C4 - Anal	C4 - Analyze			ate	C6 - Create		
COLU									

COURSE CONTENT

Study of Diode Characteristics, Study of Diode Rectifier, Study of NPN CB (Common Base) Transistor Characteristics, Study of NPN CE (Common Emitter) Transistor Characteristics, Study of BJT Biasing Circuits, Study the Characteristics of JFET, MOSFET, Mathematical Operations Using Op-Amp, Active Filters, etc.

		PROGRAM OUTCOMES (PO)												
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
	Be able to understand practically the	-	-	-	-					-				
	basic electronic devices such as Diode,													
CO1	BJT, MOSFET, FET, and special		3											
	electronic devices like operational													
	amplifiers.													
	Be able to apply the basic circuit													
CO2	components and know-how to connect	2												
02	them to make filters and other devices													
	with amplifiers.													
CO3	Be able to analyze the concepts of		3											
	electronic devices, circuits, and uses.		-											
(Numeri	cal method used for mapping which indicate	s 3 a	s higł	1, 2 a	s me	diur	n, an	d 1 a	as lov	v leve	el of n	natching	g)	
TEACH	IING LEARNING STRATEGY													
	g and Learning Activities									En	gagen	nent (ho	ours)	
Face-to-	Face Learning													
	Lecture											7		
	Practical / Tutorial / Studio											35		
	Student-Centered Learning											-		
Self-Directed Learning														
	Non-face-to-face learning									-				
	Revision of the previous and (or) subsequer	nt lec	ture a	t hon	ne					15				
Preparation for the final examination												10		
Formal Assessment												1		
Continuous Assessment Lab Test										1				
	Quiz									0.75				
	Viva									0.25				
Total										70				
	INC METHODOLOCY													
	IING METHODOLOGY													
Lecture	and discussion, Co-operative and collaborati	ve m	ethoc	l, Pro	blem	ı bas	sed n	nethe	od					
COURS	SE SCHEDULE													
Wee	k Lecture	Topi	cs								Ass	essmen	t	
1	Study of Diode Characteristics													
2	Study of Diode Rectifier													
3	Study of CB (Common Base) Transi	stor (Chara	cteris	stics					р	T	. h. 77 i	<u>o</u>	
4	Study of CE (Common Emitter) Tra					ics				кер		ab Test	, Quiz,	
5	Study of BJT Biasing Circuits											Viva		
6	Study the Characteristics of JFET	Study the Characteristics of JFET								1				
7	Lab Test- 01 and Viva									-				
	Midter		reak											
8	Study the Characteristics of MOSFE													
9 Study of Inverting and Non- inverting operations using OP-AMP								Ren	ort I	ab Test	Ouiz			
10	`	Mathematical operations using OP-AMP								кер		ab Test Viva	, Yuiz,	
11	Design Active Filters using Op-Amp									viva				
12	Design Differential Amplifiers using	Op-	Amp											

13	Lab Test- 02	and Viva		
14	Final Quiz			
ASSESSME	NT STRATEGY	Y		
Comj	Components Gradin		СО	Blooms Taxonomy
Continuous	Report	C4, C5, C3		
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3	C4, C5, C3
E'1 E	Lab Test	20%	CO1, CO2, CO3	C4, C5, C3
Final Exam	Quiz	30%	CO1, CO2, CO3	C4, C5, C3
(60%)	Viva	10%	CO1, CO2, CO3	C4, C5, C3
Total	Marks	100%		
`		- Cognitive Dom	aain, P = Psychomotor Domai	n, A = Affective Domain)
TEXT BOO				
		•••	lobert L. Boylestad	
	-	ated circuits by I	Ramakant A Gayakwad	
REFERENC				
3. Operation	nal Amplifiers ar	d Linear Integra	ted Circuit – by Robert F. Coug	shlin and Frederic R. Driscoll.
REFERENC	CE SITE			

5.2.3 Level-3, Spring

5.2.3.1 EECE 391 Digital Electronics

COURSE INFORMATION

			: 3.00
Course Code	: EECE 391	Lecture Contact Hours	: 3.00
Course Title	: Digital Electronics	Credit Hours	

PRE-REQUISITE

EECE 291: Electronic Devices and Circuits

CURRICULUM STRUCTURE Outcome-Based Education (OBE)

SYNOPSIS/RATIONALE

This course will cover the topics/subtopics that will help to learn and familiarize the fundamentals of digital electronics, including the basic logic gates, combinational and sequential circuits, Programmable logic devices, and Modular sequential logic circuit design.

OBJECTIVE

1. To acquire the basic knowledge of digital logic levels and knowledge to understand digital electronics circuits.

2. To prepare students for performing the analysis and design of various combinational and sequential circuits.

COU	COURSE OUTCOMES & GENERIC SKILLS												
No.		Course Outcome		Bloom's	РО	СР	CA	KP	Assessment				
INO.		eouise outcome		Taxonomy	10		CA	KI	Methods				
	Be able to	remember the structur	re of various										
CO1	number sys	stems and its application	on in digital	C1	1	1	-	1,3	T, F				
	design.												
	Be able to understand the design criterion of												
CO2	combinatio	nal and sequential logi	c circuits as	C2	1	1,3	-	1,3	T, F				
	needed.												
CO3	Be able to	apply the logic gates	to solve the	C3	2	1	_	1, 3	MID, F				
005	real-world	Problem of electronic c	circuits.	05	2	1		1, 5	WIID, I				
	Be able to a	analyze the memory ele	ements, state										
CO4	table, and	d state diagrams of the sequential		C4	2	1,3	-	1,3	T, F				
	circuit.												
(CP- 0	Complex Pro	blems, CA-Complex A	ctivities, KP-	Knowledge P	rofile, T	-Test;	PR – I	Project; Q	– Quiz; ASG –				
Assign	nment; Pr – P	Presentation; R - Report	t; F – Final Ex	kam)									
C1 - R	Remember	C2 - Understand	C3 - Apply	C4 - Ana	C5 - Evaluate			C6 - Create					
		•											

COURSE CONTENT

Introduction to number systems and codes: Number base conversion, Complements, and related problems, Binary codes; Analysis and synthesis of digital logic circuits: Basic logic functions, Boolean algebra, combinational logic design, minimization of combinational logic. Implementation of basic static logic gates in CMOS and BiCMOS: DC characteristics, noise margin, and power dissipation. Power optimization of basic gates and combinational logic circuits. Modular combinational circuit design: Pass transistor, pass gates, multiplexer, demultiplexer, and their implementation in CMOS, decoder, encoder, comparators, binary arithmetic elements, and ALU design. Programmable logic devices: Logic arrays, field programmable logic arrays, and programmable read-only memory. Sequential circuits:

Different types of latches, SR flip-flops, master-slave, JK flip-flops, T & D flip-flops, Flip-flops design using ASM approach, Timing analysis, and power optimization of sequential circuits. Modular sequential logic circuit design:

Shift registers, Parallel I/O and Series I/O shift registers, Universal shift register, Counters: Introduction, Asynchronous and Synchronous counters: up and down, BCD counters, Ring counter, Johnson counter. Applications of registers and counters.

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
INU.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to remember the structure of various number systems and its application in digital design.	3											
CO2	Be able to understand the design criterion of combinational and sequential logic circuits as needed.	3											
CO3	Be able to apply the logic gates to solve the real-world Problem of electronic circuits.		3										
CO4	Be able to analyze the memory elements, state table, and state diagrams of the sequential circuit.												
	rical method used for mapping which indicate	s 3 a	s higl	n, 2 a	s me	diun	n, an	d 1 a	as lov	v leve	el of n	natchin	g)
	HING LEARNING STRATEGY												
Teaching and Learning Activities								Engagement (hours)					
Face-to	-Face Learning												
	Lecture									42			
	Practical / Tutorial / Studio											-	
Calf D	Student-Centred Learning								_			-	
Sell-Di	rected Learning Non-face-to-face learning											42	
	Revision of the previous and (or) subsequer	nt lec	ture a	at hor	ne							21	
	Preparation for final examination	10 100	ture t	1101								21	
Formal	Assessment												
	Continuous Assessment											2	
	Final Examination											3	
Total										131			
TEAC	HING METHODOLOGY												
Lecture	e and discussion, Co-operative and collaborati	ve m	ethod	l, Pro	blen	n bas	ed n	netho	od				
COUR	SE SCHEDULE												
1	Week	т	onic								٨	ssessm	ont

Week	Торіс	Assessment
1	Introduction to number systems and codes	
Lecture 1	Number base conversion	
Lecture 2	Complements and related problems	
Lecture 3		
2	Analysis and synthesis of digital logic circuits	CT – 1, Final
Lecture 4	Basic logic functions	
Lecture 5	Boolean algebra	
Lecture 6	Boolean algebra	
3	Analysis and synthesis of digital logic circuits	
Lecture 7	Combinational logic design	
Lecture 8	Combinational logic design	

	Course Offereu by O	iner Depurimentis
Lecture 9	Minimization of combinational logic	
4	Implementation of basic static logic gates in CMOS and BiCMOS	
Lecture 10	DC characteristics, noise margin, and power dissipation	
Lecture 11	Power optimization of basic gates	
Lecture 12	Combinational logic circuits	
5	Modular combinational circuit design	
Lecture 13	Pass transistor, Pass gates	
Lecture 14	Multiplexer	
Lecture 15	Demultiplexer	Midterm, Final
6	Modular combinational circuit design	
Lecture 16	Implementation of multiplexer and demultiplexer in CMOS	
Lecture 17	Decoder	
Lecture 18	Encoder	
7	Modular combinational circuit design	
Lecture 19	Comparators	
Lecture 20	Binary arithmetic elements and ALU design	
Lecture 21	Binary arithmetic elements and ALU design	
	Midterm Break	
8	Programmable logic devices	
Lecture 22	Logic arrays	
Lecture 23	Field programmable logic arrays	
Lecture 24	Programmable read-only memory	
9	Sequential Circuits	
Lecture 25	Different types of latches	
Lecture 26	SR flip-flops, master-slave	CT – 2, Final
Lecture 27	JK flip-flops	
10	Sequential Circuits	
Lecture 28	T & D flip-flops	
Lecture 29	Flip-flops design using the ASM approach	
Lecture 30	Timing analysis and power optimization of sequential circuits	
11	Modular sequential logic circuit design	
Lecture 31	Shift registers	
Lecture 32	Parallel I/O shift registers.	
Lecture 33	Series I/O shift registers and	
12	Modular sequential logic circuit design	
Lecture 34	Universal shift register	
Lecture 35	Counters: Introduction	
Lecture 36	Asynchronous counters: up and down	CT – 3, FINAL
13	Modular sequential logic circuit design	
Lecture 37	Synchronous counters: up and down	
Lecture 38	BCD counters	
Lecture 39	Ring counter	
14	Application of sequential logic circuits	FINAL
Lecture 40	Johnson counter	
Lecture 41	Applications of registers	
Lecture 42	Applications of registers	
SSESSMENT ST	**	

Comr	oonents	Grading	СО	Blooms Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C4
Assessment (40%)	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C3
			CO 1	C2
Einal	Exam	60%	CO 2	C3
ГШа	Exam	0070	CO 3	C2
			CO 4	C4
Total	Marks	100%		
(CO = Course	e Outcome, C = C	Cognitive Domai	n)	
TEXT BOOK	KS			
Digital Electr 1. M. Morris M		D. Ciletti, Digita	al Design, 6 th Edition, 20108. IS	SBN -10: 0-07-147217-7
REFERENC	E BOOKS		-	
2. S Salivahan	an and S Arivazh	agan, Digital Elec	etronics, 2011.	
REFERENC	E SITE			

5.2.3.2 EECE 392 Digital Electronics Sessional

Cours	e Code	: EECE 392		Lecture Contact	Hours		: 3.0	00		
Cours	e Title	: Digital Electronics	s Sessional	Credit Hours			: 1.5	50		
PRE-	REQUISIT	E								
Cours	e Code: EEO	CE 295								
Cours	e Title: Digi	tal Electronics								
CUR	RICULUM	STRUCTURE								
Outco	ome-Based E	Education (OBE)								
SYNC	OPSIS/RAT	IONALE								
To lea purpo		liarize with the basic	es of digital elec	tronic circuits a	nd utiliz	e digita	al elect	ronic cir	cuits for p	oractica
	ECTIVE									
This c and co	course consis	sts of two parts. In th ned in EECE 391. In t								
This c and co in EE	course consis oncepts learn CE 391.		the second part,	students will de Bloom's					principles Asse	learne
This c and cc in EE COU	course consistence of the construction of the	ed in EECE 391. In t	the second part, IC SKILLS e cledge of basic	students will de Bloom's Taxonomy	sign sim	iple sys	tems u	sing the	principles Asse Me	
This c and cc in EE COU No.	Be able to and utilize	COMES & GENERI Course Outcome to apply the know	the second part, IC SKILLS e ledge of basic ically. te the necessity bes of logic and	students will de Bloom's Taxonomy C3	sign sim	CP	tems u	sing the KP	Asse Asse T, T,	learne
This c and co in EE COU	Be able to and utiliza sequential Be able to	ed in EECE 391. In t COMES & GENERI Course Outcome to apply the know ctronic circuits pract analyze and evalua ation of different typ	the second part, IC SKILLS e redege of basic ically. ite the necessity bes of logic and blems. ital circuits with	Students will de Bloom's Taxonomy C3 C4, C5	PO 2	CP	tems u	KP	Asse Asse T, 3 T, A	essmen ethods Q, R Q, R,
This c and cc in EE COU No. CO1 CO2 CO3 (CP- 0	Be able to and utiliza sequential Be able to ICs to use Complex Pro	Course Outcome Course Outcome to apply the know ctronic circuits pract analyze and evalua ation of different typ circuits for real prob create different digi	the second part, IC SKILLS e reledge of basic ically. the the necessity bes of logic and blems. ital circuits with ecessities. Ex Activities, K	students will de Bloom's Taxonomy C3 C4, C5 C6 P-Knowledge P	PO 2 2, 5 5, 9	CP 1,3	CA - -	KP 1, 3 1, 2, 3 1, 3	Assee Me T, 3 T, A T, A	learne essmen ethods Q, R Q, R, ASG Q, R
This c and cc in EE COU No. CO1 CO2 CO3 (CP- 0 Assign	Be able to and utiliza sequential Be able to ICs to use Complex Pro	Course Outcome Course Outcome to apply the know ctronic circuits pract analyze and evalua ation of different typ circuits for real prob create different digi for our day to day moblems, CA-Comple	the second part, IC SKILLS e reledge of basic ically. the the necessity bes of logic and blems. ital circuits with ecessities. Ex Activities, K	students will de Bloom's Taxonomy C3 C4, C5 C6 P-Knowledge P	PO 2 2, 5 5, 9 rofile, 1	CP 1 1, 3 1 -Test;	CA - -	KP 1, 3 1, 2, 3 Project; 0	Assee Me T, 3 T, A T, A	learne essmen ethods Q, R Q, R, ASG Q, R ASG

SKILL MAPPING

circuit, Multiplexer & de-multiplexer, Flip-flop circuits, Up and down counters.

					PR	OG	RAN	101	JTCC	MES	(PO))	
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to apply the knowledge of basic digital electronic circuits practically.		3										
CO2	Be able to analyze and evaluate the necessity and utilization of different types of logic and sequential circuits for real problems.		3			3							
CO3	Be able to create different digital circuits with ICs to use for our day to day necessities.		3			3							
(Numer	ical method used for mapping which indicate	es 3 as	s higł	n, 2 a	s me	diun	n, an	d 1 a	as lov	v leve	l of n	natching	g)
TEACI	HING LEARNING STRATEGY												
Teachin	g and Learning Activities									En	gagen	nent (ho	ours)
Face-to-	Face Learning												
	Lecture											7	
	Practical / Tutorial / Studio											35	
	Student-Centered Learning											-	
Self-Di	rected Learning												
	Non-face-to-face learning											-	
	Revision of the previous and (or) subsequent	nt lect	ture a	t hon	ne							15	
	Preparation for final examination									10			
Formal	Assessment												
	Continuous Assessment											1	
	Lab Test											1	
	Quiz										().75	
	Viva									0.25			
Total												70	
TEACI	HING METHODOLOGY												
Lecture	and discussion, Co-operative and collaborati	ve m	ethod	l, Pro	blem	bas	ed n	netho	od				
COUR	SE SCHEDULE												
Wee	Week Lecture Topics										Ass	essmen	t
1	Familiarization and use of truth table	of ba	asic l	ogic (Gate	s							
2	Verification of De Morgan's laws using the logic gates												
3 Implementing the truth tables of a digital logic circuit and its simplification using Boolean algebra								ts	Report, Assignment, Lab Test, Viva				
4	Design of adder & subtractor circuits	s usin	g bas	ic ga	tes				\neg				
5	Design and implement of encoder an	d dec	oder	circu	its								

					by Other Departments
6	-	plement of BC	D to seven-segment decoder of	circuit using	
	logic gates				
7	Lab Test with	V1va-01			
			Midterm Break	<u> </u>	
8	Design and in	plement of mul	tiplexer circuit using logic ga	tes	
9	Design and in	plement of the	ogic gates		
10	Design and in logic gates	plement variou	s types of clocked flip-flop c	rcuits using	Report, Lab Test, Quiz,
11	Design and in	plement of up a	and down counters		Viva
12	Quiz test				
13	Lab Test-02				
14	Final Viva wi	th Reports			
ASSESSME	NT STRATEGY	ł			
Com	ponents	Grading	СО	В	looms Taxonomy
		20%	CO1, CO2, CO3		C4, C5, C3
Continuous Assessment	Report	2070	001, 002, 003		04, 03, 03
(40%)	Class Participation	20%	CO1, CO2, CO3		C4, C5, C3
F. 1F	Lab Test	20%	CO1, CO2, CO3		C4, C5, C3
Final Exam (60%)	Quiz	30%	CO1, CO2, CO3		C4, C5, C3
(0000)	Viva	10%	CO1, CO2, CO3		C4, C5, C3
Total	Marks	100%		1	
(CO = Cour	se Outcome, C =	Cognitive Dor	nain, P = Psychomotor Dom	ain, A = Affe	ctive Domain)
TEXT BOO	KS				
1. Digital	Logic and Comp	uter Design- M	Morris Mano; Prentice Hall o	f India Private	e Ltd
REFERENC	CE BOOKS				
1. Digital	Fundamentals - F	Loyd; Prentice	-Hall International, Inc		
2. Pulse, I	Digital and Switcl	ning waveforms	- Jacob Millman& Herbert Ta	aub; Tata McC	Graw- Hill
REFERENC	CE SITE				

5.3 Department of Computer Science and Engineering

5.3.1 Level-2, Spring

5.3.1.1 CSE 291 Computer Programming

	E INFORMATION					
			: 3.00			
Course C	Code : CSE 291	Lecture Contact	: 3.00			
Course T	Title : Computer Programming	Hours Credit Hours				
PRE-RE	QUISITE					
CURRIC	CULUM STRUCTURE					
Outcome	Based Education (OBE)					
SYNOPS	SIS/RATIONALE					
To introd	luce with the most recent technology and to	o teach students the b	asic concep	ots of com	puter pr	ogramming.
OBJECT	ΓΙVΕ					
1. To h	ave basic idea about computer organization	n				
2. To u	inderstand the basics of computer programi	ming in C/C++.				
	earn how to think about the problems, their	6	ting it to p	rogrammi	ng	
	ING OUTCOMES& GENERIC SKILL		0 1	0	0	
No.	Course Learning Outcome	Bloom's Taxonomy	СР	CA	KP	Assessment Methods
	Be able to explain the difference betw	ween				
CO1	object oriented programming language	and C1,C2	1	-	1	T, ASG
	procedural language					
	Be able to apply C/C++ features such					
CO2	composition of structures, objects, oper		3	-	3	MT, F
	overloading, inheritance, polymorphism					
	Be able to evaluate the relative merit					
	different algorithm to solve and de programming constructs for real w	- (5(6	4	-	2, 5	Pr, F
CO3	i programming constructs for real w				1	

COURSE CONTENT

Fundamentals of computer; Major components of a computer: processor, memory, I/O devices, operating systems; Basic Programming Concepts: object, source, executable code; Program development stages: algorithms and flow charts; Number system: binary, octal, decimal and hexadecimal systems; Structured Programming using C: data types, variables and constants, operators, expressions, control statements: "if else", "switch"; Loop, function, arrays, strings, pointers, and user defined data types: structure, unions; Input output and files.

- Assignment; Pr - Presentation; R - Report; F - Final Exam, MT- Midterm Exam)

Object oriented Programming using C++: philosophy of object oriented programming (OOP), advantages of

OOP over structured programming, classes and objects, access specifiers, static and non-static members, Array of objects, constructors, destructors, copy constructor, abstraction, encapsulation, polymorphism: operator overloading, abstract classes, virtual functions, overriding; inheritance: single and multiple inheritance.

SKILL MAPPING

No.	Course Learning Outcome		PROGRAM OUTCOMES (PO)										
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to explain the difference between												
CO1	object oriented programming language and	3											
	procedural language												
CO2	Be able to apply C/C++ features such as composition of structures, objects, operator overloading, inheritance, polymorphism etc.		3										
CO3	Be able to evaluate the relative merits of different algorithm to solve and design programming constructs for real world problems		2	3							2		

JUSTIFICATION FOR CO-PO MAPPING

Mapping	Level	Justifications
CO1-PO1	High	Achieving in-depth of knowledge on programming concepts and the features of a programming languages.
CO2-PO2	High	Developing the skill of analysis to execute proper programming concepts to solve a problem.
CO3-PO2	Medium	Analysing a problem to find an appropriate solution.
СОЗ-РОЗ	High	Designing valid algorithm and solve the real life problems using specified programming language.
CO3-PO10	Medium	Through presentation, the communication skills will be developed.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	64
Revision	-
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	3
Final Examination	3
Total	132

COURSE	SCHEDULE		
Week	Lecture	Topics	
1	Lec 1	Programming Concepts, Program development	
	Lec 2	Stages, Structured programming language	
	Lec 3		
2	Lec 4	Number Systems, Data types and their memory allocation,	
	Lec 5 Lec 6	Variables, Operators	
3	Lec 6		Class Test 1
3	Lec 7 Lec 8	Expressions, Basic Input/output; Control Structure	Class Test I
	Lec 8 Lec 9	Expressions, Basic input/output, Control Structure	
4	Lec 10		
7	Lec 10	Control structures: loop, While loop	
	Lec 12	condorbalactores, toop, while loop	
5	Lec 13		
-	Lec 14	Nested loop, Functions	
	Lec 15		
6	Lec 16		Class Test 2
	Lec 17	Arrays: Single, Multi-dimensional arrays	
	Lec 18		
7	Lec 19		
	Lec 20	Strings	
	Lec 21		
8	Lec 22		
	Lec 23	Pointers	
	Lec 24		
9	Lec 25	User defined data types: Structure, unions	
	Lec 26	Input output and files	Class Test 3
10	Lec 27		
10	Lec 31		
	Lec 32 Lec 33	Object oriented Programming using C++: Introduction	
11	Lec 33		
11	Lec 28 Lec 29	Classes and objects, Array of objects, Access specifiers	
	Lec 29 Lec 30	Chasses and objects, Array of objects, Access specificits	
12	Lec 34		
14	Lee 34 Lee 35	Constructors, Abstraction, Encapsulation	
	Lec 36	, , , , , , , , , , , , , , , , , , ,	
13	Lec 37		
-	Lec 38	Polymorphism	Midterm / Project
	Lec 39	Function and operator overloading	3
14	Lec 40		
	Lec 41	Inheritance	
	Lec 42		

ASSESSMEN	T STRATEGY			
Comr	oonents	Grading	СО	Blooms Taxonomy
Continuous	Test 1-3	20%	CO 1	C1, C2
Assessment	Presentation	5%	CO 3	C5, C6
(40%)	Midterm	15%	CO 2	C3, C4
E: 1	Г	(00/	CO 2	C2. C(
Final	Exam	60%	CO 3	C3- C6
Total	Marks	100%		
(CO = C	ourse Outcome,	C = Cognitive Dor	nain, P = Psychomotor D	Domain, A = Affective Domain)
TEXT BOOK	[S			
1. Teach You	urself C - Herbert	Schidlt		
REFERENCE	E BOOKS			
1. Programm	ing with C - John	Hubbard; Schaum	"s Outlines.	
2. Programm	ing with C++ - Jo	hn Hubbard; McG	raw-Hill Int. Edn	
	urself C++ Hert			
REFERENCE	E SITE			

5.3.1.2 CSE 292 Computer Programming Sessional

COURSE INFORMATION							
Course Code Course Title	: CSE 192 : Computer Programming Sessional	Lecture Contact Hours Credit Hours	: 3.00 : 1.50				
PRE-REQUISIT	Ē		•				

Course Code: CSE 291

Course Title: Computer Programming

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to program design and development.

OBJECTIVE

- 1. To learn basic idea of programming languages.
- 2. To learn how to program with C/C++.
- 3. To learn how to think about the problems, their solutions and translating it to programming language.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Learning Outcome	Bloom's Taxonomy	СР	CA	KP	Assessment Methods
CO1	Be able to practice structured programming language and design algorithm for problems	C1, C2, A1, A2	-	2	1, 3	PR, T, Q
CO2	Be able to apply practical knowledge to develop basic programming skills with respect to program design and development	C3, C4, C6	-	3	2, 3, 6	F, T, ASG
CO3	Be able to demonstrate good programming style and discuss the impact of style on developing and maintaining programs	C4, C6, P6	-	5	4, 5	Q, ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Programming concepts, Codeblocks IDE, Input and Output: Standard input and output, Formatted input and output, Data Types, Basic Knowledge: Mathematical problems using printf, scanf, Operators, If, Else if, Switch, Loop, Nested Loop (for loop, while loop, do-while loop), function, arrays, pointers, structure unions. User defined data types. Input output and files. Object oriented Programming using C++: philosophy of object oriented programming (OOP), advantages of OOP over structured programming, classes and objects, access specifiers, static and non-static members, Array of objects, constructors, destructors, copy constructor, abstraction, encapsulation, polymorphism: operator overloading, abstract classes, virtual functions, overriding; inheritance: single and multiple inheritance.

N		C					PRO	GRA	M C	UT	COM	IES (I	PO)		
No.		Course	Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1			tice structured programming sign algorithm for problems				1						2		3
CO2			bly practical knowledge to programming skills with	3		3						3			
002	resp	ect to progra	am design and development												
CO3	style	e and discu	iss the impact of style on maintaining programs		3			2							
(3 – H	igh, 2∙	- Medium, 1	-low)												
JUSTI	FICA	TION FOR	CO-PO MAPPING												
Mapp	ing	Level				Just	ificati	ons							
CO1-P	04	Low	For preparing valid algorith	m, de	epth o	of inv	estiga	ation	and o	expe	rime	ntatio	on is r	equire	d
CO1-C	O10	Medium	Through presentation, the c	omm	unica	tion s	skills	will l	oe de	evelo	ped.				
CO1-P	012	High	Project submission will help	p to d	levelo	op ski	ll wh	ich w	ill bo	e ber	nefic	ial fo	r life t	ime.	
CO2-P	01	High	Achieving in-depth of kn programming languages.	owle	dge	on p	rogra	mmiı	ng c	once	pts	and	the fo	eature	s of
CO2-P	03	High	Developing and designing a	a prop	per so	lutio	n for	vario	us pr	oble	ms				
CO2-P	09	High	Group assignment will help	to de	evelo	p teai	n coc	rdina	tion						
CO3-P	02	High	In the process of maintainin	ng pro	ogran	ns inte	ensive	e anal	lysis	skill	will	be a	chieve	ed	
CO3-P	05	Medium	For demonstrating good sty	le mo	odern	tool	usage	wou	ld be	mu	st				
TEAC	HIN	LEARNI	NG STRATEGY												
		d Learning A										Enga	geme	nt (ho	urs)
Face-te	o-Face	e Learning										-	-		
	L	ecture											-		
	Р	ractical / Tu	torial / Studio										63	3	
			red Learning										-		
Self-D		d Learning													
			face learning										-		
	-	levision											-		
-		ssessment F	Preparations										-		
Forma		essment													
		ontinuous A											4		
Total	F1	nai Examina	ation (online)								-		1.5 X		
- 0.001											1		/	~	
TEAC	CHINO	J METHOI	DOLOGY												

COURSE SCHEDULE

Week	Topics
1	Basic I/O, Solving Mathematical problems, operators
2	If, Else if, Switch
3	Loop
4	Array, 2D Array
5	Function
6	Pointers
7	Online-1
8	User Defined Data Types: Structures, Unions
9	OOP Introduction, classes and objects, access specifiers (using C++)
10	Constructors, Destructors, Encapsulation
11	Polymorphism
12	Inheritance
13	Quiz, Project Submission
14	Online-2

ASSESSMENT STRATEGY

Components	Grading	CO	Blooms Taxonomy
Quiz	10%	CO 1, CO 3	C1,C2, C4, C6, A1, A2, P6
Project	20%	CO 1	C1,C2 A1-A2
Class Performance (T)	20%	CO1, CO 2,	C1-C4, C6, A1-A2
Online Test-1 (F)	20%	CO 2, CO 3	C3, C4, C6, P6
Online Test-2 (F)	20%	CO 2, CO 3	C3, C4, C6, P6
Assignment	10%	CO 2, CO 3	C3, C4, C6, P6
Total Marks	100%		1

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT BOOKS

- 1. Teach Yourself C Herbert Schidlt
- 2. Programming with C John Hubbard; Schaum"s Outlines.

REFERENCE BOOKS

- 1. Programming with C++ John Hubbard; McGraw-Hill Int. Edn.
- 2. Teach Yourself C++ Herbert Schidlt
- 3. Sober Jonno Computer Programming Language C- Md Kamruzzaman Niton

5.4 Department of Mechanical Engineering

5.4.1 Level-2, Fall

5.4.1.1 ME 291 Principles of Mechanical Engineering

	RSE INFOR	MATION							
Cours	e Code	: ME 291		Lecture	e Contac	et Hour	s	: 3.00	
Cours	e Title	: Principles of Mechanie	cal Engineering	g Credit l	Hours			: 3.00	
PRE-	REQUISITE			l				1	
NA									
CURI	RICULUM S	STRUCTURE							
		ucation (OBE)							
SYNC	OPSIS/RATI	ONALE							
engine	eering. These	his course is to introduce principles and concep- naterials, biofluid mecha	ots will be later	r used in cou	urses in	biome	edical e		
OBJE	ECTIVE								
1. B	e able to und	erstand the basic concep	ots in solid mech	hanics					
		ly the concepts of solid i		-		alysis			
		cribe basic laws of therm							
		reciate different control		robotics and a	automat	ion ind	ustry		
COU	RSE OUTCO	OMES & GENERIC S	KILLS						
					1	1			
No.		Course Outcome		Bloom's Taxonomy	РО	СР	CA	КР	Assessment Methods
	Be able to solid mecha	understand the basic	concepts in		РО 1	СР -	CA -	КР 1	
CO1	solid mecha Be able	understand the basic	laws of	Taxonomy		СР - -	CA - 1		Methods
CO1 CO2	solid mecha Be able thermodyna Be able to	understand the basic anics to describe basic	laws of tions ntrol system	Taxonomy C2	1	-	-	1	Methods T, MID, F
CO1 CO2 CO3	solid mecha Be able thermodyna Be able to using in rob Be able	understand the basic anics to describe basic amics with their applicat appreciate different co	laws of tions ntrol system idustry ts of solid	Taxonomy C2 C2	1	-	- 1	1	Methods T, MID, F T,F
CO1 CO2 CO3 CO4	solid mecha Be able thermodyna Be able to using in rob Be able mechanics	understand the basic anics to describe basic amics with their applicat appreciate different co potics and automation in to apply the concep	laws of tions ntrol system dustry ts of solid malysis	Taxonomy C2 C2 C2 C2 C2 C2 C3	1 1,2 2	- - 1 1	- 1 1 1	1 1 1 1 1 1	Methods T, MID, F T,F T,F T, MID, F
CO1 CO2 CO3 CO4 (CP- 0 Assign	solid mecha Be able thermodyna Be able to using in rob Be able mechanics Complex Pro	understand the basic anics to describe basic amics with their applicat appreciate different co botics and automation in to apply the concep to machine design and a	laws of tions ontrol system dustry ts of solid inalysis ctivities, KP-Ki	Taxonomy C2 C2 C2 C2 C2 C3 nowledge Pro	1 1,2 2	- - 1 - Test;	- 1 1 1	1 1 1 1 roject; Q -	Methods T, MID, F T,F T,F T, MID, F

COURSE CONTENT

The course covers basic theory in statics and solid mechanics including stress-strain analysis, bending, torsion, and different types of mechanical testing. These tests are discussed in the lights of machine design and analysis. Emphasis is given on machine failure. The syllabus further includes fundamental concepts of thermodynamics and thermal physics and control theory used in robotics and automation applications.

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	~					PR	OGI	RAM	1 O L	JTCC	MES	(PO)			
No.	Cours	se Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	Be able to und solid mechani	lerstand the basic concepts in cs	3												
CO2		describe basic laws of ics with their applications	3												
		appreciate different control													
CO3	system used industry	in robotics and automation	3	2											
CO4		apply the concepts of solid machine design and analysis		3											
(Numer	rical method use	d for mapping which indicates	3 as l	nigh,	2 as 1	nedi	um,	and	1 as	low l	evel o	of mat	ching)		
TEACI	HING LEARNI	NG STRATEGY													
-	ng and Learning										E	ngage	ment (h	ours)	
	Face-to-Face Learning											00	`	,	
	Lecture												42		
	Practical / Tuto	orial / Studio											-		
	Student-Centre	ed Learning											-		
Self-Di	rected Learning	-													
	Non-face-to-fa	ce learning									42				
		e previous and (or) subsequent	lectu	re at l	home						21				
	Preparation for	r final examination									21				
Formal	Assessment														
	Continuous As	sessment											2		
	Final Examina	tion									3				
Total													131		
TEAC	HING METHO	DOLOGY													
Lecture	and discussion,	Co-operative and collaborative	e met	hod,	Probl	em b	asec	l me	thod						
COUR	SE SCHEDUL	E													
	Week		Cont	ent								Ass	essmer	nt	
1		Introduction & Statics													
Lecture	: 1	Introduction to Mechanic Engineers	al	Engir	neerir	ıg f	or	Bio	med	ical					
Lecture		Fundamentals of statics: Force		omer	nts, S	tatic	equi	libri	um						
Lecture 3 Stress: Normal and Shear stresses											СТ		nd Mi	dterm,	
Lecture		Statics											Final		
2		Strain: Normal and Shear stra													
2	:4	I	c ma	terial	, Yoi	ing'	Mod	lulus							
2 Lecture		Hooke's Law for linear elasti													
2 Lecture Lecture	: 5	Hooke's Law for linear elasti Poisson's ratio and Bulk Moo													
2 Lecture Lecture Lecture	: 5		dulus		s Cir	cle									
2 Lecture Lecture	e 5 e 6	Poisson's ratio and Bulk Moo Stress-strain relationship an Stress-strain relationship of n	dulus nd M nater	lohr' ials											
2 Lecture Lecture 3 Lecture	2 5 6 2 7 2 8	Poisson's ratio and Bulk Moo Stress-strain relationship an Stress-strain relationship of n Stress Transformations and p	dulus nd M nater rinci	lohr' ials											
2 Lecture Lecture 3	2 5 6 2 7 2 8	Poisson's ratio and Bulk Moo Stress-strain relationship an Stress-strain relationship of n	dulus nd M nater rinci	lohr' ials											

Т

Lecture 10	Beams and support	
Lecture 11	Shear and bending moment diagrams	
Lecture 12	3 point bending test, Normal stresses in beams	
5	Bending and stress analysis	
Lecture 13	4 point bending tests	
Lecture 14	Moment of inertia	
Lecture 15	Stress analysis, Stresses in curved members	
6	Mechanical Design	
Lecture 16	Pressure vessels	
Lecture 17	Column design and coupling	Midterm, Final
Lecture 18	Shock and Impact	
7	Machine Design	
Lecture 19	Fracture, fatigue and failure modes	
Lecture 20	Failure analysis and safety consideration	
Lecture 21	Revision	
	MIDTERM	
8	Introduction to Thermodynamics	
Lecture 22	Kinetic theory of gases and Maxwell's distribution of molecular	
	speeds	
Lecture 23	Mean free path, Brownian motion, Van Der Waal's equation of	
	state	
Lecture 24	First Law of thermodynamics and its applications, Reversible and	
	irreversible processes	CT – 2, FINAL
9	Second law of thermodynamics	
Lecture 25	Second Law of thermodynamics and its applications	
Lecture 26	Entropy and disorder	
Lecture 27	Carnot's cycle and Carnot's theorem	
10	Heat engines, AC and refrigeration	
Lecture 28	Efficiency of heat engines. Thermodynamic functions	
Lecture 29	Refrigeration and AC cycles	
Lecture 30	Humidity control, HVAC systems	
11	Control systems	
Lecture 31	Introduction to control systems and engineering, Modelling of	
	basic feedback systems	
Lecture 32	Simulation of basic feedback loop-based control systems	
Lecture 33	Block Diagrams and Transfer Functions for Control Systems	CT – 3, FINAL
12	Controller design and stability analysis	
Lecture 34	Design of PID controllers	
Lecture 35	Design of PLC controllers	
Lecture 36	Stability and Robustness of controllers	
13	Robotics and mechatronics	
Lecture 37	Mechanics of linkage systems	
Lecture 38	Basic Cartesian and rotational robots	
Lecture 39	Hydraulics and pneumatics powered artificial muscles	
14	Robotics and mechatronics	
Lecture 40	Automation and frequency response	FINAL
Lecture 41	Mechatronics subsystems: sensors and actuators, Signal analysis	FINAL
	and control	
Lecture 42	Modelling of dynamic mechatronic systems	
	FINAL EXAMINATION	

			СО	Blooms Taxonomy
Comp	onents	Grading		Diccinis Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3, CO4	C2, C3
Assessment (40%)	Class Participation/ Assignment	5%	CO1, CO2, CO3, CO4	C2, C3
	Midterm	15%	CO1, CO2	C2, C3
			CO 1	C2
Final	Exam	60%	CO 2	C3
Final	Exam	0070	CO 3	C2
			CO 4	C3
Total	Marks	100%		
(CO = Course	e Outcome, C =	Cognitive Don	nain)	
TEXT BOOF	KS			
1. Introducti	ion to Mechanical	Engineering, I	Part 1, Hodder Education UK, 2009	9
REFERENC	E BOOKS			
1. Introducti	ion to Mechanical	Engineering, I	Part 2, Hodder Education UK, 2009	9
REFERENC	E SITE			
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CHAPTER 6

COURSE OFFERED BY BME DEPARTMENT

6.1 <u>Core Course Offered</u>

6.1.1 BME 101 Introduction to Biomedical Engineering

COU	RSE INFO	RMATION							
Course	e Code	: BME 101	Lec	ture Contact H	ours	: 2.00)		
Course	e Title	: Introduction to Biomedical	Cre	dit Hours		: 2.00)		
		Engineering				. 2.00	,		
PRE-I	REQUISIT	`E							
CURF	RICULUM	STRUCTURE							
		ducation (OBE)							
	PSIS/RAT								
		ers the following modules:				•	-	0.	-
		iomaterials, Tissue Engineerin				-			
	-	ants and Braces, Biosignals, E			ioMEM	s and l	piosens	ors, Biome	dical Imaging,
	-	e processing, Computational B	iology.						
	CTIVE								
1.	U	ish and identify key fields and							
2. 3.		and the role of Biomedical Eng and how the development of b				-			
		ion of healthcare for disease d		•••			instruit	ientation ca	in enhance the
1 1	1	COMES & GENERIC SKILI	-	s, treatment, at	iu pieve				
			10	Bloom's					Assessment
No.		Course Outcome		Taxonomy	PO	СР	CA	KP	Methods
CO1		understand the role of Biom		C2	1,6	_	_	_	T, MID, F
	-	in healthcare and society as a			1, 0				-,,.
CO2		o identify key fields and res	search	C2	1	-	-	-	MID, F
		n the field of BME							
		o analyze how the developm							
CO3	biomedica	al technology, devices tation can enhance the qualit	and	C4	2				тБ
COS		of healthcare for disease diag	•	C4	2	-	-	-	T, F
	-	and prevention	110515,						
		and prevention							
	-	oblems, CA-Complex Activiti		-	ofile,T	– Test;	PR - I	Project; Q -	- Quiz; ASG –
Assigr	nment; Pr –	Presentation; R - Report; F - I	Final Ex	xam)					
C1 - R	emember	C2 – Understand C3 –	Apply	C4 - Ana	lvze	C5 –	Evalua	te Co	6 – Create
N			rr-J	5 · / / ///u	- ,				

COURSE CONTENT

Introduction to Biomedical Engineering, Basic Life Science, Biotechnology, Biomaterials, Tissue Engineering, Drug Development and Delivery, Nanotechnology, Biomechanics, Biomedical Implants and Braces, Biosignals, Bioinstrumentation, BioMEMs and biosensors, Biomedical Imaging, Biomedical Image processing, Computational Biology.

No.	. Course Learning Outcome PROGRAM OUTCOMES (PO)												
110.		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to understand the role of Biomedical Engineers in healthcare and society as a whole	3					3						
CO2	Be able to identify key fields and research domains in the field of BME	3											
CO3	Be able to analyze how the development of biomedical technology, devices and instrumentation can enhance the quality and precision of healthcare for disease diagnosis, treatment, and prevention		2										
(Numer	ical method used for mapping which indicate	s 3 as	s high	n, 2 as	s me	diun	ı, an	d 1 a	ıs low	/ leve	l of m	natching	g)
TEAC	CHING LEARNING STRATEGY												
Teach	ing and Learning Activities									I	Engag	ement (hours)
Face-t	o-Face Learning												
	Lecture											28	
	Practical / Tutorial / Studio											-	
	Student-Centred Learning											-	
Self-D	virected Learning												
	Non-face-to-face learning											28	
	Revision of the previous and (or) subseque	ent le	cture	at ho	me							14	
	Preparation for final examination											14	
Forma	l Assessment												
	Continuous Assessment											2	
	Final Examination											3	
Total												89	
TEACH	HING METHODOLOGY												
Lecture	and discussion, Co-operative and collaborati	ve m	ethod	, Pro	blem	ı bas	ed n	netho	od				
COURS	SE SCHEDULE												

Course Offered by BME Department

Weeks	Topics	Assessment
1	Introduction to Biomedical Engineering	
Lecture 1	Motivation Course and Introduction	
Lecture 2	Careers in Biomedical Engineering, Current and Future Trends of	
	Biomedical Engineering: Bangladesh and International Perspective	
2	Introduction to Biomedical Engineering	
Lecture 3	Different fields of Biomedical Engineering, Guide to choosing a	
	major to specialize	
Lecture 4	Biomedical research facilities and institutions: Bangladesh and	
	International perspective, Societies, Websites	
3	Basic Life Science	CT – 1 and Midterm,
Lecture 5	Introduction to the Chemical basis of life	Final
	Introductory Biochemistry	
Lecture 6	Introduction to nucleic acids and genes	
	Fundamentals of Molecular Biology	
4	Biotechnology	
Lecture 7	Introduction to Biotechnology in BME, Examples of DNA, RNA	
	& protein technology and biomedical applications,	
Lecture 8	Introductory Genetic Engineering, Advances in Genetic	
	Engineering in BME applications	
5	Biomaterials	
Lecture 9	Introduction to material science in Biomedical Engineering	
Lecture	Definition and types of Biomaterials	
Lecture 10	Biocompatibility: Why is it important?	
Lecture 10	Examples and applications of Biomaterials	
6	Tissue Engineering	
Lecture 11	Introduction to cell and tissue engineering and regenerative	
Lecture 11	medicine	
	Applications of Tissue Engineering	
Lecture 12	Functional Tissue Engineering	Midterm, Final
Lecture 12		
	Recent advances and future trends in Tissue Engineering and	
7	Regenerative Medicine	
7 Lecture 13	Drug Development and Delivery, Nanotechnology	
Lecture 15	Introduction to Drug Development and Delivery	
T (14	Definitions of Pharmaceuticals and pharmacokinetics	
Lecture 14	Introduction to Nanotechnology	
	Nanotechnology in biomedicine	
	Nanomaterials used in BME: Examples and Application	
0	MIDTERM	
8 Lesture 15	Biomechanics, Biomedical Implants and Braces	
Lecture 15	Definition of Biomechanics Classification of Biomechanics	
T (16	Branches and application of Biomechanics	
Lecture 16	Introduction to implants and braces	
2	Different types of Medical Braces	
9	Biosignals	
Lecture 17	Physiological origins of biosignals	CT – 2, FINAL
	Different signals generated in the human body	
	Bioelectric phenomena	
Lecture 18	Basic Bioinstrumentation	
	Common Equipment used in medical facilities	
10	Bioinstrumentation	
Lecture 19	Introduction to Sensors, Transducers and Actuators	
	Introduction to Biomedical sensors	

Course Offered by BME Department

	Examples o	f Biosensors			jerea by BME Department
Lecture 20		pes of biosensors			
Lecture 20		s of biosensors			
11			iomedical Imaging		
Lecture 21		n to MEMs and Bi			
Lecture 21		applications and ad			
Lecture 22		to Biomedical Im			
Lecture 22			modalities: X-ray, CT-scar	MRI	
		Nuclear Medicine		I, WIKI,	
12			g and Computational Biolo	<u>av</u>	
Lecture 23		to Image process		gy	
Lecture 25			essing in diagnostics		CT – 3, FINAL
		f biomedical imag			CI = 3, FINAL
Lecture 24		to Bioinformatics			
Lecture 24			Biology in BME applications		
13		Optics and Lase			
Lecture 25		to Optics in BME			
Leeture 25		of optics in BME			
Lecture 26		to telehealth or e	-health		
Leeture 20		of Telemedicine	health		
14	Review We				
Lecture 27	Review Cla				_
Lecture 28	Review Cla				
	NT STRATEGY				
Com	oonents	Grading	CO		Blooms Taxonomy
Com	Class Test/	Glading			
	Assignment	20%	CO1, CO3		C2, C4
Continuous	1-3	2070	001,005		02, 04
Assessment	Class				
(40%)	Participation	5%	CO2		C2
	Midterm	15%	CO1, CO2		C1, C2
	materini	1070	CO 1		<u>C1, C2</u>
Final	Exam	60%	CO 2		C2
1 mai	DAum	0070	CO 3		C4
Total	Marks	100%			
		Cognitive Domain)		
TEXT BOOK		Sognitive Domain			
		lical Engineering	John D. Endonlo, Joseph D. J	Duonatin -	
		lical Engineering,	John D. Enderle, Joseph D. I	bronzino.	
REFERENC	E SITE				
-					

6.1.2 BME 104 CAD in Biomedical Engineering Sessional

COURSE INFORMATION			
Course Code	: BME 104	Lecture Contact Hours	: 3.00
Course Title	: CAD in Biomedical Engineering Sessional	Credit Hours	: 1.50
PRE-REQUISITE			
CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

In this course, students will be taught the designing of 3D models with printed porotypes of devices and equipment for biomedical engineering applications using software packages.

OBJECTIVE

This course aims to introduce students to 3D drafting and modeling techniques in the context of biomedical engineering. COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome		Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Be able to draw 3D parts a according to technical specirealistic constraints.		C6	1, 5	-	-	5	T, Q, R,ASG
CO2	Be able to make 3D printed mospecified design requirements.	dels following	C6	1,2	-	1	5	PR, Pr
`	Complex Problems, CA-Complex ment; Pr – Presentation; R - Repo		e	file, T -	- Test;	PR – I	Project; Q -	- Quiz; ASG –
		C3 - Apply	C4 - Analy	ze	C5 -	Evalua	ate C	6 – Create

COURSE CONTENT

Fundamental concepts of Orthographic views, 3D Isometric view, Isometric projection from orthographic views. Introduction to 2D drafting, Draw a 2D sketch of the isometric views of a complex structure, Converting 2D sketch to 3D bodies using extrude and revolve features, Generate the 3D part of a dental abutment, Make threads using the helix and spirals, and swept base/boss features, Generate the 3D part of a dental screw, Generation of planes at angles using sketches and surfaces as references, Create the model of a dynamic hip screw using the given dimensions of its cross-sections, Create complex thin models using surface tools boundary, trim, and thicken, Design a bone plate, Design and assemble the components of total hip implant part 1: Femoral hip stem and head, Design and assemble the components of total hip implant part 2: Polyethylene liner and Acetabular shell, and their assembly, Introduction to 3D printing technology, Development of a 3D printed prototype model of a biological structure.

No.	Course Learning Outcome				PF	ROG	RAM	OU	ГСОІ	MES	(PO)		
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to design 3D parts and assemblies												
CO1	according to technical specifications with	3				3							
	realistic constrains.												
CO2	Be able to create 3D printed models	3	3										
02	following specified design requirements.	3	3										
(Numer	rical method used for mapping which indicates	s 3 as	high	, 2 as	med	lium,	and	1 as 1	ow le	evel c	of mate	hing)	
[
TEA	CHING LEARNING STRATEGY												
Teach	ing and Learning Activities									En	gagem	ent (ho	urs)
Face-	to-Face Learning												
	Lecture											7	
	Practical / Tutorial / Studio											35	

-
-
10
14
1
0.25
2
0.5
0.25
70
-

COURSE SCHEDULE

Week	Lecture Topics	Assessment
1	Fundamental concepts of Orthographic views, 3D Isometric view,	
	Isometric projection from orthographic views, and 2D drafting.	
2	Draw orthographic views from the isometric view of complex	
	structures. Draw isometric views from orthographic views of complex	
	structures.	
3	Converting 2D sketch to 3D bodies using extrude and revolve features.	Report, Assignment, Lab
	Generate the 3D part of a dental abutment.	Test, Quiz, Viva
4	Make threads using the helix and spirals, and swept base/boss features.	
	Generate the 3D part of a dental screw.	
5	Generation of planes at angles using sketches and surfaces as references.	
6	Create the model of a dynamic hip screw using the given dimensions of	
	its cross-sections.	
7	Mid Lab Test	
	Midterm Break	
8	Create complex thin models using surface tools boundary, trim, and	
	thicken. Design a bone plate.	
9	Design and assemble the components of total hip implant part 1:	Report, Assignment, Lab
	Femoral hip stem and head.	Test, Quiz, Viva
10	Design and assemble the components of total hip implant part 2:	
	Polyethylene liner and Acetabular shell, and their assembly.	
11	Introduction to 3D printing technology, familiarization with slicing	Project, Presentation
	software, 3D printing prototype of a biological structure.	
12	3D Printed Final Project Presentation	
13	Final Lab Test	
14	Quiz and Viva	

Assessment Methods

T, MID, F

T, MID, F

	T STRATEGY		20	
Comp	ponents	Grading	CO	Blooms Taxonomy
Continuous Assessment	Report/ Assignment	10%	CO1, CO2	C6
(20%)	Class Participation	10%	CO1, CO2	C6
	Lab Tests	40%	CO1, CO2	C6
Final Exam	Project	20%	CO2	C6
(80%)	Quiz	10%	CO1, CO2	C6
	Viva	10%	CO1, CO2	C6
Total	Marks	100%		•
CO = Course	Outcome, C =	Cognitive Don	nain, P = Psychomotor Doma	in, A = Affective Domain)
REFERENCE	EBOOKS			
REFERENCE	E SITE			

6.1.3 **BME 105 Human Anatomy**

COURSE INFORMATION

Course Code	: BME 105	Lecture Contact Hours	: 3.00
Course Title	: Human Anatomy	Credit Hours	: 3.00
PRE-REQUISIT	`E		

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

main organs of the body

SYNOPSIS/RATIONALE

The course covers cells, tissues, organization and functions of tissues and organs of different physiological systems, organ damage and automated repairing system. Learning objectives will be achieved through a combination of lectures. In addition, students will participate in small group discussions of clinical case studies, make group presentations of topic appropriate biomedical devices, and prepare a term paper on the subject of their choice selected from a list of topics generated by the instructor.

OBJECTIVE

- 1. To provide a foundation in human anatomy appropriate for students of biomedical engineering
- 2. To analyze the structural composition of the human body from cellular to organ levels

COUI	RSE OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP		
CO1	Be able to describe the biochemical and structural organization of the body	C2	1	-	-	1		
CO2	Be able to understand the functions of the	C2	1	-	-	1		

Page | 170

						Cours	se Ojje	гей бу Б	VIL	Department
CO3	Be able to u	Inderstand some basic	pathologies	C2	3			1		ТЕ
	and how the	ey affect the function o	of the body	02	5	-	-	1		1, 1
(CP- 0	Complex Pro	blems, CA-Complex A	ctivities, KP-	Knowledge Pr	ofile,T -	– Test;	PR - 2	Project; (<u> 2</u> –	Quiz; ASG –
Assign	nment; Pr – P	resentation; R - Report	t; F – Final Ex	(am)						
C1 - R	Remember	C2 – Understand	C3 - Apply	C4 - Ana	lyze	C5 –	Evalua	ite	C6	- Create
		•	•							

COURSE CONTENT

Human cell: Structure of cell. Structure and functions of cell membrane and nucleus. Types of cellular organelles. Structure and functions of each organelle; Tissues: Types of tissues with their functions; Skeletal System: Components. Exoskeleton/endoskeleton. Bones of axial and appendicular skeleton. Organic and inorganic composition of bone. Functions of each composition. Effect of loss of Organic and inorganic composition. Classification of bones with example. Bones of different regions of the body. Functions of bone/skeleton Types of cartilage with example and functions; Joints: Definition, Classification of joints. Characteristic features of each type with example. Joints of thorax, upper limb, lower limb, Head-neck, vertebral column with types. Line of gravity. Weight transmission through the body; Muscle: Characteristic features and Functions of different types of muscles .Classification of skeletal muscles with example. Regional muscles: characteristic features and action of important muscle such as deltoid, biceps brachii, triceps, rectus abdominis, gluteal muscles, calf muscles muscles of back of the trunk; Mediastinum: Definition, Division, contents of mediastinum; Circulatory System: types and characteristic features of each type of circulation; Cardiovascular system: parts and functions of cardiovascular system. Gross feature of pericardium, pericardial sac and heart. Conducting system of heart: location and functions; Lymphatic system: Parts and functions of lymphatic system; Respiratory System: Parts of different zones of respiratory tract. Gross features and functions of pleura and lungs. Differences between right and left principal bronchus. Structure and functions of respiratory membrane. Muscles of respiration; Digestive System: Parts of digestive system. Extension, termination and constrictions of oesophagus. Gross features and functions of different parts of digestive system. Gross features and functions of liver and pancreas. Parts of extra hepatic biliary apparatus; Urinary System: parts of urinary system. Gross features and functions of different parts of urinary system; Reproductive System: Parts of Female and male reproductive system and their functions; Nervous System: Brain: different parts of brain and their functions. Spinal cord: beginning, termination and supports. Cranial nerves: motor, sensory and mixed cranial nerves; Meninges: Different parts of meninges, spaces between the meninges with their contents; Cavities/ canals: contents of thoracic cavity, abdominal cavity, pelvic cavity, cranial cavity, orbit, vertebral canal; Ear: different parts of ear with their functions; Eye Ball: parts and functions of different layers of eyeball .Refractive media of eyeball; Integumentary System: Parts and functions of skin and skin appendages; Endocrine gland: definition, location, secretion and functions of endocrine glands. Differences between exocrine and endocrine glands.

No.	Course Learning Outcome				PR	OGI	RAM	1 O U	JTCC	OMES	5 (PO))	
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to describe the biochemical and	3											
COI	structural organization of the body	5											
CO2	Be able to understand the functions of the	3											
002	main organs of the body	5											
	Be able to understand some basic												
CO3	pathologies and how they affect the			2									
	function of the body												
(Numer	ical method used for mapping which indicate	s 3 as	s high	n, 2 as	s me	diun	n, an	d 1 a	is low	leve	l of m	natching	g)

		erea by BME Department
TEACHING L	EARNING STRATEGY	
	earning Activities	Engagement (hours)
Face-to-Face Le		
Lectur	e	42
Practic	cal / Tutorial / Studio	-
Studer	nt-Centered Learning	-
Self-Directed L	earning	
Non-fa	42	
	on of the previous and (or) subsequent lecture at home	21
Prepar	21	
Formal Assessn		
Contin	2	
Final I	3	
Total		131
TEACHING M	IETHODOLOGY	
Lecture and dis	cussion, Co-operative and collaborative method, Problem based method	
COURSE SCH	IEDULE	
Week	Content	Assessment
1	Course introduction	
Lecture 1	Introduction to Anatomy	
Lecture 2	Introduction to Living cells	
Lecture 3	Human cell: type, composition, Cell membrane.	
2	Cell Biology	
Lecture 4	Nucleus Chromosome & abnormalities.	
Lecture 5	DNA, RNA, Gene	
Lecture 6	Organelles-Type, Mitochondria, ER, Golgi, Lysosome	CT – 1 and Midterm,
3		Final
Lecture 7	Ribosome Cytoskeleton inclusions.	
	Tissues	
Lecture 8	Types of tissues with their functions, Epithelial tissue.	
Lecture 9	Connective tissue.	
4	Skeletal system	
Lecture 10	Components, types, Bones of axial & appendicular skeleton.	
	Bones- features, classification, composition, blood supply function.	
	Bones of different regions of the body.	
Lecture 11	Cartilage: features, types, distributions.	
Lecture 12	Joint: Definition, Classification, Example of joints in different	
	regions, stability of the joint.	
5	Muscular system	
Lecture 13	Types of muscles, Skeletal muscle.	
Lecture 14	Smooth & cardiac muscle.	
Lecture 15	Regional muscles: features & action	Midterm, Final
6	CVS	

Lecture 16		
Lecture 17	Mediastinum Cardiovascular system.	-
Lecture 17	Features of pericardium sac, Heart, Conducting system of heart.	-
	Respiratory system.	-
7 Lecture 19		-
Lecture 19	Parts of respiratory system, Trachea, Bronchus, Bronchial tree, Respiratory membrane, RDS.	
Lecture 20	Lungs, pleura, respiratory muscles.	
	Lymphatic system	-
Lecture 21	Parts, functions, lymph nodes, spleen, lymphatic vessels.	
	MIDTERM	
8	Digestive system	
Lecture 22	Parts, extension, features, Oesophagus, Stomach, Intestine.	
Lecture 23	Liver, Biliary apparatus.	
Lecture 24	Pancreas, Digestive glands.	
9	Urinary system	1
Lecture 25	Parts, kidney.	
Lecture 26	Ureter, Urinary bladder, Urethra.	
	Reproductive system	
Lecture 27	Male genital system	
10		-
Lecture 28	Female genital system.	CT – 2, FINAL
	Nervous system	
Lecture 29	Brain - Parts	
Lecture 30	Meninges, Spinal cord.	
11		
Lecture 31	Cranial nerves. (1-6)	
Lecture 32	Cranial nerves. (7-12)	
Lecture 33	Spinal nerves, Autonomic nervous system.	
12	Cavities/Canals of the body	
Lecture 34	Thoracic, abdominal & pelvic cavities.	
Lecture 35	Cranial cavity. Orbit, vertebral canal.	
	Integumentary system.	
Lecture 36	Skin	
13	Glands	1
Lecture 37	Exocrine glands	CT – 3, FINAL
Lecture 38	Thyroid & parathyroid glands	1
Lecture 39	Pituitary glands	1
14	Sensory organs]
Lecture 40	Eye	1
Lecture 41	Nose	1
Lecture 42	Ear]
	FINAL EXAMINATION	•

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Components		Grading	CO	Blooms Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C2
Assessment (40%)	Class Participation	5%	CO2	C2
	Midterm	15%	CO1, CO2	C2
			CO 1	C2
Fina	l Exam	60%	CO 2	C2
			CO 3	C2
Tota	Marks	100%		
(CO = Cours TEXT BOOI	e Outcome, C = C	Cognitive Domai	n)	
1. Essential	s of Anatomy and	physiology, by V	alerie C. Scanlon and Tina San	ders.
2. Seeley's	Essentials of Anat	omy and physiolo	ogy, by Cinnamone Vanputte, J	ennifer Regan, Andrew Russo
DEFEDENC	E BOOKS			
REFERENC			atta	
	Human Anatomy V	/ 01-1, 2, 3. A.K.D	alla.	

6.1.4 BME 201 Human Physiology

Τ

COURSE INF	ORMATION					
			: 3.00			
Course Code	: BME 201	Lecture Contact Hours	: 3.00			
Course Title	: Human Physiology	Credit Hours				
PRE-REQUIS	ITE					
BME 105 – Hui	nan Anatomy					
CURRICULUM STRUCTURE						
Outcome Based	Education (OBE)					
SYNOPSIS/RA	TIONALE					
The course cov	vers cell, tissues, homeostasi	s, functions of different phys	siological systems and their neural and			
hormonal regula	ation, contribution to disease of	development when these physic	ological functions are dysregulated.			
OBJECTIVE						
1. To introduc	e students to a systems app	roach to the normal physiolog	gical processes of the body to maintain			
homeostasis	5					
2. To provide	the foundation of informatio	n which will allow an increase	ed understanding of the changes seen in			
pathologica	l states studied further through	hout the program				
2 Dismodial and a survey of the many their minds for an lowing survey if the shipling and a low survey have set						

3. Biomedical engineers need to prepare their minds for analyzing, quantifying, thinking, and solving problems at the interface of engineering, medicine and biology. This course sets the basic concepts for future interfacing between engineering and physiology.

COUI	RSE OUTCO	OMES & GENERIC S	SKILLS							
No.		Course Outcome		Bloom's Taxonomy	РО	CP	CA	KP	Assessment Methods	
CO1	Be able to understand the functions of the main organs of the body			C2	1	-	-	1	T, MID, F	
CO2	Be able to understand some basic pathologies and how they affect the function of the body			C2, C4	1	-	-	1	T, MID, F	
CO3	Be able to explain and analyze the interface			C2, C4	2	-	-	1	T, F	
(CP- 0	Complex Pro	blems, CA-Complex A	ctivities, KP-	Knowledge Pr	ofile,T	– Test;	PR - 1	Project; Q	– Quiz; ASG –	
Assign	nment; Pr – P	Presentation; R - Report	t; F – Final Ez	xam)						
C1 - R	Remember	C2 – Understand	C3 – Apply	C4 - Analyze			Evalua	te (C6 - Create	
		•	•							

COURSE CONTENT

Definition, goal & importance of physiology. Homeostasis: definition. Major functional systems, control systems of the body. Cellular Physiology and Blood. Composition and function of blood, Types of blood cell, Erythropoiesis, Anaemia, Phagocytosis, Hemostasis. Cardiovascular Physiology: Properties of cardiac muscle, Generation of cardiac impulse and its conduction in the heart, Cardiac cycle, heart sound, action potential of cardiac muscle, ECG. Gastrointestinal Physiology: Physiological anatomy of gastrointestinal (GI) tract. Local hormones of GIT: name, functions & regulation of secretion. Renal physiology: Kidney, functions of kidneys. Respiration: Mechanism, Pulmonary and Alveolar ventilation Pulmonary volumes and capacities and dead space, Respiratory unit and respiratory membrane, Diffusion of Gases through the respiratory membrane, Transport of Oxygen and Carbon dioxide in blood. Thermoregulation. Hormones: Definition, Classification, mechanism of action, regulation of secretion and synapse, action potential of nerve fiber. Functional organization and functions of major levels of central nervous system

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to understand the functions of the main organs of the body	3											
CO2	Be able to understand some basic pathologies and how they affect the function of the body	3											
CO3	Be able to explain and analyze the interface of Human biology and engineering		3										
(Numer	ical method used for mapping which indicate	s 3 as	s higl	n, 2 a	s me	diun	ı, an	d 1 a	ıs low	v leve	l of n	natching	g)
-	HING LEARNING STRATEGY									En	gagen	nent (ho	ours)
	-Face Learning										0 0	. (,

Course Offered by BME Department Lecture 42 Practical / Tutorial / Studio -Student-Centered Learning _ Self-Directed Learning Non-face-to-face learning 42 Revision of the previous and (or) subsequent lecture at home 21 Preparation for final examination 21 Formal Assessment 2 Continuous Assessment **Final Examination** 3 Total 131

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	Content	Assessment
1	Course introduction	
Lecture 1	Motivation & introduction to Human Physiology	
Lecture 2	Organs of Physiological systems and functions	
Lecture 3	Engineering perspective to Human Physiology	
2	Cells differentiation and Homeostasis	
Lecture 4	Cell to cell interaction or Cell communication	
Lecture 5	Cell differentiation mechanisms	
Lecture 6	Feedback system in Homeostasis	CT – 1 and Midterm,
3	Tissue	Final
Lecture 7	Epithelial Tissue	
Lecture 8	Connective Tissue	
Lecture 9	Neural and Muscle tissue	
4	Blood	
Lecture 10	Composition and function of blood	
Lecture 11	Types of blood cell, Erythropoiesis	
Lecture 12	Anaemia, Phagocytosis, Hemostasis	
5	Cardiovascular Physiology	
Lecture 13	Properties of cardiac muscle and role in blood flow	
Lecture 14	Generation of cardiac impulse and its conduction in the heart,	
	Cardiac cycle, heart sound,	
Lecture 15	Action potential of cardiac muscle, ECG	
6	Nervous System	
Lecture 16	Classification of nervous system	Midterm, Final
Lecture 17	Neurons and Glial cells, Synapses	
Lecture 18	Action potential of nerve fiber	
7	Immune system	
Lecture 19	Cellular and humoral response to infection	
Lecture 20	T helper cell differentiation, regulation and function	
Lecture 21	Crosstalk between Nervous system and Immune system	

	MIDTERM	
8	Muscular System	
Lecture 22	Function and structure of muscle	
Lecture 23	Neuromuscular junction	
Lecture 24	Muscle contraction	7
9	Respiratory System	
Lecture 25	Function and structure of Lungs	7
Lecture 26	Systemic and pulmonary respiration	
Lecture 27	Respiratory regulation	7
10	Gastrointestinal Physiology	7
Lecture 28	Physiological anatomy of gastrointestinal (GI) tract	
Lecture 29	Local hormones of GIT	CT – 2, FINAL
Lecture 30	Regulation of secretion	
11	Renal System	
Lecture 31	Introduction and function of Kidney	
Lecture 32	Glomerular filtration rate (GFR)	
Lecture 33	Regulation on kidney function	
12	Endocrine System	
Lecture 34	Types of Glands	
Lecture 35	Types of Hormones	7
Lecture 36	Mechanisms of hormone action	-
13	Hemodynamics and blood vessels	
Lecture 37	Structure and functions of blood vessels	
Lecture 38	Mechanical properties of blood vessels	
Lecture 39	Engineering approach to blood pressure, flow and resistance.	CT – 3, FINAL
14	Reproductive System, Ear and Eye	7
Lecture 40	Introduction to reproductive system	7
Lecture 41	Hearing mechanism	7
Lecture 42	Vision mechanism	7
	FINAL EXAMINATION	

ASSESSMENT STRATEGY

Comr	Components Grading		СО	Blooms Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C2
(40%)	Class	5%	CO3	C2
	Midterm	15%	CO1, CO2	C2
			CO 1	C2
Final	Exam	60%	CO 2	C2
			CO 3	C2
Total	Total Marks 100%			
(CO = Course	e Outcome, C = C	Cognitive Doma	in)	
TEXT BOOK	KS			

1. Essentials of Anatomy and physiology, by Valerie C. Scanlon and Tina Sanders.

REFERENCE BOOKS

1. Seeley's Essentials of Anatomy and physiology, by CinnamoneVanputte, Jennifer Regan, Andrew Russo **REFERENCE SITE**

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6.1.5 BME 203 Biochemistry

	SE INFUI	RMATION								
						: 3.00)			
Course	e Code	: BME 203	Lect	ure Contact H	ours	: 3.00)			
Course	e Title	: Biochemistry	stry Credit Hours							
PRE-I	REQUISIT	E								
		eral Chemistry; CHEM 125 -	- Physic	cal and Bio-or	ganic C	hemist	ry			
		STRUCTURE								
Outcor	me Based E	ducation (OBE)								
	OPSIS/RAT									
		to introduce students to structur		•		• •				
	-	tures. Concepts in enzyme kine		-					-	
		cid structures, and DNA and I			-					
		pid, and protein are analyzed	in deta	il. The genera	ation ar	nd prop	agation	n of bioe	electric potentials	
across	membrane	channels are also covered.								
OBJE	CTIVE									
1. To	o understand	the basic concepts of enzyme	kinetic	s						
2. To	describe th	e structure and mechanisms of	nuclei	e acid, DNA, I	RNA, ai	nd gene	etic eng	gineering		
3. To	o explain ai	nd analyze the pathways of o	xidatio	n, energy trai	nsfer, a	nd me	tabolis	m of ene	ergy sources and	
im	portant bio	nolecules								
4. To	o explain an	d above staving a stick water tiel .								
COUL		d characterize action potential	generat	ion and impul	se propa	agation	in mer	nbranes	and nerve fibers	
COUL	RSE OUTC	OMES & GENERIC SKILL	-	ion and impul	se propa	agation	in mer	nbranes	and nerve fibers	
No.	RSE OUTC		-	Bloom's	se propa	agation CP	in mer	mbranes KP	Assessment	
		OMES & GENERIC SKILL Course Outcome	S						and nerve fibers Assessment Methods	
	Be able to kinetics	COMES & GENERIC SKILL Course Outcome o understand concepts of end	S zyme	Bloom's					Assessment	
No.	Be able to kinetics Be able	Course Outcome course Outcome to understand concepts of ent to remember the structure	S zyme and	Bloom's Taxonomy C2	РО			KP	Assessment Methods T, MID, F	
No. CO1	Be able to kinetics Be able chemistry	Course Outcome counderstand concepts of en to remember the structure of genetic material such as DN	S zyme and IA	Bloom's Taxonomy	PO 1	СР -	CA -	KP 1	Assessment Methods	
No. CO1	Be able to kinetics Be able chemistry Be able to	COMES & GENERIC SKILL Course Outcome o understand concepts of en- to remember the structure of genetic material such as DN understand the processes invo	S zyme and IA	Bloom's Taxonomy C2	PO 1	СР -	CA -	KP 1	Assessment Methods T, MID, F MID, F	
No. CO1 CO2	Be able to kinetics Be able chemistry Be able to in digestic	COMES & GENERIC SKILL Course Outcome o understand concepts of en- to remember the structure of genetic material such as DN understand the processes invo on and metabolism	S zyme and IA olved	Bloom's Taxonomy C2 C1	PO 1 1	СР -	CA -	КР 1 1	Assessment Methods T, MID, F	
No. CO1 CO2 CO3	Be able to kinetics Be able chemistry Be able to in digestic Be able	COMES & GENERIC SKILL Course Outcome o understand concepts of ent to remember the structure of genetic material such as DN understand the processes invo on and metabolism to understand the concep	S zyme and IA olved ot of	Bloom's Taxonomy C2 C1 C2	PO 1 1 1 1	СР -	CA -	KP 1 1	Assessment Methods T, MID, F MID, F T, F	
No. CO1 CO2	Be able to kinetics Be able chemistry Be able to in digestic Be able bioelectric	COMES & GENERIC SKILL Course Outcome o understand concepts of en- to remember the structure of genetic material such as DN understand the processes invo on and metabolism to understand the concep- sity, membrane channels and	S zyme and IA olved ot of	Bloom's Taxonomy C2 C1	PO 1 1	СР -	CA -	КР 1 1	Assessment Methods T, MID, F MID, F	
No. CO1 CO2 CO3 CO4	Be able to kinetics Be able chemistry Be able to in digestic Be able bioelectric propagatio	COMES & GENERIC SKILL Course Outcome to understand concepts of en- to remember the structure of genetic material such as DN understand the processes invo on and metabolism to understand the concep- city, membrane channels and on of potentials	S zyme and IA olved ot of 1 the	Bloom's Taxonomy C2 C1 C2 C2 C2	PO 1 1 1 1 1		CA - - -	KP 1 1 1	Assessment Methods T, MID, F MID, F T, F T, F	
No. CO1 CO2 CO3 CO4 (CP- C	Be able to kinetics Be able chemistry Be able to in digestic Be able bioelectric propagatic Complex Pro	COMES & GENERIC SKILL Course Outcome o understand concepts of en- to remember the structure of genetic material such as DN understand the processes invo on and metabolism to understand the concep- city, membrane channels and on of potentials oblems, CA-Complex Activitie	S zyme and IA olved ot of 1 the es, KP-I	Bloom's Taxonomy C2 C1 C2 C2 C2 Knowledge Pr	PO 1 1 1 1 1		CA - - -	KP 1 1 1	Assessment Methods T, MID, F MID, F T, F T, F	
No. CO1 CO2 CO3 CO4 (CP- C Assign	Be able to kinetics Be able chemistry Be able to in digestic Be able bioelectric propagatic Complex Pre-	COMES & GENERIC SKILL Course Outcome to understand concepts of en- to remember the structure of genetic material such as DN understand the processes invo- on and metabolism to understand the concep- tity, membrane channels and on of potentials oblems, CA-Complex Activitie Presentation; R - Report; F – F	S zyme and IA olved ot of 1 the es, KP-1 inal Ex	Bloom's Taxonomy C2 C1 C2 C2 C2 Knowledge Pr am)	PO 1 1 1 1 ofile,T	- Test;	CA - - - PR –	KP 1 1 1 Project; (Assessment Methods T, MID, F MID, F T, F T, F Q – Quiz; ASG –	
No. CO1 CO2 CO3 CO4 (CP- C Assign	Be able to kinetics Be able chemistry Be able to in digestic Be able bioelectric propagatic Complex Pro	COMES & GENERIC SKILL Course Outcome to understand concepts of en- to remember the structure of genetic material such as DN understand the processes invo- on and metabolism to understand the concep- sity, membrane channels and on of potentials oblems, CA-Complex Activitie Presentation; R - Report; F – F	S zyme and IA olved ot of 1 the es, KP-I	Bloom's Taxonomy C2 C1 C2 C2 C2 Knowledge Pr	PO 1 1 1 1 ofile,T	- Test;	CA - - -	KP 1 1 1 Project; (Assessment Methods T, MID, F MID, F T, F T, F	
No. CO1 CO2 CO3 CO4 (CP- C Assign	Be able to kinetics Be able chemistry Be able to in digestic Be able bioelectric propagatic Complex Pre-	COMES & GENERIC SKILL Course Outcome to understand concepts of en- to remember the structure of genetic material such as DN understand the processes invo- on and metabolism to understand the concep- tity, membrane channels and on of potentials oblems, CA-Complex Activitie Presentation; R - Report; F – F	S zyme and IA olved ot of 1 the es, KP-1 inal Ex	Bloom's Taxonomy C2 C1 C2 C2 C2 Knowledge Pr am)	PO 1 1 1 1 ofile,T	- Test;	CA - - - PR –	KP 1 1 1 Project; (Assessment Methods T, MID, F MID, F T, F T, F Q – Quiz; ASG –	

ENZYMES KINETICS: Enzymes mechanism and activation energy; enzyme thermodynamics; kinetics and inhibition; Mikhaelis-Menten equation, inhibition, and regulation of enzyme activity

NUCLEIC ACID: nucleotides, Nucleotide Metabolism, DNA, RNA composition and simple structure; replication, transcription and translation, DNA repair and mutation, Recombination and Transposition, Genetic code and genetic engineering, RNA Synthesis and Regulation

VITAMINS AND COENZYMES.

Vitamins and coenzymes. Digestion of polysaccharides, lipids and proteins. Metabolism and energy transfer; Integration of Metabolism and Signal Transduction, glycolysis and oxidative phosphorylation; biological high-energy compounds. Oxidation of fatty acids and oxidative degradation of amino acids. Glucagenosis, Krebs Cycle, pyruvate dehydrogenase complex, cholesterol and steroid metabolism, Photosynthetic phosphorylation. Inter relationship and control metabolism. Some inborn errors of metabolism

BIOELECTRICITY: Introduction to Bioelectricity and Excitable Cells. Bioelectric potentials and currents: ionic composition of excitable cells, Nernst-Planck equation, membrane structure, Nernst potential, parallel-conductance model; membrane channels: channel structure, biophysical methods for measuring channel properties

No.	Course Learning Outcome				PR	OGI	RAM	100	TCO	MES	(PO)		
INU.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to understand concepts of enzyme kinetics	3											
CO2	Be able to remember the structure and chemistry of genetic material such as DNA	3											
CO3	Be able to understand the processes involved in digestion and metabolism	3											
CO4	Be able to understand the concept of bioelectricity, membrane channels and the propagation of potentials	3											
(Numer	ical method used for mapping which indicates	3 as	high	, 2 as	med	lium	, and	11 a	s low	level	l of m	atching	g)
	HING LEARNING STRATEGY												
	ng and Learning Activities									Eng	gagem	ent (ho	ours)
Face-to-	-Face Learning												
	Lecture											42	
	Practical / Tutorial / Studio											-	
	Student-Centred Learning											-	
Self-Di	rected Learning												
	Non-face-to-face learning											42	
	Revision of the previous and (or) subsequent	lect	ure at	hom	e							21	
	Preparation for final examination											21	
Formal	Assessment												
	Continuous Assessment											2	
	Final Examination											3	
Total											1	31	
TEAC	HING METHODOLOGY												

COURSE SCHED	ULE	
Week	Content	Assessment
1	Course introduction	135655116116
Lecture 1	Motivation & introduction to biochemistry	
Lecture 2	Introduction to enzymes kinetics	
Lecture 3	Enzymes mechanism and activation energy	
2	Enzyme kinetics	CT – 1 and Midterm,
Lecture 4	Enzyme thermodynamics	Final
Lecture 5	kinetics and inhibition	
Lecture 6	kinetics and inhibition	
3	Enzyme kinetics continued	
Lecture 7	Mikhaelis-Menten equation	
Lecture 8	inhibition of enzyme activity	
Lecture 9	regulation of enzyme activity	
4	Nucleic acid	
Lecture 10	Nucleotides, Nucleotide Metabolism	
Lecture 11	Composition of DNA and RNA, simple structure	
Lecture 12	Replication, transcription and translation	
5	Nucleic acid continued	
Lecture 13	Replication, transcription and translation	
Lecture 14	DNA repair and mutation	
Lecture 15	DNA repair and mutation	
6	Nucleic acid continued	
Lecture 16	Recombination and Transposition	
Lecture 17	Genetic code and genetic engineering	Midterm, Final
Lecture 18	RNA Synthesis and Regulation	
7	Vitamins and coenzymes; Metabolism	
Lecture 19	Introduction to vitamins and their types	
Lecture 20	Digestion of polysaccharides, lipids, and proteins	
Lecture 21	Metabolism and energy transfer	
	MIDTERM	
8	Digestion and metabolism	
Lecture 22	Integration of Metabolism and Signal Transduction	
Lecture 23	Integration of Metabolism and Signal Transduction	
Lecture 23	Glycolysis and oxidative phosphorylation	
9	Energy transfer and phosphorylation	
Lecture 25	Glycolysis and oxidative phosphorylation	
Lecture 26	biological high-energy compounds	CT – 2, FINAL
Lecture 27	Oxidation of fatty acids and oxidative degradation of amino	
Lecture 27	acids	
10	Gluconeogenesis and Krebs cycle	
Lecture 28	Gluconeogenesis	
Lecture 29	Gluconeogenesis	
Lecture 30	Krebs Cycle	
11	Energy transfer and phosphorylation continued	

T

Lecture 31	Pyruvate dehydrogenase complex	
Lecture 32	Cholesterol and steroid metabolism	
Lecture 33	Pentose phosphate pathway	
12	Metabolism control	CT – 3, FINAL
Lecture 34	Photosynthetic phosphorylation	
Lecture 35	Interrelationship and control metabolism	
Lecture 36	Some inborn errors of metabolism	
13	Bioelectricity	
Lecture 37	Introduction to Bioelectricity and Excitable Cells.	
Lecture 38	Bioelectric potentials and currents: ionic composition of	
	excitable cells	
Lecture 39	Nernst-Planck equation, membrane structure, Nernst potential	
14	Bioelectricity continued	FINAL
Lecture 40	Parallel-conductance model	FINAL
Lecture 41	membrane channels: channel structure	
Lecture 42	biophysical methods for measuring channel properties	
	FINAL EXAMINATION	

ASSESSMENT STRATEGY

		Grading	СО	Blooms Taxonomy
Comp	Components			5
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2
(40%)	(40%) Class Participation		CO2	C1
	Midterm	15%	CO1, CO2	C1, C2
			CO 1	C2
Einal	Exam	60%	CO 2	C1
Fillal	Exam	00%	CO 3	C2
			CO 4	C2
Total	Marks	100%		

(CO = Course Outcome, C = Cognitive Domain)

TEXT BOOKS

1. Fundamentals of Enzyme Kinetics – 4th edition, Athel Cornish-Bowden.

2. Lehninger Principles of Biochemistry- 4th Edition, by Albert L. Lehninger, David L. Nelson, and Michael M. Cox.

REFERENCE BOOKS

 Harper's Illustrated Biochemistry- 28th Edition by Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil.

2. Bioimpedance and Bioelectricity Basics, S. Grimnes and O.G. Martinsen, Academic Press, 2000

REFERENCE SITE

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6.1.6 BME 204 Biochemistry Sessional

COURSE INFORMATION				
Course Code Course Title	: BME 204 : Biochemistry Sessional	Lecture Contact Hours Credit Hours	: 3.00 : 1.50	
PRE-REQUIS				

Course Code: BME 203

Course Title: Biochemistry

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course covers the application of biochemistry and associated laboratory techniques using experiments detecting biologically relevant substances such as glucose, cholesterol, and insulin.

OBJECTIVE

This course aims to enhance students' knowledge on the basic principles of biochemical reactions and their applications.

COURSE OUTCOMES & GENERIC SKILLS

No.		Course Outcome	2	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Be able to biochemica and lipis.	C4	2, 5	-	-	1	T, Q, R		
CO2		analyze the quant cholesterol, insulin,		C4	2, 5	-	-	1	T, Q, R
CO3	as centrifu	apply laboratory tec gation, chromatograj tometry, and immur	phy,	C3	2, 5	-	-	1	T, Q, R
`		blems, CA-Complex Presentation; R - Rep	-	e	ofile, T				
C1 - R	C1 - Remember C2 - Understand C3 - Apply				yze	C5 -	- Evalu	ate C	6 - Create

COURSE CONTENT

Detection of carbohydrate in an unknown solution using Molisch's Test, Qualitative analysis of protein content using Biuret Test, Qualitative test for detecting the presence of lipids, Estimation of glucose content using colorimetric analysis, Preparation of serum and plasma from blood by centrifugation, Determination of blood glucose levels using enzymatic spectrophotometric analysis, Estimation of blood cholesterol content, Estimation of blood creatinine content, Separation of mixture components using high-performance liquid chromatography (HPLC), Measurement of insulin, Measurement of cortisol.

No.	Course Learning Outcome				PR	.OGI	RAM	1 O L	TCC	OMES	(PO)		
110.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to analyze the content of different												
CO1	biochemicals such as carbohydrates,		3			3							
	proteins, and lipis.												
	Be able to analyze the quantity of glucose,												
CO2 creatinine, cholesterol, insulin, and 3 3													
CO3	Be able to apply laboratory techniques such as centrifugation, chromatography,		3			3							
005	spectrophotometry, and immunoassay.		3			5							
(Numeri	cal method used for mapping which indicates	3 95	high	2 2	s me	dium	n an	d 1 a	s low	i leve	lofm	atching	 ז)
(ittaineri	an method used for mapping which maleuter	, 5 u	, mgn	, 2 u			i, uii		5 10 0		I OI III		5)
TEACH	ING LEARNING STRATEGY												
-	g and Learning Activities									Eng	gagen	nent (he	ours)
Face-to-	Face Learning												,
	Lecture											7	
	Practical / Tutorial / Studio											35	
	Student-Centered Learning											-	
Self-Dire	ected Learning												
	Non-face-to-face learning											-	
	Revision of the previous and (or) subsequent	t lect	ure at	t hon	ne							15	
	Preparation for final examination											10	
Formal A	Assessment												
	Continuous Assessment											1	
	Lab Test											1	
	Quiz										0	0.75	
	Viva										0	0.25	
Total												70	
TEACH	ING METHODOLOGY												
Lecture	and discussion, Co-operative and collaborativ	/e me	ethod	, Pro	blem	ı bas	ed n	nethc	d				
	E SCHEDULE												

Week		Ι	Lecture Topics		Assessment				
1		o the course, la atroduction to C	boratory rules, safety rules, and hemDraw	laboratory					
2	Use of colorir	npounds							
3	Detection of c	lisch's Test	Report, Lab Test, Quiz,						
4	Detection of r		Viva						
5									
6									
7	Lab Quiz								
8	Determination spectrophotor	n of blood netric analysis	glucose levels using	enzymatic					
9	Preparation of	on	Report, Lab Test, Quiz,						
10	Preparation a	nd visual exami	nation of a blood smear		Viva				
11	Counting RB	Cs and WBCs u	using a hematocytometer		v i vu				
12	Separation of chromatograp		stituents from a sample usin	g thin line					
13	Identification chromatograp		onstituents using high perform	nance liquid					
14	Final lab test	+ viva							
ASSESSME	NT STRATEGY	Y							
			СО	В	looms Taxonomy				
Comp	oonents	Grading			Bioonis Taxonomy				
Continuous	Report	20%	CO1, CO2, CO3		C4, C3				
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3		C4, C3				
	Lab Test	20%	CO1, CO2, CO3		C4, C3				

TENT DOO	170			
(CO = Cours	se Outcome, C =	= Cognitive Do	main, P = Psychomotor Doma	in, A = Affective Domain)
Total	Marks	100%		
(0070)	Viva	10%	CO1, CO2, CO3	C4, C3
(60%)	Quiz	30%	CO1, CO2, CO3	C4, C3
Final Exam				

TEXT BOOKS

Final Exam

1. Lab Manual in Biochemistry, Immunology, and Biotechnology by Nigam, A & Ayyagari, A. 2008, McGraw Hill **Education Publications**

2. Biochemistry Laboratory: Modern Theory and Techniques (2nd Edition), by Boyer, RF. 2011, Prentice Hall Publications

REFERENCE SITE

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: 3.00

: 3.00

6.1.7 BME 205 Biofluid Mechanics and Heat Transfer

COURSE INFORMATION

Course Code Course Title : BME 205 : Biofluid Mechanics and Heat Transfer

d Lecture Contact Hours Credit Hours

PRE-REQUISITE

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course covers the topics/subtopics that include fluid continuum, forces acting on a fluid, Surface tension, Statics of fluids, manometers, fluids in motion, shear stress and classification of fluids, principles of continuity, conservations of mass, energy and momentum and their applications, laminar and turbulent flows and boundary layer, introduction to Navier Stoke equation, modes of heat transfer, heat transfer in living body, bioheat transfer modeling, temperature measuring devices.

OBJECTIVE

- 1. To understand basic laws of fluid mechanics.
- 2. To solve different fluid mechanics equations and apply them to real-world problems.
- 3. Apply principles of heat and mass transfer to basic engineering systems.
- 4. To analyze heat transfer by conduction, convection, and radiation.
- 5. To understand the working principle temperature measuring device.

COURSE OUTCOMES & GENERIC SKILLS

		Course Outcome		Taxonomy	PO	CP	CA	KP	Methods
$COI \perp$	Be able to biofluid me	•	explain different equations in hanics.			1 -		1, 3	T, F
CO2		o apply different la to physiological flow		C3	2	1, 3	-	1, 3	T, F
$CO3 \perp$		understand and expl er mechanisms.	ain different	C2	1	1	-	1	MID, F
CO4	problems, of field involve	to analyze basic h occur in Biomedical ving Conduction, Con or providing appropria	Engineering nvection and	C4	2	1, 3	-	1, 3	T, F
`		olems, CA-Complex A resentation; R - Repo	-	e	ofile, T	– Test;	PR –	Project; (Q – Quiz; ASG –
C1 - Re	emember	C2 - Understand	C3 - Apply	C4 - Ana	lyze	C5 - 1	Evalua	te	C6 - Create

Concept of fluid continuum, forces acting on a fluid, Surface tension, Statics of fluids: equation of static equilibrium, manometers, forces on submerged surfaces; Fluids in motion: concept of shear stress and classification of fluids; Fluid flow in closed conduits; laminar and turbulent flow; friction factor; control volume analysis: balance of mass, momentum and energy; continuity equation; momentum equation; Bernoulli's principle; Newton's law of viscosity, Navier-Stokes equations, Exact solutions of Navier-stokes equations, Couette flow, Poiseuille flow, the Rayleigh problem.

Basic modes of heat transfer; Introduction to Heat Transfer in Biological System, steady-state heat conduction through a layered surface with different thermophysical properties; Effect of metabolism on heat transfer, transient (unsteady-state) heat conduction; Heat transfer with phase change; Different approaches in bioheat transfer modeling; Thermal regulation of human body; Theoretical determination of thermal properties for biomaterial and experimental techniques; Temperature measuring devices.

	Course Learning Outcome				PR	OGI	RAN	1 O L	JTCC	OMES	5 (PO)		
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to analyze different equations in biofluid mechanics.	3											
CO2	Be able to apply different laws of fluid mechanics to physiological flow systems.		3										
CO3	Be able to explain heat and different heat transfer mechanisms.	3											
CO4	Be able to evaluate basic heat transfer problems occur in Biomedical Engineering field involving Conduction, Convection and Radiation for providing appropriate solutions.		3										
(Numer	rical method used for mapping which indicates	s 3 as	s high	, 2 as	s me	dium	i, an	d 1 a	is low	v leve	l of m	atching	g)
	HING LEARNING STRATEGY												
	ng and Learning Activities									En	gagen	nent (ho	ours)
Face-to	-Face Learning												
	Lecture											42	
	Practical / Tutorial / Studio											-	
	Student-Centred Learning											-	
Self-Di	rected Learning												
Self-Di												42	
Self-Di	rected Learning	t lect	ure a	t horr	ne							42 21	
Self-Di	rected Learning Non-face-to-face learning	t lect	ure a	t horr	ne								
	rected Learning Non-face-to-face learning Revision of the previous and (or) subsequen	t lect	ure a	t hor	ıe							21	
	rected Learning Non-face-to-face learning Revision of the previous and (or) subsequen Preparation for final examination	t lect	ure a	t horr	ne							21	
	rected Learning Non-face-to-face learning Revision of the previous and (or) subsequen Preparation for final examination Assessment	t lect	ure a	t hor	ne							21 21	
	rected Learning Non-face-to-face learning Revision of the previous and (or) subsequen Preparation for final examination Assessment Continuous Assessment	t lect	ure a	t hom	ie							21 21 2	

Lecture and discussion, Co-operative and collaborative method, Problem based method

	Topic Introduction to Fluid Mechanics	
Lecture 2		
Lecture 2	Fluid as a continuum	
T (2	Introduction to shear stress and shear strain	
Lecture 3	Mechanical properties in physiological flow conditions	
2	Control Volume analysis	CT – 1, Final
Lecture 4	Control Volume, velocity field and flow rates	
Lecture 5	Fluid acceleration and its derivation	
Lecture 6	Fluid Statics	
3	Laws of conservation of Mass and Momentum	
Lecture 7	Conservation laws in fluid flow	
Lecture 8	Boundary conditions in fully formed flows	
Lecture 9	Derivation of Buoyancy equations	
4	Surface Tension	
Lecture 10	Surface tension in fluids	
Lecture 11	Surface tension in fluids	
Lecture 12	Surfactants and their roles in medicine and biology	
5	Newton's laws of viscosity and the Reynolds Number	
Lecture 13	Newton's laws of viscosity and different categories of fluid	
Lecture 14	Types of flows and Reynolds Number	
Lecture 15	Fluid flow in a rectangular cross-section	
6	Fluid flow in different cross-sections	Midterm, Final
Lecture 16	Fluid flow in a rectangular cross-section	
Lecture 17	Fluid flow in a cylindrical cross-section	
Lecture 18	Fluid flow in a cylindrical cross-section	
7	Principles in fluid mechanics	
Lecture 19	Bernoulli's principles	
Lecture 20	Navier-Stokes equation	
Lecture 21	Review Class	
	Midterm Break	
8	Modes of heat transfer	
Lecture 22	Overview of heat, relation between thermodynamic and heat	
	transfer	
Lecture 23	Conduction, Convection, and Radiation	
Lecture 24	Basic laws of heat conduction – Fourier's Law with derivation	
9	Thermal properties	
Lecture 25	Fourier's Law of conduction in different co-ordinate systems	CT – 2, Final
	and bioheat transfer in mammalian	
Lecture 26	Boundary conditions in heat transfer problems	
Lecture 27	Steady state heat conduction through a slab, layered slab with	
	different thermophysical properties (e.g. skin)	

				55	erea by BME Department			
Lecture 28			luction through a slab, layered cal properties (e.g. skin)	slab with				
Lecture 29		nermal resistivity and at transfer problems	d modeling thermal resistance in	different				
Lecture 30		eady state heat condu linder	uction through a cylinder and h	ollow				
11	C	onduction and The	rmoregulation					
Lecture 31			at transfer with relation to mam equation for mammalian tissue	mal size				
Lecture 32	St	eady state heat cond	uction with internal heat genera	tion				
Lecture 33	Pr	inciples of thermore	gulation					
12	H	eat Transfer throug	gh extended surfaces		CT – 3, FINAL			
Lecture 34			nsfer problem from extended	surfaces:				
		fferent boundary con						
Lecture 35		•		er from extended surfaces: examples				
1		athematical and real- ne bioheat equation a						
Lecture 36		oblem						
13		onvection						
Lecture 37	Tł	ne bioheat equation a	and multimodal heat transfer pro	oblem				
Lecture 38	Co	onvection and therma	al/velocity boundary layer					
Lecture 39	Lo	ocal and average con	vection co-efficient		FINAL			
14	H	eat Transfer in pha	se change					
Lecture 40	He	eat transfer with phas	se change					
Lecture 41	Fr	eezing of pure water	, solution, cells and tissues and	thawing				
Lecture 42	Re	eview Class						
ASSESSMEN	IT STRATEO	GY						
Comm	anonto	Grading	СО	I	Blooms Taxonomy			
Comp	oonents	-						
	Class Test Assignmen		CO1, CO3, CO4		C2, C4			
Continuous Assessment	1-3	11 20%	001, 003, 004		02,04			
(40%)	Class Participatio	on 5%	CO3		C2			
	Midterm	15%	CO2		C3			
	<u> </u>		CO 1		C2			
	- F		CO 2		C3			
Final	Exam	60%	CO 3	C2				
			CO 4					
Total	Marks	100%						
10101		10070						

(CO = Course Outcome, C = Cognitive Domain)

TEXT BOOKS

Biofluid Mechanics:

1. Applied Biofluid Mechanics, Lee Waite and Jerry Fine. ISBN -10: 0-07-147217-7

Heat Transfer:

1. Ashim K. Datta, Biological and Bioenvironmental Heat and Mass Transfer: Marcel Dekker, Inc., 2002.

REFERENCE BOOKS

Biofluid Mechanics:

1. A Brief Introduction to Fluid Mechanics, Young, Munson, and Okiishi; Fifth Edition

Heat Transfer:

1. Frank P. Incropera and David P. DeWitt, Fundamentals of Heat and Mass Transfer: John Wiley & Sons; 5th edition 2006.

REFERENCE SITE

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6.1.8 BME 206 Biofluid Mechanics and Heat Transfer Sessional

COURSE INFO	RMATION		
Course Code	: BME 206	Lecture Contact Hours	: 3.00
Course Title	: Biofluid Mechanics and	Credit Hours	: 1.50
	Heat Transfer Sessional		. 1.50
DDE DEQUISI			
PRE-REQUISIT			
Course Code: BN			
Course Title: Bic	ofluid Mechanics and Heat Tran	sfer	
CURRICULUM	I STRUCTURE		
Outcome Based I	Education (OBE)		
SYNOPSIS/RA7	ΓIONALE		
This course cove	rs the application of fluid mech	nanics and heat transfer in th	ne biological context using experimental
and computation	al knowledge.		
OBJECTIVE			
This course aims	to enhance students' knowledge	on the basic principles of flu	id mechanics and heat transfer solutions.
COURSE OUT	COMES & CENERIC SKILL	S	

RSE OUTCOMES & GENERIC SKILLS						
Course Outcome	Bloom's	DO	CD	CA	VD	Assessment
Course Outcome	Taxonomy	FU	Cr	CA	КГ	Methods
Be able to analyze the different hemodynamic						
and fluid flow scenarios for accessing the	C4	2		1	1	T, Q, R
physiological condition of human body.						
Be able to analyze different fluid flow						
behavior in human body using software to	C4 C5	5		1 2	1 2	T, Q, R,
evaluate and predict pathophysiological	04,03	5		1, 5	1, 2	ASG
conditions.						
	Course Outcome Be able to analyze the different hemodynamic and fluid flow scenarios for accessing the physiological condition of human body. Be able to analyze different fluid flow behavior in human body using software to evaluate and predict pathophysiological	Course OutcomeBloom's TaxonomyBe able to analyze the different hemodynamic and fluid flow scenarios for accessing the physiological condition of human body.C4Be able to analyze different fluid flow behavior in human body using software to evaluate and predict pathophysiologicalC4, C5	Course OutcomeBloom's TaxonomyPOBe able to analyze the different hemodynamic and fluid flow scenarios for accessing the physiological condition of human body.C42Be able to analyze different fluid flow 	Course OutcomeBloom's TaxonomyPOCPBe able to analyze the different hemodynamic and fluid flow scenarios for accessing the physiological condition of human body.C422Be able to analyze different fluid flow behavior in human body using software to evaluate and predict pathophysiologicalC4, C55	Course OutcomeBloom's TaxonomyPOCPCABe able to analyze the different hemodynamic and fluid flow scenarios for accessing the physiological condition of human body.C421Be able to analyze different fluid flow behavior in human body using software to evaluate and predict pathophysiologicalC4, C551, 3	Course OutcomeTaxonomyPOCPCAKPBe able to analyze the different hemodynamic and fluid flow scenarios for accessing the physiological condition of human body.C4211Be able to analyze different fluid flow behavior in human body using software to evaluate and predict pathophysiologicalC4, C551, 31, 2

							Со	urse	e Offe	ered b	y BM	E Depc	artment
CO3	Be able to apply the concept of heat transfer for assessing burn injury.	r	C.	3		2			1		1	Т	, Q, R
(CP- 0	Complex Problems, CA-Complex Activities, KI	P-Kn	owle	dge I	Profil	le, T	- Te	est;	PR –	Proje	ct; Q	– Quiz	; ASG -
Assig	nment; Pr – Presentation; R - Report; F – Final	Exar	n)										
C1 - R	RememberC2 - UnderstandC3 - Apply		C4	- An	alyze	e	C	25 -	Evalu	iate	C	6 - Cre	eate
COU	RSE CONTENT												
nor Spi vol	moulli's theorem with a venturi tube, Friction mal and pathological conditions, Rheological be rometric measurements of lung function test by umetric flow rate, Analysis of intravascular and a blood-perfused skin, Vessel segmentation from 6	ehav dete near-	ior of ermin -wall]	biol biol ation	ogica of F odyna	al flu FVC, amic	id a FEV s, St	nalo √s a udy	gs, Si nd M of fri	tudy α IVV τ ctiona	of dial ising t al flow	ysis m he con	achine, cept of
SKIL	L MAPPING												
					סק		<u> </u>	101	ITCC	MEG	5 (PO)		
No.	Course Learning Outcome	1	2	3	гк 4	5	6	7	8	9	10	11	12
CO1	Be able to analyze the different hemodynamic and fluid flow scenarios for accessing the physiological condition of human body.	1	3	5		5	0	1	0	,	10	11	12
CO2	Be able to analyze different fluid flow behavior in human body to evaluate and predict pathophysiological condition.					3							
CO3	Be able to apply the concept of heat transfer for assessing burn injury.		3										
(Numo	erical method used for mapping which indicates	3 as	s high	, 2 as	s me	dium	i, and	d 1 a	as low	v leve	l of m	atchin	g)
	CHING LEARNING STRATEGY												
	ing and Learning Activities									Eng	gagem	nent (ho	ours)
Face-t	to-Face Learning											_	
	Lecture											7 25	
	Practical / Tutorial / Studio Student-Centered Learning											35	
Self_F	Directed Learning											-	
SCII-L	Non-face-to-face learning											_	
	Revision of the previous and (or) subsequent	t leci	ture a	t hon	ne							15	
	Preparation for final examination											10	
Forma	al Assessment								1				
	Continuous Assessment											1	
	Lab Test											1	
	Quiz											.75	
	Viva										0	.25	

Total					70
TEACHING	METHODOLO	DGY			
Lecture and d	liscussion, Co-op	erative and colla	aborative method, Problem base	ed method	
COURSE SC	CHEDULE				
Week		La	ecture Topics		Assessment
1	Introduction		tics and associated software	for fluid	Assessment
	dynamics mod	•			
2	Analysis of ste	ented artery base	d on the intra aneurysmal flows	simulation	
3	Analysis of in	ntravascular and	l near-wall hemodynamic of b	oifurcation	
	-		nt-specific study		Report, Assignment, Lab
4	Segmentation MIMICS and		neurysm from CT image using N	<i>laterialize</i>	Test, Quiz, Viva
5	Study of Bern	oulli's theorem	with a venturi meter		
6	Study of bior conditions	nedical circulat	ory system in normal and pa	thological	
7	Lab Test 1				
			Midterm Break		
8		lysis of a dialys			
9			ng function test by determination cept of volumetric flow rate	on of FVC,	Report, Lab Test, Quiz, Viva
10			gical fluid analogs		vīva
11		n blood-perfused	l skin		
12		Practice session			
13	Lab Test 2				
14	Quiz and Viva				
ASSESSME	NT STRATEGY	[
Comp	oonents	Grading	CO	E	Blooms Taxonomy
Continuous	Report	20%	CO1, CO2, CO3		C4, C5, C3
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3		C4, C5, C3
Final Exam	Lab Test	20%	CO1, CO2, CO3		C4, C5, C3
(60%)	Quiz	30%	CO1, CO2, CO3		C4, C5, C3
	Viva	10%	CO1, CO2, CO3		C4, C5, C3
	Marks	100%			
(CO = Cours	e Outcome, C =	Cognitive Don	nain, P = Psychomotor Domai	in, A = Affe	ective Domain)
TEXT BOO	KS				
Biofluid Med					
		s, Lee Waite and	l Jerry Fine. ISBN -10: 0-07-14	7217-7	
Heat Transfe			,		
		1.D.	mental Heat and Mass Transfer	N 1D	11 1 2002

REFERENCE BOOKS

Biofluid Mechanics:

1. A Brief Introduction to Fluid Mechanics, Young, Munson, and Okiishi; Fifth Edition

Heat Transfer:

1. Frank P. Incropera and David P. DeWitt, Fundamentals of Heat and Mass Transfer: John Wiley & Sons; 5th edition 2006.

REFERENCE SITE

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6.1.9 BME 207 Biomedical Instrumentation and Measurements

COURSE INFORMATION

COURSEINTO									
Course Code	: BME 207	Lecture Contact Hours	: 3.00						
Course Title	: Biomedical Instrumentation and Measurements	Credit Hours	: 3.00						
PRE-REQUISI	ΓΕ	•							

EECE 191: Principles of Electrical Engineering, EECE 291: Electronic Circuits and Devices, BME 201: Human Physiology

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course is designed to give the basic concepts of Instrumentation involved in medical field and human physiology. In the course, students will be introduced to fundamentals of transducers and sensors, bio-signal measurements and concepts of the instrumentation related to biosignal measurements. The course covers the following modules: generalized medical instrumentation, transducers and sensors, bio amplifier, bio-signal recording systems, bio-signals and their measurement techniques, instrumentation of bio-signal measurements, and patient safety.

OBJECTIVE

- 1. To understand the basics of biomedical instrumentation.
- 2. To learn the principles of transducers and sensors.
- 3. To understand and apply various biomedical measurement techniques.
- 4. To analyze and design various biomedical instrumentation techniques.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Be able to understand the basics of Biomedical instrumentation and measurements.	C2	1	1	-	1	T, F
CO2	Be able to understand the principles of transducers and sensors.	C2	1	1	-	1	T, F
CO3	Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.	C3, C4	2, 5	1	-	1, 3	MID, F
CO4	Be able to apply various biomedical measurement techniques.	C3	5	1, 3	-	1, 3	T, F

		0	, ,	1				
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG –								
Assignment; Pr – Presentation; R - Report; F – Final Exam)								
				a (a				

C1 - Remember	C2 - Understand	C3 - Apply	C4 - Analyze	C5 - Evaluate	C6 - Create			
COURSE CONTENT								

Fundamentals of Medical Instrumentation: Generalized Medical Instrumentation System, Classification of Biomedical Instruments, Performance requirements of Medical Instrumentation System, General static characteristics: precision, resolution, accuracy, uncertainty, sensitivity, repeatability, calibration, maintenance, reparability, etc., General dynamic characteristics; Design process of medical instruments, Commercial medical instrumentation development process; General Constraints in Design of Medical Instrumentation Systems, regulation of medical devices.

Principles of Transducers and Sensors: The principle, classification, characteristics of Transducers and sensors, Displacement, Position, Motion, Thermal, Pressure, Force, Photoelectric, Optical, Radiative, Ultrasonic, Electrochemical sensors, Biosensors

Biopotential and Electrodes: Laws of membrane biophysics: electrical properties of cells and electrical equivalent model for the cell membrane; action potential. Origin of Bioelectric Signals (ECG, EEG, EMG, EOG, ENG, MEG, etc.) and their properties; Biopotential Electrode: Principle, Construction, Circuit model, types, Electrode-Skin interface, Polarization, artefacts and reduction technique, Electrodes for bioelectric signals, Electrode Arrays, Microelectrodes

Recording Systems, Amplifiers and Signal Conditioning: Basic Recording Systems, General Considerations for Signal Conditioners, Preamplifiers: Differential Amplifier, Instrumentation Amplifier, Carrier Amplifiers, Chopper Amplifier, Isolation amplifier, Power Amplifier, Filters for biomedical applications, Constant Current Source, Current to Voltage Converter, Analog and Digital Recorders

Instrumentation and Measurements of Biomedical Parameters: Basic Instrumentation and Measurement of ECG, EEG, EMG, EOG, PPG and other biomedical recorders. Measurement of Heart Rate, Heart Rate Variability and Pulse rate, Measurement of Body Temperature, Measurements of Blood Pressure, sound, flow, and Volume, Measurements of the Respiratory System: Pressure, Gas-flow, Lung Volume, Gas Concentration, Measurement of Nerve conduction Velocity, Measurement of Bio-impedance, Electrical Impedance Tomography (EIT).

Patient Safety: Physiological Effects of Electricity, Important Susceptibility Parameters, Electric Shock Hazards: Macro and Micro, Basic Approaches to protection against shock, Isolation circuits and Isolation mechanism, Protection: Power Distribution and Equipment Design, Safety codes and Standards for Electromedical Equipment

Course Learning Outcome	PROGRAM OUTCOMES (PO)											
Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
Be able to understand the basics of Biomedical instrumentation.	3											
Be able to understand the principles of transducers and sensors.	3											
Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.		3			3							
Be able to apply various biomedical measurement techniques.					3							
	Biomedical instrumentation. Be able to understand the principles of transducers and sensors. Be able to apply various biomedical instrumentation to analyze and solve biomedical problems. Be able to apply various biomedical	Be able to understand the basics of Biomedical instrumentation.3Be able to understand the principles of transducers and sensors.3Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.3Be able to apply various biomedical4	Image: Be able to understand the basics of Biomedical instrumentation.3Be able to understand the principles of transducers and sensors.3Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.3Be able to apply various biomedical biomedical problems.3	Image: Be able to understand the basics of Biomedical instrumentation.3Image: Be 3Be able to understand the principles of transducers and sensors.3Image: Be 3Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.3Image: Be 3Be able to apply various biomedical biomedical problems.11	Course Learning Outcome1234Be able to understand the basics of Biomedical instrumentation.334Be able to understand the principles of transducers and sensors.334Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.34Be able to apply various biomedical biomedical34	Course Learning Outcome12345Be able to understand the basics of Biomedical instrumentation.3345Be able to understand the principles of transducers and sensors.345Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.345Be able to apply various biomedical biomedical problems.345Be able to apply various biomedical biomedical problems.333	Course Learning Outcome123456Be able to understand the basics of Biomedical instrumentation.33456Be able to understand the principles of transducers and sensors.3456Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.3456Be able to apply various biomedical instrumentation to analyze and solve3456Be able to apply various biomedical instrumentation to analyze and solve3333	Course Learning Outcome1234567Be able to understand the basics of Biomedical instrumentation.334567Be able to understand the principles of transducers and sensors.34567Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.34567Be able to apply various biomedical biomedical problems.34567	Course Learning Outcome12345678Be able to understand the basics of Biomedical instrumentation.3345678Be able to understand the principles of transducers and sensors.3345678Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.345678Be able to apply various biomedical biomedical problems.3345678	Course Learning Outcome123456789Be able to understand the basics of Biomedical instrumentation.33456789Be able to understand the principles of transducers and sensors.33456789Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.3456789Be able to apply various biomedical biomedical problems.3456789	Course Learning Outcome12345678910Be able to understand the basics of Biomedical instrumentation.3345678910Be able to understand the principles of transducers and sensors.3345678910Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.3345678910Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.33345678910	Course Learning Outcome1234567891011Be able to understand the basics of Biomedical instrumentation.334567891011Be able to understand the principles of transducers and sensors.334567891011Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.34567891011Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.334567891011Be able to apply various biomedical biomedical problems.334567891011Be able to apply various biomedical biomedical434567891011Be able to apply various biomedical biomedical45567891011Be able to apply various biomedical4556789101111Be able to apply various biomedical45567891011Be able to apply various biomedical45567891011

Teaching and Learnin	g Activities	Engagement (hours)		
Face-to-Face Learnin	g			
Lecture		42		
Practical / T	utorial / Studio	-		
Student-Cen	tred Learning	-		
Self-Directed Learnin	g			
Non-face-to-	Non-face-to-face learning			
Revision of	the previous and (or) subsequent lecture at home	21		
Preparation	for final examination	21		
Formal Assessment				
Continuous	Assessment	2		
Final Exami	nation	3		
Total		131		
TEACHING METH	ODOLOGY			
Lecture and discussion	n, Co-operative and collaborative method, Problem based method			
COURSE SCHEDU	LE			
Week	Торіс	Assessment		
1	Fundamentals of Medical Instrumentation			
Lecture 1	Introduction to Biomedical Instrumentation			
Lecture 2	Generalized Medical Instrumentation System. Classification of			
	Biomedical Instruments			
Lecture 3	General static characteristics: precision, resolution, accuracy,	CT – 1, Final		
	uncertainty, sensitivity, repeatability, calibration, maintenance,			
	reparability, etc.			
2	Fundamentals of Medical Instrumentation			
Lecture 4	Generalized Dynamic Characteristics			
Lecture 5	Generalized Dynamic Characteristics			
Lecture 6	Design process of medical instruments, Commercial medical			
	instrumentation development process, Performance			
	requirements of Medical Instrumentation System.			
3	Principles of Transducers and Sensors			
Lecture 7	The principle, classification, characteristics of Transducers and			
	sensors			
Lecture 8	Displacement, Position, Motion Transducer			
Lecture 9	Thermal, Pressure, Force Transducer			
4	Physiological Transducers and Sensors			
Lecture 10	Photoelectric, Optical, Radiative Transducer			
Lecture 11	Ultrasonic, Electrochemical Transducer			
Lecture 12	Various Biosensors			
5	Bioelectric Signals and Electrodes			
Lecture 13	Biopotential, Laws of membrane biophysics: electrical			
Lootare 15	properties of cells and electrical equivalent model for the cell			
	membrane			
Lecture 14	Origin of Bioelectric Signals (ECG, EEG, EMG, EOG, ENG,	Midterm, Final		
		transfer my 1 mur		
Lecture 15	MEG) and their properties			

6	Bioelectric Signals and Electrodes	ed by BME Department
Lecture 16	Bio-potential Electrode: Principle, Construction, Circuit model,	
	types	
Lecture 17	Electrode-Skin interface, Polarizations, Artefacts and	
2000001017	Interference	
Lecture 18	Electrodes for bioelectric signals. Electrode Arrays, Microelectrodes	
7	Recording Systems, Amplifiers and Signal Conditioning	
Lecture 19	Basic Recording Systems, General Considerations for Signal Conditioners	
Lecture 20	Preamplifiers: Differential Amplifier, Instrumentation Amplifier	
Lecture 21	Carrier Amplifiers, Isolation amplifier, Driving Amplifier	
	Midterm Break	
8	Recording Systems, Amplifiers and Signal Conditioning	
Lecture 22	Sources of noise in low-level measurements and reduction	
	techniques	
Lecture 23	Filters for biomedical applications and Frequency Response	
Lecture 24	Analog and Digital Recorders	
9	Instrumentation and Measurements of Biomedical Parameters	CT – 2, Final
Lecture 25	Basic Instrumentation and Measurement of ECG	
Lecture 26	Basic Instrumentation and Measurement of ECG	
Lecture 27	Basic Instrumentation and Measurement of PPG, Heart Rate, Heart Rate Variability.	
10	Instrumentation and Measurements of Biomedical Parameters	
Lecture 28	Basic Instrumentation and Measurement of EMG	
Lecture 29	Measurement of Nerve conduction Velocity.	
Lecture 30	Basic Instrumentation and Measurement EEG.	
11	Instrumentation and Measurements of Biomedical Parameters	
Lecture 31	Measurement of EOG and Other Biomedical Recorders	
Lecture 32	Measurements of Blood Pressure, sound, flow, and Volume.	
Lecture 33		
12	Instrumentation and Measurements of Biomedical Parameters	
Lecture 34	Measurements of the Respiratory System: Pressure, Gas-flow,	CT – 3, FINAL
Lecture 35	Lung Volume, Gas Concentration	
Lecture 36		
13	Instrumentation and Measurements of Biomedical Parameters	
Lecture 37	Constant Current Source, Current to Converter	
Lecture 38	Measurement of Bioimpedance	FINAL
Lecture 39	Electrical Impedance Tomography (EIT)	
14	Electrical Safety	
Lecture 40	Physiological Effects of Electricity,	

	Important Susceptibility Parameters,
	Electric Shock Hazards: Macro and Micro
Lecture 41	Basic Approaches to protection against shock, Isolation circuits
	and Isolation mechanism
Lecture 42	Protection: Power Distribution and Equipment Design,
	Safety codes and Standards for Electromedical Equipment

ASSESSMENT STRATEGY

Comr	onents	Grading	СО	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO3	C2, C4
	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C4
	E' 1E (00/		CO 1	C2
E:1			CO 2	C2
Final Exam		60%	CO 3	C2
			CO 4	C4
Total Marks 100%				· · · · · · · · · · · · · · · · · · ·

(CO = Course Outcome, C = Cognitive Domain, P= Psychomotor domain, A= Affective Domain) **TEXT BOOKS**

1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.

John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998. 2.

REFERENCE BOOKS

1. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.

2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", 1st edition, Pearson Education, New Delhi, 2007

REFERENCE SITE

6.1.10 BME 208 Biomedical Instrumentation and Measurements Sessional

COURSE INFORMATION								
Course Code	: BME 208	Lecture Contact Hours	: 3.00					
Course Title	: Biomedical Instrumentation and Measurements Sessional	Credit Hours	: 1.50					
PRE-REQUISITE Course Code: BME 207								
Course Title: Biomedical Instrumentation and Measurements								
CURRICULU	M STRUCTURE							
Outcome Based	Education (OBE)	Outcome Based Education (OBE)						

SYNOPSIS/RATIONALE

This course covers the application of Biomedical Instrumentation and Measurements using experimental and computational knowledge.

OBJECTIVE

This course aims to enhance students' knowledge on the basic principles of Biomedical Sensor, Biomedical Instrumentation, and measurements, and develop biomedical instruments.

COUI	RSE OUTC	OMES & GENERI	C SKILLS						
No.		Course Outcome		Bloom's Taxonomy	РО	СР	CA	КР	Assessment Methods
CO1		to understand the s and sensors.	C2	2	1	-	1	T, Q, R	
CO2	Be able instrument biomedical		C3	2, 5	1, 3	-	1, 2	T, Q, R	
CO3	C4	5	1	-	1	T, Q, R			
	(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)								
Assign	nment; Pr – I	Presentation; R - Rep	ort; F – Final Ez	xam)					
C1 - R	Remember	C2 - Understand	C3 - Apply	C4 - Ana	ılyze	C5	- Evalu	iate (C6 - Create

COURSE CONTENT

Introduction to Biomedical Instrumentation and Measurements, Intro to basic sensors, Basic amplifiers (Inverting and Non-Inverting), Differential Amplifier, Instrumentation Amplifier, Biomedical Filters and frequency response analysis, constant current source and current to voltage converter, Bio-impedance measurement, Isolation Circuitry and Patient Safety protocols, ECG Data acquisition, EMG Data acquisition, PPG Data acquisition circuit and measurement of heart rate. Measurement of Nerve conduction velocity

SKILL MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
110.		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to understand the principles of transducers and sensors.		3										
CO2	Be able to apply various biomedical instrumentation to analyze and solve biomedical problems.		3			3							
CO3	Be able to apply various biomedical measurement techniques.					3							
	ical method used for mapping which indicate	s 3 as	s high	, 2 as	s meo	diun	n, an	d 1 a	s low	leve	l of m	atching	5)

IEACHING LEARNING STRATEGY

Teaching and	Learning Activities	Engagement (hours)
Face-to-Face	Learning	
Lect	7	
Prac	tical / Tutorial / Studio	35
Stud	ent-Centered Learning	-
Self-Directed	Learning	
Non	-face-to-face learning	-
Revi	sion of the previous and (or) subsequent lecture at home	15
Prep	aration for final examination	10
Formal Asses	sment	
Cont	tinuous Assessment	1
Lab	Test	1
Quiz		0.75
Viva	L	0.25
Total		70
TEACHING	METHODOLOGY	
Lecture and d	iscussion, Co-operative and collaborative method, Problem based method	
COURSE SC	CHEDULE	
Week	Lecture Topics	Assessment
1	Introduction to Biomedical Instrumentation and Measurements sessional and Intro to basic sensors	
2	Implementation of amplifiers (Inverting and Non-Inverting), Differential Amplifier	
3	Implementation of Instrumentation Amplifier	Report, Assignment, Lab
4	Implementation of Biomedical Filters and frequency response analysis	Test, Quiz, Viva
5	Implementation of constant current source and current to voltage converter	
6	Design and Implementation of Bioimpedance measurement circuit.	
7	Implementation of Isolation Circuitry and Patient Safety protocols	
	Midterm Break	<u> </u>
8	Design and Implementation of an ECG Data acquisition circuit.	
9	Design and Implementation of an EMG Data acquisition circuit	
10	Design and Implementation of a PPG Data acquisition circuit and measurement of heart rate.	Report, Lab Test, Quiz, Viva
11	Measurement of Nerve conduction velocity	
12	Review class	
13	Lab Test	
14	Quiz and Viva	
ACCECCME	NT STRATEGY	

Components Gradir		Grading	CO	Blooms Taxonomy	
Continuous	Report	20%	CO1, CO2, CO3	C4, C3, C2	
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3	C4, C3, C2	
D' 1 D	Lab Test	20%	CO1, CO2, CO3	C4, C3, C2	
Final Exam (60%)	Quiz	30%	CO1, CO2, CO3	C4, C3, C2	
(00%)	Viva	10%	CO1, CO2, CO3	C4, C3, C2	
Total Marks 100%					

TEXT BOOKS

- 1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.
- 2. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.

REFERENCE BOOKS

- 1. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.
- 2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", 1st edition, Pearson Education, New Delhi, 2007

REFERENCE SITE

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6.1.11 BME 301 Statistics and Numerical Methods for Biomedical Engineers

COURSE INF	ORMATION					
Course Code	: BME 301	Lecture Contact Hours	: 3.00			
Course Title	: Statistics and Numerical Methods for	Credit Hours	: 3.00			
	Biomedical Engineers		. 5.00			
PRE-REQUIS	ITE					
Course	Code: MATH 205					
Course	Course Title: Differential Equation, Laplace Transform and Fourier Transform					
CURRICULU	M STRUCTURE					
Outcom	Outcome Based Education (OBE)					
SYNOPSIS/R	ATIONALE					
To teac	h the students the basic concepts and principl	es of numerical methods and stat	istics. It is targeted to			
provide	a basic foundation for mathematics areas such	as various numerical approximation	ons of linear equations			
and DE	and DEs etc. Finally, this course is designed to develop the capability of solving real- life problems through					
Numeri	Numerical methods and giving statistical interpretation and comments.					
OBJECTIVE						
1. Be al	1. Be able to understand the basic knowledge of various numerical approximations for solving equations.					
2. Be al	ble to provide a statistical probability of any re	al-life problem.				
3. Impl	3. Implement numerical methods and statistical concepts in solving different engineering problems.					

No. Course Outcome Bloom's Taxonomy PO CP CA KP Assessment Methods C01 Be able to understand different numerical methods. C2 1 1 1 T, F, ASG C02 statistical data and probability concepts. C2 2 1 1 1 T, MT, F, ASG C03 statistical data and probability concepts. C2 2 1 1,2 T, MT, F, ASG C03 sampling theory and different statistical tests to solve real-world problems. C3 5 1 1,2 MT, F C04 KP - Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; MT– Midterm Exam; ASG – Assignment; F – Final Exam) Xumerical Solution of Algebraic and Transcendental Equations: Introduction, Bisection method, Newton Raphson method. Solution of system of linear equations using direct and iterative method. Interpolation: Final Exam) Statistics: Correlation: Scatter diagrams, Correlation co-efficient, Rank correlation, Correlation ratio, Theorems or correlations. Statistics: Correlation: Scatter diagrams, Correlation co-efficient, Rank correlation, Correlation ratio, Theorems or correlations. Probability: Mathematical and statistical definitions, Additive and multiplicative rule of probability Condi	COU	RSE OUTCOMES & GENERIC SKILI	LS				2		
CO1 numerical methods. C2 1 1 1 Be able to identify and analyze statistical data and probability C2 2 1 1,2 T, MT, F, ASG CO2 statistical data and probability C2 2 1 1,2 T, MT, F, ASG CO3 sampling theory and different statistical C3 5 1 1,2 MT, F CO3 sampling theory and different statistical C3 5 1 1,2 MT, F CO3 sampling theory and different statistical C3 5 1 1,2 MT, F CO4 cencepts. Image: Concepts in the interval of the interval	No.	Course Outcome		РО	СР	CA	KP		
CO2 statistical data and probability concepts. C2 2 1 1,2 CO3 Be able to apply numerical methods, sampling theory and different statistical concepts. C3 5 1 1,2 CO3 sampling theory and different statistical concepts. C3 5 1 1,2 CO3 tests to solve real-world problems. C3 5 1 1,2 CO3 COTCMPRETEX Numerical Methods For Biomedical Engineering: Numerical Solution of Algebraic and Transcendental Equations: Introduction, Bisection method, Newton Raphson method. Solution of system of linear equations using direct and iterative method. Interpolation: Finite differences, Forward and backward differences, Difference table, differences, Numerical Integration Numerical solution of ordinary differential equations. Statistics: Correlation: Scatter diagrams, Correlation co-efficient, Rank correlation, Correlation ratio, Theorems or correlations. Regression Analysis: Linear regression, Equation of the line of regression, Regression co-efficient, Curve fitting, Method of least square. Probability: Mathematical and statistical definitions, Additive and multiplicative rule of probability density function, Qualative distribution functions, Mathematical expectation. Discrete Probability Distribution: Biomial distribution, Regonential distribution, Geometrid distribution, Poisson's distribution. Correla	CO1		C2	1	1		1	T, F, ASG	
CO3 sampling theory and different statistical tests to solve real-world problems. C3 5 1 1,2 (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; MT– Midterm Exam; ASG – Assignment; F – Final Exam) COURSE CONTENT Numerical Methods For Biomedical Engineering: Numerical Methods For Biomedical Engineering: Numerical Methods For Biomedical Engineering: Numerical Methods For Biomedical Engineering: Numerical Methods For Biomedical Engineering: Numerical Golution of System of linear equations using direct and iterative method. Interpolation: Finite differences, Forward and backward differences, Difference table, difference o polynomial. Newton forward and backward interpolation formula, Central and divided differences, Numerical Integration Numerical solution of ordinary differential equations. Statistics: Correlation: Scatter diagrams, Correlation co-efficient, Rank correlation, Correlation ratio, Theorems or correlations. Regression Analysis: Linear regression, Equation of the line of regression, Regression co-efficient, Curve fitting, Method of least square. Probability: Mathematical and statistical definitions, Additive and multiplicative rule of probability Conditional probability, Baye's theorem, joint probability. Random Variables: Discrete and continuous random variables, Probability mass function, Geometric distribution, Cumulative distribution: Mormal distribution, Negative binomial distribution, Geometric distribution, Poisson's distribution. Cortinuous Probability Distribution: Normal dis	CO2	statistical data and probability	C2	2	1		1,2	T, MT, F, ASG	
ASG – Assignment; F – Final Exam) COURSE CONTENT Numerical Methods For Biomedical Engineering: Numerical Solution of Algebraic and Transcendental Equations: Introduction, Bisection method, Newton Raphson method. Solution of system of linear equations using direct and iterative method. Interpolation: Finite differences, Forward and backward differences, Difference table, difference o polynomial. Newton forward and backward interpolation formula, Central and divided differences, Numerical Integration Numerical solution of ordinary differential equations. Statistics: Correlation: Scatter diagrams, Correlation co-efficient, Rank correlation, Correlation ratio, Theorems or correlations. Regression Analysis: Linear regression, Equation of the line of regression, Regression co-efficient, Curve fitting, Method of least square. Probability: Mathematical and statistical definitions, Additive and multiplicative rule of probability Conditional probability, Baye's theorem, joint probability. Random Variables: Discrete and continuous random variables, Probability mass function, Probability density function, Cumulative distribution functions, Mathematical expectation. Discrete Probability Distribution: Binomial distribution, Negative binomial distribution, Geometric distribution, Poisson's distribution. Continuous Probability Distribution: Normal distribution, Exponential distribution, Chi-squard distribution, from a normal population. Test of Hypothesis: Statistical hypothesis, Level of significance, Type I and Type II error, One tailed and two tailed tests, Tests for proportions. <td>CO3</td> <td>sampling theory and different statistical tests to solve real-world problems.</td> <td></td> <td></td> <td></td> <td>le. T – T</td> <td></td> <td></td>	CO3	sampling theory and different statistical tests to solve real-world problems.				le. T – T			
Numerical Methods For Biomedical Engineering: Numerical Solution of Algebraic and Transcendental Equations: Introduction, Bisection method, Newton Raphson method. Solution of system of linear equations using direct and iterative method. Interpolation: Finite differences, Forward and backward differences, Difference table, difference o polynomial. Newton forward and backward interpolation formula, Central and divided differences, Numerica Integration Numerical solution of ordinary differential equations. Statistics: Correlation: Scatter diagrams, Correlation co-efficient, Rank correlation, Correlation ratio, Theorems or correlations.Regression Analysis: Linear regression, Equation of the line of regression, Regression co-efficient, Curve fitting, Method of least square.Probability: Mathematical and statistical definitions, Additive and multiplicative rule of probability Conditional probability, Baye's theorem, joint probability. Random Variables: Discrete and continuous random variables, Probability mass function, Probability density function, Cumulative distribution functions, Mathematical expectation.Discrete Probability Distribution: distribution, Poisson's distribution: Normal distribution, Exponential distribution, Chi-square distribution, t and F- distributions. Sampling Distribution: Normal distribution, Exponential distribution, Chi-square distribution from a normal population. Test of Hypothesis: Statistical hypothesis, Level of significance, Type I and Type II error, One tailed and two tailed tests, Tests for proportions.			,		8	,	,	,	
 Numerical Solution of Algebraic and Transcendental Equations: Introduction, Bisection method, Newton Raphson method. Solution of system of linear equations using direct and iterative method. Interpolation: Finite differences, Forward and backward differences, Difference table, difference o polynomial. Newton forward and backward interpolation formula, Central and divided differences, Numerical Integration Numerical solution of ordinary differential equations. Statistics: Correlation: Scatter diagrams, Correlation co-efficient, Rank correlation, Correlation ratio, Theorems or correlations. Regression Analysis: Linear regression, Equation of the line of regression, Regression co-efficient, Curve fitting, Method of least square. Probability: Mathematical and statistical definitions, Additive and multiplicative rule of probability Conditional probability, Baye's theorem, joint probability. Random Variables: Discrete and continuous random variables, Probability mass function, Probability density function, Cumulative distribution functions, Mathematical expectation. Discrete Probability Distribution: Binomial distribution, Negative binomial distribution, Geometric distribution, Poisson's distribution. Continuous Probability Distribution: Normal distribution, Exponential distribution, Chi-square distribution, t and F- distributions. Sampling Distribution: Population, Sample mean, Sample variance, Central limit theorem, Sampling distribution from a normal population. Test of Hypothesis: Statistical hypothesis, Level of significance, Type I and Type II error, One tailed and two tailed tests, Tests for proportions. 	COU	RSE CONTENT							
		 Numerical Solution of Algebraic and Transcendental Equations: Introduction, Bisection method, Newton Raphson method. Solution of system of linear equations using direct and iterative method. Interpolation: Finite differences, Forward and backward differences, Difference table, difference o polynomial. Newton forward and backward interpolation formula, Central and divided differences, Numerical Integration Numerical solution of ordinary differential equations. Statistics: Correlation: Scatter diagrams, Correlation co-efficient, Rank correlation, Correlation ratio, Theorems or correlations. Regression Analysis: Linear regression, Equation of the line of regression, Regression co-efficient, Curve fitting, Method of least square. Probability: Mathematical and statistical definitions, Additive and multiplicative rule of probability Conditional probability, Baye's theorem, joint probability. Random Variables: Discrete and continuous random variables, Probability mass function, Probability density function, Cumulative distribution functions, Mathematical expectation. Discrete Probability Distribution: Binomial distribution, Negative binomial distribution, Geometric distribution, Poisson's distribution. Continuous Probability Distribution: Normal distribution, Exponential distribution, Chi-squar distribution, t and F- distributions. Sampling Distribution: Population, Sample mean, Sample variance, Central limit theorem, Sampling distribution from a normal population. 							
	SKIL	L MAPPING							

Course Offered by BME Department PROGRAM OUTCOMES (PO) No. Course Outcome 1 2 3 5 6 12 4 7 8 9 10 11 Be able to understand different 3 CO1 numerical methods. Be able to identify and describe CO₂ statistical data and probability 3 concepts. Be able to Apply numerical methods, sampling theory and different CO3 3 statistical tests to solve real-world problems. (Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching) Justification for CO-PO mapping: **Justifications** Mapping Corresponding Level of matching CO1-PO1(a) The knowledge of mathematics has to be applied to understand different 3 numerical methods in the field of engineering study. CO2-PO1(a) 3 In order to identify and describe statistical phenomena and probability distribution, using the knowledge of mathematics and sciences is required. CO3-PO1(a) 3 Interpret various numerical methods and statistical phenomena to solve DEs using them, the knowledge of mathematics is required. TEACHING LEARNING STRATEGY Teaching and Learning Activities Engagement (hours) Face-to-Face Learning 42 Lecture Practical / Tutorial / Studio -Student-Centred Learning Self-Directed Learning Non-face-to-face learning 42 Revision of the previous lecture at home 21 Preparation for final examination 21 Formal Assessment 2 Continuous Assessment 3 **Final Examination** Total 131 **TEACHING METHODOLOGY** Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method **COURSE SCHEDULE**

Week 1	Numerical Analysis	v 1
Class 1	Numerical Solution of Algebraic and Transcendental Equations:	
	Introduction	
Class 2	Bisection method	
Class 3	Newton-Raphson method	
Week 2	Numerical Analysis	CT 1
Class 4	Solution of system of linear equations using direct method	
Class 5	Solution of system of linear equations using iterative method	
Class 6	Interpolation: Finite differences, Forward differences	
Week 3	Numerical Analysis	
Class 7	Interpolation: Finite differences, backward differences	
Class 8	Central differences, Divided differences, Difference table	
Class 9	Central differences, Divided differences, Difference table	
Week 4	Numerical Analysis	
Class 10	difference of polynomial	
Class 11	Newton interpolation formula	CT 2
Class 12	Newton forward interpolation formula, Newton backward	
	interpolation formula	
Week 5	Numerical Analysis	
Class 13	Numerical Integration	
Class 14	Numerical solution of ordinary differential equations	
Class 15	Application of numerical methods in Biomedical Engineering	
Week 6	Statistics	
Class 16	Introduction to statistics, correlation: Scatter diagrams, Correlation co- efficient	
Class 17	Rank correlation, Correlation ratio, Theorems on correlations.	
Class 18	Regression Analysis: Linear regression	
Week 7	Statistics	
Class 19	Least square method Equation of the line of regression	
Class 20	Regression co-efficient, Curve fitting	
Class 21	Probability: Mathematical and statistical definitions, Additive and	
	multiplicative rule of probability	
Week 8	Statistics	
Class 22	Conditional probability, Joint Probability, Baye's theorem	Mid
Class 23	Conditional probability, Joint Probability, Baye's theorem	Term
Class 24	Random Variables: Discrete and continuous random variables,	
Week 9	Statistics	
Class 25	Random Variable: Probability mass function	
Class 26	Probability density function, Cumulative distribution functions	
Class 27	Mathematical expectation.	
Week 10	Statistics	
Class 28	Discrete Probability Distribution: Binomial distribution,	
Class 29	Negative binomial distribution, Geometric distribution	
Class 30	Poisson's distribution.	
Week 11	Statistics	

	Course Offe	ered by BME Department
Class 31	Continuous Probability Distribution: Normal distribution:	СТ 3
	Introduction	
Class 32	Continuous Probability Distribution: Normal distribution: Theory	
Class 33	Continuous Probability Distribution: Normal distribution: Example	
Week 12	Statistics	
Class 34	Exponential distribution, Chi-square distribution, t and F- distributions	
Class 35	Sampling Distribution: Population, Sample mean, Sample variance	
Class 36	Central limit theorem, Sampling distribution from a normal	
	population.	
Week 13	Statistics	
Class 37	Test of Hypothesis: Statistical hypothesis, Level of significance,	
	Type I and Type II error	
Class 38	One tailed and two tailed tests, Tests for proportions.	
Class 39	Effect size Cohen's D method	
Week 14	Statistics	
Class 40	Analysis of Variance (ANOVA): One tailed and Two tailed tests	
Class 41	Analysis of Variance: Example	
Class 42	Statistical applications in Biomedical Engineering	1
ASSESSMENT	STRATEGY	-

Com	Components		СО	Blooms Taxonomy
	Class Test/		CO1, CO2	C2
Continuous Assessment	Assignment 1-3	20%	CO3	C3
(40%)	Class Participation	5%	CO1, CO2, CO3	C2, C3
	Midterm	15%	CO 2, CO3	C2, C3
			CO 1	C2
Final Exam 6		60%	CO 2	C2
			CO 3	C2, C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT BOOKS

1. Numerical analysis, Walter Gautschi

2. Probability and Statistics for Engineers, Scheaffer & McClave.

REFERENCE BOOKS

1. Introduction to Statistics for Biomedical Engineers, Kristina M. Ropella

2. Business Statistics, Gupta and Gupta.

REFERENCE SITE

6.1.12 BME 302 Statistics and Numerical Methods for Biomedical Engineers Sessional

COURSE INFO	ORMATION		
Course Code Course Title	: BME 302 : Statistics and Numerical Methods for Biomedical Engineers Sessional	Lecture Contact Hours Credit Hours	: 3.00 : 1.50
PRE-REQUISI	TE		
Course Code: Bl	ME 301		
Course Title: Sta	tistics and Numerical Methods fo	or Biomedical Engineers	
CURRICULUM	I STRUCTURE		
Outcome Based	Education (OBE)		
SYNOPSIS/RA	TIONALE		

A biomedical engineer or researcher has to deal with different form of complex computational problems in his/her academic and professional life. Besides, from a large scale computation and analysis different forms of statistical decisions are to make by the biomedical engineers and researchers. To make these sorts of numerical and statistical computations simpler, faster, more efficient and accurate, learning about well-known statistical and numerical methods are obligatory. This laboratory coursework includes some of these statistical and numerical techniques like regression, curve fitting, interpolation, root finding, numerical calculus, solving linear and non-linear equations, higher order statistical measures, different statistical distributions, hypothetical tests, etc. This course covers the application of the statistical and numerical methods to solve the real-life problems using computer programming language like MATLAB, Python, R, etc.

OBJECTIVE

To develop students' skill of applying different statistical and numerical methods to solve real-life biomedical engineering problems utilizing the analytical tools like MATLAB, Python, R, etc.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcom	ie	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods	
CO1	Be able to analyze and statistical techniques to sol problems.		C3, C4	2, 5	-	-	1	T, Q, R	
CO2	Be able to analyze and a numerical methods to mathematical problems.	apply different solve real-life	C3, C4	2, 5	-	-	1	T, Q, R	
CO3	Be able to compare between different statistical and numerical techniques to conclude about the suitable technique for efficient and accurate results.		C5	2, 5	-	-	1	T, Q, R	
`	(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)								
C1 - R	Remember C2 - Understand	C3 - Apply	C4 - Anal	yze	C5 -	· Evalu	ate	C6 - Create	

COURSE CONTENT

Introduction to MATLAB/Python/R; Curve fitting problems and solutions using Linear Regression, Polynomial Regression, and Lagrange's Interpolation formula; Numerical root finding approach using Bisection Method, False Position Method, and Newton-Raphson Method; Numerical differentiation; Numerical integration; Finding the solutions of a linear system; Finding the concept of lower and higher order moments of random variables; Familiarization to the Probability, Conditional Probability, and Joint Probability, and the implementation techniques of Histogram, PDF's, CDF's of random variables, Binomial Distribution, Negative Binomial Distribution, Geometric Distribution, Normal Distribution and Poisson's distribution; Overview on the Statistical Hypothesis Test and execution of z-test, t-test, and Chi-Square (χ 2) test for the statistically hypothetical decision making on Biomedical data; One-way and Two-way Analysis of Variances (ANOVA) for the statistical significance test of Biomedical data.

Na	No. Course Learning Outcome				PR	OGI	RAM	101	JTCC	OMES	5 (PO)		
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to analyze and apply different statistical techniques to solve the related problems.		3			3							
CO2	Be able to analyze and apply different numerical methods to solve real-life mathematical problems.		3			3							
CO3	Be able to compare between different statistical and numerical techniques to conclude about the suitable technique for efficient and accurate results.												
(Nume	rical method used for mapping which indicates	s 3 as	s high	, 2 as	s me	dium	n, an	d 1 a	is low	/ leve	l of m	atching	g)
TEAC	HING LEARNING STRATEGY												
Teachi	ng and Learning Activities									En	gagen	nent (ho	ours)
Face-to	-Face Learning												
	Lecture									7			
	Practical / Tutorial / Studio									35			
Student-Centered Learning									-				
Self-Di	rected Learning												
Non-face-to-face learning								-					
	Revision of the previous and (or) subsequent lecture at home										15		
Preparation for final examination										10			
Formal	Assessment												
Continuous Assessment												1	
	Lab Test								1				
	Lab Test											1	

Viv	a	0.25				
Total		70				
TEACHING	G METHODOLOGY					
Lecture and	discussion, Co-operative and collaborative method, Problem based method					
COURSE S	CHEDULE					
Week	Lecture Topics	Assessment				
1	Introduction to Statistics and Numerical Analysis Tools (MATLAB/Python/R)					
2	Introduction to curve fitting problems related to Biomedical Engineering and their solutions using Linear Regression, Polynomial Regression, and Lagrange's Interpolation formula.					
3	Numerical approach to find the root of a non-linear equation using Bisection Method, False Position Method, and Newton-Raphson Method.	Report, Lab Test, Quiz,				
4	Numerical differentiation using Forward Difference and Backward Difference approaches.	Viva				
5	Numerical integration using Trapezoidal, Simpson's (1/3), and Simpson's (3/8) rules.					
6	Finding the solutions of a linear system (a set of equations with multiple variables) using Gauss-Jordan Elimination through Pivoting and Gauss-Siedel Iterative methods.					
7	Lab Quiz					
	Midterm Break					
8	Introduction to the random variables in biomedical engineering problems and the concept of method of moments to find lower and higher order moments of random variables.					
9	Familiarization to the Probability, Conditional Probability, and Joint Probability, and the implementation techniques of Histogram, PDF's, CDF's of random variables.					
10	Familiarization and Implementation of Binomial Distribution, Negative Binomial Distribution, Geometric Distribution, Normal Distribution and Poisson's distribution.	Report, Lab Test, Quiz Viva				
11	Overview on the Statistical Hypothesis Test and execution of z-test, <i>t</i> -test, and Chi-Square (χ^2) test for the statistically hypothetical decision making on Biomedical data.					
12	A gentle introduction to the execution of One-way and Two-way Analysis of Variances (ANOVA) for the statistical significance test of Biomedical data.					
13	Final lab test					
14	Final Quiz + Viva					

			СО	Blooms Taxonomy
Components		Grading	00	Dioonis Tuxonomy
Continuous	Report	20%	CO1, CO2, CO3	C4, C3
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3	C4, C3
D' 1D	Lab Test	20%	CO1, CO2, CO3	C4, C3
Final Exam (60%)	Quiz	30%	CO1, CO2, CO3	C4, C3
(00%)	Viva	10%	CO1, CO2, CO3	C4, C3
Total	Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain) TEXT BOOKS

TEXT BOOKS

3. Numerical Methods for Engineers by Steven C. Chapra & Raymond P. Canale. 2015 (Seventh Edition), McGraw Hill Education Publications

- 4. Statistics in MATLAB: A Primer By MoonJung Cho, Wendy L. Martinez. 2015 (First Edition), CRC Press.
- 5. Numerical and Statistical Methods for Bioengineering: Applications in MATLAB (Cambridge Texts in Biomedical Engineering) 1st Edition; by Michael R. King and Nipa A. Mody.

REFERENCE SITE

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6.1.13 BME 303 Biomechanics

COURSE INFO	ORMATION		
Course Code Course Title	: BME 303 : Biomechanics	Lecture Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISI	 ΓΕ		
ME 291: Princip	le of mechanical engineering		
PHY 127: Struct	ure of matter, Electricity, Ma	gnetism, and Mechanics	
CURRICULUM	1 STRUCTURE		
Outcome Based	Education (OBE)		
SYNOPSIS/RA	TIONALE		
This course cov	ers the major topics/subtopi	cs that include introduction to	b biomechanics, tissue mechanics, joint
biomechanics, n	novement mechanics, dynar	nics to human motion, linear	and angular kinematics, examples in
biomechanics, n	odern kinematic measureme	ent techniques, applications of	human motion analysis, introduction to
viscoelasticity.			
OBJECTIVE			
1. To describe	the fundamental of biomecha	nics.	
2. To Study the	deformability, strength, visc	oelasticity of bone and flexible	tissues, modes of loading and failure.
3. To describe	the types and mechanics of sl	celetal joints.	
movement (l	cinetics).		and also to consider the role of force in
5 To tooch stur	lants the unique features of h	interior flows comparingly con	stitutive large and have device

5. To teach students the unique features of biological flows, especially constitutive laws and boundaries.

6. To consider the mechanics of orthopedic implants and joint replacement, artificial heart valve, mechanical properties of cardiovascular and respiratory mechanics

COUI	RSE OUTCO	OMES & GENERIC S	SKILLS						
No.		Course Outcome		Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	systems an to compete	explain the mechanics d familiarity with hum ntly analyze gross mo f the human body.	an anatomy	C2	1	1	-	1	T, F
CO2	hard tissue cartilage, te	understand various p s (bone) & soft tissue endons and ligaments) opriate model to behavior	es (articular and identify	C4	2	1	-	1, 3	T, F
CO3	different hu	o analyze the biomonic the biomonic the biomonic term of t	e forces at a	C2	1	1	-	1, 3	MID, F
CO4	Be able to understand mechanics at the cellular and tissue levels and explain the role of mechanobiology in different diseases		C5	4	1	-	1	T, F	
	-	blems, CA-Complex A		-	ofile, T	- Test	PR - 1	Project; Q	– Quiz; ASG –
Assign	nment; Pr – P	resentation; R - Report	t; F – Final Ex	am)					
C1 - R	Remember	C2 - Understand	C3 - Apply	C4 - Ana	lyze	C5 - 1	Evalua	te C	6 - Create

COURSE CONTENT

Kinematic and Kinetic Concepts:

Forms of motion, Standard reference terminology, Joint movement terminology, Force, moment, couples, loads on the human body, Equations of static equilibrium, Structural idealization applications in biomechanics, stress and strain analysis.

Muscle and Movement:

Skeletal muscle morphology, Isotonic versus isometric construction, Muscles constitutive modelling, whole muscle mechanics parallel versus pinnate muscle types, Factors affecting muscular force generation; Muscular strength, power, endurance; muscle and bone interactions.

Basic Statics and Movements at Specific Joints:

Shoulder and Shoulder Girdle; Elbow and Forearm; Wrist and Hand; Trunk and Spine; Hip, Knee, Ankle; Patterns of movement; Structural and Functional Analysis.

Linear and Angular Kinematics of Human Movement:

Overview of linear kinematics, Acceleration, Projectile motion analysis, Linear and angular motion relationship, Modern kinematics measurement techniques.

Linear and Angular Kinetics of Human Movement:

Kinetic law of motion, Angular analogues of Newton's law of motion, Modern kinetics measurement techniques, Application of human motion.

Human Movement in Fluid Medium:

Nature of fluid, Viscoelasticity, Buoyancy, Drag, Lift force, Propulsion in fluid medium.

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
1.0.		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to explain the mechanics of moving systems and familiarity with human anatomy to competently analyze gross movement and dynamics of the human body.	3											
CO2	Be able to understand various properties of hard tissues (bone) & soft tissues (articular cartilage, tendons and ligaments) and identify the appropriate model to demonstrate mechanical behavior	3											
CO3	Be able to analyze the biomechanics of different human joints and also the forces at a skeletal joint for various static and dynamic human activities.		3										
CO4	Be able to understand mechanics at the cellular and tissue levels and explain the role of mechanobiology in different diseases	3											
(Numer	rical method used for mapping which indicates	s 3 as	high	i, 2 a	s me	dium	ı, an	d 1 a	s low	leve	l of n	natching	 z)
	HING LEARNING STRATEGY												
	ng and Learning Activities									Eng	gagen	nent (ho	ours)
Face-to	-Face Learning											10	
	Lecture Practical / Tutorial / Studio											42	
	Student-Centred Learning											-	
Self-Di	rected Learning												
	Non-face-to-face learning											42	
	Revision of the previous and (or) subsequen	t lect	ure a	t hon	ne							21	
	Preparation for final examination											21	
Formal	Assessment												
	Continuous Assessment											2	
	Final Examination											3	
Total												131	
TEAC	HING METHODOLOGY												
	and discussion, Co-operative and collaborative		.1 1	- D		1	1	а	1				

Week	Торіс	Assessment
1	Kinematic and Kinetic Concepts	
Lecture 1	Forces, moments, couples, mechanical loads and effects of	
	loading	
Lecture 2	Forms of motion, Anatomical reference position, planes and	
	axes, Joint movement terminology	CT – 1, Final
Lecture 3	Equations of static equilibrium and structural idealization	
	applications in biomechanics	
2	Human Motion Analysis	
Lecture 4	Modern kinematic measurement techniques	
Lecture 5	Applications of human motion analysis	
Lecture 6	The human gait cycle	
3	Linear kinematics	
Lecture 7	Rigid body mechanics	
Lecture 8	Linear kinematics in human motion: measurements and analysis	
Lecture 9	Joint kinematics and Euler's angles	
4	Angular Kinematics	
Lecture 10	Angular kinematics relationships, comparison between angular	
	and linear kinematics	
Lecture 11	Angular kinematics of different joints	
Lecture 12	Kinetics in human motion – center of pressure, and ground	
	reaction forces	
5	Kinetics in human motion	
Lecture 13	Analysis of ground reaction forces in different axis	
Lecture 14	Forces and moments determination in kinetic studies	Midterm, Final
Lecture 15	Determination of joint moments and power	
6	Musculoskeletal System	
Lecture 16	Review: stress-strain analysis of materials	
Lecture 17	Introduction to musculoskeletal system- bone anatomy and	
	architecture	
Lecture 18	Mechanical properties of bone, fracture mechanics and healing	
7	Muscles and Movement	
Lecture 19	Skeletal muscle morphology and architecture	
Lecture 20	Isotonic versus isometric contraction	
Lecture 21	Muscles constitutive modelling, Whole muscle mechanics	
	parallel versus pinnate muscle types	
	Midterm Break	
8	Introduction to Joints	
Lecture 22	Joint – structure and properties	
Lecture 23	Joint – types and movement	
Lecture 24	Structure, movement and loads on the shoulder	
9	Human Joint Articulation	
Lecture 25	Joint Architecture, stability and flexibility	
Lecture 26	Common Joint injuries and introduction to the biomechanics of	CT – 2, Final
	human upper extremity	

oint Movement Analysis structure, movement and loads on the elbow and wrist structure, movement and loads on the hip, knee and ankle broblem solving oint Movement Analysis of Spine stress relaxation properties of articular cartilage structure, properties and functions of spine spine mechanics and movement Acchanics of tendons, ligaments and articular cartilage structure and organization of tendons and ligaments Acchanical and viscoelastic properties of tendons and ligaments structure, function and mechanical properties of articular	CT – 3, FINAL
tructure, movement and loads on the hip, knee and ankle roblem solving oint Movement Analysis of Spine tress relaxation properties of articular cartilage tructure, properties and functions of spine pine mechanics and movement Aechanics of tendons, ligaments and articular cartilage tructure and organization of tendons and ligaments Aechanical and viscoelastic properties of tendons and ligaments	CT – 3. FINAL
Problem solving oint Movement Analysis of Spine stress relaxation properties of articular cartilage structure, properties and functions of spine spine mechanics and movement Acchanics of tendons, ligaments and articular cartilage structure and organization of tendons and ligaments Mechanical and viscoelastic properties of tendons and ligaments	CT – 3. FINAL
oint Movement Analysis of Spine itress relaxation properties of articular cartilage itructure, properties and functions of spine ippine mechanics and movement Acchanics of tendons, ligaments and articular cartilage itructure and organization of tendons and ligaments Mechanical and viscoelastic properties of tendons and ligaments	CT – 3. FINAL
tress relaxation properties of articular cartilage tructure, properties and functions of spine pine mechanics and movement Aechanics of tendons, ligaments and articular cartilage tructure and organization of tendons and ligaments Aechanical and viscoelastic properties of tendons and ligaments	CT – 3. FINAL
tructure, properties and functions of spine pine mechanics and movement Aechanics of tendons, ligaments and articular cartilage tructure and organization of tendons and ligaments Aechanical and viscoelastic properties of tendons and ligaments	CT – 3. FINAL
pine mechanics and movement Aechanics of tendons, ligaments and articular cartilage tructure and organization of tendons and ligaments Aechanical and viscoelastic properties of tendons and ligaments	CT – 3. FINAL
Aechanics of tendons, ligaments and articular cartilage tructure and organization of tendons and ligaments Aechanical and viscoelastic properties of tendons and ligaments	CT – 3. FINAL
tructure and organization of tendons and ligaments Acchanical and viscoelastic properties of tendons and ligaments	CT – 3. FINAL
Aechanical and viscoelastic properties of tendons and ligaments	CT – 3. FINAL
	CT – 3. FINAL
tructure function and mechanical properties of articular	CT – 3. FINAL
indentities in and incention properties of articular)
artilage	
ntroduction to cell mechanics and mechanobiology	
Overview of multi-scale mechanobiology	
Cell/tissue mechanics – implications in development and disease	
Cell/tissue mechanics – implications in development and disease	TINIAT
Review Class	FINAL
ingle cell and bulk tissue mechanical measurements systems	
leview and mathematical problem solving	
Co Co Co	ell/tissue mechanics – implications in development and disease ell/tissue mechanics – implications in development and disease eview Class

Commente		<u> </u>	СО	Blooms Taxonomy
Com	ponents	Grading		
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C2, C4, C5
Assessment (40%)	Class Participation	5%	CO3	C2
	Midterm	15%	CO3	C2
			CO 1	C2
Eine			CO 2	C4
Final Exam		60%	CO 3	C2
			CO 4	C5
Total	Marks	100%		

(CO = Course Outcome, C = Cognitive Domain)

TEXT BOOKS

1. Susan J. Hall, Basic Biomechanics, McGraw Hill, Sixth Edition.

2. Emico okuno, Luciano Fratin, Biomechanics of the Human Body, Springer.

REFERENCE SITE

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6.1.14 BME 304 Biomechanics Sessional

COU								
					: 3.00	0		
Cours	se Code	: BME 304	Lecture Contact H	Iours	: 1.50)		
Cours	se Title	: Biomechanics Sessional	Credit Hours					
PRE-	REQUISIT	ſE						
Cours	se Code: BN	1E 303						
Cours	se Title: Bio	mechanics						
CURI	RICULUM	STRUCTURE						
Outco	ome Based I	Education (OBE)						
SYNC	OPSIS/RAT	FIONALE						
	n body.	rs the application of experimenta	analysis and comp	outationa	al techr	niques t	o the bic	omechanics of th
OBJE	ECTIVE							
		to introduce students to the gene	ration and analysis	of biom	echani	cal mod	lels and	data.
This c	course aims	to introduce students to the gene	· · · · · ·	of biom	echani	cal mod	lels and o	data.
This c	course aims		· · · · · ·	of biom	echanio CP	cal moc	lels and o	data. Assessmen Methods
This c	course aims RSE OUTO Be able	COMES & GENERIC SKILLS Course Outcome to analyze the electromyogra d mechanics of muscle contract	Bloom's Taxonomy phy		I			Assessmen
This c COUI No.	Be able signal an and joints	COMES & GENERIC SKILLS Course Outcome to analyze the electromyogra d mechanics of muscle contract	Bloom's Taxonomy phy tion C4 ular	РО	I	CA	KP	Assessmen Methods
This c COUI No. CO1	Be able signal an and joints Be able kinetics a	COMES & GENERIC SKILLS Course Outcome to analyze the electromyogra d mechanics of muscle contracts. to analyze the linear and ang	Bloom's Taxonomy phy tion C4 ular n. C4	PO 2, 5	CP -	CA 1	KP 1	Assessmen Methods T, Q, R
This c COU No. CO1 CO2 CO3 (CP- C	Be able signal an and joints Be able kinetics a Be able t of a body Complex Pr	COMES & GENERIC SKILLS Course Outcome to analyze the electromyogra d mechanics of muscle contracts. to analyze the linear and ang nd kinematics of a body in motion o evaluate the computational m in motion.	Bloom's Taxonomy phy tion C4 ular n. C4 odel C5 KP-Knowledge Ph	PO 2, 5 2, 5 2, 5 2, 5	СР - -	CA 1 1,3	KP 1 1 2	Assessmen Methods T, Q, R T, Q, R T, Q, R
This c COUI No. CO1 CO2 CO3 (CP- C Assign	Be able signal an and joints Be able kinetics a Be able t of a body Complex Pr	COMES & GENERIC SKILLS Course Outcome to analyze the electromyogra d mechanics of muscle contracts. to analyze the linear and ang nd kinematics of a body in motio o evaluate the computational m in motion.	Bloom's Taxonomy phy tion C4 ular n. C4 odel C5 KP-Knowledge Ph	PO 2, 5 2, 5 2, 5 2, 5	СР - -	CA 1 1,3	KP 1 1 2	Assessmen Methods T, Q, R T, Q, R T, Q, R

Introduction to skeletal biomechanics, The study of muscular contraction using electromyography, The study of joint biomechanics, Linear Kinematics of an object in motion and total body center of mass determination, Introduction to linear kinetics and analysis of vertical ground reaction force, Introduction to angular kinematics and range of motion, Creating and simulating the computational model of a dynamic body in motion, Biomedical Orthosis/ Prosthesis design & simulation, Study of Ankle Injury Using OpenSim (Both Free Fall & AFO Assisted), Creating and simulating the computational model of a static and dynamic body in motion

No.	Course Learning Outcome				PR	OGI	RAM	1 O L	JTCC	MES	5 (PO))	
INU.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to analyze the electromyography signal and mechanics of muscle contraction and joints.		3			3							
CO2	Be able to analyze the linear and angular kinetics and kinematics of a body in motion through experimental and computational models		3			3							
CO3	Be able to evaluate orthosis/prosthetics through computational solid dynamics		3			3							
CO4	Be able to evaluate the computational model of a body in motion		3			3							
(Numeri	cal method used for mapping which indicates	s 3 as	high	, 2 as	s med	lium	i, an	d 1 a	s low	leve	l of m	atching	g)
TEACH	IING LEARNING STRATEGY												
Teaching	g and Learning Activities									Eng	gagen	nent (ho	ours)
Face-to-	Face Learning												
	Lecture											7	
	Practical / Tutorial / Studio											35	
	Student-Centered Learning											-	
Self-Dire	ected Learning												
	Non-face-to-face learning											-	
	Revision of the previous and (or) subsequent	t lect	ure at	t hom	ne							15	
	Preparation for final examination											10	
Formal A	Assessment												
	Continuous Assessment											1	
	Lab Test											1	
	Quiz										0).75	
	Viva										0).25	
									1			70	

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week		Ι	Lecture Topics		Assessment
1	Introduction to	o skeletal biom	echanics		
2	The study of n	nuscular contra	ction using electromyography		
3	Linear Kinem	atics of an obje	ct in motion and total body center of	of mass	
	determination				Report, Lab Test, Quiz,
4	Introduction to force	o linear kinetic	s and analysis of vertical ground re	eaction	Viva
5	Introduction to	o angular kinen	natics and range of motion		
6	Analysis of ki				
7	Analysis of ki	netics & kinem	atics data part 2		
			Midterm Break		
8	Mid Lab Test				
9	Biomedical O	rthosis/ Prosthe	esis design & simulation		
10	Study of Ankle	e Injury Using	OpenSim (Both Free Fall & AFO As	sisted)	Report, Lab Test, Quiz
11	-	-	omputational model of a static body		Viva
12	Creating and s motion	imulating the c	computational model of a dynamic b	ody in	
13	Final Lab Test	t			
14	Quiz and viva				
ASSESSME	NT STRATEGY	7			
Com	oonents	Grading	СО	E	Blooms Taxonomy
Continuous	Report	20%	CO1, CO2, CO3, CO4		C4, C5
Assessment (30%)	Class Participation	10%	CO1, CO2, CO3, CO4		C4, C5
	Lab Test	35%	CO1, CO2, CO3, CO4		C4, C5
Final Exam	Quiz	25%	CO1, CO2, CO3, CO4		C4, C5
(70%)	Viva	10%	CO1, CO2, CO3, CO4		C4, C5
Total	Marks	100%	I		
(CO = Cours	e Outcome, C =	Cognitive Do	main, P = Psychomotor Domain, A	A = Affe	ective Domain)
	VO		· · · · · · · · · · · · · · · · · · ·		
		ontala of Dia	echanics, Second Edition, Springer	nuhliast	ion 2007 (UNUT W)
	-			•	,
	Group, LLC, 200	-	tino, Biomechanics Principles and a	ppncatio	ons, CKC Press, Taylor &

REFERENCE SITE

 $\underline{https://simtk-confluence.stanford.edu:8443/display/OpenSim/Building+a+Dynamic+Walker+in+Matlab}$

6.1.15 BME 305 Biomedical Signal Processing

	RSE INFO								
	e Code e Title	: BME 305 : Biomedical Signal Pro	ecessing H	Lecture Contact ours Credit Hours	t	: 3.00			
PRE-	REQUISIT	Έ							
Math 2	205: Differe	ential Equation, Laplace	Transform a	and Fourier Tran	nsform				
CURE	RICULUM	STRUCTURE							
Outco	me Based F	ducation (OBE)							
SYNC	OPSIS/RAT	TIONALE							
		to introduce the fundam	-						
signal	and system	s with a particular emph	nasis on the u	inderstanding of	f the bas	sic Bior	nedical	signals a	and systems.
OBJE	CTIVE								
. To Bi	o equip stud iosignal.	e knowledge about the d lents skilled to apply the	e knowledge		-	-	-	•	
. To Bi COUI	o equip stud iosignal.	-	e knowledge	e of signal proce Bloom's	-	-	-	•	Assessment
. To Bi C OUI No.	equip stud iosignal. RSE OUTC Be able t	lents skilled to apply the	e knowledge SKILLS in the time,	e of signal proce Bloom's Taxonomy	essing to	o solve	the rea	l life pro	bblems related
. To Bi COUI No.	RSE OUTC Be able t frequency Be able	Comes & Generic S Comes & Generic S Course Outcome o understand signals i	e knowledge SKILLS in the time,	e of signal proce Bloom's Taxonomy C2	PO	CP	the rea	l life pro	Assessme Methods
. To Bi COUI No. CO1	Be able to signal pro Be able to and their the state of the second secon	COMES & GENERIC S Course Outcome o understand signals is , Laplace, and Z domain to comprehend the f cessing techniques acquire popular biomed fundamental features'	e knowledge SKILLS in the time, ns fundamental dical signals	Bloom's Taxonomy C2 C2 C2 C2	PO 1	CP 1	the rea CA -	I life pro KP 1,3	Assessmen Methods T, F
2. To Bi COUI No. CO1 CO2 CO3 CO4	Be able to and their frequency Be able to and their frequency Be able to and their frequency and their frequency be able to and the frequency be able to an additional to a frequency be able to an additional to a frequency be able	Comes & GENERIC S Course Outcome o understand signals i , Laplace, and Z domain to comprehend the fi cessing techniques acquire popular biomed fundamental features' to design and analyze g techniques for the	e knowledge SKILLS in the time, ns fundamental dical signals ze the basic Biomedical	Bloom's Taxonomy C2 C2 C2 C2 C2 C3, C4	PO 1 1 2 3	CP 1 1,3 1 1,3 1	CA - - -	1 life pro KP 1,3 1,3 1,3	Assessmer Methods T, F T, F MID, F T, F
2. To Bi COUI No. CO1 CO2 CO3 CO4	Be able to and their to Be able to and their to Be able signal pro Be able to and their to Be able processing signals	COMES & GENERIC S Course Outcome o understand signals in , Laplace, and Z domain to comprehend the find cessing techniques acquire popular biomed fundamental features' to design and analyze	e knowledge SKILLS in the time, ns fundamental dical signals ze the basic Biomedical	Bloom's Taxonomy C2 C2 C2 C2 C3, C4 P-Knowledge Pr	PO 1 1 2 3	CP 1 1,3 1 1,3 1	CA - - -	1 life pro KP 1,3 1,3 1,3	Assessmer Methods T, F T, F MID, F T, F

COURSE CONTENT

Signal and System: Linearity of System, Classification and properties of signals, Common signals in engineering, Continuous-Time (CT) and Discrete-Time (DT) signal and system, Quantization, Analog to digital conversion of signal. **Modeling of Signals and Systems:** Impulse Response, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) of Discrete-Time Systems, Difference Equation, Convolution, Correlation, Covariance, Transient and Steady-state Response. **Signal Transformation:** Discrete Fourier Transformation (DFT), Fast Fourier Transformation (FFT), Inverse FFT, Z-Transformation, Inverse Z-Transformation. **Randomness and Estimation of Signals:** Linear Time Invariant (LTI) system, Stationarity and Ergodicity, Power Spectral Density, Frequency and Power Spectrum.

Introduction to Biosignals: Origins, properties and suitable models of popular biosignals, Objectives and challenges of Biosignal Analysis; Steps of Biosignal Processing. **Noise** and **Filters:** Noise Models, Averaging filters, Design and

principles of Wiener Filter, FIR and IIR filters. **Biomedical Signal Processing:** Spectral analysis of ECG, EEG, EMG, and EOG signals, Case study on ECG and EMG signals, Introduction to Feature Extractions and Classification.

No.	Course Learning Outcome				Pl	ROC	RA	MO	UTC	OME	S (PO) –		
NO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	Be able to understand signals in the time, frequency, Laplace, and Z domains	3												
CO2	Be able to comprehend the fundamental signal processing techniques	3												
CO3	Be able to acquire popular biomedical signals and their fundamental features'		3											
CO4	Be able to design and analyze the basic processing techniques for the Biomedical signals			3										
(Num	erical method used for mapping which indicate	es 3 a	as hig	;h, 2	as m	ediu	m, a	nd 1	as lo	w lev	el of 1	natchin	ng)	
	CHING LEARNING STRATEGY													
	ing and Learning Activities									Eı	ngage	ment (h	nours)	
Face-t	to-Face Learning													
	Lecture											42		
	Practical / Tutorial / Studio											-		
	Student-Centred Learning											-		
Self-D	Directed Learning													
	Non-face-to-face learning											42		
	Revision of the previous and (or) subseque	nt leo	cture	at ho	me					21				
	Preparation for final examination											21		
Forma	al Assessment													
	Continuous Assessment											2		
	Final Examination											3		
Total												131		
TEA	CHING METHODOLOGY													
	re and discussion, Co-operative and collaborat	ive n	netho	d, Pr	oblei	n ba	sed	meth	od					
Lectu														

Week	Торіс	Assessment
1	Signal and System	
Lecture 1	Linearity of System, Classification and properties of signals,	
	Common signals in engineering	
Lecture 2	Continuous-Time (CT) and Discrete-Time (DT) signal and	
	system	
Lecture 3	Quantization, Analog to digital conversion of signal	
2	Modeling of Signals and Systems	CT – 1, Final

Lecture 4	Impulse Response	V 1
Lecture 5	Finite Impulse Response (FIR) of Discrete-Time Systems	
Lecture 6	Infinite Impulse Response (IIR) of Discrete-Time Systems	
3	Modeling of Signals and Systems	
Lecture 7	Difference Equation	
Lecture 8	Convolution	
Lecture 9	Correlation, Covariance, Transient and Steady-State Response	
4	Signal Transformation	
Lecture 10	Discrete Fourier Transformation (DFT)	
Lecture 11	Fast Fourier Transformation (FFT)	
Lecture 12	Fast Fourier Transformation (FFT)	
5	Signal Transformation	
Lecture 13	Inverse FFT	
Lecture 14	Z-Transformation	
Lecture 15	Z-Transformation	
6	Randomness of Biosignals	Midterm, Final
Lecture 16	Z-Transformation	<i>,</i>
Lecture 17	Inverse Z-Transformation	
Lecture 17	Inverse Z-Transformation	
-		
7	Randomness of Biosignals	
Lecture 19	Linear Time-Invariant (LTI) system, Stationarity and Ergodicity,	
Lecture 20	Frequency and Power Spectrum	
Lecture 21	Frequency and Power Spectrum	
	Midterm Break	
8	Introduction to Biosignals	
Lecture 22	Origins, properties and suitable models of popular biosignals	
Lecture 23	Objectives and challenges of Biosignal Analysis	
Lecture 24	Steps of Biosignal Processing	
9	Noise and Filters	
Lecture 25	Noise Model	
Lecture 26	Averaging filters	CT – 2, Final
Lecture 27		
	Averaging filters Time Domain Filters	
10 Lecture 28		
L	Design and principles of Wiener Filter	
Lecture 29	Design and principles of Wiener Filter	
Lecture 30	FIR filters	
11	Digital Filters	
Lecture 31	FIR filters	
Lecture 32	Fundamental Design of Window-based FIR filter	
Lecture 33	Fundamental Design of Window-based FIR filter	
12	Digital Filters	
Lecture 34	IIR Filter design	
Lecture 35	IIR Filter design	OT 2 DINAT
Lecture 36	Applications of IIR Filters in Biosignals	CT – 3, FINAL
13	Biomedical Signal Processing	FINAL

				Course Offered by BME Department
Lecture 37	1		G and EEG signals	
Lecture 38	1 1	•	G and EOG signals	
Lecture 39	Case	e study on ECG and	EMG signals	
14	Bior	nedical Signal Pro	cessing	
Lecture 40		study on ECG and	6	
Lecture 41	Intro	duction to Feature	Extractions and Classification	
Lecture 42	Intro	duction to Feature	Extractions and Classification	
ASSESSMEN	NT STRATEGY	7		·
Comr	oonents	Grading	СО	Blooms Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C3
Assessment (40%)	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C3
			CO 1	C2
T:1	Exam	60%	CO 2	C3
Final	Exam	00%	CO 3	C2
			CO 4	C4
Total	Marks	100%		
(CO = Course	e Outcome, C =	Cognitive Domai	n)	
TEXT BOOK				
			Digital Signal Processing: A Pr	actical Approach," Second Edition,
	son Publications			
	•			Signal Processing and Physiologica
Syste	ems Modeling,"	Second Edition, Sp	ringer Publication, 2013.	
REFERENC				
1. KJF	Blinowska and J	Zygierewicz, "Prac	tical Biomecial Signal Analysi	s Using MATLAB," CRC Press,

- Jygi Igi IY ıg 2012.
- 2. Robert B. Northrop, Signals and Systems in Biomedical Engineering, CRC Press, 2003

6.1.16 BME 306 Biomedical Signal Processing Sessional

COURSE INFO	ORMATION		
Course Code	: BME 306	Lecture Contact Hours	: 3.00
Course Title	: Biomedical Signal Processing Sessional	Credit Hours	: 1.50
PRE-REQUISI			
BME 305: Biom	edical Signal Processing		

REFERENCE SITE

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course aims to prepare students to apply the knowledge of digital signal processing to apply to Biomedical signals for processing and finding the hidden information inside the Biosignals.

OBJECTIVE

- 1. To perform different signal processing algorithms and techniques to process the Biomedical signals
- 2. To apply the knowledge of signals processing techniques for the real-life problems regarding the Biomedical signals

No.		Course Outcome		Bloom's Taxonomy	РО	СР	CA	КР	Assessment Methods
CO1	related pi	understand the signa oblems and releva- in biomedical signals		C2	2		1	1	T, Q, R
CO2		apply the theoretical k essing and analyze the	-	C3, C4	2, 5		1, 3	1, 2	T, Q, R, ASG
CO3	Be able information signals	to evaluate the from the real-life	meaningful biomedical	C5	2, 5		1	1	T, Q, R
`		blems, CA-Complex A Presentation; R - Repor	-	e	ofile, T	– Test	; PR –	Project; Q -	- Quiz; ASG –
C1 - R	Remember	C2 - Understand	C3 - Apply	C4 - Ana	lyze	C5 - 1	Evalua	te Co	6 - Create
COUI	RSE CONTI	ENT							
-	0.1	ation, and representation		0					

COURSE OUTCOMES & GENERIC SKILLS

signal, Convolution and its application, Correlation and Covariance of signals with its applications, Determination of DFT, FFT, PSD of the Signal, Z-transformation and inverse Z-transformation, Wiener Filter, Window-based FIR filter, IIR filter, Linear transformation.

Na		PROGRAM OUTCOMES (PO)												
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	Be able to understand the signal processing related problems and relevant solution techniques in biomedical signals		3											
CO2	Be able to apply the theoretica knowledge of signal processing and analyze the biomedical signals		3			3								
CO3	Be able to evaluate the meaningful information from the real-life biomedical signals		3			3								
(Numer	ical method used for mapping which indica	tes 3 a	s higl	n, 2 a	s me	diun	n, an	d 1 a	as lov	v leve	l of n	natching	g)	
	CHING LEARNING STRATEGY ing and Learning Activities									Eı	ngage	ment (ł	ours)	
	o-Face Learning										00	(,	
	Lecture											7		
	Practical / Tutorial / Studio											35		
	Student-Centered Learning											_		
Self-D	Directed Learning													
	Non-face-to-face learning											-		
	Revision of the previous and (or) subseq	uent le	ecture	at ho	me							15		
	Preparation for final examination											10		
Forma	l Assessment											-		
1 011110	Continuous Assessment											1		
	Lab Test											1		
	Quiz											0.75		
	Viva											0.25		
Total												70		
TEACI	HING METHODOLOGY													
Lecture	and discussion, Co-operative and collabora	tive m	ethoo	l, Pro	blem	ı bas	ed n	netho	od					
COUR	SE SCHEDULE													
Wee	ek Lectur	e Topi	cs								Ass	essmen	t	
1	Introductory Practice on the Fundamentals of Signal Processing													
	Matlab programming software													
2	Experiment on sampling, quantiza Biosignals	tion, a	nd re	prese	ntati	on c	of di	ffere	nt	Repo		signme t, Viva	ent, Lab 1	
3	Experiment on the finite and infinit	e resp	onse	deteri	nina	tion	of a	sign	al					
	Experiment of Convolution and its	-						-						

				Course O <u>f</u>	fered by BME Department
5	-	on Correlation	with its		
	applications in				
6	Determination	of DFT, FFT, P			
7	-	n the utilization	verse Z-		
	transformation	in Biosignal pro	ocessing		
			Midterm Break		
8	Designing a W	iener Filter to re	move noises from Biosignals		
9	Designing win pass filters	dow-based FIR	filter for low pass, high pass, a	nd band-	Report, Lab Test, Quiz, Viva
10	Designing IIR	filter for low pas	ss, high pass, and band-pass filt	er	vīva
11	Experiment on	the linear transf	formation of Biosignals		
12	Evaluation of t	he signal proces	sing-based Project given to the	students	
13	Lab Test				
14	Quiz and Viva				
Comp	oonents	Grading	СО	H	Blooms Taxonomy
Continuous	Report	20%	CO1, CO2, CO3		C4, C5, C3
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3		C4, C5, C3
D' 1 D	Lab Test	20%	CO1, CO2, CO3		C4, C5, C3
Final Exam (60%)	Quiz	30%	CO1, CO2, CO3		C4, C5, C3
(0070)	Viva	10%	CO1, CO2, CO3		C4, C5, C3
Total	Marks	100%			
(CO = Cour	se Outcome, C =	Cognitive Dom	nain)		
TEXT BOOI	KS				
Pearson P	Publications, 2002		rital Signal Processing: A Practi		
2. K J Blino REFERENC		rewicz, "Practic	al Biomedical Signal Analysis U	Jsing MA	ILAB, UKU Press, 2012.
		ala and St-	in Diamadical Environmin O'		naina and Dhuri-1i1
			in Biomedical Engineering: Signeer Publication, 2013.	gnai Proces	ssing and Physiological
Systems	modeling, secol	ia Eanon, sprii	iger rublication, 2015.		

REFERENCE SITE

6.1.17 BME 307 Medical Imaging

COURSE INFO	RMATION		
Course Code	: BME 307	Lecture Contact Hours	: 3.00
Course Title	: Medical Imaging	Credit Hours	: 3.00

PRE-REOUISIT	Έ

BME 101: Introduction to Biomedical Engineering

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course designs covering the topics/subtopics that help to learn and familiarize the fundamental methodologies of different medical imaging systems including the modality, imaging physics, image construction algorithms, image intervention, and safety measures during imaging.

OBJECTIVE

- 1. To acquire the rudimentary knowledge about the medical imaging system and its applicative variances.
- 2. To provide students with an overview of the computational and mathematical methods in medical imaging.

	NSE OUTCO	JHES & GENERIC	SKILLS						
No.		Course Outcome		Bloom's Taxonomy	РО	CP	CA	KP	Assessment Methods
CO1		identify different types ystems and their app gnosis.		C1	2	1	-	1,3	T, F
CO2		o understand the the the the the technologies behind stems.		C2	1	1,3	-	1,3	T, F
CO3		pply the computationa image construction in d	-	C3	2	1	-	1	MID, F
CO4		investigate the effect in image computation.		C4	4	1,3	-	1,3	T, F
(CP- 0	Complex Pro	blems, CA-Complex A	ctivities, KP-	Knowledge Pr	ofile, T	- Test	; PR –	Project; Q	– Quiz; ASG –
Assign	nment; Pr – P	resentation; R - Report	t; F – Final Ex	(am)					
C1 - R	Remember	C2 - Understand	C3 - Apply	C4 - Ana	lyze	C5 - 1	Evalua	te (C6 - Create
		•	•						

COURSE CONTENT

Introduction to Medical Imaging: Non-invasive medical imaging specialty, Medical imaging modalities with applications, Image Characteristics. **X-Ray:** X-ray generation, x-ray generators, Filters, intensifying screens X-radiography, Spatial resolution, Image noise and Image contrast, Introduction to fluoroscopy, Angiography, and mammography, Digital X-ray, Fundamental of Interventional Radiology. **Computed tomography** (**CT**): Basics of CT scanner system, Radon Transformation for CT imaging, Image reconstruction algorithms: Fourier slice theorem, Fourier Reconstruction, Back-projection Algorithm, Filtered back-projection method, Iterative reconstruction algorithm; CT number, Image artifacts, and Filtering, Evolution of CT from 1G to 5G. **Nuclear Imaging:** Principles of Gamma Camera, Imaging principles of Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT), Brief description of PET and SPECT modalities with differences, Safety measures in nuclear imaging.

Magnetic Resonance Imaging (MRI): Evolution of magnetic resonance imaging (MRI) technology and clinical applications, Fundamentals of nuclear magnetic resonance: Angular momentum, magnetic dipole moment, Magnetization, Larmor frequency, Midterm Break, RF and resonance, free induction decay (FID); Different coils and slice selection, spin-echo pulse sequence; Different modes of MRI Images: T1 and T2 Relaxation images, Gradient echo imaging, Diffusion-weighted imaging, etc.; Biological effects of magnetic fields and MRI imaging safety.

Functional Magnetic Resonance Imaging (fMRI): Physics behind hemodynamics and NMR, Principle of imaging, Image Features, and Applications. **Ultrasound Imaging:** Principle of imaging, brief description of modality, Doppler effect, Generation and detection of ultrasound-piezoelectric effect; ultrasonic transducers, Focusing arrays, Transducer beam characteristics: Huygens's principle, beam profiles, pulsed ultrasonic field, Axial and lateral resolution, Farfield and near field concept, Modes of Ultrasound Images, Introduction to Doppler imaging.

SKILL MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to remember the different types												
CO1	of medical imaging systems and their		3										
	applications in clinical diagnosis.												
	Be able to understand the fundamental												
CO2	physics and technologies behind the	3											
	different imaging systems.												
	Be able to apply the computational												
CO3	techniques to regulate image construction		3										
	in digital space.												
CO4	Be able to analyze the effect of different				4								
004	algorithms in image computation.				4								

TEACHING LEARNING STRATEGY Teaching and Learning Activities Engagement (hours) Face-to-Face Learning Lecture 42 Practical / Tutorial / Studio _ Student-Centred Learning Self-Directed Learning Non-face-to-face learning 42 Revision of the previous and (or) subsequent lecture at home 21 Preparation for final examination 21 Formal Assessment Continuous Assessment 2 **Final Examination** 3 Total 131 **TEACHING METHODOLOGY**

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	Торіс	Assessment
1	Introduction to Medical Imaging	

Lecture 1	Non-invasive medical imaging specialty	
Lecture 2	Medical imaging modalities with applications	
Lecture 3	Image Characteristics	
2	X-Ray	CT – 1, Final
Lecture 4	X-ray generation, x-ray generators,	
Lecture 5	Filters, intensifying screens X-radiography, Spatial resolution,	
Lecture 6	Image noise and Image contrast	
3	X-Ray	
Lecture 7	Introduction to fluoroscopy, Angiography, mammography	
Lecture 8	Principles of digital X-ray (CR and DR)	
Lecture 9	Fundamental of Interventional Radiology	
4	Computed tomography (CT)	
Lecture 10	Basics of CT scanner system	
Lecture 11	Radon Transformation	
Lecture 12	Radon Transformation	
5	Computed tomography (CT)	
Lecture 13	Fourier slice theorem	
Lecture 14	Fourier Reconstruction	
Lecture 15	Back-projection Algorithm and Filtered back-projection method	Midterm, Final
6	Computed tomography (CT)	
Lecture 16	Iterative methods for Image reconstruction	
Lecture 17	CT number, Image artifacts, and Filtering	
Lecture 18	Evolution of CT from 1G to 5G.	
7	Nuclear Imaging	
Lecture 19	Principles of Gamma Camera) and Imaging principles of	
	Positron Emission Tomography (PET)	
Lecture 20	Single Photon Emission Computed Tomography (SPECT)	
Lecture 21	Brief description of PET and SPECT modalities with	
	differences and safety measures	
	Midterm Break	
8	Magnetic Resonance Imaging (MRI)	
Lecture 22	Evolution of magnetic resonance imaging (MRI) technology	
	and clinical applications,	CT – 2, Final
Lecture 23	Fundamentals of nuclear magnetic resonance: Angular	
	momentum, magnetic dipole moment,	
Lecture 24	Fundamentals of nuclear magnetic resonance: Magnetization,	
	Larmor frequency	
9	Magnetic Resonance Imaging (MRI)	
Lecture 25	RF and resonance, free induction decay (FID)	
Lecture 26	Different coils and slice selection	
Lecture 27	T1 and T2 Relaxation images	
10	Magnetic Resonance Imaging (MRI)	
Lecture 28	Gradient echo imaging	
Lecture 29	Diffusion weighted imaging	
Lecture 30	Biological effects of magnetic fields and MRI imaging safety	
11	Functional Magnetic Resonance Imaging (fMRI)	CT – 3, FINAL

	55	7 1
Lecture 31	Physics behind hemodynamics and NMR	
Lecture 32	Principle of imaging	
Lecture 33	Image Features and Applications.	
12	Ultrasound Imaging	
Lecture 34	Principle of imaging, brief description of modality,	
Lecture 35	Doppler effect; Generation and detection of ultrasound-	
	piezoelectric effect;	
Lecture 36	ultrasonic transducers, Focusing arrays	
13	Ultrasound Imaging	
Lecture 37	Transducer beam characteristics: Huygens's principle, beam	
	profiles,	
Lecture 38	Pulsed ultrasonic field, Axial and lateral resolution,	
Lecture 39	Far field and near field concept	
14	Ultrasound Imaging	FINAL
Lecture 40	Introduction to Doppler imaging	
Lecture 41	Diagnosis process of Ultrasound images, applications, safety	
Lecture 41	measures	
Lecture 42	Future trends in Medical imaging	

ASSESSMENT STRATEGY

			СО	Blooms Taxonomy
Components		Grading		Dieenne Tunionenity
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C4
(40%)	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C3
			CO1	C2
Final	Exam	60%	CO2	C3
1 11141	Exam	0070	CO3	C2
			CO4	C4
Total	Marks	100%		

(CO = Course Outcome, C = Cognitive Domain)

TEXT BOOKS

- 1. J. T. Bushberg, J. A. Seibert, E. M. Leidholdt JR, and J. M. Boone, The Essential Physics of Medical Imaging, Third Edition, LIPPINCOTT WILLIAMS & WILKINS, 2012.
- 2. P. Dhawan, H. K. Huang, and D. S. Kim, Principles and Advanced Methods in Medical Imaging and Image Analysis, World Scientific Publishing, 2008.

REFERENCE BOOKS

- 1. Chris Guy and Dominic Ffytche, An Introduction to The Principles of Medical Imaging, Revised Edition, Imperial College Press, 2005.
- 2. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, Medical Science Series, 1999.

REFERENCE SITE

6.1.18 BME 309 Biomedical Transport Phenomenon

	RSE INFO e Code	: BME 309	Lecture (Contact Hours	2	: 3.0	0			
Course		Biomedical Transport Phenomenon	Credit H		,	: 3.00				
PRE-F	REQUISIT									
Course	e Code: BM	1E 205								
Course	e Title: Bio	fluid Mechanics and Heat	Transfer							
CURR	RICULUM	STRUCTURE								
Outcor	me Based H	Education (OBE)								
SYNO	OPSIS/RAT	TIONALE								
continu metabo oxyger	uity and m olism in c nators, Uns	rs the topics that include r notion, molecular mechaniorgans and tissues, comp teady-state heat transfer mo body and surrounding; Ana	ics of fluid a partmental mo odes and laws,	nd electrolyte odels for pha heat transfer o	e transj armaco coeffic	port, S kineti ient, h	Shear s c anal eat trar	stress, r yses, a sfer ins	nass naly side t	transfer and sis of blood the body, hea
	CTIVE	body and surrounding, 7 m	logy equation	is relating mor	mentun	ii, eiie	igy and	i mass t	iuns	
iı a	integrated fo and from th	aims to develop students' orm through an array of exa e design of medical device	mples and ana s.	lysis from bio	ological	syste	ms (cel	lular, tis	ssue,	organ levels
ii a 2. Ap p ii	ntegrated for and from th pplication problems in implants, in	orm through an array of exa	mples and ana s. quantitative icance, and pro- constructs.	lysis from bio methods base	ological ed on	syster funda	ms (cel mental	lular, tis physic	ssue, al la	organ levels
ii a 2. Ap p ii	ntegrated for and from th pplication problems in implants, in	orm through an array of exa e design of medical devices of these principles, using biology, of clinical signific cluding tissue-engineered of	mples and ana s. quantitative icance, and pro- constructs. ILLS Blo	lysis from bio methods base	ological ed on	syster funda	ms (cel mental	lular, tis physic	al la	organ levels
in a 2. Ap in COUR	integrated for and from the pplication problems in implants, in RSE OUTC Be able to dynamics	orm through an array of exa e design of medical devices of these principles, using biology, of clinical signific cluding tissue-engineered of COMES & GENERIC SK	mples and ana s. quantitative icance, and pro- constructs. IILLS Blo Taxc	lysis from bio methods base oblems in the om's	ological ed on design	syster funda and d	ms (cel mental levelop	lular, tis physic ment of	al la	organ levels ws, to solve dical devices Assessmen
in a 2. A _I p in COUR No. CO1	ntegrated for and from the pplication problems in mplants, in RSE OUTC Be able dynamics physiolog Be able	orm through an array of exa e design of medical devices of these principles, using biology, of clinical signific cluding tissue-engineered of COMES & GENERIC SK Course Outcome to apply principles of flut to model and characteri	mples and ana s. quantitative icance, and pro- constructs. IILLS Blo Taxc nid ze (nd	Ilysis from bio methods base oblems in the om's onomy	ed on design PO	system funda: and d CP	ms (cel mental levelop	lular, tis physic ment of KP	al la f me	organ levels ws, to solv dical devices Assessmen Methods
in a 2. Ap p in COUR No.	The second secon	orm through an array of exa e design of medical devices of these principles, using biology, of clinical signific cluding tissue-engineered of COMES & GENERIC SK Course Outcome to apply principles of flut to model and characteristical flow conditions to analyze and understan sport in biological and livit to assess models of dr and delivery in vario	mples and ana s. quantitative icance, and pro- constructs. TILLS Blo Taxc iid ze (nd ng (lysis from bio methods base oblems in the om's onomy C3	PO PO 2	system fundation and do CP	ms (cel mental levelop	lular, tis physic ment of KP 1,3	al la f me	organ levels ws, to solve dical devices Assessmen Methods T, F
in a 2. Ap p in COUR No. CO1 CO2 CO3 (CP- C	The grated for and from the pplication problems in implants, in RSE OUTO Be able in dynamics physiolog Be able in mass transystems Be able transport disease co	orm through an array of exa e design of medical devices of these principles, using biology, of clinical signific cluding tissue-engineered of COMES & GENERIC SK Course Outcome to apply principles of flut to model and characteristical flow conditions to analyze and understan sport in biological and livit to assess models of dr and delivery in vario	mples and ana s. quantitative icance, and pro- constructs. ILLS Blo Taxc id ze (nd ng (ug us (ivities, KP-Kn	Ilysis from bio methods base oblems in the om's momy C3 C4 C5 owledge Profi	PO PO 2 2 4	system fundation and do CP 1 1,3 1	CA - -	lular, tis physic ment of KP 1,3 1,3 1	al la f me	organ levels ws, to solve dical devices Assessmen Methods T, F T, F T, F

Introduction to mass and momentum in living systems; Basic hemodynamic; Application of momentum balance; Use of the equations of continuity and motion to set up complex flow problems; Conservation relation for fluid transport, dimensional analysis and scaling; Methods for analysing complex physiological flow; Flow in circulatory system and tissue; Flow within distensible tubes; Mass transfer and metabolism in organs and tissues; Diffusion: mass transfer between fluids, membrane and pores; Diffusion with convection or electrical potential; Microscopic and macroscopic mass balances; Transport in porous media; Transvascular transport; Transport of gases between blood and tissue; Analysis of blood oxygenators; Fluid transport in the kidneys; A whole organ approach to renal modelling; Drug transport in solid tumors; Transport in organs and organisms; Compartmental models for pharmacokinetic analyses.

SKILL MAPPING PROGRAM OUTCOMES (PO) No. Course Learning Outcome 9 10 12 1 2 3 4 5 6 7 8 11 Be able to apply principles of fluid dynamics to model and characterize CO1 3 physiological flow conditions Be able to analyze and understand CO2 3 mass transport in biological and living systems Be able to assess models of drug CO3 transport and delivery in various disease 3 conditions TEACHING LEARNING STRATEGY Teaching and Learning Activities Engagement (hours) Face-to-Face Learning Lecture 42 Practical / Tutorial / Studio Student-Centred Learning Self-Directed Learning Non-face-to-face learning 42 Revision of the previous and (or) subsequent lecture at home 21 21 Preparation for final examination Formal Assessment Continuous Assessment 2 **Final Examination** 3 131 Total (Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching) TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	Торіс	Assessment
1	Introduction to transport fundamentals	
Lecture 1	Overview of the transport process and cellular transport	
Lecture 2	Application of transport process in disease pathology	
Lecture 3	An overview of hemodynamics and boundary conditions	
2	Dimensionless numbers	CT – 1, Final
Lecture 4	The Buckingham Pi Theorem and dimensionless numbers	
Lecture 5	Dimensionless numbers in biofluid dynamics	
Lecture 6	Equation of conservation of mass and linear momentum	
3	Conservation of mass and momentum	
Lecture 7	Differential continuity equation in rectangular co-ordinates	
Lecture 8	Momentum balance and forces in fluids	
Lecture 9	Euler's, Bernoulli's, and the general form of the Navier-Stokes equation	
4	Dynamic similarity and introduction to pulsatile flow	
Lecture 10	Relationship between Navier Stokes and Hagen– Poiseuille equation	
Lecture 11	Dynamic similarity and non-dimensionalizing the Navier- Stokes equation	
Lecture 12	Introduction to oscillating flow in blood vessels	
5	Pulsatile flow	
Lecture 13	Velocity profile in pulsatile flow	
Lecture 14	Velocity profile in pulsatile flow	Midterm, Final
Lecture 15	Volumetric flow rate in pulsatile flow	
6	Pulsatile flow continued	
Lecture 16	Velocity-pressure phase lag in pulsatile flow	
Lecture 17	Womersley number and entrance length in physiological flows	
Lecture 18	Introduction to flow in curved vessels, Dean number and secondary flows	
7	Flow in curved vessels	
Lecture 19	Flow separation, adverse pressure gradient, and flow in branching vessels	
Lecture 20	Blood flow and velocity profiles in major arteries	
Lecture 21	Modeling and visualizing blood flow	
	Midterm Break	
8	Transport in Porous Media	
Lecture 22	Porosity, Tortuosity, and Volume fraction	
Lecture 23	Fluid flow in porous media	CT – 2, Final
Lecture 24	Solute transport in porous media	

9	Ι	Mass Transport	in Biological System	Offered by BME Department			
Lecture 25	(Conservation and	constitutive relation				
Lecture 26		Diffusion, Diffus liffusion	ion coefficient, Steady-state and unstead	у			
Lecture 27	I	Diffusion-limited	reaction				
10	1	Diffusion with C	onvection or Electrical Potential				
Lecture 28	I	Fick's law, Dimer	nsional analysis, Electrolyte transport				
Lecture 29	Ι	Diffusion and con	vection, mass transfer coefficients	_			
Lecture 30		Aicroscopic an nembranes	d macroscopic mass balances acros	55			
11]	Fransport of Ga	ses between Blood and Tissue				
Lecture 31	(Oxygen-Hemoglo	bin equilibria				
Lecture 32		Dynamics of oxy issue	genation of blood and oxygen delivery i	n CT – 3, FINAL			
		-	action and transport in tissue				
Lecture 33	V	Whole-organ app	oach to renal modeling				
12			in Solid Tumors				
Lecture 34			ug delivery in cancer treatment				
Lecture 35	I	Analysis of transv	ascular and interstitial fluid transport				
Lecture 36	Ι	nterstitial hyperte	ension in solid tumor				
13			in Solid Tumors, and Pharmacokinetics				
Lecture 37		-	titial transport of solutes				
Lecture 38	(Consideration in I	Pharmacokinetics				
Lecture 39	(Compartment mo	dels in pharmacokinetic analysis	FINAL			
14		-	gans and Organisms				
Lecture 40	I	hysiologically back	ased pharmacokinetic models				
Lecture 41	I	Review					
Lecture 42	I	Review					
ASSESSMEN	NT STRATI	EGY					
Comp	ponents	Grading	СО	Blooms Taxonomy			
Continuous	Class Tes Assignme 1-3		CO1, CO2, CO3	C2, C4			
Assessment (40%)	Class Participati	on 5%	CO1, CO2, CO3	C2			
	Midtern	n 15%	CO1	C3			
	1		CO 1	C2			
Final	Exam	60%	CO 2	C3			
			CO 3	C2			

Total Marks	100%	
(CO = Course Outcome, C = Cog	gnitive Domai	in)
TEXT BOOKS		
1.Truskey, Yuan, and Katz, Transp	oort Phenomer	a in Biological Systems, Second Edition, Pearson Education, Inc.
2.Johnson and Ethier, Problems in	n Biomedical	Fluid Mechanics and Transport Phenomena, Cambridge University
Press.		
REFERENCE SITE		

6.1.19 BME 311 Embedded Systems and Interfacing

COU	RSE INFO	RMATION						
Cours	e Code	: BME 311	Lecture Contact Ho	ours	: 3.00)		
Cours	e Title	: Embedded Systems and Interfacing	Credit Hours		: 3.00)		
PRE-	REQUISIT	TE			1			
Cours	e Code: CS	E 291						
Cours	e Title: Cor	nputer Programming						
Cours	e Code: CS	E 292						
Cours	e Title: Cor	nputer Programming Lab						
Cours	e Code: EE	CE 391						
Cours	e Title: Dig	ital Electronics						
Cours	e Code: EE	CE 392						
Cours	e Title: Dig	ital Electronics Lab						
		STRUCTURE						
Outco	me Based I	Education (OBE)						
SYNC	OPSIS/RAT	FIONALE						
The g	oal of this c	ourse is to expose students to the	field of embedded s	ystems	and to	provid	e a knowled	lge foundation
which	will enable	students to pursue a career in rele	evant fields. Key con	cepts o	of hardv	ware-so	ftware inter	rfacing control
archite	ectures, deb	ugging, and communication proto	ocols will be discuss	ed in th	is cour	se. Stu	dents will b	e familiar with
differe	ent firmwar	e architectures and can apply thei	r knowledge in relev	ant fiel	ds suc	h as; cli	nical devic	e development
and ro	botics in he	ealthcare.	-					-
OBJE	ECTIVE							
1. T	o identify a	and understand fundamentals of	microprocessors, m	icrocor	ntroller	s, com	munication	protocols and
eı	mbedded fi	rmware.	-					-
2. T	o apply the	fundamental concepts of embedd	led engineering					
3. T	o analyze tl	ne various firmware architectures	and systems					
	•	various large scale embedded syst	•					
		COMES & GENERIC SKILLS						
No.		Common Origina and	Bloom's	РО	СР	CA	VD	Assessment
NO.		Course Outcome	Taxonomy	PO	CP	CA	KP	Methods
CO1	Be able fundamer	to identify and understand tals of microprocess		1,2	1	-	3	T, F

			Course Offered by BME Department											
		n protocols												
		concepts of	C3	2	1,3	-	3	T, F						
	·	ıs firmware	C4	2	1	-	5	MID, F						
		large scale	C5	4	1,3	-	5	T, F						
Complex Pro	blems, CA-Complex A	ctivities, KP-	Knowledge Pr	ofile,T	– Test;	PR – 1	Project; Q	– Quiz; ASG –						
nment; Pr – P	Presentation; R - Report	t; F – Final Ex	kam)											
lemember	C2 - Understand	C3 - Apply	C4 - Ana	C5 - Evaluate			C6 - Create							
	and embedd Be able to embedded o Be able to architecture Be able t embedded s Complex Prol ment; Pr – P	 and embedded firmware. Be able to apply the fundamental embedded engineering. Be able to analyze the variou architectures and systems. Be able to evaluate various embedded systems Complex Problems, CA-Complex Ament; Pr – Presentation; R - Report 	Be able to apply the fundamental concepts of embedded engineering. Be able to analyze the various firmware architectures and systems. Be able to evaluate various large scale embedded systems Complex Problems, CA-Complex Activities, KP- ment; Pr – Presentation; R - Report; F – Final Ex-	and embedded firmware.Be able to apply the fundamental concepts of embedded engineering.C3Be able to analyze the various firmware architectures and systems.C4Be able to evaluate various large scale embedded systemsC5Complex Problems, CA-Complex Activities, KP-Knowledge Pr mment; Pr – Presentation; R - Report; F – Final Exam)	and embedded firmware.Image: Complex Problems, CA-Complex Activities, KP-Knowledge Profile, TBe able to analyze the various large scale embedded systemsC42Be able to evaluate various large scale embedded systemsC54	microcontrollers, communication protocols and embedded firmware.protocols and embedded firmware.Be able to apply the fundamental concepts of embedded engineering.C321,3Be able to analyze the various firmware architectures and systems.C421Be able to evaluate various large scale embedded systemsC541,3Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test; ment; Pr – Presentation; R - Report; F – Final Exam)EE	microcontrollers, communication protocols and embedded firmware.nBe able to apply the fundamental concepts of embedded engineering.C321,3Be able to analyze the various firmware architectures and systems.C421Be able to evaluate various large scale embedded systemsC541,3-Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test; PR – Imment; Pr – Presentation; R - Report; F – Final Exam)	microcontrollers, communication protocols and embedded firmware.nnBe able to apply the fundamental concepts of embedded engineering.C321,3-3Be able to analyze the various firmware architectures and systems.C421-5Be able to evaluate various large scale embedded systemsC541,3-5Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test; PR – Project; Q ment; Pr – Presentation; R - Report; F – Final Exam)						

COURSE CONTENT

Introduction to Embedded System : Introduction to Embedded Engineering, Chronological development of Firmware and Embedded Technology, Possible Implementation in Healthcare, Review on Digital Techniques : Bit and Bytes, Memory, Number systems, Additions, Subtractions, Multiplications, Boolean Algebra, Divisions, Logic Gates, Combinational Circuits, Decoders, Encoders, Bit and Bytes, Memory, Number systems, Additions, Subtractions, Multiplications, Boolean Algebra, Divisions, Subtractions, Multiplications, Boolean Algebra, Divisions. **Microprocessors and Microcontrollers:** Flags, Resistors, Processor Types, Processor Architecture, Instruction Sets, Addressing Modes, SAP, 8086 Microprocessors, Memory, Memory Architecture, Virtual Memory, DMA and DMA Controller, AVR and ARM controllers, Overview of Developmental Microcontroller and Microprocessors, Thread, Interrupts, Programmable Timers, Multitasking, Workflow and Architecture of 16 bit/32bit PIC **Firmware Programming:** Assembly Language: Basic Assembly, Bit Operators, Sub Programs, Switch Day, Arrays, Strcuts, Instruction sets, Loops, Conditional Statements. (Higher Level Language; Python: Data Types, python Data Structure, Functions, Object Oriented Programming, Encapsulation, Abstraction), Inheritance, Polymorphism Or C++/objective C: Data Types, Data Structure, Struc, Encapsulation, Abstraction), Inheritance Firmware Architecture, Reset Circuit, Watchdog Timer. **Advanced Systems:** Operating Systems, Real Time OS, Virtual Machine, FPGA, Clustering, Master Slave Topology, Multithread Processors, IoT Architecture, Medical robotics

NI-	Course Loomin - Ortoone	PROGRAM OUTCOMES (PO)											
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to identify and understand the												
CO1	fundamentalsofmicroprocessors,microcontrollers,communicationprotocols and embedded firmware.	3	3										
CO2	Be able to apply the fundamental concepts of embedded engineering.		3										
CO3	Be able to analyze the various firmware architectures and systems.		3										
CO4	Be able to evaluate various large scale embedded systems				3								
(Numer	rical method used for mapping which indicate	s 3 as	s high	i, 2 as	s mee	dium	n, an	d 1 a	s low	leve	l of m	atching	<u>z</u>)
TEAC	HING LEARNING STRATEGY												
Teachir	ng and Learning Activities									En	gagen	nent (ho	urs)

Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous and (or) subsequent lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131
TEACHING METHODOLOGY	

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	Торіс	Assessment				
1	Motivation and course introduction					
Lecture 1	Introduction to Embedded Engineering, Chronological					
	development of Firmware and Embedded Technology,					
	Importance of Embedded Engineering in Healthcare					
Lecture 2	Review of Bit and Bytes, Subtractions, Multiplications,					
	Division, Boolean Algebra					
Lecture 3	Review of Logic Gates, Combinational Circuits, Decoders,					
	Encoders					
2	Introduction to microprocessors	CT – 1, Final				
Lecture 4	Microprocessor Fundamentals, Types of Processors					
Lecture 5	Processor architecture					
Lecture 6	Simple As Possible (SAP) Architecture					
3						
Lecture 7						
Lecture 8	8086 Microprocessor Instruction sets					
Lecture 9	8086 Microprocessor Addressing Modes					
4	Basic Embedded Firmware					
Lecture 10	Assembly Language – 1					
Lecture 11	Assembly Language – 2					
Lecture 12	Assembly Language – 3					
5	Higher Level Embedded Firmware					
Lecture 13	Introduction to Data Types, Variable, Operators, If-else, Lists,	Middaum Einal				
	Functions and basic syntax	Midterm, Final				
Lecture 14	Object-Oriented Programming					
Lecture 15	Object-Oriented Programming					
6						
Lecture 16	Intro to Computer Networking and Networking Layers, Bus					
	Interface, I/O Hardware and Interface, Peripheral Interfacing,					

Lecture 17		red by BME Department
Lecture 17	Wired Communication Protocols (USB, UART, I2C,	
Lecture 18	SPI, CAN) Wireless Communication Protocols (Bluetooth, GSM,	
Lecture 18		
	ZigBEE, BLE and others)	
7	Sensors, Actuators and Interfacing	
Lecture 19	Introduction to Sensors and Actuators, Fundamentals of	
	Sensors and Different Types of Sensors	
Lecture 20	Fundamentals of Actuators and Different Types of Actuators,	
	Interfacing of Sensors and Actuators	
Lecture 21	Interfacing of Sensors and Actuators (Continued)	
	Midterm Break	
8	Overview of Memory	
Lecture 22	Introduction to Memory, Memory Architecture	
Lecture 23	Memory Hierarchy, Memory Interface	
Lecture 24	Virtual Memory, DMA (Direct Memory Access) and DMA	
	Controller	
9	Threads, Interrupts, Timer and Multitasking	
Lecture 25	Basic Concepts and Applications of Threads, Overview of	CT – 2, Final
Lecture 25	Interrupts	
Lecture 26	Introduction to Programmable Timer fundamentals,	
Lecture 20	e ·	
1 4 27	Fundamental Concepts of Programmable Interrupt Controller,	
Lecture 27	Overview of Multitasking in Microprocessors and Embedded	
	Systems	
10	Microcontrollers Basics, Microcontroller	
	Architectures and Application	
Lecture 28	AVR and ARM Microcontrollers	
Lecture 29	Overview PIC Microcontroller	
Lecture 30	Overview PIC Microcontroller (continued)	
11	Advance Firmware Architecture and Advance Concepts in	
	Embedded Engineering	
Lecture 31	Reset Circuit, Watchdog Timer, Reliable Architecture in	
	Firmware and system design approaches	
Lecture 32	Reliable Architecture in Firmware and system design	
	approaches (continued)	
Lecture 33	Operating Systems Basics, RTOS, Virtual Machines	
12	FPGA Boards	CT – 3, FINAL
Lecture 34	Introduction to FPGA Boards	
Lecture 35	Fundamentals of FPGA Boards	
Lecture 36	Applications of FPGA Boards	
13	Distributed Systems, Artificial Intelligence and IoT	
15	Architecture in Embedded Systems	
Lecture 37	Clustering, Master-Slave Topology, Multithread Processors	
Lecture 38	IoT Architecture and Web Assembly	FINAL
Lecture 39	AI Algorithms in microcontrollers and microprocessors	
14	Embedded Systems in Healthcare, R&D work process and	
	Production Line Designing	
Lecture 40	Current Trends in Embedded Systems in Healthcare	

			Course Ojj	fered by BME Department
Overvi	ew of Robotics i	n Healthcare, Advanced	Surgical	
Proced	ures and Medical D	evice Development		
R&D v	vork Process and Pr	oduction Line Designing		
T STRATEGY				
		<u> </u>		Blooms Taxonomy
oonents	Grading	CO	-	Bioonis Taxonomy
Class Test/ Assignment 1-3	20%	CO1, CO2		C1,C2,C3
Class Participation	5%	CO1		C1,C2
Midterm	15%	C01,C02		C1,C2,C3
		CO 1		CO 1
Evom	60%	CO 2		CO 2
Exam	0070	CO 3		CO 3
		CO 4		CO 4
Marks	100%			
e Outcome, C =	Cognitive Domain)			
KS				
W. Valvano, Br	ookes/Colem Embe	edded Mircrocomputer Sys	tems: Real	Time Interfacing, Pacific
00				
larut and Ytha Y	. YuAssembly Lan	guage Programming and Or	rganization	of the IBM PC: McGraw-
. ISBN: 0071128	964, 978007112896	64		
E BOOKS				
· 1		6		
Rafiquzzaman, I	Microprocessors and	d Microcomputer-based Sys	tem Design	n, CRC Press, 1995
E SITE				
	Procedi R&D w AT STRATEGY T STRATEGY T STRATEGY Assignment 1-3 Class Participation Midterm Exam Marks 2 Outcome, C = 0 S W. Valvano, Brood farut and Ytha Y LISBN: 00711289 E BOOKS / Hall, Microproce	Procedures and Medical D R&D work Process and Pr T STRATEGY T STRATEGY S S T S S S T S S	Procedures and Medical Device Development R&D work Process and Production Line Designing T STRATEGY T STRATEGY Conents Grading CO CO Donents Grading Class Test/ Assignment 20% Assignment 20% CO1, CO2 1-3 Control CO1 Midterm 15% CO1,CO2 Exam 60% CO2 CO 3 CO 4 Marks 100% CO 4 W. Valvano, Brookes/Colem Embedded Mircrocomputer System CO Sum and Ytha Y. YuAssembly Language Programming and On ISBN: 0071128964, 9780071128964 E BOOKS Value on and System S	Overview of Robotics in Healthcare, Advanced Surgical Procedures and Medical Device Development R&D work Process and Production Line Designing IT STRATEGY Soments Grading Class Test/ Assignment 20% I-3 CO1, CO2 Participation 5% Midterm 15% CO1, CO2 CO1 Exam 60% CO2 CO3 CO4 CO4 Marks 100% S S W. Valvano, Brookes/Colem Embedded Mircrocomputer Systems: Real 00 arut and Ytha Y. YuAssembly Language Programming and Organization ISBN: 0071128964, 9780071128964 E BOOKS / Hall, Microprocessors and Interfacing Rafiquzzaman, Microprocessors and Microcomputer-based System Design

6.1.20 BME 312 Embedded Systems and Interfacing Sessional

COURSE INFO	ORMATION			
Course Code	: BME 312	Lecture Contact Hours	: 3.00	
Course Title	: Embedded Systems and Interfacing Sessional	Credit Hours	: 1.50	
PRE-REQUIS				
	nbedded Systems and Interfacin	g		
Course Code: C	SE 291	0		
Course Title: Co	omputer Programming			
Course Code: C	SE 292			
Course Title: Co	omputer Programming Lab			
Course Code: E	ECE 391			
Course Title: Di	gital Electronics			

Course Code: EECE 392

Course Title: Digital Electronics Lab

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course covers the application of embedded engineering in the domain of biomedical device development and interfacing.

OBJECTIVE

This course aims to enhance students' knowledge on the basic principles of fluid mechanics and heat transfer design problem solution.

COURSE OUTCOMES & GENERIC SKILLS

No.		Course Outcome	e	Bloom's Taxonomy		СР	CA	KP	Assessment Methods			
CO1		apply the fundamer engineering.	ntal concepts of	C3	2	-	1,3	3	T, Q, R			
CO2		Be able to analyze the various firmware urchitectures and systems.			2	-	1	5	T, Q, R, ASG			
CO3	Be able embedded	to evaluate variou systems	is large scale	C5	4	-	1,3	5	T, Q, R			
(CP- C	Complex Pro	blems, CA-Complex	Activities, KP-	Knowledge Pr	ofile, T	– Test	PR –	Project; (Q – Quiz; ASG –			
Assign	nment; Pr – I	Presentation; R - Rep	oort; F – Final Ex	kam)								
C1 - R	Remember	C2 - Understand	C3 - Apply	C4 - Anal	yze	C5 -	- Evalu	ate	C6 - Create			

COURSE CONTENT

Boolean functions and logic gates, interfacing digital lighting display with microprocessor, stepper motor control with 8086 microprocessor, introduction to developmental boards, stepper motor control with developmental boards, introduction to single board computers, capturing video feedback with single board computers, USB communication, Bluetooth communication, biosignal acquisition with developmental boards and single board computers, implementation of threads, programmable timers, clusters, introduction and overview of 16bit PIC microcontroller, PCB designing.

N	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
No.		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to apply the fundamental concepts of embedded engineering.		3										
CO2	Be able to analyze the various firmware architectures and systems.		3										
CO3	Be able to evaluate various large scale embedded systems				3								
(Numer	ical method used for mapping which indicate	s 3 as	s high	i, 2 as	s me	dium	n, an	d 1 a	s low	leve	l of m	atching	g)
TEACH	IING LEARNING STRATEGY												
Teachin	g and Learning Activities									Eng	gagen	nent (ho	ours)
Face-to-	Face Learning												
	Lecture 7												

		fered by BME Department			
Pract	tical / Tutorial / Studio	35			
Stud	-				
Self-Directed	•				
Non-	-				
	sion of the previous and (or) subsequent lecture at home	15			
	aration for final examination	10			
Formal Assess					
	inuous Assessment	1			
Lab '		1			
Quiz		0.75			
Viva		0.25			
Total		70			
TEACHING	METHODOLOGY				
Lecture and d	iscussion, Co-operative and collaborative method, Problem based method				
COURSE SC	THEDULE				
Week	Lecture Topics	Assessment			
1 1	Implementation of Boolean functions using logic gates	Assessment			
2	Interfacing digital lighting display (Dot-matrix) with microprocessor				
3	Stepper Motor Control With 8086 Microprocessor				
)					
	Introduction to Arduino Development Board and Stepper Motor Control	Report, Assignment, Lab			
4	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno	Report, Assignment, Lab Test, Quiz, Viva			
4 5	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi				
4 5	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and				
4 5 6	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi				
3 4 5 6 7	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and Interfacing with Temperature Sensor	Report, Assignment, Lab Test, Quiz, Viva			
4 5 6	Introduction to Arduino Development Board and Stepper Motor Controlwith Arduino UnoIntroduction to Raspberry Pi and Video Feed Capture with Raspberry PiUSB Communication Between Arduino and Raspberry Pi andInterfacing with Temperature SensorPCB Designing in Proteus, Discussion on Project Proposal				
4 5 6 7	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and Interfacing with Temperature Sensor PCB Designing in Proteus, Discussion on Project Proposal Midterm Break				
4 5 6 7 8	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and Interfacing with Temperature Sensor PCB Designing in Proteus, Discussion on Project Proposal Midterm Break Introduction To IoT: Bluetooth Communication and Storing of Data				
4 5 6 7 8	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and Interfacing with Temperature Sensor PCB Designing in Proteus, Discussion on Project Proposal <u>Midterm Break</u> Introduction To IoT: Bluetooth Communication and Storing of Data with Raspberry Pi and Arduino				
4 5 6 7 8 9	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and Interfacing with Temperature Sensor PCB Designing in Proteus, Discussion on Project Proposal Midterm Break Introduction To IoT: Bluetooth Communication and Storing of Data with Raspberry Pi and Arduino Biosignal Acquisition and Display with Arduino and Raspberry Pi	Test, Quiz, Viva			
4 5 6 7 8 9	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and Interfacing with Temperature Sensor PCB Designing in Proteus, Discussion on Project Proposal Midterm Break Introduction To IoT: Bluetooth Communication and Storing of Data with Raspberry Pi and Arduino Biosignal Acquisition and Display with Arduino and Raspberry Pi Cluster	Test, Quiz, Viva Report, Lab Test, Quiz,			
4 5 6 7 8 9 10	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and Interfacing with Temperature Sensor PCB Designing in Proteus, Discussion on Project Proposal Midterm Break Introduction To IoT: Bluetooth Communication and Storing of Data with Raspberry Pi and Arduino Biosignal Acquisition and Display with Arduino and Raspberry Pi Cluster Implementation of Threads, Programmable Timer with Raspberry Pi-	Test, Quiz, Viva Report, Lab Test, Quiz,			
4 5 6 7 8 9 10	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and Interfacing with Temperature Sensor PCB Designing in Proteus, Discussion on Project Proposal Midterm Break Introduction To IoT: Bluetooth Communication and Storing of Data with Raspberry Pi and Arduino Biosignal Acquisition and Display with Arduino and Raspberry Pi Cluster Implementation of Threads, Programmable Timer with Raspberry Pi- Arduino Cluster and LEDs	Test, Quiz, Viva Report, Lab Test, Quiz,			
4 5 6 7	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and Interfacing with Temperature Sensor PCB Designing in Proteus, Discussion on Project Proposal Midterm Break Introduction To IoT: Bluetooth Communication and Storing of Data with Raspberry Pi and Arduino Biosignal Acquisition and Display with Arduino and Raspberry Pi Cluster Implementation of Threads, Programmable Timer with Raspberry Pi- Arduino Cluster and LEDs Introduction to 16bit PIC Microcontroller and LED Switching with 16	Test, Quiz, Viva Report, Lab Test, Quiz,			
4 5 6 7 8 9 10 11	Introduction to Arduino Development Board and Stepper Motor Control with Arduino Uno Introduction to Raspberry Pi and Video Feed Capture with Raspberry Pi USB Communication Between Arduino and Raspberry Pi and Interfacing with Temperature Sensor PCB Designing in Proteus, Discussion on Project Proposal Midterm Break Introduction To IoT: Bluetooth Communication and Storing of Data with Raspberry Pi and Arduino Biosignal Acquisition and Display with Arduino and Raspberry Pi Cluster Implementation of Threads, Programmable Timer with Raspberry Pi- Arduino Cluster and LEDs Introduction to 16bit PIC Microcontroller and LED Switching with 16 bit PIC Microcontroller	Test, Quiz, Viva Report, Lab Test, Quiz,			

Components		Grading	CO	Blooms Taxonomy		
Continuous Assessment (40%)	Report	20%	CO1, CO2, CO3	C3, C4, C5		
	Class Participation	20%	CO1, CO2, CO3	C3, C4, C5		
Final Exam (60%)	Lab Test	20%	CO1, CO2, CO3	C3, C4, C5		
	Quiz	30%	CO1, CO2, CO3	C3, C4, C5		
	Viva	10%	CO1, CO2, CO3	C3, C4, C5		
Total	Marks	100%				

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT BOOKS

1.Onatham W. Valvano, Brookes/Colem Embedded Mircrocomputer Systems: Real Time Interfacing, Pacific Grove: 2000

2.Charles Marut and Ytha Y. YuAssembly Language Programming and Organization of the IBM PC: McGraw-Hill, 1992. ISBN: 0071128964, 9780071128964

REFERENCE BOOKS

1.Douglas V Hall, Microprocessors and Interfacing

2. Mohamed Rafiquzzaman, Microprocessors and Microcomputer-based System Design, CRC Press, 1995

REFERENCE SITE

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6.1.21 BME 313 Biomedical Image Processing

COURSE INFO	RMATION		
Course Code	: BME 313	Lecture Contact Hours	: 3.00
Course Title	: Biomedical Image	Credit Hours	: 3.00
	Processing		. 3.00
PRE-REQUISIT	 		
-	edical Signal Processing		
BME 305: Blonk	6 6		
	5 5		
CURRICULUM			
Outcome Based I	Education (OBE)		
SYNOPSIS/RA7	FIONALE		
The goal of this	course is to prepare students	to learn the basic knowledge	e regarding the processing techniques of
medical images	including filtering, transfor	mation, compression, storage	e, reconstruction, segmentation, etc. to
enhance its qualit	ty so that the medical image-	based diagnosis process could	be aided.
OBJECTIVE	· · ·	• •	
1. To provide ki	nowledge about the different	processing techniques regarding	ng medical images.
2. To equip stu	dents theoretically skilled in	n medical image processing t	o solve the real-life problem related to
imaging-base	d clinical diagnosis.		-
COURSE OUT	COMES & GENERIC SKI	LLS	

						Cour	se Offe	E Department		
No.	Course Outcome			Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods	
CO1	biomedical	understand differe image processing ste s in clinical diagnosis.	-	C1	1	1	-	1,3	T, F	
CO2	Be able to processing	C2	1	1,3	-	1,3	T, F			
CO3	Be able to apply the basic image processing techniques with a modified form to medical images.			C3	5	1	-	1	MID, F	
CO4	Be able to to real-life techniques	C4	2	1,3	-	1,3	T, F			
(CP- 0	Complex Pro	blems, CA-Complex A	Activities, KP	Knowledge P	rofile, T	-Test;	PR – I	Project; Q	– Quiz; ASG –	
Assign	nment; Pr – P	Presentation; R - Repor	t; F – Final Ex	kam)						
C1 - F	Remember	C2 - Understand	C3 - Apply	C4 - Ana	lyze	C5 - 2	Evalua	te C	6 - Create	
		1		I		1				

COURSE CONTENT

Origin of Medical Images and Processing: Medical image sources, Properties, Processing challenges, Processing steps, Image representation, Hardware, and software requirements. **Image as Two-dimensional (2D) systems:** Image as a 2D signal, 2D sequences, and systems, Vector-space image representation, superposition and convolution, 2D Sampling theory, Image quantization, Image perception, Smoothing & Sharpening, Spatial filtering, Quality measures. **Image Transforms:** 2D Fourier Transform, Sine and Cosine transformation, Hadamard transformation, Slant, and KL transformation. **Colors in Image:** Concept of monochrome and color images, Color Fundamentals, Color Models, Pseudo Color Image Processing, Basics of Full-Color Image Processing, Color Transformations.

Image Enhancement: Image Enhancement in spatial domain: Gray Level Transformations, Histogram Processing, Smoothing and Sharpening Spatial Filters; Image Enhancement in the frequency domain: Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters. **Image Reconstruction:** Reconstruction concept of medical images, Image reconstruction in X-Ray, Image reconstruction in CT, Fourier slice theorem, Back projection algorithm for parallel projection data, Filtered-back projection algorithm, Image Reconstruction in Magnetic Resonance Imaging, Image Reconstruction in Ultrasound Imaging. **Image segmentation:** Feature Extraction, Edge Detection, Boundary Extraction, Region Representation, Moment Representation, Shape Features, Scene Matching Image Segmentation, Threshold-based segmentation, Region growing segmentation, Active contour model for segmentation. **SKILL MAPPING**

														ırtment	
No.	Cour	rse Learning Outcome	PROGRAM OUT												
	De chie te v	indepetend different store of	1	2	3	4	5	6	7	8	9	10	11	12	
CO1		inderstand different steps of image processing steps and	3												
COI		tions in clinical diagnosis.													
		understand the fundamental													
CO2		ssing technique.	3												
		apply the basic image													
CO3		echniques with the modified					3								
		medical images.													
		analyze the medical image													
~~ .		al-life problems and possible													
CO4	processing	techniques for aiding		3											
	diagnosis.														
(Numer		ed for mapping which indicate	s 3 as	s high	, 2 a	s me	diun	ı, an	d 1 a	ıs low	leve	l of m	atching	g)	
TEAC	HING LEARN	ING STRATEGY													
Teachir	ng and Learning	g Activities									En	gagen	nent (h	ours)	
Face-to	-Face Learning	5													
	Lecture												42		
	Practical / Tu	torial / Studio											-		
	Student-Cent	red Learning											-		
Self-Di	rected Learning	5													
	Non-face-to-	face learning									42				
	Revision of t	he previous and (or) subsequen	t lect	ure a	t hon	ne					21				
	-	or final examination									21				
Formal	Assessment														
	Continuous A										2				
	Final Examin	ation									3				
Total											131				
TEAC	HING METH	ODOLOGY													
Lecture	e and discussion	n, Co-operative and collaborati	ve m	ethod	, Pro	blem	n bas	ed n	netho	od					
COUR	SE SCHEDUI	LE													
	Week	,	Topi	c								Asse	essmen	t	
1		Origin of Medical Images and Processing													
Lecture	e 1	Medical image sources, Prop													
Lecture	2	Processing challenges, Processing steps									-				
Lecture		Image representation, hardware and software requirements								\neg					
2		Image as Two-dimensional (2D) systems								\neg					
Lecture	e 4	Image as a 2D signal, 2D sequences, and systems							\neg	-					
Lecture		Vector-space image representation								CT –	1, Fin	al			
Lecture		superposition and convolution													
3		Image as Two-dimensional		syst	ems										
	e 7	2D Sampling theory, Image		-		nage	perc	cepti	on						
Lecture		1 2 2 8- 1			,	0-	T	- I							
Lecture	2 8	Smoothing & Sharpening, Q	uality	/ mea	sures	5									
4	Image Transforms														
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Lecture 10	2D Fourier Transform	_													
Lecture 11	Sine transformation	-													
Lecture 12	Cosine transformation	_													
5	Bio-image compression algorithms	-													
Lecture 13	Hadamard Transformation	_													
Lecture 14	Slant Transform	_													
Lecture 15	KL Transform	_													
6	Colors in Image	Midterm, Final													
Lecture 16	Concept of monochrome and color images	_													
Lecture 17	Color Fundamentals	_													
Lecture 18	Color Models	_													
7	Colors in Image	_													
Lecture 19	Pseudo Color Image Processing	_													
Lecture 20	Basics of Full-Color Image Processing														
Lecture 21	Color Transformations	_													
	Midterm Break														
8	Image Enhancement (Spatial Domain)														
Lecture 22	Gray Level Transformations, Histogram Processing	_													
Lecture 23	Smoothing Spatial Filters	_													
Lecture 24	Sharpening Spatial Filters	_													
9	Image Enhancement (Frequency Domain)	_													
Lecture 25	Smoothing Frequency-Domain Filters	_													
Lecture 26	Smoothing Frequency-Domain Filters	CT – 2, Final													
Lecture 27	Sharpening Frequency Domain Filters	_													
10	Image Reconstruction	_													
Lecture 28	Reconstruction concept of medical images	_													
Lecture 29	Image reconstruction in X-Ray														
Lecture 30	Image reconstruction in CT														
11	Image Reconstruction														
Lecture 31	Fourier slice theorem														
Lecture 32	Back projection algorithm for parallel projection data														
Lecture 33	Filtered-back projection algorithm	CT – 3, FINAL													
12	Image Reconstruction	_													
Lecture 34	Image Reconstruction in Magnetic Resonance Imaging														
Lecture 35	Image Reconstruction in Ultrasound Imaging	_													
Lecture 36	Feature Extraction														
13	Image segmentation														
Lecture 37	Edge Detection, Boundary Extraction														
Lecture 38	Region Representation, Moment Representation														
Lecture 39	Shape Features, Threshold-based segmentation														
14	Image segmentation	– FINAL													
Lecture 40	Scene Matching Image Segmentation														
Lecture 41	Region growing segmentation,														
Lecture 42	Active contour model for segmentation														
ASSESSMENT		1													

C			СО	Blooms Taxonomy
Comj	oonents	Grading		·
	Class Test/ Assignment	20%	CO1, CO3, CO4	C2, C4
Continuous Assessment	1-3			,
(40%)	Class	5%	CO3	C2
(1070)	Participation	570	005	62
	Midterm	15%	CO2	C3
			CO1	C2
Final Exam		60%	CO2	C3
		0070	CO3	C2
			CO4	C4
Total	Marks	100%		
(CO = Cours	e Outcome, C = 0	Cognitive Domai	n)	
TEXT BOOH	KS			
1. Rafael C.	Gonzalez and Ric	hard E. Woods, D	Digital Image Processing, Fourth	n Edition, Pearson, 2017.
2. Atam P. E	hawan, Medical	Image Analysis, S	econd Edition, IEEE Series in I	Biomedical Engineering, 2011.
REFERENC	E BOOKS			
1. Jiri Jan. M	edical Image Proc	essing, Reconstru	ction and Restoration: Concept	and Method, Taylor and Francis
Publisher,	2006.			

6.1.22 BME 314 Biomedical Image Processing Sessional

COURSE INFO	ORMATION						
Course Code	rse Code : BME 314 Lecture Contact Hours : 3.00						
Course Title	: Sessional on Biomedical Image Processing	Credit Hours	: 1.50				
PRE-REQUISI							
BME 307: Medi	0 0						
BME 313: Biom	edical Image Processing						
CURRICULU	A STRUCTURE						
Outcome Based	Education (OBE)						
SYNOPSIS/RA	TIONALE						
quality assurance		, and maintenance of med	Biomedical Image Processing including dical imaging devices, as well as the				
OBJECTIVE							

1. To perform the quality assurance, quality control, calibration, and maintenance of medical imaging modalities

2. To process the problems regarding the medical image reconstruction and quality enhancement

No.		Course Outcome		Bloom's Taxonomy	РО	СР	CA	КР	Assessment Methods
CO1	quality ass and mair	o understand the urance quality contro- ntenance of medic practically.	ol, calibration	C2	1	-	1	1	T, Q, R
CO2		apply and analyze the ssing mechanism of		C3, C4	2	-	1, 3	1, 2	T, Q, R, ASG
CO3		apply different algo mages to solve in		C2	5	-	1	1	T, Q, R
`	-	blems, CA-Complex . Presentation; R - Repo	-	e	ofile, T	– Test;	; PR –	Project; Q	– Quiz; ASG -
C1 - R	Remember	C2 - Understand	C3 - Apply	C4 - Ana	C5 - Evaluate			C6 - Create	

COURSE CONTENT

Introduction to Medical Imaging, their modalities, and the relevance to Biomedical Engineering, Observation the imaging techniques of different medical imaging modalities and learning about quality control system as per guideline of IAE and NCRT, Fundamental image processing techniques by MATLAB, Processing techniques of an X-ray Image, Radon transformation and Sinogram for the CT Imaging, Back projection algorithm to reconstruct CT image, Image Segmentation, Case study on medical images to improve the image quality for aiding diagnosis.

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10		12
CO1	Be able to understand the procedure of quality assurance quality control, calibration, and maintenance of medical imaging modalities practically.	3											
CO2	Be able to apply and analyze the construction and processing mechanism of the medical images.		3										
CO3	Be able to apply different algorithms to the medical images to solve imaging- based diagnosis					3							
(Numer	rical method used for mapping which indicate	s 3 as	s high	, 2 a	s me	diun	n, an	d 1 a	is low	leve	l of m	atching	g)
-	HING LEARNING STRATEGY									-		. (1	
Teachir	ng and Learning Activities									Eng	gagen	nent (ho	ours)
Face-to	-Face Learning												

	Course Oj	fered by BME Department			
Lectu	ire	7			
Pract	ical / Tutorial / Studio	35			
Stude	ent-Centered Learning	-			
Self-Directed	Learning				
Non-	face-to-face learning	-			
Revis	sion of the previous and (or) subsequent lecture at home	15			
Prepa	aration for final examination	10			
Formal Assess	ment				
Conti	nuous Assessment	1			
Lab 7	ſest	1			
Quiz		0.75			
Viva		0.25			
Total		70			
TEACHING	METHODOLOGY				
Lecture and di	scussion, Co-operative and collaborative method, Problem based method				
COURSE SC	HEDULE				
Week	Lecture Topics	Assessment			
1	Introduction to Medical Imaging, their modalities, and the relevance to Biomedical Engineering				
2	A study tour to a medical imaging center to observe the imaging techniques of X-ray and CT and learning about quality control system as per guideline of IAE and NCRT.				
3	A study tour to a medical imaging center to observe the techniques of MRI and Ultrasound imaging and learning about quality control system as per guideline of IAE and NCRT.	Report, Assignment, Lab			
4	A study tour to a medical imaging center to observe the techniques of Nuclear Imaging and learning about quality control system as per guideline of IAE and NCRT.	Test, Viva			
5	Introductory practice on the fundamental image processing techniques by MATLAB				
6	Experiment on the processing techniques of an X-ray Image				
7	Experiment on the Radon transformation and Sinogram for the CT				
	Imaging				
	-				
8	Imaging				
	Imaging Midterm Break Design and implementation of the back-projection algorithm to				
8	Imaging Midterm Break Design and implementation of the back-projection algorithm to reconstruct CT image	Report, Lab Test, Quiz, Viva			
8	Imaging Midterm Break Design and implementation of the back-projection algorithm to reconstruct CT image Experiment on the segmentation of the brain MRI images Case study on image processing to improve the image quality for aiding	•			

13	Final Lab Tes	t		
14	Quiz/Viva			
ASSESSME	NT STRATEGY	ľ		
Com	oonents	Grading	СО	Blooms Taxonomy
Continuous	Report	20%	CO1, CO2, CO3	C4, C5, C3
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3	C4, C5, C3
D' 1 D	Lab Test	20%	CO1, CO2, CO3	C4, C5, C3
Final Exam (60%)	Quiz	30%	CO1, CO2, CO3	C4, C5, C3
(0070)	Viva	10%	CO1, CO2, CO3	C4, C5, C3
Total	Marks	100%		
(CO = Cours	se Outcome, C =	Cognitive Don	nain)	
TEXT BOO	KS			
			Digital Image Processing, Fourt Second Edition, IEEE Series in	
REFERENC	CE BOOKS			
1.Jiri Jan, M Publisher, 20		ocessing, Recon	struction and Restoration: Cor	cept and Method, Taylor and Franc
REFERENC	CE SITE			

6.1.23 BME 315 Biomaterials

COURSE INFO	RMATION		
			: 3.00
Course Code	: BME 315	Lecture Contact Hours	: 3.00
Course Title	: Biomaterials	Credit Hours	
PRE-REQUISI	ГЕ		
СНЕМ 103 – Ge	neral Chemistry; CHEM 125 –	Physical and Bio-organic	Chemistry; BME 203– Biochemistry
CURRICULUM	I STRUCTURE		
Outcome Based I	Education (OBE)		
SYNOPSIS/RA7	ΓIONALE		
The course cove	ers the following modules: Stru	cture of solids, characteriz	zation of biomaterials, metallic implant
materials, ceram	ic implant materials, synthetic	polymeric materials, com	posite biomaterials and material-tissue
interactions, steri	lization of biomaterials, structure	e and function of natural bi	omaterials.
OBJECTIVE			
1. To introduce	e students to different implants	s, prosthetic and function	al materials, investigate the materials'
properties inc	cluding their designs and applica	tions.	
2. To investigat	e both synthetic and natural poly	mers, and explore biomateri	al-tissue interaction in detail with a focus
on applicatio	ns in tissue engineering and card	iology.	

COU	RSE OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	КР	Assessment Methods	
CO1	Be able to identify different types of biomaterials	C2	2	-	-	1	T, MID	
CO2	Be able to understand and analyze the properties of biomaterials	C2	1	-	-	1	T, MID, F	
CO3	Be able to comprehend the interactions of cell and tissues with biomaterials based on biomaterial properties and reactivity	C5	4,2	-	3	1	MID, F	
CO4	Be able to design and apply different types of biomaterials to solve biomedical problems	C3	3	-	-	1	T, F	
(CP- C	Complex Problems, CA-Complex Activities, KP-	Knowledge Pr	ofile, T	- Test	; PR –	Project; Q	– Quiz; ASG –	
Assign	nment; Pr – Presentation; R - Report; F – Final E	xam)						
C1 - R	emember C2 – Understand C3 - Apply	C4 - Analyze		C5 – Evaluate			C6 - Create	
	RSE CONTENT		1.1				1	

The structure of solid: Structure of solids overview, classification of solids, classification of solids based on structure, lattice imperfections and defects

Properties and Characterization of Materials: Thermal properties phase diagrams, strengthening by heat treatments, surface properties and adhesion. Electrical properties, optical properties, x-ray absorption, acoustic and ultrasonic properties, density and porosity and diffusion properties, XPS, XRD, spectroscopy, SFM, AFM, optical characterization of biomaterials

Metallic Biomaterials: Stainless steels, co-based alloys, Ti and Ti-based alloys, dental metals, other metals, corrosion of metallic implants.

Ceramic Implant Materials: Structural property relationship of ceramics, aluminum oxides (alumina), zirconium oxides (zirconia), calcium phosphate, glass ceramics, other ceramics, carbons, deterioration of ceramics.

Synthetic Polymeric Material: Basic structure, classifications (thermoplasts, thermoset, and elastomers), different physical and mechanical properties, and various uses of biomaterials. Natural polymeric materials, biodegradable polymers, applications and functions

Composites as Biomaterials: Structure, mechanics of composites, applications of composite biomaterials, biocompatibility of composite, biomaterials.

Biological response to biomaterials: biocompatibility, toxicity of biomaterials, host response of biological materials to biomaterials, sterilization of biomaterials, applications of biomaterials in cardiology and tissue engineering

No.	Course Learning Outcome				PR	lOG	RAN	101	JTCC	COMES (PO)						
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12			
CO1	Be able to identify different types of biomaterials		3													
CO2	Be able to understand and analyze the properties of biomaterials	3														
	Be able to comprehend the interactions of															
CO3	cell and tissues with biomaterials based on		3		3											
	biomaterial properties and reactivity															
~~ (Be able to design and apply different types															
CO4	of biomaterials to solve biomedical			3												
()]	problems					1.		1.1		<u> </u>	1 0		<u> </u>			
(Numer	ical method used for mapping which indicate	s 3 a	s higi	1, 2 a	s me	dıun	ı, an	dla	is lov	v leve	l of m	hatching	g)			
	HING LEARNING STRATEGY															
	ig and Learning Activities									En	gager	nent (h	ours)			
Face-to	-Face Learning															
	Lecture											42				
	Practical / Tutorial / Studio											-				
a 10 D'	Student-Centred Learning									-						
Self-Directed Learning									42							
Non-face-to-face learning									42 21							
Revision of the previous and (or) subsequent lecture at home Preparation for final examination									21							
Formal	Assessment									21						
1 ormai	Continuous Assessment									2						
	Final Examination									3						
Total										131						
	HING METHODOLOGY											101				
Lecture	and discussion, Co-operative and collaborati	ve m	ethod	l, Pro	blen	n bas	ed n	netho	od							
COUR	SE SCHEDULE															
W		ntent									Ass	essmer	ıt			
1	Course Introduction and the str	ructu	re of	solic	ls											
Lecture																
Lecture																
Lecture	e	of so	olids													
2	Structure of solids															
Lecture			rysta	lline	mate	erials	3									
Lecture	1 5									07			• .			
Lecture	e ,	sile a	nd co	ompro	essio	n pr	oper	ties	of	CT		nd Mio Final	iterm,			
	biomaterials										1	mai				
3	Mechanical properties and chan								_							
Lecture	7 Shear properties, stress-strain pro	pertie	s and	l anal	ysis	of bi	oma	teria	ls							

Lecture 8	Bending properties, creep, fatigue, and stress relaxation of biomaterials	
Lecture 9	Thermal processing and properties of biomaterials	
4	Phase diagram	
Lecture 10	Basic concepts of phases and microstructure	
Lecture 11	Iron-Iron Carbide phase diagram	
Lecture 12	Phase transformation	
5	Physical Properties of Biomaterials	
Lecture 13	Electrical properties of biomaterials	
Lecture 13	Optical properties of biomaterials	
Lecture 14	X-ray diffraction, ultrasonic, and acoustic properties	
6	Characterization of biomaterials	
o Lecture 16		
	Spectroscopic analysis of biomaterials	Midterm, Final
Lecture 17	Surface characterization of biomaterials -AFM, SFM, SEM, and optical techniques	,
Lecture 18	Introduction to metallic biomaterials - stainless steel and Co-Cr based alloys	
7	Metallic biomaterials	
Lecture 19	Titanium and Titanium based alloys	
Lecture 20	Corrosion of metallic implants	
Lecture 21	Revision	
	MIDTERM	
8	Ceramic Biomaterials	
Lecture22	Structure property relationship of ceramics	
Lecture 23	Aluminum Oxides (Alumina) & Zirconium Oxides (Zirconia)	
Lecture 24	Glass ceramics	
9	Polymeric biomaterials	
Lecture 25	Structure and classification of polymeric materials	
Lecture 26	Properties and processing of polymeric materials	
Lecture 27	Natural polymeric materials – properties and functions	
10	Polymeric biomaterials	
Lecture 28	Hydrogel – properties, functions and applications	
Lecture 29	Biodegradable polymers – properties, functions and applications	CT – 2, FINAL
Lecture 30	Polymeric biomaterials in biosensors	
11	Composite biomaterials and Biocompatibility	
Lecture 31	Structure and anisotropy of composites	
Lecture 32	Fibrous and particulate composites	
Lecture 33	Biocompatibility of biomaterials	
12	Biological response to biomaterials	
Lecture 34	Protein-biomaterial interactions	
Lecture 35	Cell/tissue-biomaterial interactions	
Lecture 36	Toxicity and immune response	
Lecture 36 13	Toxicity and immune response Soft tissue replacement	
Lecture 36	Toxicity and immune response	

14	Hard tissue replacement			
Lecture 40	Fracture and spinal plates]		
Lecture 41	Dental restorations and implants	1		
Lecture 42	Revision	1		

ASSESSMENT STRATEGY

			СО	Blooms Taxonomy
Comp	onents	Grading	00	Broomb Functionity
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO3	C2
(40%)	Class Participation	5%	CO2	C4
	Midterm	15%	CO1, CO2	C2, C4
			CO 1	C2
Final	Exam	60%	CO 2	C4
			CO 3	C2
Total	Marks	100%		
(CO = Course	e Outcome, C = C	Cognitive Domain)	
TEXT BOOK	KS			
1. Biomateria	als, Joyce Y Wong	g, Joseph D Bronzi	no, CRC Press (latest edition	1)
2. Biomateria	als: An Introducti	on, 3rd Edition by	Joon Park R.S. Lakes	
REFERENC	E BOOKS			
1. Materials	Science and Engi	neering - An Introd	duction, 4th Ed,WD Callister	, Jr. and David G. Rethwisch
REFERENC	E SITE			
-				

6.1.24 BME 316 Biomaterials Sessional

COURSE INF	ORMATION		
Course Code	: BME 316	Lecture Contact Hours	: 3.00
Course Title	: Biomaterials Sessional	Credit Hours	: 1.50
DDE DEALIS			
PRE-REQUIS			
Course Code: B	ME 303		
Course Title: Bi	iomaterials		
CURRICULU	M STRUCTURE		
Outcome Based	Education (OBE)		
SYNOPSIS/RA	TIONALE		
This course cov	ers the characterization of mec	hanical, physical, and chemic	cal properties, such as young's modulus,
ductility, porosi	ty, corrosion, and surface topog	raphy of biomaterials.	
J * 1		× 1 ×	

OBJECTIVE

This c	ourse aims to	o introduce students	to biomaterial te	sting and the f	actors in	nfluenc	ing the	ir functio	ons.		
COU	COURSE OUTCOMES & GENERIC SKILLS										
No.		Course Outcome	e	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods		
CO1		investigate different their mechanical stre	C4	4		1	1, 2	T, Q, R			
CO2		synthesize polymer eterize their physica		C4	4		1	1, 2	T, Q, R		
CO3		design, develop an ls for biomedical ap	C6	3,10		1	5	PR, Pr			
,	(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)										
C1 - R	temember	C2 - Understand	C3 - Apply	C4 - Anal	yze	C5 -	- Evalu	ate	C6 - Create		

COURSE CONTENT

Τ

Determination of elasticity and Young's modulus, stress and strain analysis, tensile test, compressive test, bending test, impact test, corrosion test, microscopic analysis, surface topography and porosity, hydrogel and composite biomaterial fabrication, bone cement preparation, spectrophotometric and FTIR characterization of biomaterials.

No.	Course Learning Outcome		PROGRAM OUTCOMES (PO)											
110.			2	3	4	5	6	7	8	9	10	11	12	
CO1	Be able to investigate different biomaterials to determine their mechanical strength properties				3									
CO2	Be able to synthesize polymeric biomaterials and characterize their physical and chemical properties				3									
CO3	Be able to design , develop and test synthetic biomaterials for biomedical applications.			3							2			

TEACHING	LEARNING STRATEGY	
Teaching and	Learning Activities	Engagement (hours)
Face-to-Face	Learning	
Lec	ture	7
Prae	ctical / Tutorial / Studio	35
Stud	lent-Centered Learning	-
Self-Directed	Learning	
	n-face-to-face learning	-
	ision of the previous and (or) subsequent lecture at home	15
	paration for final examination	10
Formal Asse		
	tinuous Assessment	1
	Test	1
Qui		0.75
Viv	a	0.25
Total		70
TEACHING	GMETHODOLOGY	
Lecture and	discussion, Co-operative and collaborative method, Problem based method	
COURSE S	CHEDULE	
Week	Lecture Topics	Assessment
1	Introduction to biomaterials lab, laboratory techniques, laboratory rules.	
-	Introduction to polymer biomaterials	
2	Preparation and synthesis of hydrogel	
3	Physical property and qualitative assessment of the hydrogel.Preparation of hydrogel for lyophilization and degradation test	D
4	Analysis of the lyophilized hydrogel and water absorption test Measurement of the degradation test	Report, Lab Test, Quiz, Viva
5	Measurement of water absorption test and degradation test	
	Preparation for FTIR analysis and tensile test	
6	FTIR analysis of hydrogels	
7	Tensile testing of hydrogels	
	Midterm Break	
8	Lab Test 1	
9	Preparation and fabrication of bone cement	
10	Compression analysis of bone cement	Report, Lab Test, Quiz,
11	Three point bending of bone cement/other relevant composite/biological materials	Viva

12	UV-VIS spec solutions	etrophotometry	ntrations of	Project, Presentation							
13	Optical proper	Optical property measurement of different materials									
14	Quiz and Viva	ı									
ASSESSME	NT STRATEGY	l									
		P	Blooms Taxonomy								
Comp	oonents	Grading	СО		noonis Tuxononiy						
Continuous	Report	20%	CO1, CO2		C4						
Assessment (30%)	Class Participation	10%	CO1, CO2, CO3		C4, C6						
	Lab Test	15%	CO1, CO2		C4						
Final Exam	Project	15%	CO3		C6						
(70%)	Quiz	30%	CO1, CO2		C4						
	Viva	10%	CO1, CO2		C4						
Total	Marks	100%		ł							
(CO = Cours	se Outcome, C =	Cognitive Dor	nain, P = Psychomotor Dom	ain, A = Affe	ective Domain)						
TEXT BOO	KS										
1. Elen	nents of Material	s Science and E	ngineering 6th Edition. by L.	H. Van Vlack							
REFERENC	CE SITE										
-											

6.1.25 BME 318 Biomedical Engineering Design Sessional I

	RSE INFO									
Cours	e Code	: BME 318	Lect	ure Contact H	ours	: 3.00)			
Cours	se Title	: Biomedical Engineering Design Sessional	Cred	lit Hours		: 1.50)			
PRE-	REQUISIT	ſE	1			1				
Cours	e Code: BN	1E 104								
Cours	e Title: CA	D in Biomedical Engineering	Sessiona	ıl						
CUR	RICULUM	STRUCTURE								
Outco	me Based I	Education (OBE)								
SYNC	OPSIS/RA]	FIONALE								
This c	course cove	rs the application of design to	ols to m	odel prototype	es and d	levelop	the inc	dividua	al pro	ject ideas and
		f an individual project.				-			-	-
	CTIVE									
OBJE The ai		ourse is to enhance student's id	ea about	project and de	evelop t	heir car	abiliti	es of pr	roject	management.
The ai	im of this co	ourse is to enhance student's id			evelop t	heir cap	pabilitio	es of pr	roject	-
The ai	im of this co			project and de Bloom's Taxonomy	evelop t	heir cap	cA	es of pr		Assessment Methods
The ai	im of this co RSE OUTO Be able to	COMES & GENERIC SKIL	LS ools to	Bloom's	-			-		Assessment
The ai	Be able to develop facilities. Be able to develop	COMES & GENERIC SKIL	LS ools to lthcare m and would	Bloom's Taxonomy	PO	СР	CA	KI	P	Assessment Methods
The ai COUI No. CO1	im of this co RSE OUTO Be able to develop facilities. Be able to using eng be able to Be able to	COMES & GENERIC SKILL Course Outcome to apply modern engineering to projects to enhance heal to analyze a complex problec ineering tools and knowledge	LS ools to lthcare m and would es and	Bloom's Taxonomy C3	PO 3, 5	CP 1	CA _	KI 1	2	Assessment Methods T, Q, R T, Q, R,
The ai COU No. CO1 CO2 CO3	im of this co RSE OUTO Be able to develop facilities. Be able to using eng be able to Be able to Be able to	COMES & GENERIC SKILL Course Outcome to apply modern engineering to projects to enhance heal to analyze a complex problem ineering tools and knowledge formulate a suitable solution. to design and develop device	LS ools to lthcare m and would es and ies.	Bloom's Taxonomy C3 C4 C6	PO 3, 5 2, 5 3	CP 1 1 1,3	CA - -	KI 1 1,: 5	2	Assessment Methods T, Q, R T, Q, R, ASG T, Q, R
The ai COU No. CO1 CO2 CO3 (CP- 0	im of this co RSE OUTO Be able to develop facilities. Be able to using eng be able to Be able to Complex Pr	COMES & GENERIC SKILL Course Outcome to apply modern engineering to projects to enhance heat to analyze a complex problec ineering tools and knowledge formulate a suitable solution. to design and develop device at to improve healthcare faciliti	LS ools to lthcare m and would es and ies. ies, KP-I	Bloom's Taxonomy C3 C4 C6 Knowledge Pr	PO 3, 5 2, 5 3	CP 1 1 1,3	CA - -	KI 1 1,: 5	2	Assessment Methods T, Q, R T, Q, R, ASG T, Q, R

COURSE CONTENT

The course introduces students to the fundamental fabrication techniques utilized in biomedical engineering research and medical device production. In the first 7 weeks students are given hands-on training on a range of techniques such as FDM printing, SLA printing, PCB design and fabrication, CNC milling, laser cutting, and PDMS microfabrication. Students are then given specific design challenges which they will address utilizing the relevant design principals. Design challenges are directed by the course instructor(s) and may include topics ranging from instrumentation to prosthetic/orthotic development.

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)														
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12			
	Be able to apply modern engineering tools															
CO1	to develop projects to enhance healthcare			2		3										
	facilities.															
	Be able to analyze a complex problem and															
CO2	using engineering tools and knowledge															
002	would be able to formulate a suitable															
	solution.															
	Be able to design and develop devices and															
CO3	equipment to improve healthcare			3												
	facilities.															
(Numeri	ical method used for mapping which indicate	s 3 as	s higł	n, 2 as	s me	diun	ı, an	d 1 a	ıs low	v leve	l of m	atching	g)			
ТЕАСН	IING LEARNING STRATEGY															
Teachin	g and Learning Activities									En	gagen	nent (ho	ours)			
Face-to-	Face Learning															
	Lecture											7				
	Practical / Tutorial / Studio											35				
	Student-Centered Learning											-				
Self-Dir	ected Learning															
	Non-face-to-face learning											-				
	Revision of the previous and (or) subsequen	nt lect	ure a	t hon	ne							15				
	Preparation for final examination											10				
Formal A	Assessment															
	Continuous Assessment											1				
	Lab Test											1				
	Quiz										().75				
	Viva									0.25						
Total												70				
TEACH	IING METHODOLOGY															
Lecture	and discussion, Co-operative and collaborati	ve m	ethod	l, Prol	blem	n bas	ed n	netho	od							
COURS	SE SCHEDULE															
Wee	k Lecture	Topic	s								Ass	essmen	t			
1	Introduction to biomedical design	, gro	up f	òrma	tion,	an	d di	recte	ed							
	development of a sample prototype i	n rele	vant	desig	n so	ftwa	re									
2	Prototype printing using Stereolithog	graph	y prir	nting	(SLA	A) ar	nd ar	nalys	is							
	of the printed model		-	-		-		-		P						
3	Designing an electrical circuit using	CNC	milli	ing						-		signme				
				-					\neg		rest, (Quiz, V	ıva			
4	Designing an electrical circuit using a PCB printer Creation of micro-channels on acrylic using laser cutter									_						
4 5																
	Fabrication, inspection and assembly		-			anne	ls		\neg							

	Midterm Break	
8	Brainstorming feasible solutions to the design challenge	
9	Prototype development	Report, Lab Test, Quiz,
10		Viva
11	Prototype measurement and characterization	
12	Prototype testing and validation	
13	Presentation and project showcasing	
14	Project Submission with complete documentation (Drawing, user	
	manual, report and design history file)	
ACCEC	MENT STDATECV	

ASSESSMENT STRATEGY

Comr	oonents	Grading	СО	Blooms Taxonomy
Com	501101113	Orading		
Continuous	Report	20%	CO1, CO2, CO3	C4, C5, C3
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3	C4, C5, C3
Final Exam	Lab Test	20%	CO1, CO2, CO3	C4, C5, C3
(60%)	Quiz	30%	CO1, CO2, CO3	C4, C5, C3
(0070)	Viva	10%	CO1, CO2, CO3	C4, C5, C3
Total	Total Marks			

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT BOOKS

1. Robbinson C.J., Rehabilitation Engineering. CRC press 1995

2. Gerald E. Miller, Artificial Organs, Morgan & Claypool Publishers, 2006

REFERENCE BOOKS

1. Bronzino. Joseph, Handbook of biomedical engineering. CRC; 2 Sub editions, 1999

2. BallabioE.etal, Rehabilitation Engineering. IOS press 1993.

REFERENCE SITE

6.1.26 BME 300 Industrial Training

COURSE INFORMATION								
			: 1.50					
Course Code Course Title	: BME 300 : Industrial Training	Lecture Contact Hours Credit Hours	: 1.50					
PRE-REQUIS	ITE							
CURRICULU	M STRUCTURE							
Outcome Based	Education (OBE)							
SYNOPSIS/RA	TIONALE							
Training in indu	stry, hospital or healthcare or	ganization will be conducted for	r a duration of 4 weeks at the end of level					
3 term 2. Stude	nts will learn how to apply	their skills as a biomedical eng	gineer in a professional setting and will					
undergo extensi	ve training in preparation for	their role in the industry, hosp	bital, or healthcare facilities. The training					
can be arranged	by the department.							

OBJECTIVE

1. To learn and explore the different technical aspects and management of health-related organizations.

COURSE OUTCOMES & GENERIC SKILLS

	COURSE OUTCOMES & GENERIC SKILLS									
No.		Course Outcome		Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods	
CO1		to understand the engineer in their respe		C2	6, 12	-	7	7	R, Pr	
CO2		evaluate various techn cal equipment	ical aspects	C5	9, 10	2	-	7	R, Pr	
CO3	ethics, res	b learn and apply p ponsibilities and the pering practice.	C3	8, 12	-	7	7	R, Pr		
CO4	Be able to comprehend and write effective				10	-	-	7	R, Pr	
CO5	Be able to a knowledge	C3	9, 11, 12	1	-	6	R			
`	-	blems, CA-Complex A Presentation; R - Report	-	e	ofile, T	– Test	, PR –	Project;	Q – Quiz; ASG –	
C1 - R	Remember	C2 – Understand	C3 - Apply	C4 - Ana	lyze	C5 –	Evalua	aluate C6 – Create		

COURSE CONTENT

4 weeks of industrial training at an industry, hospital, or healthcare organization. This is obligatory for the completion of B.Sc. course. An evaluation report from the industry is to be submitted at the end of the training and accordingly to be incorporated in the tabulation sheet.

No.	Course Looming Outcome	PROGRAM OUTCOMES (PO)											
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to understand the role of a												
CO1	biomedical engineer in their respective						3						3
	fields												
CO2	Be able to evaluate various technical									2	3		
002	aspects of biomedical equipment									2	5		
	Be able to learn and apply professional												
CO3	ethics, responsibilities and the norms								3				3
	of the engineering practice.												
	Be able to comprehend and write												
CO4	effective reports, design documentation,										3		
04	make effective presentations and give and										5		
	receive clear instructions.												

						Co	urse	Offer	ed by B	ME Depc	artment
~~ -		apply their biomedical									
CO5	engineering setting	knowledge in a professional							3	3	3
(Numer	rical method use	ed for mapping which indicate	s 3 as hig	h, 2 as me	diun	ı, and	11 as	s low	level of	matchin	g)
		ING STRATEGY									
	ng and Learning	Activities						_	Engag	ement (h	ours)
Face-to	-Face Learning									-	
	Lecture	· 1 / C+ 1								7	
	Practical / Tut									35	
Salf Di	Student-Cente rected Learning	_						_		-	
Sell-Di	Non-face-to-f									_	
		e previous and (or) subsequent	t lecture :	at home						- 15	
		or final examination	it leeture (at nonic						10	
Formal	Assessment									10	
	Continuous A	ssessment								2	
	Final Presenta	tion								1	
Total										70	
TEAC	HING METHO	DOLOGY									
		, Co-operative and collaborati	ve metho	d Problem	has	ed m	etho	1 Tra	ining		
		-	ve metho	u, 11001011	1 0 4 5		cuio	u, 11a	nnng.		
	SE SCHEDUL										
1	Week	Industrial Training at an	Content	hospital	0.1	haalt	haar		A	ssessmen	IT
1		organization	maustry,	nospital,	or	nean	ncar				
2		Industrial Training at an	industry	hospital	or	healt	hcar	e			
2		organization	maasa y,	nospital,	01	nean	neur		ontinu	ous Asse	ssment
3		Industrial Training at an	industry.	hospital.	or	healt	hcar			Report	55111111
-		organization	<i>j</i> ,	r,							
4		Industrial Training at an	industry,	hospital.	or	healt	hcar	e			
		organization		1							
		-	l Presen	tation				I			
ASSES	SMENT STRA	ATEGY									

Co	mponents	Grading	CO			Blo	ooms Tax	konomy	
Continuou		20%	CO1, CO2,	CO3			C2, C3,	C5	
Assessmen (40%)	-	20%	CO1, CO2,	CO3			C2, C3,	C3, C5	
Final Exan (60%)	n Final Presentation	60%	CO1, CO2,	CO3			C2, C	C2, C5	
То	tal Marks	100%							
(CO = Co)	irse Outcome, C =	Cognitive Doma	in)						
TEXT BO	OKS								
-	UK5								
REFERE	NCE SITE								
COURSE	INFORMATION								
Course Co				Lectur	e Contac	t Hours		: 3.00	
Course Tit		nd Numerical Metl	hods for	Credit					
	Biomedical	Engineers						: 3.00	
		-							
PRE-REQ		205							
	urse Code: MATH urse Title: Differen		lago Tronsform	and Four	ion Trong	form			
	JLUM STRUCTU			and Four	Ter Trans	siorm			
	tcome Based Educa								
	S/RATIONALE			2					
	teach the students	-						-	
- 1	ovide a basic founda d DEs etc. Finally,					* *		-	
	merical methods a			-	-	-	eai- me	problems uroug	
		iu giving statistica	i merpretation a		nems.				
	VF								
OBJECTI		nd the basic knowl	ladge of various	numerio	al approx	imations	for solv	na aquations	
OBJECTI	Be able to understa		-			timations	for solv	ng equations.	
OBJECTI 1. 2.	Be able to understa Be able to provide a	a statistical probab	ility of any real-	life prob	lem.				
OBJECTI 1. 2. 3.	Be able to understa Be able to provide a Implement numeric	a statistical probab al methods and sta	ility of any real- atistical concepts	life prob	lem.				
OBJECTI 1. 2. 3.	Be able to understa Be able to provide a	a statistical probab al methods and sta GENERIC SKILI	ility of any real- atistical concepts .S Bloom's	life prob	lem.			oblems.	
OBJECTI 1. 2. 3. COURSE No.	Be able to understa Be able to provide a Implement numeric OUTCOMES & C Course Out	a statistical probab cal methods and sta GENERIC SKILI come	ility of any real- atistical concepts	life prob in solvi	lem. ng differ	ent engin	eering pr	oblems.	
OBJECTI 1. 2. 3. COURSE No. CO1 Be nur	Be able to understa Be able to provide a Implement numeric OUTCOMES & C Course Out able to under nerical methods.	a statistical probab al methods and sta GENERIC SKILI scome stand different	ility of any real- tistical concepts .S Bloom's Taxonomy	life prob	lem. ng differ CP	ent engin	eering pr KP	oblems. Assessment Methods T, F, ASG	
OBJECTI 1. 2. 3. COURSE No. CO1 Be nur Be	Be able to understa Be able to provide a Implement numeric OUTCOMES & C Course Out able to under nerical methods. able to identif	a statistical probab al methods and sta GENERIC SKILI scome stand different	ility of any real- tistical concepts .S Bloom's Taxonomy	life prob	lem. ng differ CP	ent engin	eering pr KP	oblems. Assessment Methods	

Τ

								С	ourse	e Offe	ered	by E	BME .	Depart	ment
	Be able	to apply numerical methods,												MT,	F
CO3	sampling	theory and different statistical	C3			5		1			1	1,2			
	tests to so	olve real-world problems.													
	(CP- Co	mplex Problems, CA-Complex	Activities	s, KP	Kno	owle	dge	Prof	ïle, 7	T – T	est;	MT	– Mi	dterm	Exam;
	ASG – A	Assignment; F – Final Exam)													
COU	RSE CON	TENT													
	Numer	ical Methods For Biomedical	Engineer	ing:											
	Numer	ical Solution of Algebraic and	Transcen	dent	al Eo	quat	ions	: Int	roduc	ction,	, Bise	ectio	on me	thod, N	Jewton
	Raphso	on method. Solution of system o	of linear eq	uatio	ns us	sing	dire	ct ar	d iter	rative	e me	thod			
	Interp	olation: Finite differences, Fo	orward an	nd ba	ckw	ard	diff	eren	ces,	Diffe	erenc	ce ta	able,	differ	ence o
	polyno	mial. Newton forward and backy	ward inter	polati	on fe	ormu	ıla, O	Cent	ral an	d div	vided	l diff	erend	ces, Nu	merica
	Integra	tion Numerical solution of ordin	nary differ	ential	equ	atio	ns.								
	Statisti	ics:													
	Correl	ation: Scatter diagrams, Corre	lation co-	efficie	ent,	Ranl	k co	rrela	tion,	Cor	relati	ion	ratio,	Theor	ems o
	correla	tions.													
		sion Analysis: Linear regression	on, Equati	on of	the	line	of 1	egre	ssion	, Re	gress	sion	co-e	fficient	, Curv
	-	Method of least square.													
		oility: Mathematical and stati					itive	and	1 mu	ltipli	icativ	ve r	ule o	of prol	pability
		ional probability, Baye's theore	• •		-										
		m Variables: Discrete and co									mas	s fu	inctio	on, Pro	babilit
		function, Cumulative distributi						-							
		te Probability Distribution:	Binomial	dist	ribut	ion,	Ne	gativ	ve bi	nom	ial c	distr	ibutic	on, Ge	ometri
		tion, Poisson's distribution.													
		uous Probability Distribut	t ion : Nor	mal	dist	ribu	tion,	E	xpone	ential	l di	istrił	oution	ı, Ch	i-squar
		tion, t and F- distributions.													
	-	ing Distribution: Population,	-	nean,	Sai	mple	va	rianc	e, C	entra	al lir	nit	theor	em, Sa	amplin
		tion from a normal population.													
		Hypothesis: Statistical hypothe	esis, Level	of sig	gnifi	canc	e, T	ype	I and	Туре	e II e	rror	One	tailed	and tw
		ests, Tests for proportions.													
	-	is of Variance: One way and T	wo classif	ficatio	on of	AN	OV	A							
SKIL	L MAPPI	NG													
	No.	Course Outcome		PROGRAM OUTCOMES (PO)											
				1	2	3	4	5	6	7	8	9	10	11	12
		Be able to understand	different												

No.	Course Outcome										· ·	/	
INO.	Course Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to understand different numerical methods.	3											
CO2	Be able to identify and describe statistical data and probability concepts.		3										
CO3	Be able to Apply numerical methods, sampling theory and different statistical tests to solve real-world problems.					3							
(Numeri	cal method used for mapping which indic	ates (3 as 1	nigh,	2 as	mee	diun	n and	d 1 as	low	level	of mat	ching)
stification for	· CO-PO mapping:												

Mapping	Corresponding	Justifications	
	Level of		
	matching		
CO1-PO1(a)	3	The knowledge of mathematics has to be ap	plied to understand different
		numerical methods in the field of engineering st	udy.
CO2-PO1(a)	3	In order to identify and describe statistical	phenomena and probability
		distribution, using the knowledge of mathematic	es and sciences is required.
CO3-PO1(a)	3	Interpret various numerical methods and statist	ical phenomena to solve DEs
		using them, the knowledge of mathematics is re	quired.
	EARNING STRATE	CGY	
	earning Activities		Engagement (hours)
Face-to-Face Le	•		12
Lectur			42
	cal / Tutorial / Studio		-
	t-Centred Learning		-
Self-Directed L	•		10
	ace-to-face learning	41	42
	on of the previous lect		21
	ation for final examin	ation	21
Formal Assessn			2
	uous Assessment		2
	Examination		3
Total			131
	IETHODOLOGY		
Lecture and Dis	cussion, Co-operative	and Collaborative Method, Problem Based Meth	od
COURSE SCH	IEDULE		
Week 1		Numerical Analysis	
Class 1	Numerical Solution	n of Algebraic and Transcendental Equations:	
Class 2	Bisection method		
Class 3	Newton-Raphson m	nethod	
Week 2		Numerical Analysis	
Class 4	Solution of system	of linear equations using direct method	CT 1
Class 5		of linear equations using iterative method	
Class 6		te differences, Forward differences	
Week 3		Numerical Analysis	
Class 7	Interpolation: Fini	te differences, backward differences	
Class 8	Central differences,	Divided differences, Difference table	
Class 9		Divided differences, Difference table	
Week 4		Numerical Analysis	
Class 10	difference of polyne	omial	
Class 11	Newton interpolation		CT 2
Class 12	-	erpolation formula, Newton backward	
		•	

Week 5	Numerical Analysis	
Class 13	Numerical Integration	
Class 14	Numerical solution of ordinary differential equations	
Class 15	Application of numerical methods in Biomedical Engineering	
Week 6	Statistics	
Class 16	Introduction to statistics, correlation: Scatter diagrams, Correlation co- efficient	
Class 17	Rank correlation, Correlation ratio, Theorems on correlations.	
Class 18	Regression Analysis: Linear regression	
Week 7	Statistics	
Class 19	Least square method Equation of the line of regression	
Class 20	Regression co-efficient, Curve fitting	
Class 21	Probability: Mathematical and statistical definitions, Additive and multiplicative rule of probability	
Week 8	Statistics	
Class 22	Conditional probability, Joint Probability, Baye's theorem	Mid
Class 23	Conditional probability, Joint Probability, Baye's theorem	Term
Class 24	Random Variables: Discrete and continuous random variables,	
Week 9	Statistics	
Class 25	Random Variable: Probability mass function	
Class 26	Probability density function, Cumulative distribution functions	
Class 27	Mathematical expectation.	
Week 10	Statistics	
Class 28	Discrete Probability Distribution: Binomial distribution,	
Class 29	Negative binomial distribution, Geometric distribution	
Class 30	Poisson's distribution.	
Week 11	Statistics	
Class 31	Continuous Probability Distribution : Normal distribution: Introduction	CT 3
Class 32	Continuous Probability Distribution: Normal distribution: Theory	
Class 33	Continuous Probability Distribution: Normal distribution: Example	
Week 12	Statistics	
Class 34	Exponential distribution, Chi-square distribution, t and F- distributions	
Class 35	Sampling Distribution: Population, Sample mean, Sample variance	
Class 36	Central limit theorem, Sampling distribution from a normal population.	
Week 13	Statistics	
Class 37	Test of Hypothesis : Statistical hypothesis, Level of significance, Type I and Type II error	
Class 38	One tailed and two tailed tests, Tests for proportions.	
Class 39	Effect size Cohen's D method	
Week 14	Statistics	
Class 40	Analysis of Variance (ANOVA): One tailed and Two tailed tests	
Class 41	Analysis of Variance: Example	
Class 42	Statistical applications in Biomedical Engineering	

ASSESSMEN	T STRATEGY	T		
Comr	oonents	Grading	СО	Blooms Taxonomy
1	Class Test/		CO1, CO2	C2
Continuous Assessment	Assignment 1-3	20%	CO3	C3
(40%)	Class Participation	5%	CO1, CO2, CO3	C2, C3
	Midterm	15%	CO 2, CO3	C2, C3
			CO 1	C2
Final	Exam	60%	CO 2	C2
			CO 3	C2, C3
Total	Marks	100%		
		autschi Engineers, Scheaf	fer & McClave.	
REFERENC	E BOOKS			
	n to Statistics for latistics, Gupta and	-	eers, Kristina M. Ropella	
REFERENC	E SITE			
COURSE IN	FORMATION			
	: BME 302			: 3.00
Course Code	: Statistics	and Numerical	Lecture Contact Hours	: 1.50
Course Title		for Biomedical	Credit Hours	
PRE-REQUI	SITE		1	1
Course Code:	BME 301			
Course Title: S	Statistics and Nun	nerical Methods fo	or Biomedical Engineers	
CURRICULU	JM STRUCTUR	E		
Outcome Base	ed Education (OB	E)		
SYNOPSIS/R	ATIONALE			
A biomedical	engineer or resea	rcher has to deal	with different form of con	pplex computational problems in his
	-		•	nd analysis different forms of statist
	-	-		e these sorts of numerical and statist
-	-		-	t well-known statistical and numer
methods are o	bligatory. This la	boratory coursewo	ork includes some of these	statistical and numerical techniques

regression, curve fitting, interpolation, root finding, numerical calculus, solving linear and non-linear equations, higher order statistical measures, different statistical distributions, hypothetical tests, etc. This course covers the application of the statistical and numerical methods to solve the real-life problems using computer programming language like MATLAB, Python, R, etc.

OBJECTIVE

To develop students' skill of applying different statistical and numerical methods to solve real-life biomedical engineering problems utilizing the analytical tools like MATLAB, Python, R, etc.

COU	RSE OUTCOMES & GENERIC S	KILLS						
No.	Course Outcome		Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Be able to analyze and apply statistical techniques to solve t problems.		C3, C4	2, 5	-	-	1	T, Q, R
CO2	Be able to analyze and apply numerical methods to solve mathematical problems.		C3, C4	2, 5	-	-	1	T, Q, R
CO3	Be able to compare between statistical and numerical tech conclude about the suitable tech efficient and accurate results.	niques to	C5	2, 5	-	-	1	T, Q, R
`	Complex Problems, CA-Complex Ac	-	e	ofile, T	– Test;	PR –	Project; Q -	Quiz; ASG –
Assign	nment; Pr – Presentation; R - Report;	F - Final Ex	am)					
C1 - R	C2 - Understand C3	8 - Apply	C4 - Anal	C5 -	Evalu	ate C6	- Create	

COURSE CONTENT

Introduction to MATLAB/Python/R; Curve fitting problems and solutions using Linear Regression, Polynomial Regression, and Lagrange's Interpolation formula; Numerical root finding approach using Bisection Method, False Position Method, and Newton-Raphson Method; Numerical differentiation; Numerical integration; Finding the solutions of a linear system; Finding the concept of lower and higher order moments of random variables; Familiarization to the Probability, Conditional Probability, and Joint Probability, and the implementation techniques of Histogram, PDF's, CDF's of random variables, Binomial Distribution, Negative Binomial Distribution, Geometric Distribution, Normal Distribution and Poisson's distribution; Overview on the Statistical Hypothesis Test and execution of z-test, t-test, and Chi-Square (χ 2) test for the statistically hypothetical decision making on Biomedical data; One-way and Two-way Analysis of Variances (ANOVA) for the statistical significance test of Biomedical data.

					PR	<u>ogi</u>	2 4 1	101	TCC	MES	(PO)			
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	Be able to analyze and apply different statistical techniques to solve the related problems.		3			3								
CO2	Be able to analyze and apply different numerical methods to solve real-life mathematical problems.		3			3								
CO3	Be able to compare between different statistical and numerical techniques to conclude about the suitable technique for efficient and accurate results.		3			3								
(Numeri	cal method used for mapping which indicate	s 3 as	s high	, 2 as	s mee	dium	n, an	d 1 a	s low	leve	l of m	atching	g)	
	ING LEARNING STRATEGY g and Learning Activities									Eng	gagen	nent (ho	ours)	
	Face Learning											,	,	
	Lecture									7				
	Practical / Tutorial / Studio											35		
	Student-Centered Learning											-		
Self-Dir	ected Learning													
	Non-face-to-face learning											-		
	Revision of the previous and (or) subsequent	t lect	ure at	hom	ne					15				
	Preparation for final examination									10				
Formal A	Assessment													
	Continuous Assessment									1				
	Lab Test											1		
	Quiz).75		
	Viva											0.25		
Total												70		
TEACH	ING METHODOLOGY													
Lecture	and discussion, Co-operative and collaborativ	ve m	ethod	, Prol	olem	bas	ed m	netho	d					
COURS	SE SCHEDULE													
Wee	k Lecture	Topic	s								Ass	essmen	t	
1	Introduction to Statistics and (MATLAB/Python/R)	N	umeri			alys		Тоо		Rep			, Quiz,	
2	Introduction to curve fitting pr Engineering and their solutions usir Regression, and Lagrange's Interpola	ng Li	near	Regr						•P		Viva	, ,	

				00	
3	-	-	the root of a non-linear equ osition Method, and Newt	•	
	Method.	cuiou, ruise r	obition method, and reeve	on raphson	
4	Numerical di	fferentiation us	ing Forward Difference and	l Backward	
	Difference ap	proaches.			
5	Numerical in Simpson's (3/	-	g Trapezoidal, Simpson's	(1/3), and	
6	Finding the so	olutions of a line	ar system (a set of equations w	ith multiple	
	variables) usin Siedel Iterativ	-	1 Elimination through Pivoting	and Gauss-	
7	Lab Quiz				
	1		Midterm Break		
8	Introduction	to the randon	n variables in biomedical	engineering	
	-	-	f method of moments to find	l lower and	
	•	noments of rand			
9			bility, Conditional Probability		
		nd the impleme lom variables.	entation techniques of Histogr	am, PDF's,	
10			ntation of Binomial Distributio	n Negative	
10			etric Distribution, Normal Dist		Report, Lab Test, Quiz,
	Poisson's dist				Viva
11	Overview on	the Statistical H	Iypothesis Test and execution	of z-test, t-	
			for the statistically hypotheti	cal decision	
	-	omedical data.			
12	-		e execution of One-way an	•	
	Biomedical da		VA) for the statistical signific	ance test of	
13	Final lab test				
13	Final Quiz + '	Viva			
	NT STRATEGY				
TISSESSITE.		L			
Comp	oonents	Grading	CO	E	Blooms Taxonomy
Continuous	Report	20%	CO1, CO2, CO3		C4, C3
Assessment (40%)	Class	20%	CO1, CO2, CO3		C4, C3
(4070)	Participation				-
Final Exam	Lab Test	20%	CO1, CO2, CO3		C4, C3
(60%)	Quiz	30%	CO1, CO2, CO3		C4, C3
	Viva	10%	CO1, CO2, CO3		C4, C3
	Marks	100%			
		Cognitive Do	main, P = Psychomotor Dom	ain, A = Affe	ective Domain)
TEXT BOO			~ ~ ~ ~ ~ .	~ 1	(A. 1. 7. 11. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1
6. Numerica	al Methods for E	ngineers by Stev	ven C. Chapra & Raymond P.	Canale. 2015	(Seventh Edition), McGraw

Hill Education Publications

- 7. Statistics in MATLABA Primer By MoonJung Cho, Wendy L. Martinez. 2015 (First Edition), CRC Press.
- 8. Numerical and Statistical Methods for Bioengineering: Applications in MATLAB (Cambridge Texts in Biomedical Engineering) 1st Edition; by Michael R. King and Nipa A. Mody.

REFERENCE SITE

COURSE INFORMATION

		: 3.00
: BME 303 : Biomechanics	Lecture Contact Hours Credit Hours	: 3.00

PRE-REQUISITE

ME 291: Principle of mechanical engineering

PHY 127: Structure of matter, Electricity, Magnetism, and Mechanics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course covers the major topics/subtopics that include introduction to biomechanics, tissue mechanics, joint biomechanics, movement mechanics, dynamics to human motion, linear and angular kinematics, examples in biomechanics, modern kinematic measurement techniques, applications of human motion analysis, introduction to viscoelasticity.

OBJECTIVE

- 7. To describe the fundamental of biomechanics.
- 8. To Study the deformability, strength, viscoelasticity of bone and flexible tissues, modes of loading and failure.
- 9. To describe the types and mechanics of skeletal joints.
- 10. To describe movement precisely, using well defined terms (kinematics) and also to consider the role of force in movement (kinetics).
- 11. To teach students the unique features of biological flows, especially constitutive laws and boundaries.
- 12. To consider the mechanics of orthopedic implants and joint replacement, artificial heart valve, mechanical properties of cardiovascular and respiratory mechanics

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	To understand various properties of hard tissues (bone) & soft tissues (articular cartilage, tendons and ligaments) and identify the appropriate model to demonstrate mechanical behavior.	C2	1	1	-	1	T, F
CO2	To analyze the biomechanics of different human joints and also the forces at a skeletal joint for various static and dynamic human activities.	C4	2	1	-	1, 3	T, F
CO3	To explain the mechanics of moving systems and familiarity with human anatomy to competently analyze gross movement and dynamics of the human body.	C2	1	1	-	1, 3	MID, F

	To evalua	te the design requi	rements of								
CO4	D4 medical implants based on human anatomy and biological responses to biomaterials.			C5	4	1	-	1	T, 1	T, F	
(CP- 0	Complex Pro	blems, CA-Complex A	ctivities, KP-K	nowledge Pr	ofile, T	– Test;	PR –	Project; Q	– Quiz; A	SG –	
Assign	Assignment; Pr – Presentation; R - Report; F – Final E										
C1 - R	Remember C2 - Understand C3 - Apply C		C4 - Ana	lyze	C5 - 1	Evalua	te (C6 - Create			

COURSE CONTENT

Kinematic and Kinetic Concepts:

Forms of motion, Standard reference terminology, Joint movement terminology, Force, moment, couples, loads on the human body, Equations of static equilibrium, Structural idealization applications in biomechanics, stress and strain analysis.

Muscle and Movement:

Skeletal muscle morphology, Isotonic versus isometric construction, Muscles constitutive modelling, whole muscle mechanics parallel versus pinnate muscle types, Factors affecting muscular force generation; Muscular strength, power, endurance; muscle and bone interactions.

Basic Statics and Movements at Specific Joints:

Shoulder and Shoulder Girdle; Elbow and Forearm; Wrist and Hand; Trunk and Spine; Hip, Knee, Ankle; Patterns of movement; Structural and Functional Analysis.

Linear and Angular Kinematics of Human Movement:

Overview of linear kinematics, Acceleration, Projectile motion analysis, Linear and angular motion relationship, Modern kinematics measurement techniques.

Linear and Angular Kinetics of Human Movement:

Kinetic law of motion, Angular analogues of Newton's law of motion, Modern kinetics measurement techniques, Application of human motion.

Human Movement in Fluid Medium:

Nature of fluid, Viscoelasticity, Buoyancy, Drag, Lift force, Propulsion in fluid medium.

No.	Course Learning Outcome				PR	OGI	RAM	1 O L	JTCC	MES	5 (PO)		
110.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	To understand various properties of hard tissues (bone) & soft tissues (articular cartilage, tendons and ligaments) and identify the appropriate model to demonstrate mechanical behavior.	3											
CO2	To analyze the biomechanics of different human joints and also the forces at a skeletal joint for various static and dynamic human activities.		3										
CO3	To explain the mechanics of moving systems and familiarity with human anatomy to competently analyze gross movement and dynamics of the human body.	3											
CO4	To evaluate the design requirements of medical implants based on human				3								

	Course Off	ered by BME Department
anatomy biomater	and biological responses to ials.	
(Numerical method	used for mapping which indicates 3 as high, 2 as medium, and 1 as low	w level of matching)
TEACHING LEA	RNING STRATEGY	
Teaching and Learn	ing Activities	Engagement (hours)
Face-to-Face Learni	ing	
Lecture		42
	Tutorial / Studio	-
	entred Learning	-
Self-Directed Learn	-	42
	f the previous and (or) subsequent lecture at home	42 21
	n for final examination	21
Formal Assessment		21
	s Assessment	2
Final Exan		3
Total		131
TEACHING MET	HODOLOGY	
Lecture and discuss	ion, Co-operative and collaborative method, Problem based method	
COURSE SCHED	ULE	
Week	Торіс	Assessment
1 vveek	Kinematic and Kinetic Concepts	Assessment
Lecture 1	Forces, moments, couples, mechanical loads and effects of	
	loading	
Lecture 2	Forms of motion, Anatomical reference position, planes and	
	axes, Joint movement terminology	CT – 1, Final
Lecture 3	Equations of static equilibrium and structural idealization	
	applications in biomechanics	
2	Human Motion Analysis	
Lecture 4	Modern kinematic measurement techniques	
Lecture 5	Applications of human motion analysis	
Lecture 6	The human gait cycle	
3	Linear kinematics	
Lecture 7	Rigid body mechanics	
Lecture 8	Linear kinematics in human motion: measurements and analysis	
Lecture 9	Joint kinematics and Euler's angles	
4	Angular Kinematics	

	**	red by BME Department
Lecture 10	Angular kinematics relationships, comparison between angular and linear kinematics	
Lecture 11	Angular kinematics of different joints	
Lecture 12	Kinetics in human motion – center of pressure, and ground reaction forces	
5	Kinetics in human motion	
Lecture 13	Analysis of ground reaction forces in different axis	
Lecture 14	Forces and moments determination in kinetic studies	Midterm, Final
Lecture 15	Determination of joint moments and power	,
6	Musculoskeletal System	
Lecture 16	Review: stress-strain analysis of materials	
Lecture 17	Introduction to musculoskeletal system- bone anatomy and	
Lecture 17	architecture	
Lecture 18		
	Mechanical properties of bone, fracture mechanics and healing	
7 Lesture 10	Muscles and Movement	
Lecture 19	Skeletal muscle morphology and architecture	
Lecture 20	Isotonic versus isometric contraction	
Lecture 21	Muscles constitutive modelling, Whole muscle mechanics	
	parallel versus pinnate muscle types	
	Midterm Break	
8	Introduction to Joints	
Lecture 22	Joint – structure and properties	
Lecture 23	Joint – types and movement	
Lecture 24	Structure, movement and loads on the shoulder	
9	Human Joint Articulation	
Lecture 25	Joint Architecture, stability and flexibility	
Lecture 26	Common Joint injuries and introduction to the biomechanics of	CT – 2, Final
	human upper extremity	
Lecture 27	Structure, movement and loads on the shoulder	
10	Joint Movement Analysis	
Lecture 28	Structure, movement and loads on the elbow and wrist	
Lecture 29	Structure, movement and loads on the hip, knee and ankle	
Lecture 30	Problem solving	
11	Joint Movement Analysis of Spine	
Lecture 31	Stress relaxation properties of articular cartilage	
Lecture 32	Structure, properties and functions of spine	
Lecture 33	Spine mechanics and movement	
12	Mechanics of tendons, ligaments and articular cartilage	
Lecture 34	Structure and organization of tendons and ligaments	
Lecture 35	Mechanical and viscoelastic properties of tendons and ligaments	
Lecture 36	Structure, function and mechanical properties of articular	CT – 3, FINAL
2000000000	cartilage	
13	Introduction to cell mechanics and mechanobiology	
Lecture 37	Overview of multi-scale mechanobiology	
Lecture 38	Cell/tissue mechanics – implications in development and disease	FINAL
Lecture 39		
Lecture 39	Cell/tissue mechanics – implications in development and disease	

14	Revie	w Class				
Lecture 40	Single	e cell and bulk tissu	e mechanical measurements sy	vstems		
Lecture 41	Pavia	w and Mathematic	al problem solving			
Lecture 42	Kevie		ai problem sorving			
ASSESSMEN	T STRATEGY	7				
			CO	Blooms Taxonomy		
Comp	onents	Grading	60	Bioonis Taxonomy		
	Class Test/					
Continuous	Assignment	20%	CO1, CO2, CO4	C2, C4, C5		
Assessment	1-3					
(40%)	Class	5%	CO3	C2		
(1070)	Participation					
	Midterm	15%	CO3	C2		
			CO 1	C2		
Final	Exam	60%	CO 2	C4		
1 11141	LAdin	0070	CO 3	C2		
		Γ	CO 4	C5		
Total	Marks	100%				
(CO = Course	Outcome, C =	Cognitive Domai	n)			
TEXT BOOK	S					
1. Susan J. Hal	l, Basic Biome	chanics, McGraw H	Iill, Sixth Edition.			
2. Emico okun	o, Luciano Frat	in, Biomechanics o	f the Human Body, Springer.			
REFERENCE	E SITE					

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COURSE INF	ORMATION		
			: 3.00
Course Code	: BME 304	Lecture Contact Hours	: 1.50
Course Title	: Biomechanics Sessional	Credit Hours	
PRE-REQUIS	ITE		
Course Code: B	ME 303		
Course Title: Bi	omechanics		
CURRICULU	M STRUCTURE		
Outcome Based	Education (OBE)		
SYNOPSIS/RA	TIONALE		
This course cov	ers the application of experimen	tal analysis and computation	al techniques to the biomechanics of the
human body.			
OBJECTIVE			

This course aims to introduce students to the generation and analysis of biomechanical models and data.

and joints. Be able to analyze the linear and angular kinetics and kinematics of a body in motion. C4 2, 5 - 1 1 T, Q, R C03 Be able to evaluate the computational model of a body in motion. C5 2, 5 - 1, 3 2 T, Q, R C03 Be able to evaluate the computational model of a body in motion. C5 2, 5 - 1, 3 2 T, Q, R C04 C9 Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) C1 - Remember C2 - Understand C3 - Apply C4 - Analyze C5 – Evaluate C6 - Create COURSE CONTENT Introduction to skeletal biomechanics, The study of muscular contraction using electromyography, The study of joint biomechanics, Linear Kinematics of an object in motion and total body center of mass determination, Introduction to linear kinetics and analysis of vertical ground reaction force, Introduction to angular kinematics and range of motion, Creating and simulating the computational model of a dynamic body in motion. Biomedical Orthosis/ Prosthesis design & simulation, Study of Ankle Injury Using OpenSim (Both Free Fall & AFO Assisted), Creating and simulating the computational model of a static and dynamic body in motion SKILL MAPPING No. Course Learning Outcome	COUR	RSE OUTCOMES & GENERIC SKILLS								00			1	
CO1 signal and mechanics of muscle contraction C4 2, 5 - 1 1 T, Q, R CO2 Be able to analyze the linear and angular C4 2, 5 - 1 1 T, Q, R CO3 Be able to evaluate the computational model C5 2, 5 - 1, 3 2 T, Q, R CO3 Be able to evaluate the computational model C5 2, 5 - 1, 3 2 T, Q, R CO4 of a body in motion. C4 2, 5 - 1, 3 2 T, Q, R CO4 of a body in motion. C4 2, 5 - 1, 3 2 T, Q, R CO4 of a body in motion. C4 2, 5 - 1, 3 2 T, Q, R CO4 cf a body in motion. C4 2, 5 - 1, 3 2 T, Q, R C04 cf a body in motion. C4 2, 5 - 1, 3 2 T, Q, R C07 Example Project, Paluate C6 Create C6 Create Stopanstice frametics of an obj	No.	Course Outcome]	PO	CF	,	CA	H	КР		
CO2 kinetics and kinematics of a body in motion. C4 2, 5 - 1 1 T, Q, R CO3 Be able to evaluate the computational model of a body in motion. C5 2, 5 - 1,3 2 T, Q, R CO4 complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) C1 - Remember C2 - Understand C3 - Apply C4 - Analyze C5 – Evaluate C6 - Create COURSE CONTENT Introduction to skeletal biomechanics, The study of muscular contraction using electromyography, The study of joint biomechanics, Linear Kinematics of an object in motion and total body center of mass determination, Introduction to linear Kinematics and analysis of vertical ground reaction force, Introduction to angular kinematics and range of motion, Creating and simulating the computational model of a dynamic body in motion. Biomedical Orthosis' Prosthesis design & simulation, Study of Ankle Injury Using OpenSim (Both Free Fall & AFO Assisted), Creating and simulational model of a static and dynamic body in motion SKILL MAPPING No. Course Learning Outcome PROGRAM OUTCOMES (PO) No Course Learning Outcome 3 3 1 1 12 Be able to analyze the electromyography 3 3 3 1 <t< td=""><td>CO1</td><td>signal and mechanics of muscle contraction</td><td></td><td>C</td><td>4</td><td>2</td><td>2, 5</td><td>-</td><td></td><td>1</td><td></td><td>1</td><td>T</td><td>, Q, R</td></t<>	CO1	signal and mechanics of muscle contraction		C	4	2	2, 5	-		1		1	T	, Q, R
COS of a body in motion. COS 2.3 - 1.3 2 1, Q, K (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam) C1 - Remember C2 - Understand C3 - Apply C4 - Analyze C5 – Evaluate C6 - Create COURSE CONTENT Introduction to skeletal biomechanics, The study of muscular contraction using electromyography, The study of joint biomechanics, Linear Kinematics of an object in motion and total body center of mass determination, Introduction to linear kinetics and analysis of vertical ground reaction force, Introduction to angular kinematics and range of motion, Creating and simulating the computational model of a dynamic body in motion, Biomedical Orthosis/ Prosthesis design & simulation, Study of Ankle Injury Using OpenSim (Both Free Fall & AFO Assisted), Creating and simulating the computational model of a static and dynamic body in motion SKILL MAPPING No. Course Learning Outcome PROGRAM OUTCOMES (PO) No. Course Learning of muscle 3 3 1 1 12 Re able to analyze the linear and angular contraction and joints. 3 3 3 1 1 1 1 C01 kinetics and kinematics of a body in motion. 3 3 3 1<	CO2	•		C	4	2	2, 5	-		1	1		T	, Q, R
Assignment; Pr – Presentation; R - Report; F – Final Exam) C1 - Remember C2 - Understand C3 - Apply C4 - Analyze C5 – Evaluate C6 - Create COURSE CONTENT Introduction to skeletal biomechanics, The study of muscular contraction using electromyography, The study of joint biomechanics, Linear Kinematics of an object in motion and total body center of mass determination, Introduction to linear kinetics and analysis of vertical ground reaction force, Introduction to angular kinematics and range of motion, Creating and simulating the computational model of a dynamic body in motion, Biomedical Orthosis/ Prosthesis design & simulation, Study of Ankle Injury Using OpenSim (Both Free Fall & AFO Assisted), Creating and simulating the computational model of a static and dynamic body in motion SKILL MAPPING No. Course Learning Outcome PROGRAM OUTCOMES (PO) 1 2 3 4 5 6 7 8 9 10 11 12 C01 signal and mechanics of muscle on analyze the electromyography isgnal and mechanics of a body in 3 3 3 4 5 <t< td=""><td>CO3</td><td></td><td>1</td><td>C</td><td>5</td><td>2</td><td>2, 5</td><td>-</td><td></td><td>1,3</td><td></td><td>2</td><td>T</td><td>, Q, R</td></t<>	CO3		1	C	5	2	2, 5	-		1,3		2	T	, Q, R
COURSE CONTENT Introduction to skeletal biomechanics, The study of muscular contraction using electromyography, The study of joint biomechanics, Linear Kinematics of an object in motion and total body center of mass determination, Introduction to linear kinetics and analysis of vertical ground reaction force, Introduction to angular kinematics and range of motion, Creating and simulating the computational model of a dynamic body in motion, Biomedical Orthosis/ Prosthesis design & simulation, Study of Ankle Injury Using OpenSim (Both Free Fall & AFO Assisted), Creating and simulating the computational model of a static and dynamic body in motion SKILL MAPPING No. Course Learning Outcome PROGRAM OUTCOMES (PO) 1 2 3 4 5 6 7 8 9 10 11 12 CO1 signal and mechanics of muscle contraction and joints. 3 3 3 1 1 12 CO2 Be able to analyze the linear and angular motion. 3 3 3 1 1 12 CO2 kinetics and kinematics of a body in motion. 3 3 3 1 1 12 CO1 signal and mechanics of a body in motion. 3 3 3 1 1 1 1 1 1 1 1		· · · ·			dge F	Profi	le, T	– Te	st;]	PR –	Proje	ct; Q	– Quiz	; ASG –
Introduction to skeletal biomechanics, The study of muscular contraction using electromyography, The study of joint biomechanics, Linear Kinematics of an object in motion and total body center of mass determination, Introduction to linear kinetics and analysis of vertical ground reaction force, Introduction to angular kinematics and range of motion, Creating and simulating the computational model of a dynamic body in motion, Biomedical Orthosis/ Prosthesis design & simulation, Study of Ankle Injury Using OpenSim (Both Free Fall & AFO Assisted), Creating and simulating the computational model of a static and dynamic body in motion SKILL MAPPING PROGRAM OUTCOMES (PO) I 1 2 3 4 5 6 7 8 9 10 11 12 Be able to analyze the electromyography 3 a 3 a a a a a a a a a a a a a a a a a	C1 - R	emember C2 - Understand C3 - Apply		C4	- Ana	alyze	e	C	5 –	Evalu	late	C	6 - Cre	ate
No. Course Learning Outcome 1 2 3 4 5 6 7 8 9 10 11 12 Be able to analyze the electromyography signal and mechanics of muscle contraction and joints. 3 3 3 4 5 6 7 8 9 10 11 12 C01 signal and mechanics of muscle contraction and joints. 3 3 3 4 <			of a s	tatic	and d	lynai	nic l	oody	in r	notio	n			
No. Course Learning Outcome 1 2 3 4 5 6 7 8 9 10 11 12 Be able to analyze the electromyography signal and mechanics of muscle contraction and joints. 3 3 3 4 5 6 7 8 9 10 11 12 C01 signal and mechanics of muscle contraction and joints. 3 3 3 4 <						DD	0.01		01	ITCC				
Be able to analyze the electromyography 3 3 4 <td>No.</td> <td>Course Learning Outcome</td> <td>1</td> <td>2</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>12</td>	No.	Course Learning Outcome	1	2	3									12
CO2 kinetics and kinematics of a body in motion. 3 3 3 3 3 1 <t< td=""><td>CO1</td><td>signal and mechanics of muscle</td><td></td><td>3</td><td></td><td></td><td></td><td></td><td>-</td><td></td><td></td><td></td><td></td><td></td></t<>	CO1	signal and mechanics of muscle		3					-					
CO3 model of a body in motion. 3 3 3 1 <td< td=""><td>CO2</td><td>kinetics and kinematics of a body in</td><td></td><td>3</td><td></td><td></td><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	CO2	kinetics and kinematics of a body in		3			3							
TEACHING LEARNING STRATEGY	CO3	-		3			3							
	(Nume	rical method used for mapping which indicates	s 3 as	high	i, 2 as	s me	dium	i, and	18	is low	v leve	l of m	atching	g)
	TEAC	HING LEARNING STRATEGY												
											Eng	gagen	nent (ho	ours)

Pace-IO-Face	Course Off	y 1
	Learning	7
		7
	ctical / Tutorial / Studio	35
	dent-Centered Learning	-
Self-Directed	1 Learning n-face-to-face learning	
	-	
	vision of the previous and (or) subsequent lecture at home	15
	paration for final examination	10
Formal Asse		_
	ntinuous Assessment	1
	9 Test	1
Qui		0.75
Viv	a	0.25
Total		70
TEACHING	G METHODOLOGY	
Lecture and	discussion, Co-operative and collaborative method, Problem based method	
COURSE S	CHEDULE	
XX 7 1		
Week	Lecture Topics	Assessment
1	Introduction to skeletal biomechanics	
2	The study of muscular contraction using electromyography	
	Linear Kinematics of an object in motion and total body center of mass determination	Depart Lab Test Ouis
3		Report, Lab Test, Quiz, Viva
3	determination Introduction to linear kinetics and analysis of vertical ground reaction	
3 4 5	determination Introduction to linear kinetics and analysis of vertical ground reaction force	
3 4 5 6	determination Introduction to linear kinetics and analysis of vertical ground reaction force Introduction to angular kinematics and range of motion	
3 4 5 6	determination Introduction to linear kinetics and analysis of vertical ground reaction force Introduction to angular kinematics and range of motion Analysis of kinetics & kinematics data part 1	
3 4 5 6 7	determination Introduction to linear kinetics and analysis of vertical ground reaction force Introduction to angular kinematics and range of motion Analysis of kinetics & kinematics data part 1 Analysis of kinetics & kinematics data part 2	
3 4 5 6 7 8	determination Introduction to linear kinetics and analysis of vertical ground reaction force Introduction to angular kinematics and range of motion Analysis of kinetics & kinematics data part 1 Analysis of kinetics & kinematics data part 2 Midterm Break	
3 4 5 6 7 8 9	determination Introduction to linear kinetics and analysis of vertical ground reaction force Introduction to angular kinematics and range of motion Analysis of kinetics & kinematics data part 1 Analysis of kinetics & kinematics data part 2 Midterm Break Mid Lab Test	Viva
3 4 5 6 7 8 9 10	determination Introduction to linear kinetics and analysis of vertical ground reaction force Introduction to angular kinematics and range of motion Analysis of kinetics & kinematics data part 1 Analysis of kinetics & kinematics data part 2 Mid Lab Test Biomedical Orthosis/ Prosthesis design & simulation	Viva
3 4 5 6 7 8 9 10 11	determination Introduction to linear kinetics and analysis of vertical ground reaction force Introduction to angular kinematics and range of motion Analysis of kinetics & kinematics data part 1 Analysis of kinetics & kinematics data part 2 Mid Lab Test Biomedical Orthosis/ Prosthesis design & simulation Study of Ankle Injury Using OpenSim (Both Free Fall & AFO Assisted)	Viva Report, Lab Test, Quiz,
- - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 -	determination Introduction to linear kinetics and analysis of vertical ground reaction force Introduction to angular kinematics and range of motion Analysis of kinetics & kinematics data part 1 Analysis of kinetics & kinematics data part 2 Midterm Break Mid Lab Test Biomedical Orthosis/ Prosthesis design & simulation Study of Ankle Injury Using OpenSim (Both Free Fall & AFO Assisted) Creating and simulating the computational model of a static body at rest Creating and simulating the computational model of a dynamic body in	Viva Report, Lab Test, Quiz,

Components		Grading	СО	Blooms Taxonomy
Continuous	Report	20%	CO1, CO2, CO3	C4, C5
Assessment (30%)	Class Participation	10%	CO1, CO2, CO3	C4, C5
	Lab Test	35%	CO1, CO2, CO3	C4, C5
Final Exam (70%)	Quiz	25%	CO1, CO2, CO3	C4, C5
(7070)	Viva	10%	CO1, CO2, CO3	C4, C5
Total	Marks	100%		
(CO = Cours	*	Cognitive Dom	nain, P = Psychomotor Dom	ain, A = Affective Domain)

4. Donald R. Peterson and Joseph D. Bronzino, Biomechanics Principles and applications, CRC Press, Taylor & Francis Group, LLC, 2008 (UNIT II, III)

REFERENCE SITE

 $\underline{https://simtk-confluence.stanford.edu:8443/display/OpenSim/Building+a+Dynamic+Walker+in+Matlab}$

	KSE INFO	RMATION							
Course Course	e Code e Title	: BME 305 : Biomedical Signal Pr	He	Lecture Contact ours Credit Hours	t	: 3.00			
	REQUISIT		ł			1			
		ential Equation, Laplace	Transform a	nd Fourier Trar	nsform				
		STRUCTURE							
		ducation (OBE)							
	PSIS/RAT								
signal		to introduce the fundam s with a particular emph	-						• •
4. To	equip stud	lents skilled to apply the	e knowledge	of signal proce	essing to	o solve	the rea	al life pro	blems related t
Bi	osignal. RSE OUTC	COMES & GENERIC	-					1	
Bi	-		-	Bloom's Taxonomy	PO	СР	CA	KP	Assessmen Methods
Bi COUF No.	Be able	COMES & GENERIC S Course Outcome to understand signals y, Laplace, and Z doma	SKILLS in the time, ins	Bloom's					Assessmen
Bi COUF No. CO1	Be able frequence Be able	COMES & GENERIC S Course Outcome to understand signals	SKILLS in the time, ins	Bloom's Taxonomy	PO	СР	СА	KP	Assessmer Methods
Bi COUF No. CO1 CO2	Be able frequence Be able signal pr Be able signals a	COMES & GENERIC S Course Outcome to understand signals y, Laplace, and Z doma to comprehend the occessing techniques to acquire popular nd their fundamental fea	SKILLS in the time, ins fundamental biomedical atures'	Bloom's Taxonomy C2	PO 1	CP 1	СА	KP 1,3	Assessmer Methods T, F
Bi COUF	RSE OUTC Be able frequenc Be able signal pr Be able signals a Be able	COMES & GENERIC S Course Outcome to understand signals y, Laplace, and Z doma to comprehend the occessing techniques to acquire popular	SKILLS in the time, ins fundamental biomedical atures' ze the basic	Bloom's Taxonomy C2 C2	PO 1 1	CP 1 1,3	CA - -	KP 1,3 1,3	Assessmer Methods T, F T, F
Bi COUR No. CO1 CO2 CO3 CO4	RSE OUTC Be able frequenc Be able signal pr Be able signals a Be able processin signals	COMES & GENERIC S Course Outcome to understand signals y, Laplace, and Z doma to comprehend the occessing techniques to acquire popular nd their fundamental fea to design and analyz	SKILLS in the time, ins fundamental biomedical atures' ze the basic Biomedical	Bloom's Taxonomy C2 C2 C2 C2 C3, C4	PO 1 1 2 3	CP 1 1,3 1 1,3	CA - -	KP 1,3 1,3 1 1,3	Assessmer Methods T, F T, F MID, F T, F
Bit COUR No. CO1 CO2 CO3 CO4 (CP- C)	RSE OUTC Be able frequenc Be able signal pr Be able signals a Be able processin signals Complex Pro	Comes & GENERIC S Course Outcome to understand signals y, Laplace, and Z doma to comprehend the occessing techniques to acquire popular nd their fundamental fea to design and analyz ng techniques for the	SKILLS in the time, ins fundamental biomedical atures' ze the basic Biomedical	Bloom's Taxonomy C2 C2 C2 C2 C3, C4 -Knowledge Pr	PO 1 1 2 3	CP 1 1,3 1 1,3	CA - -	KP 1,3 1,3 1 1,3	Assessmer Methods T, F T, F MID, F T, F

COURSE CONTENT

Signal and System: Linearity of System, Classification and properties of signals, Common signals in engineering, Continuous-Time (CT) and Discrete-Time (DT) signal and system, Quantization, Analog to digital conversion of signal. **Modeling of Signals and Systems:** Impulse Response, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) of Discrete-Time Systems, Difference Equation, Convolution, Correlation, Covariance, Transient and Steady-state Response. **Signal Transformation:** Discrete Fourier Transformation (DFT), Fast Fourier Transformation (FFT), Inverse FFT, Z-Transformation, Inverse Z-Transformation. **Randomness and Estimation of Signals:** Linear Time Invariant (LTI) system, Stationarity and Ergodicity, Power Spectral Density, Frequency and Power Spectrum.

Introduction to Biosignals: Origins, properties and suitable models of popular biosignals, Objectives and challenges of Biosignal Analysis; Steps of Biosignal Processing. **Noise** and **Filters:** Noise Models, Averaging filters, Design and principles of Wiener Filter, FIR and IIR filters. **Biomedical Signal Processing:** Spectral analysis of ECG, EEG, EMG, and EOG signals, Case study on ECG and EMG signals, Introduction to Feature Extractions and Classification.

SKILL MAPPING PROGRAM OUTCOMES (PO) No. Course Learning Outcome 2 3 4 5 6 7 9 10 12 1 8 11 Be able to **understand** signals in the 3 CO1 time, frequency, Laplace, and Z domains Be able to **comprehend** the fundamental 3 CO2 signal processing techniques Be able to **acquire** popular biomedical CO3 3 signals and their fundamental features' Be able to **design** and **analyze** the basic CO4 processing techniques for the Biomedical 3 signals (Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching) TEACHING LEARNING STRATEGY Teaching and Learning Activities Engagement (hours) Face-to-Face Learning Lecture 42 Practical / Tutorial / Studio Student-Centred Learning -Self-Directed Learning 42 Non-face-to-face learning Revision of the previous and (or) subsequent lecture at home 21 Preparation for final examination 21 Formal Assessment 2 Continuous Assessment **Final Examination** 3 Total 131 **TEACHING METHODOLOGY** Lecture and discussion, Co-operative and collaborative method, Problem based method **COURSE SCHEDULE** Week Topic Assessment 1 Signal and System Linearity of System, Classification and properties of signals, Lecture 1 Common signals in engineering Continuous-Time (CT) and Discrete-Time (DT) signal and Lecture 2 system Quantization, Analog to digital conversion of signal Lecture 3 CT – 1, Final **Modeling of Signals and Systems** 2 Lecture 4 Impulse Response Lecture 5 Finite Impulse Response (FIR) of Discrete-Time Systems Infinite Impulse Response (IIR) of Discrete-Time Systems Lecture 6

		ed by BME Department
3	Modeling of Signals and Systems	
Lecture 7	Difference Equation	
Lecture 8	Convolution	
Lecture 9	Correlation, Covariance, Transient and Steady-State Response	
4	Signal Transformation	
Lecture 10	Discrete Fourier Transformation (DFT)	
Lecture 11	Fast Fourier Transformation (FFT)	
Lecture 12	Fast Fourier Transformation (FFT)	
5	Signal Transformation	
Lecture 13	Inverse FFT	
Lecture 14	Z-Transformation	
Lecture 15	Z-Transformation	
6	Randomness of Biosignals	Midterm, Final
Lecture 16	Z-Transformation	
Lecture 17	Inverse Z-Transformation	
Lecture 18	Inverse Z-Transformation	
7	Randomness of Biosignals	
Lecture 19	Linear Time-Invariant (LTI) system, Stationarity and	
Lecture 19	Ergodicity,	
Lecture 20	Frequency and Power Spectrum	
-		
Lecture 21	Frequency and Power Spectrum	
2	Midterm Break	
8	Introduction to Biosignals	
Lecture 22	Origins, properties and suitable models of popular biosignals	
Lecture 23	Objectives and challenges of Biosignal Analysis	
Lecture 24	Steps of Biosignal Processing	
9	Noise and Filters	
Lecture 25	Noise Model	
Lecture 26	Averaging filters	CT – 2, Final
Lecture 27	Averaging filters	
10	Time Domain Filters	
Lecture 28	Design and principles of Wiener Filter	
Lecture 29	Design and principles of Wiener Filter	
Lecture 30	FIR filters	
11	Digital Filters	
Lecture 31	FIR filters	
Lecture 32	Fundamental Design of Window-based FIR filter	
Lecture 33	Fundamental Design of Window-based FIR filter	
12	Digital Filters	
Lecture 34	IIR Filter design	
Lecture 35	IIR Filter design	
Lecture 36	-	CT – 3, FINAL
	Applications of IIR Filters in Biosignals	
13	Biomedical Signal Processing	
Lecture 37	Spectral analysis of ECG and EEG signals	FINAL
Lecture 38	Spectral analysis of EMG and EOG signals	·
Lecture 39	Case study on ECG and EMG signals	
14	Biomedical Signal Processing	
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Lecture 40	Case study on ECG and EMG signals	
Lecture 41	Introduction to Feature Extractions and Classification	
Lecture 42	Introduction to Feature Extractions and Classification	
ASSESSMENT S	STRATEGY	

Com	Components Grading		СО	Blooms Taxonomy
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C3
(40%)	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C3
			CO 1	C2
Einal	Exam	60%	CO 2	C3
ГШа	Exam	0070	CO 3	C2
			CO 4	C4
Total	Marks	100%		

(CO = Course Outcome, C = Cognitive Domain)

TEXT BOOKS

- 3. Emmanuel Ifeachor and Barrie Jervis, "Digital Signal Processing: A Practical Approach," Second Edition, Pearson Publications, 2002.
- 4. S. R. Devasahayam, "Signals and Systems in Biomedical Engineering: Signal Processing and Physiological Systems Modeling," Second Edition, Springer Publication, 2013.

REFERENCE BOOKS

- 1. K J Blinowska and J Zygierewicz, "Practical Biomecial Signal Analysis Using MATLAB," CRC Press, 2012.
- 2. Robert B. Northrop, Signals and Systems in Biomedical Engineering, CRC Press, 2003
- REFERENCE SITE

COURSE INFORMATION

Course Code	: BME 306	Lecture Contact Hours	: 3.00
Course Title	: Biomedical Signal Processing Sessional	Credit Hours	: 1.50
PRE-REQUISIT	ГЕ		
BME 305: Biome	edical Signal Processing		

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course aims to prepare students to apply the knowledge of digital signal processing to apply to Biomedical signals for processing and finding the hidden information inside the Biosignals.

OBJECTIVE

- 3. To perform different signal processing algorithms and techniques to process the Biomedical signals
- 4. To apply the knowledge of signals processing techniques for the real-life problems regarding the Biomedical signals

COURSE OUTCOMES & GENERIC SKILLS Bloom's Assessment PO CP CA No. Course Outcome KP Methods Taxonomy Be able to **understand** the signal processing CO1 related problems and relevant solution C2 2 1 1 T, Q, R techniques in biomedical signals Be able to **apply** the theoretical knowledge T, Q, R, CO2 of signal processing and analyze the C3, C4 2, 5 1, 3 1, 2 ASG biomedical signals Be able to evaluate the meaningful CO3 1 information from the real-life biomedical C5 2, 5 1 T, Q, R signals (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T - Test; PR - Project; Q - Quiz; ASG -Assignment; Pr – Presentation; R - Report; F – Final Exam) C2 - Understand C1 - Remember C4 - Analyze C5 - Evaluate C6 - Create C3 - Apply

COURSE CONTENT

Sampling, quantization, and representation of different Biosignals, Finite and infinite response determination of a signal, Convolution and its application, Correlation and Covariance of signals with its applications, Determination of DFT, FFT, PSD of the Signal, Z-transformation and inverse Z-transformation, Wiener Filter, Window-based FIR filter, IIR filter, Linear transformation.

No.	Course Learning Outcome		PROGRAM OUTCOMES (PO)										
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to understand the signal processing related problems and relevant solution techniques in biomedical signals		3										
CO2	Be able to apply the theoretical knowledge of signal processing and analyze the biomedical signals		3			3							
CO3	Be able to evaluate the meaningful information from the real-life biomedical signals		3			3							

		<u> </u>
TEACHIN	G LEARNING STRATEGY	
	nd Learning Activities	Engagement (hours)
Face-to-Fac	ce Learning	
Le	cture	7
Pı	actical / Tutorial / Studio	35
St	udent-Centered Learning	-
Self-Direct	ed Learning	
Ν	on-face-to-face learning	-
Re	evision of the previous and (or) subsequent lecture at home	15
Pı	reparation for final examination	10
Formal Ass	essment	
C	ontinuous Assessment	1
La	ıb Test	1
Q	uiz	0.75
V	va	0.25
Total		70
FEACHING	G METHODOLOGY	
ecture and	discussion, Co-operative and collaborative method, Problem based method	
	discussion, Co-operative and conaborative method, Problem based method	
COURSE S	CHEDULE	
Week	Lecture Topics	Assessment
	Introductory Practice on the Fundamentals of Signal Processing in	
	Matlab programming software	
:	Matlab programming software Experiment on sampling, quantization, and representation of different	
	Matlab programming software Experiment on sampling, quantization, and representation of different Biosignals	
5	Matlab programming software Experiment on sampling, quantization, and representation of different Biosignals Experiment on the finite and infinite response determination of a signal	
) 	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal Processing	Report, Assignment, Lab Test, Viva
) 	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its	
	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its applications in Biosignals	
3 4 5	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its applications in BiosignalsDetermination of DFT, FFT, PSD of a Biosignal	
	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its applications in Biosignals	
5 5	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its applications in BiosignalsDetermination of DFT, FFT, PSD of a BiosignalExperiment on the utilization of Z-transformation and inverse Z-	
5 5 7	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its applications in BiosignalsDetermination of DFT, FFT, PSD of a BiosignalExperiment on the utilization of Z-transformation and inverse Z- transformation in Biosignal processing	
3 4 5 7 3	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its applications in BiosignalsDetermination of DFT, FFT, PSD of a BiosignalExperiment on the utilization of Z-transformation and inverse Z- transformation in Biosignal processingMidterm Break	Test, Viva
5 7 7	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its applications in BiosignalsDetermination of DFT, FFT, PSD of a BiosignalExperiment on the utilization of Z-transformation and inverse Z- transformation in Biosignal processingMidterm BreakDesigning a Wiener Filter to remove noises from Biosignals	Test, Viva Report, Lab Test, Quiz,
; ; ; ; ;	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its applications in BiosignalsDetermination of DFT, FFT, PSD of a BiosignalExperiment on the utilization of Z-transformation and inverse Z- transformation in Biosignal processingMidterm BreakDesigning a Wiener Filter to remove noises from BiosignalsDesigning window-based FIR filter for low pass, high pass, and band-	Test, Viva
	Matlab programming software Experiment on sampling, quantization, and representation of different Biosignals Experiment on the finite and infinite response determination of a signal Experiment of Convolution and its application in Biosignal Processing Investigation on Correlation and Covariance of signals with its applications in Biosignals Determination of DFT, FFT, PSD of a Biosignal Experiment on the utilization of Z-transformation and inverse Z-transformation in Biosignal processing Midterm Break Designing a Wiener Filter to remove noises from Biosignals Designing window-based FIR filter for low pass, high pass, and bandpass filters	Test, Viva Report, Lab Test, Quiz,
3 4 5 7 3 0 1	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its applications in BiosignalsDetermination of DFT, FFT, PSD of a BiosignalExperiment on the utilization of Z-transformation and inverse Z- transformation in Biosignal processingDesigning a Wiener Filter to remove noises from BiosignalsDesigning window-based FIR filter for low pass, high pass, and band- pass filtersDesigning IIR filter for low pass, high pass, and band-pass filter	Test, Viva Report, Lab Test, Quiz,
2 3 4 5 7 7 3 9 10 11 12 13	Matlab programming softwareExperiment on sampling, quantization, and representation of different BiosignalsExperiment on the finite and infinite response determination of a signalExperiment of Convolution and its application in Biosignal ProcessingInvestigation on Correlation and Covariance of signals with its applications in BiosignalsDetermination of DFT, FFT, PSD of a BiosignalExperiment on the utilization of Z-transformation and inverse Z- transformation in Biosignal processingDesigning a Wiener Filter to remove noises from BiosignalsDesigning window-based FIR filter for low pass, high pass, and band- pass filtersDesigning IIR filter for low pass, high pass, filterExperiment on the linear transformation of Biosignals	Report, Lab Test, Quiz,

ASSESSMENT STRATEGY

	Components	Grading		СО			Blo	ooms Taxor	nomy
Continu	-	20%	CO1, CO2, CO3					C4, C5, C	3
Assessn (40%	Class	20%	CO	D1, CO2, CO3				C4, C5, C	3
E' 1 E	Lab Test	20%	CO	01, CO2, CO3				C4, C5, C	3
Final Ex (60%	()1117	30%	CO	D1, CO2, CO3				C4, C5, C	3
(0070	Viva	10%	CO	D1, CO2, CO3				C4, C5, C	3
	Total Marks	100%			1				
(CO =	Course Outcome, C	C = Cognitive Dom	nain)						
TEXT	BOOKS								
4. KJ REFER 2. S.F	rson Publications, 20 Blinowska and J Zyg RENCE BOOKS R. Devasahayam, "Si	gierewicz, "Practic gnals and Systems	in Bion	nedical Engined	-				
	stems Modeling," Se	cond Edition, Sprir	nger Pub	lication, 2013.					
REFER	RENCE SITE								
COURS	SE INFORMATIO	N				: 3.00			
Course Course				ture Contact H dit Hours	ours	: 3.00			
PDF_D	EQUISITE								
	01: Introduction to B	iomedical Enginee	ring						
	CULUM STRUCT								
	e Based Education (
	SIS/RATIONALE								
differen interven	urse designs covering t medical imaging s ntion, and safety mea	ystems including t	he moda	-					-
OBJEC	CTIVE								
	acquire the rudiment provide students with				•				
COURS	SE OUTCOMES &	GENERIC SKIL	LS						
No.		e Outcome		Bloom's Taxonomy	РО	СР	CA	KP	Assessmen Methods
CO1	Be able to identify imaging systems a clinical diagnosis.			C1	2	1	-	1,3	T, F

CO2	Be able to understand the fundamental physics and technologies behind different		1	1,3	-	1,3	T, F
	imaging systems.						
	Be able to apply the computational						
CO3	techniques to regulate image construction in	C3	2	1	-	1	MID, F
	digital space.						
CO4	Be able to investigate the effect of different	C4	4	1.3	_	1,3	T, F
0.04	algorithms in image computation.		-	1,5	-	1,5	1, 1
(CP- C	Complex Problems, CA-Complex Activities, KH	-Knowledge Pr	rofile, T	- Test	; PR –	Project; Q -	- Quiz; ASG –
Assign	iment; Pr – Presentation; R - Report; F – Final I	Exam)					
C1 - R	emember C2 - Understand C3 - Apply	C4 - Ana	alyze	C5 -]	Evalua	te Ce	5 - Create
		•				•	

COURSE CONTENT

Introduction to Medical Imaging: Non-invasive medical imaging specialty, Medical imaging modalities with applications, Image Characteristics. **X-Ray:** X-ray generation, x-ray generators, Filters, intensifying screens X-radiography, Spatial resolution, Image noise and Image contrast, Introduction to fluoroscopy, Angiography, and mammography, Digital X-ray, Fundamental of Interventional Radiology. **Computed tomography** (**CT**): Basics of CT scanner system, Radon Transformation for CT imaging, Image reconstruction algorithms: Fourier slice theorem, Fourier Reconstruction, Back-projection Algorithm, Filtered back-projection method, Iterative reconstruction algorithm; CT number, Image artifacts, and Filtering, Evolution of CT from 1G to 5G. **Nuclear Imaging:** Principles of Gamma Camera, Imaging principles of Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT), Brief description of PET and SPECT modalities with differences, Safety measures in nuclear imaging.

Magnetic Resonance Imaging (MRI): Evolution of magnetic resonance imaging (MRI) technology and clinical applications, Fundamentals of nuclear magnetic resonance: Angular momentum, magnetic dipole moment, Magnetization, Larmor frequency, Midterm Break, RF and resonance, free induction decay (FID); Different coils and slice selection, spin-echo pulse sequence; Different modes of MRI Images: T1 and T2 Relaxation images, Gradient echo imaging, Diffusion-weighted imaging, etc.; Biological effects of magnetic fields and MRI imaging safety. Functional Magnetic Resonance Imaging (fMRI): Physics behind hemodynamics and NMR, Principle of imaging, Image Features, and Applications. Ultrasound Imaging: Principle of imaging, brief description of modality, Doppler effect, Generation and detection of ultrasound-piezoelectric effect; ultrasonic transducers, Focusing arrays, Transducer beam characteristics: Huygens's principle, beam profiles, pulsed ultrasonic field, Axial and lateral resolution, Farfield and near field concept, Modes of Ultrasound Images, Introduction to Doppler imaging.

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N					PR	OG	RAN	101	JTCC	OMES	5 (PO))	
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to remember the different	*1											
CO1	of medical imaging systems and	their	3										
	applications in clinical diagnosis.												
	Be able to understand the fundam												
CO2	physics and technologies behind	1 the 3											
	different imaging systems.												
GO2	Be able to apply the computat												
CO3		mage	3										
	construction in digital space. Be able to analyze the effect of diff	Concent											
CO4	algorithms in image computation.	erent			4								
Numar	ical method used for mapping which in	diantas 3 d	ng higt	2.0		dium		d 1 a			lofm	otahin	
													5/
TEACH	IING LEARNING STRATEGY												
	g and Learning Activities									En	gagen	nent (ho	ours)
Face-to-	Face Learning												
	Lecture											42	
Practical / Tutorial / Studio							-						
	Student-Centred Learning									-			
Self-Dir	ected Learning											10	
	Non-face-to-face learning	. 1		. 1								42	
	Revision of the previous and (or) subs Preparation for final examination	sequent lec	ture a	t hon	ne					21 21			
Formal	Assessment											21	
Formar	Continuous Assessment											2	
	Final Examination											2	
Total	T mar Examination									131			
												191	
	IING METHODOLOGY and discussion, Co-operative and colla	housting	athad	Data	b 1	. h aa		a the					
	SE SCHEDULE			, 110		i bas			Ju				
	Week	Тор									Asse	essmen	t
1	Introduction to Medi	0											
Lecture													
Lecture	88	alities with	appli	catio	ns								
Lecture	6										СТ	1, Fin	al
2	X-Ray										CI-	• 1, г ш	ai
Lecture				1	0	. 1							
Lecture	5 Filters, intensifying sc	reens X-ra	diogra	iphy,	Spat	tial r	esol	utior	ı,				

		ered by BME Department
Lecture 6	Image noise and Image contrast	
3	X-Ray	
Lecture 7	Introduction to fluoroscopy, Angiography, mammography	
Lecture 8	Principles of digital X-ray (CR and DR)	
Lecture 9	Fundamental of Interventional Radiology	
4	Computed tomography (CT)	
Lecture 10	Basics of CT scanner system	
Lecture 11	Radon Transformation	
Lecture 12	Radon Transformation	
5	Computed tomography (CT)	
Lecture 13	Fourier slice theorem	
Lecture 14	Fourier Reconstruction	
Lecture 15	Back-projection Algorithm and Filtered back-projection	
	method	Midterm, Final
6	Computed tomography (CT)	
Lecture 16	Iterative methods for Image reconstruction	
Lecture 17	CT number, Image artifacts, and Filtering	
Lecture 18	Evolution of CT from 1G to 5G.	
7	Nuclear Imaging	
Lecture 19	Principles of Gamma Camera) and Imaging principles of	
Lecture 17	Positron Emission Tomography (PET)	
Lecture 20	Single Photon Emission Computed Tomography (SPECT)	
Lecture 21	Brief description of PET and SPECT modalities with	
Lecture 21	differences and safety measures	
	Midterm Break	
8		
	Magnetic Resonance Imaging (MRI)	
Lecture 22	Evolution of magnetic resonance imaging (MRI) technology	
T / 02	and clinical applications,	CT – 2, Final
Lecture 23	Fundamentals of nuclear magnetic resonance: Angular	
1	momentum, magnetic dipole moment,	
Lecture 24	Fundamentals of nuclear magnetic resonance: Magnetization,	
	Larmor frequency	
9	Magnetic Resonance Imaging (MRI)	
Lecture 25	RF and resonance, free induction decay (FID)	
Lecture 26	Different coils and slice selection	
Lecture 27	T1 and T2 Relaxation images	
10	Magnetic Resonance Imaging (MRI)	
Lecture 28	Gradient echo imaging	
Lecture 29	Diffusion weighted imaging	
Lecture 30	Biological effects of magnetic fields and MRI imaging safety	
11	Functional Magnetic Resonance Imaging (fMRI)	
Lecture 31	Physics behind hemodynamics and NMR	
Lecture 32	Principle of imaging	
Lecture 33	Image Features and Applications.	CT – 3, FINAL
Lecture 33		CI – 3, FINAL

Doppler effect; Generation and detection of ultrasound- piezoelectric effect;	
ultrasonic transducers, Focusing arrays	
Ultrasound Imaging	
Transducer beam characteristics: Huygens's principle, beam profiles,	
Pulsed ultrasonic field, Axial and lateral resolution,	
Far field and near field concept	
Ultrasound Imaging	FINAL
Introduction to Doppler imaging	
Diagnosis process of Ultrasound images, applications, safety measures	
Future trends in Medical imaging	
	piezoelectric effect; ultrasonic transducers, Focusing arrays Ultrasound Imaging Transducer beam characteristics: Huygens's principle, beam profiles, Pulsed ultrasonic field, Axial and lateral resolution, Far field and near field concept Ultrasound Imaging Introduction to Doppler imaging Diagnosis process of Ultrasound images, applications, safety measures

ASSESSMENT STRATEGY

	1		СО	Blooms Taxonomy
Comp	oonents	Grading		ý
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C4
(40%)	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C3
			CO1	C2
Final	Exam	60%	CO2	C3
гша	Exam	00%	CO3	C2
			CO4	C4
Total	Marks	100%		

(CO = Course Outcome, C = Cognitive Domain)

TEXT BOOKS

3. J. T. Bushberg, J. A. Seibert, E. M. Leidholdt JR, and J. M. Boone, The Essential Physics of Medical Imaging, Third Edition, LIPPINCOTT WILLIAMS & WILKINS, 2012.

4. P. Dhawan, H. K. Huang, and D. S. Kim, Principles and Advanced Methods in Medical Imaging and Image Analysis, World Scientific Publishing, 2008.

REFERENCE BOOKS

- 1. Chris Guy and Dominic Ffytche, An Introduction to The Principles of Medical Imaging, Revised Edition, Imperial College Press, 2005.
- 2. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, Medical Science Series, 1999.

REFERENCE SITE

COURSE INFORMATION

Course Code	: BME 309	Lecture Contact Hours	: 3.00
Course Title	:Biomedical Transport Phenomenon	Credit Hours	: 3.00

PRE-REQUISITE	

Course Code: BME 203

Course Title: Biofluid Mechanics and Heat Transfer

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course covers the topics that include mass, momentum and heat transport, Basic hemodynamic, equations of continuity and motion, molecular mechanics of fluid and electrolyte transport, Shear stress, mass transfer and metabolism in organs and tissues, compartmental models for pharmacokinetic analyses, analysis of blood oxygenators, Unsteady-state heat transfer modes and laws, heat transfer coefficient, heat transfer inside the body, heat transfer between body and surrounding; Analogy equations relating momentum, energy and mass transfer.

OBJECTIVE

- 3. This course aims to develop students' basic engineering knowledge of momentum, mass, and heat transfer in integrated form through an array of examples and analysis from biological systems (cellular, tissue, organ levels) and from the design of medical devices.
- 4. Application of these principles, using quantitative methods based on fundamental physical laws, to solve problems in biology, of clinical significance, and problems in the design and development of medical devices, implants, including tissue-engineered constructs.

COU	RSE OUTCOMES & GENERIC SKILI	LS					
No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	To apply mathematics, science, and engineering principles, methodologies to formulate and solve problems at the interface of engineering and biology, physiology, including processes leading to disease states.	C3	2	1	-	1,3	T, F
CO2	To interpret results from formulated engineering problems derived for living systems as well as the ability to infer and to make refinement for further insights at the interaction between living and non-living materials and systems.	C4	2	1,3	-	1,3	T, F
CO3	To evaluate the breadth and depth across the range of engineering topics and their applications in biological, physiological problems including	C5	4	1	-	1	MID, F

COURSE OUTCOMES & GENERIC SKILLS

				Course Offered by	y BME Department
	devices that enhanc healthcare delivery.	e the			
` I	oblems, CA-Complex Presentation; R - Repo			Г – Test; PR – Projec	ct; Q – Quiz; ASG –
C1 - Remember	C2 - Understand	C3 - Apply	C4 - Analyze	C5 - Evaluate	C6 - Create
COUDSE CONT					

COURSE CONTENT

Introduction to mass, momentum and heat transport in living systems; Basic hemodynamic; Use of the equations of continuity and motion to set up complex flow problems; Basic molecular mechanics of fluid and electrolyte transport across cell membranes and epithelia; Flow within distensible tubes; Shear stress and endothelial cell function; Mass transfer and metabolism in organs and tissues; Microscopic and macroscopic mass balances; Diffusion: mass transfer between fluids, membrane and pores; mass transfer coefficient; Blood-tissue transport of solutes in the microcirculation; Mass transfer in kidney dialysis; Compartmental models for pharmacokinetic analyses; Analysis of blood oxygenators; Unsteady-state heat transfer modes and laws, heat transfer coefficient, heat transfer inside the body, heat transfer between body and surrounding; Analogy equations relating momentum, energy and mass transfer.

Introduction to mass and momentum in living systems; Basic hemodynamic; Application of momentum balance; Rheology and blood flow; Conservation relation for fluid transport, dimensional analysis and scaling; Methods for analysing complex physiological flow; Flow in circulatory system and tissue; Flow within distensible tubes; Shear stress and endothelial cell function; Heart-valve hemodynamics; Mass transfer and metabolism in organs and tissue; Diffusion: mass transfer between fluids, membrane and pores; Diffusion with convection or electrical potential; Microscopic and macroscopic mass balances; Transport in porous media; Transvascular transport; Transport of gases between blood and tissue; Analysis of blood oxygenators; Fluid transport in the kidneys; A whole organ approach to renal modelling; Drug transport in solid tumors; Transport in organs and organisms; Compartmental models for pharmacokinetic analyses.

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
INO.			2	3	4	5	6	7	8	9	10	11	12
CO1	To apply mathematics, science, and engineering principles, methodologies to formulate and to solve problems at the interface of engineering and biology, physiology, including processes leading to disease states.		3										
CO2	To interpret results from formulated engineering problems derived for living systems as well as the ability to infer and to make refinement for further insights at the interaction between living and non-living materials and systems.		3										

							Cou	rse C	Offere	d by B	ME Dep	artment
CO3	To evaluate the breadth across the range of engineer and their applications in physiological problems medical devices that en quality of healthcare deliver	ering topics biological, including hance the		3	3							
TEACH	ING LEARNING STRATE	GY	-1 1	I		1			1			I
Teaching	and Learning Activities]	Engage	ement (h	ours)
Face-to-F	ace Learning											
	Lecture										42	
	Practical / Tutorial / Studio										-	
	Student-Centred Learning										-	
	cted Learning											
	Non-face-to-face learning										42	
	Revision of the previous and		lecture	at hor	ne						21	
	Preparation for final examination	tion									21	
	ssessment											
	Continuous Assessment								2			
	Final Examination								3			
Total	cal method used for mapping										131	
	ING METHODOLOGY											
	nd discussion, Co-operative	and collaborativ	e metho	od, Pro	blem	base	d me	thod				
										А	ssessme	nt
V	Veek	,	Торіс									
N 1		n to transport f	-	entals								
	Introduction		undam			ransp	ort		_			
1	Introduction Overview of	n to transport f	undam ocess an	nd cell	ular t	-						
1 Lecture 1	Introduction Overview of Application	n to transport f	undam ocess an cess in c	nd cell lisease	ular t path	ology	τ		_			
1 Lecture 1 Lecture 2	Introduction Overview of Application	n to transport f the transport proof transport proof transport proof of hemodynam	undam ocess an cess in c	nd cell lisease	ular t path	ology	τ			C	Γ – 1, Fi	nal
1 Lecture 1 Lecture 2 Lecture 3	Introduction Overview of Application An overview Dimensionle	n to transport f the transport proof transport proof transport proof of hemodynam	Sundam ocess an cess in c ics and	nd cell disease bound	ular t pathe lary ce	ology ondit	ions		-	C	Γ – 1, Fi	nal
1 Lecture 1 Lecture 2 Lecture 3 2	Introduction Overview of Application An overview Dimensionle The Bucking	n to transport f the transport pro of transport proc of hemodynam ess numbers	rundam ocess an cess in c ics and n and di	nd cell disease bound	ular t pathe lary co onles	ology ondit	ions	3		C	Γ – 1, Fi	nal
1Lecture 1Lecture 2Lecture 32Lecture 4	Introduction Overview of Application An overview Dimensionle The Bucking Dimensionle	n to transport f the transport proof transport proof of hemodynam ess numbers tham Pi Theorem	Yundam ocess an cess in c ics and n and d iofluid	nd cell disease bound imensi dynam	ular t path lary co onles ics	ology ondit s nun	nbers	3		C	Γ – 1, Fi	nal
1Lecture 1Lecture 2Lecture 32Lecture 4Lecture 5	Introduction Overview of Application An overview Dimensionle The Bucking Dimensionle Equation of	n to transport f the transport proof of transport proof of hemodynam ess numbers ss numbers in bi	rundam ocess an cess in c ics and n and d iofluid mass ar	nd cell disease bound imensi dynam	ular t path lary co onles ics	ology ondit s nun	nbers	3		C	Γ – 1, Fi	nal
1Lecture 1Lecture 2Lecture 32Lecture 4Lecture 5Lecture 6	Introduction Overview of Application An overview Dimensionle Dimensionle Equation of e Conservation	n to transport f the transport proof of transport proof of hemodynam ess numbers ham Pi Theorem ss numbers in bi conservation of	rundam ocess an ics and n and d iofluid mass ar momen	nd cell disease bound imensi dynam nd line tum	ular t pathe lary co onles ics ar mo	ology ondit s nun	nbers um			C	Γ – 1, Fi	nal

I (C		red by BME Department
Lecture 9	Euler's, Bernoulli's, and the general form of the Navier-Stokes equation	
4	Dynamic similarity and introduction to pulsatile flow	
Lecture 10	Relationship between Navier Stokes and Hagen– Poiseuille equation	
Lecture 11	Dynamic similarity and non-dimensionalizing the Navier- Stokes equation	
Lecture 12	Introduction to oscillating flow in blood vessels	
5	Pulsatile flow	
Lecture 13	Velocity profile in pulsatile flow	
Lecture 14	Velocity profile in pulsatile flow	Midterm, Final
Lecture 15	Volumetric flow rate in pulsatile flow	
6	Pulsatile flow continued	
Lecture 16	Velocity-pressure phase lag in pulsatile flow	
Lecture 17	Womersley number and entrance length in physiological flows	
Lecture 18	Introduction to flow in curved vessels, Dean number and secondary flows	
7	Flow in curved vessels	
Lecture 19	Flow separation, adverse pressure gradient, and flow in branching vessels	
Lecture 20	Blood flow and velocity profiles in major arteries	
Lecture 21	Modeling and visualizing blood flow	
	Midterm Break	
8	Transport in Porous Media	
Lecture 22	Porosity, Tortuosity, and Volume fraction	
Lecture 23	Fluid flow in porous media	CT – 2, Final
Lecture 24	Solute transport in porous media	
9	Mass Transport in Biological System	
Lecture 25	Conservation and constitutive relation	
Lecture 26	Diffusion, Diffusion coefficient, Steady-state and unsteady diffusion	
Lecture 27	Diffusion-limited reaction	
10	Diffusion with Convection or Electrical Potential	
Lecture 28	Fick's law, Dimensional analysis, Electrolyte transport	
Lecture 29	Diffusion and convection, mass transfer coefficients	
Lecture 30	Microscopic and macroscopic mass balances across membranes	
11	Transport of Gases between Blood and Tissue	
Lecture 31	Oxygen-Hemoglobin equilibria	
Lecture 32	Dynamics of oxygenation of blood and oxygen delivery in tissue Nitric oxide production and transport in tissue	CT – 3, FINAL

Lecture 33	Whole-organ approach to renal modeling	
12	Drug Transport in Solid Tumors	
Lecture 34	Introduction to drug delivery in cancer treatment	
Lecture 35	Analysis of transvascular and interstitial fluid transport	
Lecture 36	Interstitial hypertension in solid tumor	
13	Drug Transport in Solid Tumors, and Pharmacokinetics	
Lecture 37	Analysis of interstitial transport of solutes	
Lecture 38	Consideration in Pharmacokinetics	
Lecture 39	Compartment models in pharmacokinetic analysis	
14	Transport in Organs and Organisms	FINAL
Lecture 40	Physiologically based pharmacokinetic models	
Lecture 41	Review	
Lecture 42	Review	

ASSESSMENT STRATEGY

			СО	Blooms Taxonomy
Components		Grading	00	Dioonis Tuxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C4
Assessment (40%)	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C3
			CO 1	C2
Final	Exam	60%	CO 2	C3
Final	Exam	00%	CO 3	C2
			CO 4	C4
Total	Marks	100%		

(CO = Course Outcome, C = Cognitive Domain)

TEXT BOOKS

1. Truskey, Yuan, and Katz, Transport Phenomena in Biological Systems, Second Edition, Pearson Education, Inc.

2.Johnson and Ethier, Problems in Biomedical Fluid Mechanics and Transport Phenomena, Cambridge University Press.

REFERENCE SITE

https://classroom.google.com/u/0/c/NDQzMzQ1NDQzNjla

COURSE INFORMATION									
Course Code	: BME 311	Lecture Contact Hours	: 3.00						
Course Title	: Embedded Systems and Interfacing	Credit Hours	: 3.00						

		55 5	1
PRE-REQUISITE			
Course Code: CSE 291			
Course Title: Computer Programming			
Course Code: CSE 292			
Course Title: Computer Programming Lab			
Course Code: EECE 391			
Course Title: Digital Electronics			
Course Code: EECE 392			
Course Title: Digital Electronics Lab			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SVNODSIS/DATIONALE			

SYNOPSIS/RATIONALE

The goal of this course is to expose students to the field of embedded systems and to provide a knowledge foundation which will enable students to pursue a career in relevant fields. Key concepts of hardware-software interfacing control architectures, debugging, and communication protocols will be discussed in this course. Students will be familiar with different firmware architectures and can apply their knowledge in relevant fields such as; clinical device development and robotics in healthcare.

OBJECTIVE

- 5. To identify and understand fundamentals of microprocessors, microcontrollers, communication protocols and embedded firmware.
- 6. To apply the fundamental concepts of embedded engineering
- 7. To analyze the various firmware architectures and systems
- 8. To evaluate various large scale embedded systems

No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Be able to identify and understand the fundamentals of microprocessors, microcontrollers, communication protocols and embedded firmware.	C1, C2	1,2	1	-	3	T, F
CO2	Be able to apply the fundamental concepts of embedded engineering.	C3	2	1,3	-	3	T, F
CO3	Be able to analyze the various firmware architectures and systems.	C4	2	1	-	5	MID, F
CO4	Be able to evaluate various large scale embedded systems	C5	4	1,3	-	5	T, F
`	Complex Problems, CA-Complex Activities, KP- nment; Pr – Presentation; R - Report; F – Final Ex	e	ofile,T	– Test;	PR - 1	Project; Q	– Quiz; ASG –
C1 - R	Remember C2 - Understand C3 - Apply	C4 - Ana	lyze	C5 - 1	Evalua	te	C6 - Create
COU	RSE CONTENT						

Introduction to Embedded System : Introduction to Embedded Engineering, Chronological development of Firmware and Embedded Technology, Possible Implementation in Healthcare, Review on Digital Techniques : Bit and Bytes, Memory, Number systems, Additions, Subtractions, Multiplications, Boolean Algebra, Divisions, Logic Gates, Combinational Circuits, Decoders, Encoders, Bit and Bytes, Memory, Number systems, Additions, Subtractions, Multiplications, Boolean Algebra, Divisions, Subtractions, Multiplications, Boolean Algebra, Divisions. **Microprocessors and Microcontrollers:** Flags, Resistors, Processor Types, Processor Architecture, Instruction Sets, Addressing Modes, SAP, 8086 Microprocessors, Memory, Memory Architecture, Virtual Memory, DMA and DMA Controller, AVR and ARM controllers, Overview of Developmental Microcontroller and Microprocessors, Thread, Interrupts, Programmable Timers, Multitasking, Workflow and Architecture of 16 bit/32bit PIC **Firmware Programming:** Assembly Language: Basic Assembly, Bit Operators, Sub Programs, Switch Day, Arrays, Strcuts, Instruction sets, Loops, Conditional Statements. (Higher Level Language; Python: Data Types, python Data Structure, Functions, Object Oriented Programming, Encapsulation, Abstraction), Inheritance, Polymorphism Or C++/objective C: Data Types, Data Structure, Struc, Encapsulation, Abstraction), Inheritance Firmware Architecture, Reset Circuit, Watchdog Timer. **Advanced Systems:** Operating Systems, Real Time OS, Virtual Machine, FPGA, Clustering, Master Slave Topology, Multithread Processors, IoT Architecture, Medical robotics

CO1 Be able to identi fundamentals microcontrollers, protocols and em CO2 CO2 Be able to ap concepts of embe Be able to analyz architectures and s	arning Outcome	1	PROGRAM OUTCOMES (PO)										
CO1 fundamentals microcontrollers, protocols and em CO2 Be able to ap concepts of embe concepts of embe Be able to analyz architectures and s Be able to evalu embedded system Numerical method used for TEACHING LEARNING Feaching and Learning Active Face-to-Face Learning	Be able to identify and understand the	1	2	3	4	5	6	7	8	9	10	11	12
CO2 concepts of embed CO3 Be able to analyz architectures and s Be able to evalu CO4 Be able to evalu cO4 embedded system Numerical method used for FaccHING LEARNING Feaching and Learning Activ Face-to-Face Learning	of microprocessors, communication	3	3										
architectures and s CO4 Be able to evalu embedded system Numerical method used for TEACHING LEARNING Feaching and Learning Activ Face-to-Face Learning	ply the fundamental dded engineering.		3										
embedded system (Numerical method used for FEACHING LEARNING Teaching and Learning Activ Face-to-Face Learning	e the various firmware ystems.		3										
FEACHING LEARNING Feaching and Learning Activ Face-to-Face Learning	ate various large scale				4								
Feaching and Learning Activ Face-to-Face Learning	mapping which indicate	s 3 as	s high	n, 2 a	s mee	dium	, and	d 1 a	s low	leve	l of m	atching	g)
Face-to-Face Learning	STRATEGY												
Ũ	vities									Eng	gagem	ent (ho	ours)
Lecture													
												42	
Practical / Tutorial	/ Studio									-			
Student-Centred Le	arning											-	
Self-Directed Learning													
Non-face-to-face le	-											42	
	vious and (or) subsequen	t lect	ure a	t hon	ne							21	
Preparation for fina	al examination											21	
Formal Assessment												•	
Continuous Assessment									2				
Final Examination									-	3			
Гotal												31	
FEACHING METHODOI	LOGY												
Lecture and discussion, Co-o			.1 1	-									

COURSE SCHEDULE

Week	Торіс	Assessment
1	Motivation and course introduction	
Lecture 1	Introduction to Embedded Engineering, Chronological	
	development of Firmware and Embedded Technology,	
	Importance of Embedded Engineering in Healthcare	
Lecture 2	Review of Bit and Bytes, Subtractions, Multiplications,	
	Division, Boolean Algebra	
Lecture 3	Review of Logic Gates, Combinational Circuits, Decoders,	
	Encoders	
2	Introduction to microprocessors	CT – 1, Final
Lecture 4	Microprocessor Fundamentals, Types of Processors	
Lecture 5	Processor architecture	
Lecture 6	Simple As Possible (SAP) Architecture	
3	Microprocessor Fundamentals	
Lecture 7	Overview of 8086 Microprocessor	
Lecture 8	8086 Microprocessor Instruction sets	
Lecture 9	8086 Microprocessor Addressing Modes	
4	Basic Embedded Firmware	
Lecture 10	Assembly Language – 1	
Lecture 11	Assembly Language – 2	
Lecture 12	Assembly Language – 3	
5	Higher Level Embedded Firmware	
Lecture 13	Introduction to Data Types, Variable, Operators, If-else, Lists,	
	Functions and basic syntax	
Lecture 14	Object-Oriented Programming	
Lecture 15	Object-Oriented Programming	
6	Communication Protocols	
Lecture 16	Intro to Computer Networking and Networking Layers, Bus	
	Interface, I/O Hardware and Interface, Peripheral Interfacing,	Midterm, Final
Lecture 17	Wired Communication Protocols (USB, UART, I2C,	
	SPI, CAN)	
Lecture 18	Wireless Communication Protocols (Bluetooth, GSM,	
	ZigBEE, BLE and others)	
7	Sensors, Actuators and Interfacing	
Lecture 19	Introduction to Sensors and Actuators, Fundamentals of	
	Sensors and Different Types of Sensors	
Lecture 20	Fundamentals of Actuators and Different Types of Actuators,	
-	Interfacing of Sensors and Actuators	
Lecture 21	Interfacing of Sensors and Actuators (Continued)	
-	Midterm Break	
8	Overview of Memory	
Lecture 22	Introduction to Memory, Memory Architecture	
· · · · · ·	macdaetion to memory, memory Aremitecture	

Lecture 24	Virtual Memory, DMA (Direct Memory Access) and DMA	ea by BME Department
	Controller	
9	Threads, Interrupts, Timer and Multitasking	
Lecture 25	Basic Concepts and Applications of Threads, Overview of	CT – 2, Final
	Interrupts	
Lecture 26	Introduction to Programmable Timer fundamentals,	
	Fundamental Concepts of Programmable Interrupt Controller,	
Lecture 27	Overview of Multitasking in Microprocessors and Embedded Systems	
10	Microcontrollers Basics, Microcontroller	
	Architectures and Application	
Lecture 28	AVR and ARM Microcontrollers	
Lecture 29	Overview PIC Microcontroller	
Lecture 30	Overview PIC Microcontroller (continued)	
11	Advance Firmware Architecture and Advance Concepts in	
	Embedded Engineering	
Lecture 31	Reset Circuit , Watchdog Timer, Reliable Architecture in	
	Firmware and system design approaches	
Lecture 32	Reliable Architecture in Firmware and system design approaches (continued)	
Lecture 33	Operating Systems Basics, RTOS, Virtual Machines	
12	FPGA Boards	CT – 3, FINAL
Lecture 34	Introduction to FPGA Boards	
Lecture 35	Fundamentals of FPGA Boards	
Lecture 36	Applications of FPGA Boards	
13	Distributed Systems, Artificial Intelligence and IoT	
	Architecture in Embedded Systems	
Lecture 37	Clustering, Master-Slave Topology, Multithread Processors	
Lecture 38	IoT Architecture and Web Assembly	
Lecture 39	AI Algorithms in microcontrollers and microprocessors	
14	Embedded Systems in Healthcare, R&D work process and	FINAL
	Production Line Designing	
Lecture 40	Current Trends in Embedded Systems in Healthcare	
Lecture 41	Overview of Robotics in Healthcare, Advanced Surgical	
	Procedures and Medical Device Development	
Lecture 42	R&D work Process and Production Line Designing	

Come	onents	Grading	СО	Blooms Taxonomy
Comp	onents	Grading		
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO2	C1,C2,C3
(40%)	Class Participation	5%	CO1	C1,C2
	Midterm	15%	C01,C02	C1,C2,C3
			CO 1	CO 1
F ' 1	E I	(00/	CO 2	CO 2
Final Exam		60%	CO 3	CO 3
			CO 4	CO 4
Total	Marks	100%		
(CO = Course	e Outcome, C = C	Cognitive Doma	ain)	
ГЕХТ ВООК	KS			
REFERENC				
3. Douglas V	V Hall, Microproc	essors and Inter	facing	
5. Douglas	· 1			
-	-		and Microcomputer-based S	ystem Design, CRC Press, 1995
4. Mohamed	l Rafiquzzaman, N		and Microcomputer-based S	ystem Design, CRC Press, 1995
4. Mohamed REFERENC	l Rafiquzzaman, N		and Microcomputer-based S	ystem Design, CRC Press, 1995
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4. Mohamed REFERENCI COURSE IN	l Rafiquzzaman, N E SITE		and Microcomputer-based S	ystem Design, CRC Press, 1995
4. Mohamed REFERENCI COURSE IN Course Code	l Rafiquzzaman, N E SITE FORMATION	Aicroprocessors		: 3.00
4. Mohamed REFERENCI COURSE IN Course Code	I Rafiquzzaman, N E SITE FORMATION : BME 312	Aicroprocessors	Lecture Contact Hours	· · · ·
4. Mohamed REFERENCI COURSE IN Course Code	I Rafiquzzaman, N E SITE FORMATION : BME 312 : Embedded S	Aicroprocessors	Lecture Contact Hours	: 3.00
4. Mohamed REFERENC COURSE IN Course Code Course Title	I Rafiquzzaman, N E SITE FORMATION : BME 312 : Embedded S Interfacing S	Aicroprocessors	Lecture Contact Hours	: 3.00
4. Mohamed REFERENCI COURSE IN Course Code Course Title PRE-REQUI	I Rafiquzzaman, N E SITE FORMATION : BME 312 : Embedded S Interfacing S SITE	Aicroprocessors	Lecture Contact Hours	: 3.00
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4. Mohamed REFERENCE COURSE IN Course Code Course Title PRE-REQUI Course Code: Course Title: I Course Code:	I Rafiquzzaman, N E SITE FORMATION : BME 312 : Embedded S Interfacing S SITE BME 311 Embedded System CSE 291	Aicroprocessors Systems and essional as and Interfacin	Lecture Contact Hours Credit Hours	: 3.00
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4. Mohamed REFERENC 	FORMATION FORMATION : BME 312 : Embedded S Interfacing S SITE BME 311 Embedded System CSE 291 Computer Program	Aicroprocessors Systems and essional as and Interfacin mming	Lecture Contact Hours Credit Hours	: 3.00
4. Mohamed REFERENCE COURSE IN Course Code Course Title PRE-REQUI Course Code: Course Title: I Course Code: Course Title: O Course Code: Course Title: O	I Rafiquzzaman, N E SITE FORMATION : BME 312 : Embedded S Interfacing S SITE BME 311 Embedded System CSE 291 Computer Program CSE 292 Computer Program	Aicroprocessors Systems and essional as and Interfacin mming	Lecture Contact Hours Credit Hours	: 3.00
4. Mohamed REFERENCE COURSE IN Course Code Course Title PRE-REQUI Course Code: Course Code: Course Title: I Course Code: Course Title: Course Code: Course Title: Course Code: Course Code:	I Rafiquzzaman, N E SITE FORMATION : BME 312 : Embedded S Interfacing S SITE BME 311 Embedded System CSE 291 Computer Program CSE 292 Computer Program	Aicroprocessors Systems and essional as and Interfacin mming mming Lab	Lecture Contact Hours Credit Hours	: 3.00
4. Mohamed REFERENCE COURSE IN Course Code Course Title PRE-REQUI Course Code: Course Title: I Course Code: Course Title: C Course Title: I Course Code: Course Title: I Course Code: Course Title: I Course Code: Course Code: Co	I Rafiquzzaman, N E SITE FORMATION : BME 312 : Embedded S Interfacing S SITE BME 311 Embedded System CSE 291 Computer Program CSE 292 Computer Program EECE 391 Digital Electronics EECE 392	Aicroprocessors Systems and essional as and Interfacin aming aming Lab	Lecture Contact Hours Credit Hours	: 3.00
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4. Mohamed REFERENCE COURSE IN Course Code Course Title PRE-REQUI Course Code: Course Title: I Course Code: Course Title: C Course Title: I Course Code: Course Title: I Course Title: I Course Title: I	I Rafiquzzaman, N E SITE FORMATION : BME 312 : Embedded S Interfacing S SITE BME 311 Embedded System CSE 291 Computer Program CSE 292 Computer Program EECE 391 Digital Electronics EECE 392 Digital Electronics	Aicroprocessors Systems and essional as and Interfacin aming aming Lab as Lab E	Lecture Contact Hours Credit Hours	: 3.00
4. Mohamed REFERENCE COURSE IN Course Code Course Title PRE-REQUI Course Code: Course Title: I Course Code: Course Title: Course Title: I Course Code: Course Title: I Course Code: Course Title: I Course Code: Course Title: I Course Code: Course Title: I Course Code: Course Title: I COURSE CODE: COURSE TITLE: I COURSE CODE: COURSE	FORMATION E SITE FORMATION : BME 312 : Embedded S Interfacing S SITE BME 311 Embedded System CSE 291 Computer Program CSE 292 Computer Program EECE 391 Digital Electronics EECE 392 Digital Electronics SHORT STRUCTUR CATIONALE	Aicroprocessors Systems and essional as and Interfacin mming mming Lab s s Lab E E E)	Lecture Contact Hours Credit Hours	: 3.00 : 1.50
4. Mohamed REFERENCE COURSE IN Course Code Course Title PRE-REQUI Course Code: Course Title: I Course Code: Course Title: C Course Title: I Course Code: Course Title: I Course Code: Course Title: I Course Title: I COURSE CODE: COURSE	FORMATION E SITE FORMATION : BME 312 : Embedded S Interfacing S SITE BME 311 Embedded System CSE 291 Computer Program CSE 292 Computer Program EECE 391 Digital Electronics EECE 392 Digital Electronics SHORT STRUCTUR CATIONALE	Aicroprocessors Systems and essional as and Interfacin mming mming Lab s s Lab E E E)	Lecture Contact Hours Credit Hours	: 3.00

OBJECTIVE

This course aims to enhance students' knowledge on the basic principles of fluid mechanics and heat transfer design problem solution.

COURSE OUTCOMES & GENERIC SKILLS

0001	course our comes a dervina e smilles								
No.		Course Outcome		Bloom's Taxonomy	PO	СР	CA	KP	Assessment Methods
CO1		o apply the fundament d engineering.	ntal concepts of	C3	2	-	1,3	3	T, Q, R
CO2		to analyze the var ares and systems.	rious firmware	C4	2	-	1	5	T, Q, R, ASG
CO3	Be able embedded	to evaluate variou systems	is large scale	C5	4	-	1,3	5	T, Q, R
(CP- C	Complex Pro	blems, CA-Complex	Activities, KP-	Knowledge Pr	ofile, T	- Test	; PR –	Project;	Q – Quiz; ASG –
Assign	nment; Pr – l	Presentation; R - Rep	oort; F – Final Ex	kam)					
C1 - R	Remember	C2 - Understand	C3 - Apply	C4 - Ana	lyze	C5 -	- Evalu	ate	C6 - Create

COURSE CONTENT

Boolean functions and logic gates, interfacing digital lighting display with microprocessor, stepper motor control with 8086 microprocessor, introduction to developmental boards, stepper motor control with developmental boards, introduction to single board computers, capturing video feedback with single board computers, USB communication, Bluetooth communication, biosignal acquisition with developmental boards and single board computers, implementation of threads, programmable timers, clusters, introduction and overview of 16bit PIC microcontroller, PCB designing.

					PR	OGI	RAN	101	ITCC	MES	(PO)		
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to apply the fundamental concepts of embedded engineering.		3										
CO2	Be able to analyze the various firmware architectures and systems.		3										
CO3	Be able to evaluate various large scale embedded systems				3								
(Numeri	cal method used for mapping which indicates	s 3 as	high	i, 2 as	s me	diun	i, an	d 1 a	ıs low	leve	l of m	atching	g)
TEACH	ING LEARNING STRATEGY												
Teaching	and Learning Activities									Engagement (hours)			
Face-to-	Face Learning												
	Lecture									7			
	Practical / Tutorial / Studio											35	
	Student-Centered Learning											-	
Self-Dire	ected Learning												
	Non-face-to-face learning									-			
	Revision of the previous and (or) subsequen	t lect	ure a	t hom	ne							15	
Preparation for final examination								10					
Formal A	Assessment												

	<i>Course Offered by BME Department</i>
Continuous Assessment	1
Lab Test	1
Quiz	0.75
Viva	0.25
Total	70

. .

C3, C4, C5

TEACHING METHODOLOGY

Viva

10%

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week			ecture Topics		Assessment				
1	-		inctions using logic gates						
2	Interfacing di	gital lighting dis	play (Dot-matrix) with micro	processor					
3			3086 Microprocessor						
4	Introduction t	o Arduino Deve	lopment Board and Stepper M	lotor Control					
	with Arduino				Report, Assignment, Lab				
5	Introduction t	o Raspberry Pi a	and Video Feed Capture with I	Raspberry Pi	Test, Quiz, Viva				
6	USB Communication Between Arduino and Raspberry Pi and								
	Interfacing with Temperature Sensor								
7	PCB Designin	ng in Proteus, D	iscussion on Project Proposal						
			Midterm Break						
8			oth Communication and Stor	ring of Data					
	with Raspberr	ry Pi and Arduir							
9	Biosignal Ac	Raspberry Pi							
	Cluster				Report, Lab Test, Quiz,				
10	-		Programmable Timer with R	aspberry Pi-	Viva				
	Arduino Clus								
11			crocontroller and LED Swite	hing with 16					
	bit PIC Micro								
12	Project Preser	ntation							
13	Lab Test								
14	Quiz and Viv								
ASSESSME	NT STRATEGY	Y							
			СО	F	Blooms Taxonomy				
Comp	ponents	Grading		-					
Continuous	Report	20%	CO1, CO2, CO3		C3, C4, C5				
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3		C3, C4, C5				
E' 1 E	Lab Test	20%	CO1, CO2, CO3		C3, C4, C5				
Final Exam	Quiz	30%	CO1, CO2, CO3		C3, C4, C5				
(60%)	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								

 Total Marks
 100%

 (CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

CO1, CO2, CO3

TEXT BOOKS

1.Onatham W. Valvano, Brookes/Colem Embedded Mircrocomputer Systems: Real Time Interfacing, Pacific Grove: 2000

2.Charles Marut and Ytha Y. YuAssembly Language Programming and Organization of the IBM PC: McGraw-Hill, 1992. ISBN: 0071128964, 9780071128964

REFERENCE BOOKS

1.Douglas V Hall, Microprocessors and Interfacing

2. Mohamed Rafiquzzaman, Microprocessors and Microcomputer-based System Design, CRC Press, 1995

REFERENCE SITE

	RSE INFOI	XMATION						
Course	e Code	: BME 313	Lecture Contact H	ours	: 3.00)		
Course	e Title	: Biomedical Image	Credit Hours		: 3.00)		
		Processing			. 5.00	,		
PRE-F	REQUISIT	E						
BME 3	305: Biome	dical Signal Processing						
BME 3	307: Medica	al Imaging						
CURR	RICULUM	STRUCTURE						
Outcor	me Based E	ducation (OBE)						
SYNO	PSIS/RAT	IONALE						
The go	oal of this c	course is to prepare students to	learn the basic know	wledge	regard	ing the	processing	g techniques o
medica	al images i	ncluding filtering, transformat	ion, compression,	storage	, recon	structio	n, segmer	ntation, etc. to
enhanc	e its quality	y so that the medical image-base	d diagnosis process	could b	be aide	1.		
OBJE	CTIVE							
3. To	provide kn	owledge about the different pro-	cessing techniques r	egardin	ıg medi	cal ima	ges.	
4. To	equip stud	lents theoretically skilled in me	edical image proces	ssing to	o solve	the rea	ıl-life prob	olem related to
im	aging-based	l clinical diagnosis.						
COUR	RSE OUTC	OMES & GENERIC SKILLS						
			D1 1					
No		Course Outcome	Bloom's	PO	CP	CA	KP	Assessment
No.		Course Outcome	Taxonomy	РО	CP	CA	KP	Assessment Methods
		to understand different steps	Taxonomy s of	РО	СР	CA		Methods
No. CO1	biomedic	to understand different steps cal image processing steps and t	Taxonomy s of	PO 1	CP 1	CA -	КР 1,3	Assessment Methods T, F
	biomedic applicati	to understand different steps cal image processing steps and t ons in clinical diagnosis.	Taxonomy s of heir C1					Methods
CO1	biomedic applicati Be able	to understand different steps cal image processing steps and t ons in clinical diagnosis. to understand the fundame	Taxonomy s of heir C1		1		1,3	Methods T, F
	biomedic applicati Be able image pr	to understand different steps cal image processing steps and t ons in clinical diagnosis. to understand the fundame ocessing technique.	Taxonomy s of heir C1 ntal C2	1		-		Methods
CO1 CO2	biomedic applicati Be able image pr Be able t	to understand different steps cal image processing steps and t ons in clinical diagnosis. to understand the fundame ocessing technique. to apply the basic image process	Taxonomy s of heir C1 ntal C2 sing	1	1 1,3	-	1,3	Methods T, F T, F
CO1	biomedia applicati Be able image pr Be able t techniqu	to understand different steps cal image processing steps and t ons in clinical diagnosis. to understand the fundame ocessing technique.	Taxonomy s of heir C1 ntal C2 sing	1	1	-	1,3	Methods T, F
CO1 CO2	biomedic applicati Be able image pr Be able t techniqu images.	to understand different steps cal image processing steps and to ons in clinical diagnosis. to understand the fundame ocessing technique. to apply the basic image process es with a modified form to med	Taxonomy s of heir C1 ntal C2 sing C3	1	1 1,3	-	1,3	Methods T, F T, F
CO1 CO2 CO3	biomedia application Be able image pr Be able t technique images. Be able t	to understand different steps cal image processing steps and to ons in clinical diagnosis. to understand the fundame ocessing technique. to apply the basic image process es with a modified form to med o analyze the medical image relation	Taxonomy s of heir C1 ntal C2 sing lical C3 ated	1 1 5	1 1,3 1	-	1,3 1,3 1	Methods T, F T, F MID, F
CO1 CO2	biomedia applicati Be able image pr Be able t techniqu images. Be able t to real-li	to understand different steps cal image processing steps and to ons in clinical diagnosis. to understand the fundame ocessing technique. to apply the basic image process es with a modified form to med o analyze the medical image rela- fe problems and possible process	Taxonomy s of heir C1 ntal C2 sing lical C3 ated	1	1 1,3	-	1,3	Methods T, F T, F
CO1 CO2 CO3 CO4	biomedia applicati Be able image pr Be able t techniqu images. Be able t to real-lit techniqu	to understand different steps cal image processing steps and to ons in clinical diagnosis. to understand the fundame occessing technique. to apply the basic image process es with a modified form to med to analyze the medical image rela- fe problems and possible process es for aiding diagnosis.	Taxonomy s of heir C1 ntal C2 sing C3 ated C4	1 1 5 2	1 1,3 1 1,3	-	1,3 1,3 1 1,3	Methods T, F T, F MID, F T, F
CO1 CO2 CO3 CO4 (CP- C	biomedia application Be able image pr Be able t technique images. Be able t to real-lin technique Complex Press	to understand different steps cal image processing steps and to ons in clinical diagnosis. to understand the fundame ocessing technique. to apply the basic image process es with a modified form to med o analyze the medical image rela- fe problems and possible process es for aiding diagnosis. oblems, CA-Complex Activities	Taxonomy s of heir C1 ntal C2 sing C3 ated C4 s, KP-Knowledge Participation	1 1 5 2	1 1,3 1 1,3	-	1,3 1,3 1 1,3	Methods T, F T, F MID, F T, F
CO1 CO2 CO3 CO4 (CP- C Assign	biomedia application Be able image pr Be able t technique images. Be able t to real-lin technique Complex Press	to understand different steps cal image processing steps and to ons in clinical diagnosis. to understand the fundame occessing technique. to apply the basic image process es with a modified form to med to analyze the medical image rela- fe problems and possible process es for aiding diagnosis.	Taxonomy s of heir C1 ntal C2 sing C3 ated C4 s, KP-Knowledge Praticular nal Exam)	1 1 5 2 rofile, 7	1 1,3 1 1,3 Г-Test;	-	1,3 1,3 1 1,3 ^{(roject; Q -}	Methods T, F T, F MID, F T, F

Origin of Medical Images and Processing: Medical image sources, Properties, Processing challenges, Processing steps, Image representation, Hardware, and software requirements. Image as Two-dimensional (2D) systems: Image as a 2D signal, 2D sequences, and systems, Vector-space image representation, superposition and convolution, 2D Sampling theory, Image quantization, Image perception, Smoothing & Sharpening, Spatial filtering, Quality measures. Image Transforms: 2D Fourier Transform, Sine and Cosine transformation, Hadamard transformation, Slant, and KL transformation. Colors in Image: Concept of monochrome and color images, Color Fundamentals, Color Models, Pseudo Color Image Processing, Basics of Full-Color Image Processing, Color Transformations.

Image Enhancement: Image Enhancement in spatial domain: Gray Level Transformations, Histogram Processing, Smoothing and Sharpening Spatial Filters; Image Enhancement in the frequency domain: Smoothing Frequency-

Domain Filters, Sharpening Frequency Domain Filters. **Image Reconstruction:** Reconstruction concept of medical images, Image reconstruction in X-Ray, Image reconstruction in CT, Fourier slice theorem, Back projection algorithm for parallel projection data, Filtered-back projection algorithm, Image Reconstruction in Magnetic Resonance Imaging, Image Reconstruction in Ultrasound Imaging. **Image segmentation:** Feature Extraction, Edge Detection, Boundary Extraction, Region Representation, Moment Representation, Shape Features, Scene Matching Image Segmentation, Threshold-based segmentation, Region growing segmentation, Active contour model for segmentation. **SKILL MAPPING**

~														
No.	Course Learning Outcome				PR	OG	RAN	1 O I	JTCC	MES	(PO)			
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
	Be able to understand different steps of													
CO1	biomedical image processing steps and	3												
	their applications in clinical diagnosis.													
CO2	Be able to understand the fundamental	3												
ļ	image processing technique.													
	Be able to apply the basic image					2								
CO3	processing techniques with the modified form to medical images.					3								
	Be able to analyze the medical image													
	related to real-life problems and possible													
CO4	processing techniques for aiding		3											
	diagnosis.													
(Numeri	cal method used for mapping which indicate	es 3 as	s high	i, 2 as	s me	diun	ı, an	d 1 a	ıs low	leve/	l of n	atching	g)	
TEACH	TEACHING LEARNING STRATEGY													
Teaching	g and Learning Activities									Engagement (hours)				
Face-to-	Face Learning													
	Lecture									42				
	Practical / Tutorial / Studio									-				
G 10 D	Student-Centred Learning											-		
Self-Dir	ected Learning											42		
	Non-face-to-face learning	at 1a at		+ h								42		
	Revision of the previous and (or) subsequent Preparation for final examination	n leci	ure a	t non	le					21 21				
Formal	Assessment								-			21		
	Continuous Assessment									2				
	Final Examination											3		
Total												131		
TEACH	IING METHODOLOGY													
Lecture	and discussion, Co-operative and collaborat	ive m	ethod	, Pro	blem	bas	ed n	netho	od					
COURS	SE SCHEDULE													
	Week	Topi	c								Asso	essmen	t	
1	Origin of Medical Images	and F	roce	ssing										
Lecture 1 Medical image sources, Properties														
	Lecture 2 Processing challenges, Processing steps													
Lecture	U I				e rec	quire	men	ts						
2	Image as Two-dimensional (2D) systems													

Lecture 4	Image as a 2D signal, 2D sequences, and systems	
Lecture 5	Vector-space image representation	CT – 1, Final
Lecture 6	superposition and convolution	
3	Image as Two-dimensional (2D) systems	-
Lecture 7	2D Sampling theory, Image quantization, Image perception	-
Lecture 8	Smoothing & Sharpening, Quality measures	-
Lecture 9	Spatial filtering	-
4	Image Transforms	
Lecture 10	2D Fourier Transform	-
Lecture 11	Sine transformation	
Lecture 12	Cosine transformation	_
5	Bio-image compression algorithms	-
Lecture 13	Hadamard Transformation	-
Lecture 14	Slant Transform	
Lecture 15	KL Transform	-
6	Colors in Image	Midterm, Final
Lecture 16	Concept of monochrome and color images	-
Lecture 17	Color Fundamentals	-
Lecture 18	Color Models	-
7	Colors in Image	-
Lecture 19	Pseudo Color Image Processing	-
Lecture 20	Basics of Full-Color Image Processing	-
Lecture 21	Color Transformations	-
	Midterm Break	
8	Image Enhancement (Spatial Domain)	
Lecture 22	Gray Level Transformations, Histogram Processing	_
Lecture 23	Smoothing Spatial Filters	7
Lecture 24	Sharpening Spatial Filters	7
9	Image Enhancement (Frequency Domain)	7
Lecture 25	Smoothing Frequency-Domain Filters	7
Lecture 26	Smoothing Frequency-Domain Filters	CT – 2, Final
Lecture 27	Sharpening Frequency Domain Filters	
10	Image Reconstruction	-
Lecture 28	Reconstruction concept of medical images	_
Lecture 29	Image reconstruction in X-Ray	7
Lecture 30	Image reconstruction in CT	
11	Image Reconstruction	
Lecture 31	Fourier slice theorem	7
Lecture 32	Back projection algorithm for parallel projection data	
Lecture 33	Filtered-back projection algorithm	CT – 3, FINAL
12	Image Reconstruction	
Lecture 34	Image Reconstruction in Magnetic Resonance Imaging	7
Lecture 35	Image Reconstruction in Ultrasound Imaging	
Lecture 36	Feature Extraction	
13	Image segmentation	
Lecture 37	Edge Detection, Boundary Extraction	- FINAL

			\mathbf{I}
Lecture 38	Region Representation, Moment Representation		
Lecture 39	Shape Features, Threshold-based segmentation		
14	Image segmentation		
Lecture 40	Scene Matching Image Segmentation		
Lecture 41	Region growing segmentation,		
Lecture 42	Active contour model for segmentation		
ASSESSMENT	STRATEGY	· · · · · · · · · · · · · · · · · · ·	

ENT STRA

			СО	Blooms Taxonomy				
Comp	Components		20	blooms raxonomy				
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C4				
(40%)	Class Participation	5%	CO3	C2				
	Midterm	15%	CO2	C3				
			CO1	C2				
Einal	Exam	60%	CO2	C3				
rinai	Exam	0070	CO3	C2				
			CO4	C4				
Total	Marks	100%						
(CO = Course	(CO = Course Outcome, C = Cognitive Domain)							

TEXT BOOKS

3. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Fourth Edition, Pearson, 2017.

4. Atam P. Dhawan, Medical Image Analysis, Second Edition, IEEE Series in Biomedical Engineering, 2011.

REFERENCE BOOKS

1. Jiri Jan, Medical Image Processing, Reconstruction and Restoration: Concept and Method, Taylor and Francis Publisher, 2006.

REFERENCE SITE

COURSEINTO										
Course Code	: BME 314	Lecture Contact Hours	: 3.00							
Course Title	: Sessional on Biomedical Image Processing	Credit Hours	: 1.50							

PRE-REQUISITE

BME 307: Medical Imaging

BME 313: Biomedical Image Processing

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course aims to furnish students' knowledge of Medical Imaging and Biomedical Image Processing including quality assurance, quality control, calibration, and maintenance of medical imaging devices, as well as the reconstruction and processing of medical images.

OBJECTIVE

3. To perform the quality assurance, quality control, calibration, and maintenance of medical imaging modalities

4. To process the problems regarding the medical image reconstruction and quality enhancement

COUF	COURSE OUTCOMES & GENERIC SKILLS								
No.		Course Outcome	Bloom's Taxonomy	РО	СР	CA	КР	Assessment Methods	
CO1	Be able quality as and mai modalities	C2	1	-	1	1	T, Q, R		
CO2	Be able constructi the medic	nalyze the echanism of	C3, C4	2	-	1, 3	1, 2	T, Q, R, ASG	
CO3		ithms to the aging-based	C2	5	-	1	1	T, Q, R	
(CP- C	Complex Pro	blems, CA-Complex A	ctivities, KP-	Knowledge Pr	ofile, T	– Test	; PR –	Project; Q	– Quiz; ASG –
Assign	nment; Pr – P	Presentation; R - Report	t; F – Final Ex	kam)					
C1 - Remember C2 - Understand C3 - Apply C4 - Analyze C5 - Evaluate C6 - Create						C6 - Create			
		1	1					L	

COURSE CONTENT

Introduction to Medical Imaging, their modalities, and the relevance to Biomedical Engineering, Observation the imaging techniques of different medical imaging modalities and learning about quality control system as per guideline of IAE and NCRT, Fundamental image processing techniques by MATLAB, Processing techniques of an X-ray Image, Radon transformation and Sinogram for the CT Imaging, Back projection algorithm to reconstruct CT image, Image Segmentation, Case study on medical images to improve the image quality for aiding diagnosis.

		PROGRAM OUTCOMES (PO)												
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	Be able to understand the procedure of quality assurance quality control, calibration, and maintenance of medical imaging modalities practically.	ality assurance quality control, ibration, and maintenance of medical 3												
CO2	Be able to apply and analyze the construction and processing mechanism of the medical images.		3											
CO3	Be able to apply different algorithms to the medical images to solve imaging- based diagnosis					3								
(Numer	ical method used for mapping which indicat	es 3 as	s high	i, 2 a	s me	diun	i, an	d 1 a	is low	v leve	l of m	atching	g)	
	IING LEARNING STRATEGY								-	En	~~~~~	nent (ho)	
	g and Learning Activities Face Learning									En	gagen	ient (no	ours)	
1/400-10-	Lecture									7				
	Practical / Tutorial / Studio									35				
	Student-Centered Learning									-				
Self-Dir	ected Learning													
	Non-face-to-face learning									-				
	Revision of the previous and (or) subseque	nt lect	ure a	t hon	ne					15				
	Preparation for final examination									10				
Formal	Assessment													
	Continuous Assessment									1				
	Lab Test											1		
	Quiz										0	.75		
	Viva										0	.25		
Total												70		
TEACH	IING METHODOLOGY													
Lecture	and discussion, Co-operative and collaborat	ive m	ethod	, Pro	blem	ı bas	ed n	netho	od					
COURS	SE SCHEDULE													
Wee	k Lecture	Торі	cs								Asse	essmen	t	
1	Introduction to Medical Imaging, th Biomedical Engineering	eir m	odalit	ies, a	nd tl	he re	leva	nce		Der	ant A		at I -1-	
2		A study tour to a medical imaging center to observe the imaging techniques of X-ray and CT and learning about quality control system							ng	керс		sıgnme t, Viva	ent, Lab	

Course	Offered	by	BME Department
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	- 1			0	ffered by BME Department						
3	-	A study tour to a medical imaging center to observe the techniques of									
	MRI and Ultra										
		ne of IAE and N									
4		to a medical ima	-								
	-	ging and learnin	em as per								
	-	AE and NCRT.									
5	Introductory p by MATLAB		undamental image processing	techniques							
6	Experiment of	n the processing	techniques of an X-ray Image								
7	Experiment o Imaging	n the Radon tr	ansformation and Sinogram f	for the CT							
	1		Midterm Break								
8	Design and	implementation	of the back-projection alg	gorithm to							
	reconstruct C	Гimage									
9	Experiment of	n the segmentati	on of the brain MRI images								
10	-		ng to improve the image quality	y for aiding	Report, Lab Test, Quiz, Viva						
	diagnosis.			-	v iva						
11	Case study on	Case study on image processing to improve the image quality for aiding									
	diagnosis.										
12	A project show	w based on medi	udents								
13	Final Lab Tes										
14	Quiz/Viva										
ASSESSME	NT STRATEGY	ł									
			СО	P	Blooms Taxonomy						
Comj	ponents	Grading			, 						
Continuous	Report	20%	CO1, CO2, CO3		C4, C5, C3						
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3		C4, C5, C3						
E:1 E	Lab Test	20%	CO1, CO2, CO3		C4, C5, C3						
Final Exam (60%)	Quiz	30%	CO1, CO2, CO3		C4, C5, C3						
(00%)	Viva	10%	CO1, CO2, CO3		C4, C5, C3						
Total	Marks	100%									
(CO = Cours	se Outcome, C =	- Cognitive Don	nain)								
TEXT BOO											
		hard E. Woods,	Digital Image Processing, Four	rth Edition, I	Pearson, 2017.						
			Second Edition, IEEE Series in								
REFERENC	CE BOOKS										
		ocessing, Recon	struction and Restoration: Co	ncept and M	Method, Taylor and Franci						
Publisher, 20	06.										

REFERENCE SITE

COU	DEE INEO	RMATION				cours	se ojje	eu oy biin	E Department	
COU	KSE INFU	RMATION				2.00	<u> </u>			
						: 3.00)			
	e Code			ure Contact H	: 3.00					
Cours	e Title	: Biomaterials	Cred	it Hours						
PRE-	REQUISIT	'E				1				
		neral Chemistry; CHEM 125 – F	Physic	al and Bio-or	ganic C	hemist	ry; BM	E 203–Bi	ochemistry	
		STRUCTURE								
Outco	me Based E	Education (OBE)								
	OPSIS/RAT									
		rs the following modules: Struc							-	
		c implant materials, synthetic p			-			erials and	material-tissue	
		ization of biomaterials, structure	and f	unction of nat	tural bio	materi	als.			
	CTIVE									
		students to different implants,	-	thetic and fu	inctiona	l mate	rials, i	nvestigate	the materials'	
-	-	luding their designs and applicati								
		e both synthetic and natural polym			omateria	l-tissu	e intera	ction in det	ail with a focus	
		ns in tissue engineering and cardio								
COU	RSE OUTC	COMES & GENERIC SKILLS								
No.		Course Outcome		Bloom's	PO	CP	CA	KP	Assessment	
				Taxonomy					Methods	
CO1		e to identify different types	of	C2	2	-	-	1	T, MID	
	biomater	rials							,	
cor	D1.1.	to an dougton doubt and an almost	41	Cl	1			1		
CO2		to understand and analyze of biomaterials	the	C2	1	-	-	1	T, MID, F	
		comprehend the interactions of comprehend the interactions o	11							
CO3		tes with biomaterials based		C5	4,2		3	1	MID, F	
COS		al properties and reactivity	on	0.5	4,2	-	5	1	MID, F	
		b design and apply different types	s of							
CO4		als to solve biomedical problems		C3	3	-	-	1	T, F	
(CP_ (oblems, CA-Complex Activities,		nowledge Pr	ofile T	Test	· DD 1	Project: 0	Quiz: ASG	
		Presentation; R - Report; F – Fin			onic, i	- 1030	, I K – I	i iojeci, Q	- Quiz, A50 -	
-	Remember	C2 - Understand $C3 - Ap$		C4 - Ana	lvze	C5 -	Evalua	te C	6 - Create	
	RSE CONT	1	ppiy	C+ / Ind	iyze		Lvarua			
			1	· · · · · · · · · · · · · · · · · · ·	1.1	I	· · ·	<u> </u>	1 4 4	
		solid: Structure of solids overview	w, clas	ssification of s	solids, c	assific	ation of	solids bas	ea on structure,	
	-	ons and defects		1						
-		Characterization of Material			-		-	-	• •	
		e properties and adhesion. Electric	-		-	-	-	-		
		ties, density and porosity and dif	1105101	n properties, .	лр5, Х	кD, sp	bectrosc	ору, SFM	, AFM, optical	
cnarac	cierization o	f biomaterials								

Metallic Biomaterials: Stainless steels, co-based alloys, Ti and Ti-based alloys, dental metals, other metals, corrosion of metallic implants.

Ceramic Implant Materials: Structural property relationship of ceramics, aluminum oxides (alumina), zirconium oxides (zirconia), calcium phosphate, glass ceramics, other ceramics, carbons, deterioration of ceramics.

Synthetic Polymeric Material: Basic structure, classifications (thermoplasts, thermoset, and elastomers), different physical and mechanical properties, and various uses of biomaterials. Natural polymeric materials, biodegradable polymers, applications and functions

Composites as Biomaterials: Structure, mechanics of composites, applications of composite biomaterials, biocompatibility of composite, biomaterials.

Biological response to biomaterials: biocompatibility, toxicity of biomaterials, host response of biological materials to biomaterials, sterilization of biomaterials, applications of biomaterials in cardiology and tissue engineering

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)												
110.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	Be able to identify different types of biomaterials													
CO2	Be able to understand and analyze the properties of biomaterials													
CO3	Be able to investigate the interactions of cell and tissues with biomaterials based on biomaterial properties and reactivity	nd tissues with biomaterials based on 3 3												
CO4	Be able to design and apply different types of biomaterials to solve biomedical problems	e to design and apply different f biomaterials to solve biomedical 3												
(Numer	ical method used for mapping which indicate	s 3 a	s higł	n, 2 a	s me	diun	i, an	d 1 a	is lov	v leve	l of m	atchin	g)	
	HING LEARNING STRATEGY ng and Learning Activities									En	gagen	nent (h	ours)	
										LII	gagen	nent (n	ouisj	
Face-to-Face Learning Lecture										42				
Lecture Practical / Tutorial / Studio									42					
	Student-Centred Learning									-				
Self-Di	rected Learning									-				
2011 21	Non-face-to-face learning									42				
	Revision of the previous and (or) subsequen	t lect	ture a	t hon	ne					21				
	Preparation for final examination									21				
Formal	Assessment													
	Continuous Assessment											2		
	Final Examination											3		
Total												131		
TEAC	HING METHODOLOGY													
Lecture	e and discussion, Co-operative and collaborati	ve m	ethod	l, Pro	blem	ı bas	ed n	netho	od					
	SE SCHEDULE													
W		itent									Ass	essmer	nt	
1	Course Introduction and the str			solic	ls									
Lecture			ials											
Lecture		Overview of classification of Solids												
Lecture	3 Overview of structure of solids						3 Overview of structure of solids							

2	Structure solids	<i>y</i> 1
Lecture 4	Classification of solids according to structure	
Lecture 5	Lattice imperfections and defects	
Lecture 6	Mechanical testing methods, tensile and compression properties of	CT – 1 and Midterm,
	biomaterials	Final
3	Mechanical properties and characterization of biomaterials	
Lecture 7	Shear properties, stress-strain properties and analysis of biomaterials	
Lecture 8	Bending properties, time independent properties, creep and fatigue	
-	of biomaterials	
Lecture 9	Phase Diagrams 1	
4	Thermal processing and properties of biomaterials	
Lecture 10	Phase Diagrams 2	
Lecture 11	Thermal properties and heat treatment of biomaterials	
Lecture 12	Surface properties and adhesion	
5	Physical Properties of Biomaterials Electrical and optical properties of biomaterials	
Lecture 13 Lecture 14	X-ray diffraction, ultrasonic properties, density, porosity and	
Lecture 14	diffusion properties	
Lecture 15	X-ray diffraction, Bragg's Law, crystal structure determination	
6	Characterization of biomaterials	
Lecture 16	XPS, spectroscopy techniques	Midterm, Final
Lecture 17	AFM, SFM, SEM, and optical techniques	
Lecture 18	Different types of metallic biomaterials - stainless steel, Co-Cr alloy,	
	Titanium, dental implants	
7	Metallic biomaterials	
Lecture 19	Different types of metallic biomaterials - stainless steel, Co-Cr alloy,	
	Titanium, dental implants	
Lecture 20	Properties, fabrication and corrosion of metallic implants	
Lecture 21	Revision	
0	MIDTERM	
8 Lecture22	Ceramic Biomaterials Structural Property relationship of ceramics	
Lecture 23	Properties and functions of alumina, zirconia, calcium phosphate	
Lecture 24	Glass ceramics, other ceramics, degradation of ceramics	
9	Polymeric biomaterials	
Lecture 25	Structure, classification, properties and processing of polymeric	
Lecture 25	materials	
Lecture 26	Structure, classification, properties and processing of polymeric	
	materials	
Lecture 27	Natural polymeric materials – function and properties	
10	Polymeric biomaterials	CT – 2, FINAL
Lecture 28	Hydrogel – properties, functions and applications	
Lecture 29	Biodegradable polymers – properties, functions and applications	
Lecture 30	Polymeric biomaterials in biosensor applications	
11	Composite Biomaterials and Biocompatibility	
Lecture 31	Structure of composite biomaterials	
Lecture 32	Composite biomaterials – functions, properties, and applications	

		55 5 1				
Lecture 33	Biocompatibility and toxicity of biomaterials					
12	Biomaterial interactions with proteins/tissues					
Lecture 34	Protein-biomaterial interactions					
Lecture 35	Cell/tissue-biomaterial interactions					
Lecture 36	Cell/tissue-biomaterial interactions					
13	Biological response to biomaterials					
Lecture 37	Host response (biological response) to biomaterials					
Lecture 38	Toxicity and immune response					
Lecture 39	Sterilization methods and handling of biomaterials	CT – 3, FINAL				
14	Applications of biomaterials					
Lecture 40	Tissue engineering scaffolds and stem cell engineering					
Lecture 41	Lecture 41 Cardiac applications of biomaterials					
Lecture 42	Revision					
	FINAL EVAMINATION					

FINAL EXAMINATION

ASSESSMENT STRATEGY

			СО	Blooms Taxonomy		
Comp	Components		00	bioonis raxonomy		
	Class Test/	2007	G01 00 1			
Continuous Assessment	Assignment 1-3	20%	CO1, CO3	C2		
(40%)	Class	5%	CO2	C4		
(1070)	Participation	570	002			
	Midterm	15%	CO1, CO2	C2, C4		
			CO 1	C2		
Final	Exam	60%	CO 2	C4		
			CO 3	C2		
Total Marks 100%						
(CO = Course	e Outcome, C =	Cognitive Doma	in)			

TEXT BOOKS

3. Biomaterials, Joyce Y Wong, Joseph D Bronzino, CRC Press (latest edition)

 Mechanics of Biomaterials: Fundamental Principles for Implant Design (1st edition), Lisa A Pruitt, Ayyana M. Chakravartula, Cambridge University Press

REFERENCE BOOKS

2. Materials Science and Engineering - An Introduction, 4th Ed,WD Callister, Jr.

REFERENCE SITE

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COURSE INFO	ORMATION		
Course Code	: BME 316	Lecture Contact Hours	: 3.00
Course Title	: Biomaterials Sessional	Credit Hours	: 1.50
PRE-REQUIS	TE		-
Course Code: B	ME 315		
Course Title: Bi	omaterials		
CURRICULU	M STRUCTURE		
Outcome Based	Education (OBE)		
SYNOPSIS/RA	TIONALE		
This course cov	ers the characterization of mec	hanical, physical, and chemic	cal properties, such as young's modulus,
ductility, porosi	ty, corrosion, and surface topog	graphy of biomaterials.	

OBJECTIVE

This course aims to introduce students to biomaterial testing and the factors influencing their functions.

COUL	RSE OUTC	OMES & GENERI	C SKILLS						
No.		Course Outcom	e	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Be able to investigate different biomaterials to determine their mechanical properties.			C4	4		1	1, 2	T, Q, R
CO2	Be able to investigate different biomaterials to determine their microstructural properties.			C4	4		1	1, 2	T, Q, R
CO3	Be able to investigate metallic biomaterials to determine their biochemical (corrosion) property.				4		1	1, 2	T, Q, R
CO4Be able to design, develop and test synthetic biomaterials for biomedical applications.			C6	3,10		1	5	PR, Pr	
	-	blems, CA-Comple Presentation; R - Re		-	ofile, T	– Test;	; PR – 1	Project;	Q – Quiz; ASG –
C1 - R	C1 - Remember C2 - Understand C3 - Apply		C4 - Analyze		C5 - Evaluate			C6 - Create	

COURSE CONTENT

Determination of elasticity and Young's modulus, stress and strain analysis, Tensile test, compressive test, creep test, fatigue test, torsion test, shear test, ductility test, bending test, impact test, corrosion test, hardness test, indentation test, etch test, metallurgical microscopic analysis, surface topography and porosity, hydrogel and composite biomaterial fabrication, and FTIR characterization of biomaterials.

					PR	OGI			Offered by BME Department TCOMES (PO)						
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	Be able to investigate different biomaterials to determine their mechanical properties.				3										
CO2	Be able to investigate different biomaterials to determine their microstructural properties.				3										
CO3	Be able to investigate metallic biomaterials to determine their biochemical (corrosion) property.				3										
CO4	Be able to design, develop and test synthetic biomaterials for biomedical applications. 3										2				
(Numeri	cal method used for mapping which indicates	3 as	high	, 2 as	med	lium	, and	d 1 a	s low	leve	l of m	atching	g)		
TEACH	ING LEARNING STRATEGY														
-	g and Learning Activities									Eng	gagem	ent (ho	ours)		
Face-to-	Face Learning														
	Lecture									7					
	Practical / Tutorial / Studio									35					
	Student-Centered Learning									-					
Self-Dire	ected Learning														
	Non-face-to-face learning									-					
	Revision of the previous and (or) subsequent	lect	ure at	hom	e					15					
	Preparation for final examination											10			
Formal A	Assessment											1			
	Continuous Assessment									1					
	Lab Test									0.75					
	Quiz Viva									0.75					
Total	viva									70					
TEACH	IING METHODOLOGY														
Lecture	and discussion, Co-operative and collaborativ	ve me	ethod	, Proł	olem	base	ed m	etho	d						
COURS	SE SCHEDULE														
Wee	k Lecture T	opic	s								Asse	essmen	t		
1	Introduction to biomaterials lab, laboratory techniques, laboratory rules. Introduction to polymer biomaterials						s.								
2	Preparation and synthesis of hydrogel	l								Repo		b Test	, Quiz,		
3	Physical property and qualitative Preparation of hydrogel for lyophiliza	ass					•	roge	1.		``	/iva			

4	Analysis of	the lyophilized	hydrogel and water absor		fered by BME Department					
	Measurement of the degradation test									
5	Measurement									
	Preparation fo									
6	FTIR analysis	of hydrogels								
7	Tensile testing	g of hydrogels								
			Midterm Break							
8	Lab Test 1									
9	Preparation an	d fabrication of	bone cement							
10	-	analysis of bone			Report, Lab Test, Quiz,					
11	Three point be materials	nding of bone ce	ment/other relevant composite	/biological	Viva					
12	UV-VIS spec solutions	trophotometry a	analysis of different concent	trations of	ons of Project, Presentation					
13	Optical proper	ty measurement	of different materials							
14	Quiz and Viva	l								
ASSESSME	NT STRATEGY	7								
			СО	В	looms Taxonomy					
Comp	ponents	Grading								
Continuous	Report	20%	CO1, CO2		C4					
Assessment (30%)	Class Participation	10%	CO1, CO2, CO3		C4, C6					
	Lab Test	15%	CO1, CO2		C4					
Final Exam	Project	15%	CO3		C6					
(70%)	Quiz	30%	CO1, CO2		C4					
	Viva	10%	CO1, CO2		C4					
Total	Marks	100%								
(CO = Cours	se Outcome, C =	Cognitive Dom	ain, P = Psychomotor Doma	in, A = Affe	ctive Domain)					
TEXT BOO										
1. Elen	nents of Material	s Science and Er	gineering 6th Edition. by L. H	I. Van Vlack						
REFERENC	CE SITE									
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COURSE INFORMATION								
Course Code	: BME 318	Lecture Contact Hours	: 3.00					
Course Title	: Biomedical Engineering	Credit Hours	: 1.50					
	Design Sessional		. 1.50					
PRE-REQUIS	[TE							
Course Code: B	ME 104							
Course Title: CA	AD in Biomedical Engineering S	Sessional						
CURRICULU	M STRUCTURE							
Outcome Based	Education (OBE)							
SYNOPSIS/RATIONALE								
This course cov	ers the application of design too	ols to model prototypes and	develop the individual project ideas and					
full completion of an individual project.								
OBJECTIVE								
The aim of this course is to enhance student's idea about project and develop their capabilities of project management.								

COURSE	OUTCOMES &	GENERIC SKILLS
COURSE	our comins a	OLIVERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods		
		• • •	Тахоношу					Wiethous	
	Be able to apply modern enginee	ring tools to							
CO1	develop projects to enhance	healthcare	C3	3, 5	1	-	1	T, Q, R	
	facilities.								
	Be able to analyze a complex p						тор		
CO2	using engineering tools and know	ng engineering tools and knowledge would			1	-	1, 2	T, Q, R,	
	be able to formulate a suitable sol	ution.						ASG	
000	Be able to design and develop	devices and		2	1.2		-	TOD	
CO3	equipment to improve healthcare	facilities.	C6 3	1, 3	-	5	T, Q, R		
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG –									
Assignment; Pr – Presentation; R - Report; F – Final Exam)									
C1 - R	Remember C2 - Understand C	C1 - Remember C2 - Understand C3 - Apply C4 - Analyze C5 - Evaluate C6 - Create							

COURSE CONTENT

This course exposes students to the entire design process from problem definition to prototype validation. The course is organized like a biomedical engineering company, with projects sponsored by real clients from the Medical School, Dental School, College of Engineering research labs, and local industry. This course comprises six main components:

1. Problem Definition – Students will generate/ be assigned a project idea and expected to decompose the problem, generate design specifications, and plan out the project.

2. Concept Generation and Evaluation – Students will use brainstorming and decision evaluation tools to generate and evaluate solutions to reach a design consensus.

3. Detailed Design – Students will generate a paper design of their proposed prototype including device specifications, key materials and components, detailed drawings, and principles of operation with all choices justified and supported through proof-of-concept.

4. Fabrication and Validation – Students will fabricate and conduct testing of their prototype, assess the degree to which the prototype meets the design specifications, and recommend design modifications to improve the prototype.
5. Project Management – Students will create and update a project timeline, budget, design history file, and maintain engineering notebooks throughout all phases of the project.

6. Technical Communication – Students will be required to describe, explain, and support the progress and solutions of their project at all phases of the design process.

No.	Course Learning Outcome				PR	OG		1 O L	JTCC	MES	(PO)		
110.		1	2	3	4	5	6	7	8	9	10	11	12
	Be able to apply modern engineering												
CO1	tools to develop projects to enhance			2		3							
	healthcare facilities.												
	Be able to analyze a complex problem												
CO2	and using engineering tools and		2			3							
002	knowledge would be able to formulate a		-										
	suitable solution.												
	Be able to design and develop devices												
CO3	and equipment to improve healthcare			3									
	facilities.												
(Numer	ical method used for mapping which indicate	s 3 as	high	, 2 as	s me	diun	ı, an	d 1 a	s low	leve	l of m	atching	g)
TEACE	IING LEARNING STRATEGY												
	g and Learning Activities									Engagement (hours)			
	Face Learning												,
	Lecture									7			
	Practical / Tutorial / Studio									35			
	Student-Centered Learning									-			
Self-Dir	ected Learning												
	Non-face-to-face learning											-	
	Revision of the previous and (or) subsequen	t lect	ure a	t hom	ne					15			
	Preparation for final examination											10	
Formal	Assessment												
	Continuous Assessment											1	
	Lab Test											1	
	Quiz										().75	
	Viva										().25	
Total	Total									70			
TEACH	HING METHODOLOGY												
Lecture	and discussion, Co-operative and collaborati	ve m	ethod	, Pro	blem	ı bas	ed n	netho	od				
	SE SCHEDULE	ve me	ethod	, Pro		1 bas	ed m		a				

				Course Oj	ffered by BME Department		
Week		L	ecture Topics		Assessment		
1	Introduction,	Course overview	v, Evaluation process, Form gr	oup			
2			projects and project scope				
3	Discussion or	n project idea an	d design consideration				
4	Idea based pro	oject presentatio	n, budget and timeline		Report, Assignment, Lab		
	Define need a	nd project scope	e, design requirements		Test, Quiz, Viva		
5			sting, engineering analysis				
6	Finalization	of design with	n detailed drawing and cor	nputational			
	validation test	e					
7	Finalization o	f Project and sta	rt the prototype fabrication pro	ocess			
			Midterm Break				
8	• •		and troubleshooting				
9		ification and val	_		Report, Lab Test, Quiz,		
10	• •	ification and val			Viva		
11	-	Submission and					
12			omplete documentation (Dra	wing, user			
	-	t and design his	tory file)				
13	Presentation						
14	Project Show	casing					
ASSESSME	NT STRATEGY	Y					
			СО	Г	Plaams Taxonomy		
Comp	oonents	Grading	CO		Blooms Taxonomy		
Continuous	Report	20%	CO1, CO2, CO3		C4, C5, C3		
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3		C4, C5, C3		
E' 1 E	Lab Test	20%	CO1, CO2, CO3		C4, C5, C3		
Final Exam	Quiz	30%	CO1, CO2, CO3		C4, C5, C3		
(60%)	Viva	10%	CO1, CO2, CO3		C4, C5, C3		
Total	Marks	100%		I			
(CO = Cours	e Outcome, C =	- Cognitive Dor	nain, P = Psychomotor Doma	nin, A = Affe	ective Domain)		
TEXT BOO	KS						
			. CRC press 1995				
2. Gerald E. N	Miller, Artificial	Organs, Morgan	h & Claypool Publishers, 2006				
REFERENC	E BOOKS						
1. Bronzino.	Joseph, Handboo	ok of biomedical	engineering. CRC; 2 Sub edit	ions, 1999			
2. BallabioE.	etal, Rehabilitati	on Engineering.	IOS press 1993.				
REFERENC	E SITE						
COUDSE IN	FORMATION						
COURSE IN				: 1.50			
_							
Course Code	: BME 300		Lecture Contact Hours	: 1.50			
Course Title	: Industrial	Training	Credit Hours				
DDE DEOU							
PRE-REQU	ISITE						

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Training in industry, hospital or healthcare organization will be conducted for a duration of 4 weeks at the end of level 3 term 2. Students will learn how to apply their skills as a biomedical engineer in a professional setting and will undergo extensive training in preparation for their role in the industry, hospital, or healthcare facilities. The training can be arranged by the department.

OBJECTIVE

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2. To learn and explore the different technical aspects and management of health-related organizations.

No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Be able to understand the role of a biomedical engineer in their respective fields	C2	6, 12	-	7	7	R, Pr
CO2	Be able to evaluate various technical aspects of biomedical equipment	C5	9, 10	2	-	7	R, Pr
CO3	Be able to learn and apply professional ethics, responsibilities and the norms of the engineering practice.	C3	8, 12	-	7	7	R, Pr
CO4	Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.	C6	10	-	-	7	R, Pr
CO5	Be able to apply their biomedical engineering knowledge in a professional setting	C3	9, 11, 12	1	-	6	R
	Complex Problems, CA-Complex Activities, KP-	-	ofile, T	– Test	; PR –	Project; Q	– Quiz; ASG –
Assignment; Pr – Presentation; R - Report; F – Final Exam)C1 - RememberC2 – UnderstandC3 - ApplyC4 - AnalyzeC5 – EvaluateC6 – Create							
	RSE CONTENT cs of industrial training at an industry, hospital, o	r healthcare or	mizatio	on Thi	s is obl	igatory for	the completion

COURSE OUTCOMES & GENERIC SKILLS

4 weeks of industrial training at an industry, hospital, or healthcare organization. This is obligatory for the completion of B.Sc. course. An evaluation report from the industry is to be submitted at the end of the training and accordingly to be incorporated in the tabulation sheet.

	~					PR	OGI	RAN	101	JTCC	OMES	(PO))		
No.	Cours	se Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
	Be able to	understand the role of a													
CO1	biomedical	engineer in their respective						3						3	
	fields														
CO2		evaluate various technical									2	3			
002	aspects of b	iomedical equipment										5			
		earn and apply professional													
CO3	ethics, resp	oonsibilities and the norms								3				3	
	of the engine	neering practice.													
		o comprehend and write													
CO4	-	ports, design documentation,										3			
		tive presentations and give													
	and receive clear instructions.														
007		o apply their biomedical									2		2	2	
CO5	0 0	knowledge in a professional									3		3	3	
(NI	setting	ed for mapping which indicates	- 2 -	1.1.1	2 -		1:		11.	- 1	. 1	1 - 6	- 4 - 1		
,			s 5 a:	s nign	1, 2 a	sme	ululi	i, an	u 1 a	is low	leve	1 01 11	latening	<u></u>	
TEACHING LEARNING STRATEGY									Engagement (hours)						
	Teaching and Learning Activities														
Face-to-Face Learning Lecture											7				
Practical / Tutorial / Studio									35						
	Student-Cente										-				
Self-Dir	ected Learning														
	Non-face-to-fa										-				
	Revision of th	e previous and (or) subsequen	t lect	ure a	t hon	ne					15				
	Preparation for	or final examination									10				
Formal	Assessment														
	Continuous A	ssessment									2				
	Final Presenta	ition											1		
Total													70		
TEACH	HING METHO	DDOLOGY													
Lecture	and discussion	, Co-operative and collaborativ	ve m	ethod	, Pro	blem	bas	ed n	netho	od, Tr	rainin	g.			
COURS	SE SCHEDUL	E													
	Week	C	onte	nt								Ass	essmen	t	
1		Industrial Training at an	indu	stry,	hosp	ital,	or	heal	thca	re					
	organization														
2								re							
		organization									Cont			ssment,	
3								re		R	eport				
		organization													
4		Industrial Training at an	indus	stry,	hosp	ital,	or	heal	thca	re					
		organization													

			Final Presentation	
ASSESSME	NT STRATEGY	ł		
Comp	ponents	Grading	СО	Blooms Taxonomy
Continuous	Report	20%	CO1, CO2, CO3	C2, C3, C5
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3	C2, C3, C5
Final Exam (60%)	Final Presentation	60%	CO1, CO2, CO3	C2, C5
Total	Marks	100%		
•	se Outcome, C =	Cognitive Don	nain)	
TEXT BOO	KS			
-				
REFERENC	'E SITE			

6.1.27 BME 401 Diagnostic and Therapeutic Equipment

COURSE INFO	RMATION								
Course Code	: BME 401	Lecture Contact Hours	: 3.00						
Course Title	: Diagnostic and Therapeutic	Credit Hours	: 3.00						
	Equipment		. 5.00						
PRE-REQUISIT									
BME 207: Biome	edical Instrumentation and Measure	urements							
CURRICULUM	STRUCTURE								
Outcome Based I	Education (OBE)								
SYNOPSIS/RA7	FIONALE								
The course aims	to teach students about various d	iagnostic and therapeutic ec	uipment. The course covers the						
following module	es: cardiac equipment, neurologi	cal equipment, skeletal mus	cular equipment, respiratory						
equipment, diathe	ermy, drug delivery systems, inc	ubator, some special diagno	stic techniques and patient						
monitoring.									
OBJECTIVE									
The objective of	the course is to make the student	s familiarized with the med	ical devices used in healthcare for						
diagnostic and the	diagnostic and therapeutic purposes. Understand the principles of operation and identify the application areas.								
Also to make the students able to analyze, troubleshoot, repair, and calibrate diagnostic and therapeutic									
equipment.									
COURSE OUT	COMES & GENERIC SKILLS	5							
L									

						Cours	se Offe	red by B	ME Department
No.	Course Out	come		Bloom's	РО	CP	CA	KP	Assessme
				Taxonomy					nt
									Methods
CO1	Be familia	r with the various equip	oment used	C1	1	1	-	1	T, F
	in Diagnostic and therapeutic purposes.								
CO2	Be able to u	inderstand the princip	les of	C2	1	1	-	1	T, F
	various diag	gnostic and therapeutic	equipment						
CO3	Be able to a	analyze, troubleshoot, 1	repair, and	C4	2, 4	1,3	-	1,3	MID, F
	calibrate dia	agnostic equipment.							
CO4	Be able to a	analyze, troubleshoot, 1	repair, and	C4	2, 4	1,3	-	1,3	T, F
	calibrate therapeutic equipment								
(CP- C	Complex Prob	olems, CA-Complex Ad	ctivities, KP-I	Knowledge Pro	ofile, T -	– Test;	PR – I	Project; (Q – Quiz;
ASG -	Assignment	; Pr – Presentation; R -	Report; F - I	Final Exam)					
C1 - R	emember	C2 - Understand	C3 - Apply	C4 - Ana	lyze	C5 - 1	Evalua	te	C6 - Create

COURSE CONTENT

Introduction to Diagnostic and Therapeutic Equipment: Definition, Difference between diagnostic and therapeutic equipment, Electrocardiograph (ECG) Machine: Principle and construction, Ambulatory Monitoring System: Principle and application, Phonocardiography, Cardiac Pacemaker, Defibrillator: Principle, types, application, risk factors, EEG recording system, Principle of MEG, Muscle & Nerve stimulators, EMG Machine, EMG Bio-Feedback Instrumentation, Ventilator: Principle, construction, types, modes of operation, testing and calibration., CPAP, BiPAP: Principle and applications, High Flow Nasal Cannula (HFNC): Principle and applications, Thermography – Recording and clinical application., Electro-surgery machine: Principle, applications, risk factors, Principles of Cryogenic technique and application, Syringe and Infusion pumps, Endoscopy, Laparoscopy: Principle, and application and principle of Lithotripsy, Co-60 Units: Principle, and applications, Cyclotron: Principle and applications, Linear Accelerator (LINAC), Optical Coherence Tomography (OCT), Opthalmoscope, Special Diagnostic Techniques, Near-Infrared Spectroscopy (NIRS), ICU/CCU/HDU Equipment and setup, Heart Lung Machine: Need for the unit, principle, functioning of bubble, disc type and membrane type oxygenators,, finger pump, roller pump, electronic monitoring of functional parameters, Safety, maintenance and repair of biomedical equipment, Current trends in clinical engineering

N		PROGRAM OUTCOMES (PO)											
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be familiar with the various equipment												
CO1	used in Diagnostic and therapeutic	3											
	purposes.												
CO2	Be able to learn the principles of various												
002	diagnostic and therapeutic equipment	3											
CO3	Be able to analyze , troubleshoot, repair,		3	3									
COS	and calibrate diagnostic equipment.		5		5								
CO4	Be able to analyze , troubleshoot, repair,		3		3								
004	and calibrate therapeutic equipment		5		5								
(Numer	rical method used for mapping which indicat	es 3	as hig	gh, 2	as m	nediu	ım, a	and 1	as l	ow le	vel of	match	ing)
TEAC	HING LEARNING STRATEGY												
Teachi	ng and Learning Activities	Teaching and Learning Activities Engagement (hours)											

Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous and (or) subsequent lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	Торіс	Assessment
1	Introduction + Cardiac equipment	
Lecture 1	Introduction to Diagnostic and Therapeutic Equipment: Definition,	
	Difference between diagnostic and therapeutic equipment	
Lecture 2	Electrocardiograph (ECG) Machine: Principle and construction	
Lecture 3		
2	Cardiac equipment	
Lecture 4	Ambulatory Monitoring System: Principle and application	CT – 1, Final
Lecture 5	Phonocardiography + Cardiac Pacemaker	
Lecture 6	Defibrillator: Principle, types, application, risk factors	
3	Neurological equipment + Skeletal muscular equipment	
Lecture 7	EEG recording system + Principle of MEG	
Lecture 8	Muscle & Nerve stimulators	
Lecture 9	EMG Machine + EMG Bio-Feedback Instrumentation	-
4	Respiratory Equipment	
Lecture 10	Ventilator: Principle, construction, types, modes of operation, testing and	
Lecture 11	calibration.	
Lecture 12		
5	Respiratory Equipment	
Lecture 13	CPAP, BiPAP: Principle and applications	Midterm, Final
Lecture 14		
Lecture 15	High Flow Nasal Cannula (HFNC): Principle and applications	
6	Diathermy and Thermography	
Lecture 16	Thermography – Recording and clinical application.	1
Lecture 17	Electro-surgery machine: Principle, applications, risk factors	1
Lecture 18	1	

7	Special equipme	ent			fered by BME Department
Lecture 19			ue and application		
Lecture 20			1 and approximit		
Lecture 21	Syringe and Infu	sion pumps			
	- ,8	<u>r</u> <u>r</u> -	Midterm Break		
8	Special equipme	ent			
Lecture 22					
Lecture 23	Endoscopy + La	paroscopy: Pri	nciple, and application		
Lecture 24	Patient monitorin	ng system			
9	Dialysis Machin				
Lecture 25	Haemodialysis n				
Lecture 26			F1-0		CT – 2, Final
Lecture 27	Application and	principle of Li	thotripsy		
10	Radiotherapy E				
Lecture 28	Co-60 Units: Pri		olications		
Lecture 29	Cyclotron: Princ				
Lecture 30	Linear Accelerat				
11	Special Diagnos				
Lecture 31	Optical Coheren	-			
Lecture 32		0 1			
Lecture 33	Opthalmoscope				
12	Special Diagnos	tic Technique	es		CT – 3, FINAL
Lecture 34	Near-Infrared Sp	-			
Lecture 35			,		
Lecture 36	ICU/CCU/HDU	Equipment and	d Setup		
13	Heart-Lung Ma		*		
Lecture 37	e		the unit, principle, function	oning of bubble,	
	disc type and me	mbrane type o	xygenators	-	
Lecture 38	Heart Lung Mac	hine: finger pu	mp, roller pump		
Lecture 39	Heart Lung Mac	hine: electroni	c monitoring of functional	parameters.	FINAL
14	Safety, Mainten	ance, Repair	of Biomedical Equipmen	t	
Lecture 40	Safety				
Lecture 41	Maintenance and	l Repair			
Lecture 42	Current trends in	clinical engin	eering		
ASSESSME	NT STRATEGY				
			CO	D1	Γ
Components	,	Grading	— CO	Biooms	Taxonomy
	Class Test/				
Continuous	Assignment	20%	CO1, CO3, CO4	C1, C2, 0	C4
Assessment	l-3				
(40%)	Class	5%	CO3	C4	
	Participation				
	Midterm	15%	CO2	C2	
Final Exam		60%	CO 1	C1	

		CO 2	C2						
		CO 3	C4						
		CO 4	C4						
Total Marks	100%								
(CO = Course Outcome, C = Cognitive Domain)									
TEXT BOOKS									
1. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.									
2. John G. Webster, Medical	Instrumentation	n Application and Design, Johr	Wiley and sons, New York, 1998.						
REFERENCE BOOKS									
1. Joseph J.carr and John M.	Brown, Introdu	ction to Biomedical Equipmen	t Technology, John Wiley and sons,						
New York, 4th Edition, 20	012.								
REFERENCE SITE									

6.1.28 BME 403 Molecular Biology for Engineers

COURSE I	NFORMATION						
Course	: BME 403	Lecture Contact Hou	rs :	3.00			
Code	: Molecular Biology for Engineers	Credit Hours	:	3.00			
Course Title							
PRE-REQU	JISITE						
	Course Code : BME 201	Course Code	: BMI	E 203	3		
	Course Titile : Human Physiology	Course Titile	: Bioc	hemi	istry		
CURRICU	LUM STRUCTURE						
	Outcome Based Education (OBE)						
SYNOPSIS	/RATIONALE						
	The aim of this course is to present	t the knowledge of mo	olecula	r cel	l biolc	gy to eng	gineering students
	especially students of Biomedical E		-			-	
	molecular interplays which are the	-			-	•	•
	the course is to provide students with						
	emphases on its relationship with b	iomedical engineering	g. The	cour	se cov	ers the fo	llowing modules:
	DNA, chromosomes, RNA, protein	, genetics, gene expres	sion				
OBJECTIV	TES						
	1. To be able to impart basic know	U					
	2. To be able to find the molecular	reasons of physiologic	cal diso	order	s		
	3. To be able to suggest molecular		ical di	sord	ers		
COURSE O	OUTCOMES & GENERIC SKILLL	S					
		Bloom's P	0 0	CP	CA	KP	Assessment
No.	Course outcome	Taxonomy					Methods
CO1	Be able to understand fundamenta		1 1			1,	T, F
	concepts on molecular cell biology	/,				3	
	biochemistry, and geneti	c					
	engineering						
CO2	Be able to apply the principles of	of C3	3 3			5	T, Mid
	molecular methods in a design t					1	Term, F

	Trans Genou Techn No. CO1 CO2 CO2 CO3 (Nume match	netics: Epigenetic markers, epigenetic co lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of molecular methods in a design to sense, study or control a biological system. Be able to analyze a design involving a quantitative molecular application used in a research, biomedicine or healthcare setting. erical method used for mapping which in ing) PO mapping sponding of	n, te NA 1 3	2 ttes 3	I 3 2 3 as	PROO 4 3	d po Edit	AM 6	rans Gé OU 7	TCO 8	PME 9	s (PC 10	D) 11	12
Justification	Trans Genou Techn No. CO1 CO2 CO2 CO3 (Nume match	lation: Initiation of translation, elongation ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of molecular methods in a design to sense, study or control a biological system. Be able to analyze a design involving a quantitative molecular application used in a research, biomedicine or healthcare setting. erical method used for mapping which in ing)	n, te NA 1 3	2 ttes 3	I 3 2 3 as	PROO 4 3 high	d po Edit	AM 6	rans Gé	TCO 8	PME 9	s (PC 10	D) 11	12
	Trans Genou Techn No. CO1 CO2 CO2 CO3	lation: Initiation of translation, elongation ne analysis and Gene Sequencing: Diques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of molecular methods in a design to sense, study or control a biological system. Be able to analyze a design involving a quantitative molecular application used in a research, biomedicine or healthcare setting. erical method used for mapping which in ing)	n, te NA 1 3	2	II 3 2	PROO 4 3	d po Edit	AM 6	rans Gé	TCO 8	PME 9	s (PC 10	D) 11	12
SKILL MA	Trans Genou Techn APPING (No. CO1 CO2 CO2	lation: Initiation of translation, elongation ne analysis and Gene Sequencing: Diques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of molecular methods in a design to sense, study or control a biological system. Be able to analyze a design involving a quantitative molecular application used in a research, biomedicine or healthcare setting. erical method used for mapping which in	n, te NA 1 3	2	II 3 2	PROO 4 3	d po Edit	AM 6	rans Gé	TCO 8	PME 9	s (PC 10	D) 11	12
SKILL MA	Trans Genou Techn No. CO1 CO2 CO3	lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of molecular methods in a design to sense, study or control a biological system. Be able to analyze a design involving a quantitative molecular application used in a research, biomedicine or healthcare setting.	n, te NA 1 3	2	II 3 2	PROO 4 3	d po Edit	AM 6	rans Gé	TCO 8	PME 9	s (PC 10	D) 11	12
SKILL MA	Trans Genou Techn No. CO1 CO2	lation: Initiation of translation, elongatione analysis and Gene Sequencing: Diques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of molecular methods in a design to sense, study or control a biological system. Be able to analyze a design involving a quantitative molecular application used in a research, biomedicine or	n, te NA	rmir typi	Ing a straight for the second	PROC	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genou Techn No. CO1 CO2	lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of molecular methods in a design to sense, study or control a biological system. Be able to analyze a design involving a quantitative molecular application	n, te NA	rmir typi	Ing a straight for the second	PROC	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genou Techn No. CO1 CO2	lation: Initiation of translation, elongation ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of molecular methods in a design to sense, study or control a biological system.	n, te NA	rmir typi	Ing a straight for the second	PROC	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genou Techn APPING (No.	lation: Initiation of translation, elongation ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of molecular methods in a design to sense, study or control a biological	n, te NA	rmir typi	Ing a straight for the second	and PRO	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genou Techn APPING (No.	lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of molecular methods in a design to	n, te NA	rmir typi	Ing a straight for the second	and PRO	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genou Techn APPING (No.	lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering Be able to apply the principles of	n, te NA	rmir typi	Ing a straight for the second	and PRO	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genou Techn APPING (No.	lation: Initiation of translation, elongation ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology, biochemistry, and genetic engineering	n, te NA	rmir typi	Ing a straight for the second	and PRO	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genor Techn APPING (No.	lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental concepts on molecular cell biology,	n, te NA	rmir typi	natio	and PRO	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genor Techn APPING (No.	lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome Be able to understand fundamental	n, te NA	rmir typi	natio	and PRO	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genor Techn APPING (No.	lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING) Course outcome	n, te NA	rmir typi	natio	and PRO	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genor Techn	lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING)	n, te NA	rmir typi	natio	and PRO	d po Edit GR/	ost-ti ting,	rans Ge OU	lation enom	nics DME	and S (PC	Prote	
SKILL MA	Trans Genor Techn	lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing CO-PO MAPPING)	n, te	rmir	natio	on and	d po Edit	ost-tı ting,	rans Ge	latio: enom	nics	and	Prote	comics,
	Trans Genor Techn	lation: Initiation of translation, elongatio ne analysis and Gene Sequencing: D iques in Gene sequencing	n, te	rmir	natio	n an	d po	ost-tı	rans	latio				comics,
	Trans	lation: Initiation of translation, elongatio	n, te	rmir	natio	n an	d po	ost-tı	rans	latio				omics,
						-					nal o	contr	ol	
		netics: Epigenetic markers, epigenetic co	ntrol	oft	rans	sposa	ble	elen	nen	15				
	-						1.1.	1		te.				
	corepr		14115	cnp	uon	Tact	013,	ua	1301	ipuo	1141	coac	irvato	ns and
		cription: Mechanism of transcription, t	-			-		-						
		nbinant DNA technology and molecular for analyzing gene expression: Reporter			-		-				ndl	1:	zoti	
		repair and recombination: DNA damag								-				
		replication: Replication process, proofree		-										
	-	a, Description of different protein structur												
		ersatility of RNA and Gene to Protein: 1				of dif	fere	nt st	ruct	ures	of F	NA,	The (Central
	-	nic Organisation: from Nucleotides to C	hror	nati	n,									
		coiling of DNA												
	to 3',	tructure of DNA: Components of nuclei	c ac	ia D	aseu		11110	erem	l Sti	uctui	le, 3	igiiii	icanc	e 01 5
		edical Engineering		:4 1.	aad		1:					:~~:f		a of 57
		luction: Introduction to molecular biolog	y, m	olec	ular	perc	epti	on o	fliv	ving l	bein	gs, aj	oplica	ation in
COURSE (
	Quize	; ASG-Assignment; Pr-Presentaion; R-Re	port	, F-F	Final	Exa	m)							
		omplex Problems, CA-Complex Activit					-	Pro	file	, T-1	Fest;	PR	Proje	ect; Q-
	biome	dicine or healthcare setting.												
		ation used in a research,												
		ing a quantitative molecular C4			т					5			ABC	, 11
005	-	ble to analyze a design		+	4	1				3		-	ASG	b Pr
CO3	system	study or control a biological												
CO3	sense,													

CO1 DO1			11	. 1 . 1 . 1.							
CO1-PO1	3	to describe molecular functions of cells in human body.									
CO2-PO3	2	Knowledge of contemporary issues regard	ling the molecular	mechanisms of disease							
		or knowledge of molecular solutions of the	nese diseases are r	equired.							
CO3-PO2	2	Knowledge of analyzing biological data	, knowledge of it	lentifying problems are							
		instrumental to ensure better health.									
TEACHING	G LEARNIN STF	RATEGY									
Teaching an	d Learning Activit	ties	Engagement (h	ours)							
Face-to-Face	e Learning										
Lec				42							
	ctical/Tutorial/Stu			-							
	dent-Centered Lea	rning		-							
Self-Directe	-										
	n-Face-to Face Lea	arning ous lecture at home		42							
		21									
	paration for the fin	al examination		21							
Formal Asse				2							
	ntinuous assessmen al Examination	11		2							
		3									
Total				131							
Lecture a	G METHODOLO		method, Proble	em based metho							
Lecture a COURSE S	nd Discussion,	Co-operative and collaborative	method, Proble								
Lecture a COURSE S Week	nd Discussion, CHEDULE	Co-operative and collaborative Content	method, Proble	em based method							
Lecture a COURSE S Week 1	nd Discussion, CHEDULE Course introdu	Co-operative and collaborative Content action	method, Proble								
Lecture a COURSE S Week Lecture 1	CHEDULE Course introduction to	Co-operative and collaborative Content uction molecular biology	method, Proble								
Lecture a COURSE S Week 1 Lecture 1 Lecture 2	Ind Discussion, CHEDULE Course introduction to Introduction to Molecular perc	Co-operative and collaborative Content Content molecular biology eption of living beings	method, Proble								
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 3	CHEDULE Course introdu Introduction to Molecular perc Application in 1	Co-operative and collaborative Content Content Uction molecular biology eption of living beings Biomedical Engineering	method, Proble								
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 322	CHEDULE Course introd Introduction to Molecular perc Application in The Structure	Co-operative and collaborative Content Content uction molecular biology eption of living beings Biomedical Engineering of DNA	method, Proble								
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 32Lecture 4	CHEDULE Course introd Introduction to Molecular perc Application in The Structure	Co-operative and collaborative Content Content molecular biology eption of living beings Biomedical Engineering of DNA Cnucleic acid based on different structure	method, Proble								
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 32Lecture 4Lecture 5	CHEDULE Course introd Introduction to Molecular perc Application in The Structure Components of Significance of	Co-operative and collaborative Co-operative and collaborative Content	method, Proble								
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 32Lecture 4Lecture 5Lecture 6	CHEDULE Course introdu Introduction to Molecular perc Application in The Structure Components of Significance of Supercoiling of	Co-operative and collaborative Co-operative and collaborative Content	method, Proble	Assessment							
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 2Lecture 32Lecture 4Lecture 5Lecture 5Lecture 633	CHEDULE Course introdu Introduction to Molecular perc Application in The Structure Components of Significance of Supercoiling of	Co-operative and collaborative Content	method, Proble	Assessment							
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 2Lecture 32Lecture 4Lecture 5Lecture 5Lecture 63Lecture 7	CHEDULE Course introdu Introduction to Molecular perc Application in The Structure Components of Significance of Supercoiling of Genomic Orga	Co-operative and collaborative Co-operative and collaborative Content	method, Proble	Assessment							
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 32Lecture 4Lecture 5Lecture 63Lecture 7Lecture 8	CHEDULE Course introduction to Molecular perce Application in The Structure Components of Significance of Supercoiling of Genomic Orga Eukaryotic gen	Co-operative and collaborative Co-operative and collaborative Content	method, Proble	Assessment							
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 32Lecture 4Lecture 5Lecture 5Lecture 63Lecture 7Lecture 8Lecture 9	CHEDULE Course introdu Introduction to Molecular perc Application in The Structure Components of Significance of Supercoiling of Genomic Orga Eukaryotic gen Bacterial genor RNA based ger	Co-operative and collaborative Co-operative and collaborative Content	method, Proble	Assessment							
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 32Lecture 4Lecture 5Lecture 5Lecture 63Lecture 7Lecture 8Lecture 94	CHEDULE Course introdu Introduction to Molecular perc Application in The Structure Components of Significance of Supercoiling of Genomic Orga Eukaryotic gen Bacterial genor RNA based ger The Versatility	Co-operative and collaborative Co-operative and collaborative Content	method, Proble	Assessment							
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 32Lecture 4Lecture 5Lecture 63Lecture 7Lecture 8Lecture 94Lecture 10	CHEDULE Course introdu Introduction to Molecular perc Application in The Structure Components of Significance of Supercoiling of Genomic Orga Eukaryotic gen Bacterial genor RNA based ger The Versatility	Co-operative and collaborative Content Content uction molecular biology eption of living beings Biomedical Engineering of DNA `nucleic acid based on different structure 5' to 3' `DNA mization: from Nucleotides to Chromatin ome nome y of RNA and Gene to Protein different structures of RNA	method, Proble	Assessment							
LectureaCOURSE SWeek1Lecture 1Lecture 2Lecture 3	CHEDULE Course introdu Introduction to Molecular perc Application in The Structure Components of Significance of Supercoiling of Genomic Orga Eukaryotic gen Bacterial genor RNA based ger The Versatility Description of The Central dog	Co-operative and collaborative Content Content uction molecular biology eption of living beings Biomedical Engineering of DNA `nucleic acid based on different structure 5' to 3' `DNA mization: from Nucleotides to Chromatin ome nome y of RNA and Gene to Protein different structures of RNA		Assessment							
Lecture a COURSE S Week 1 Lecture 1 Lecture 2 Lecture 3 2 Lecture 4 Lecture 5 Lecture 6 3 Lecture 7 Lecture 8 Lecture 9 4 Lecture 10 Lecture 11	CHEDULE Course introdu Introduction to Molecular perc Application in The Structure Components of Significance of Supercoiling of Genomic Orga Eukaryotic gen Bacterial genor RNA based ger The Versatility Description of The Central dog Description of of	Co-operative and collaborative Content uction molecular biology eption of living beings Biomedical Engineering of DNA Inucleic acid based on different structure 5' to 3' Inucleotides to Chromatin ome Inization: from Nucleotides to Chromatin Inization: from Nucleotides to Protein Inization: from Nucleotides to Chromatin Inization: from Nucleotides to Protein Inization: from Nucleotides to Chromatin Inization: from Nucleotides to Protein Inization: from Nucleotides to Protein Inization: from Structures of RNA Inization Inization: from Structures and identification Inization		Assessment							
Lecture a COURSE S Week 1 Lecture 1 Lecture 2 Lecture 3 2 Lecture 4 Lecture 5 Lecture 6 3 Lecture 7 Lecture 8 Lecture 9 4 Lecture 10 Lecture 11 Lecture 12	CHEDULE Course introdu Introduction to Molecular perc Application in The Structure Components of Significance of Supercoiling of Genomic Orga Eukaryotic gen Bacterial genor RNA based ger The Versatility Description of Description of Description of Description of DNA replication	Co-operative and collaborative Content uction molecular biology eption of living beings Biomedical Engineering of DNA inucleic acid based on different structure 5' to 3' 'DNA inization: from Nucleotides to Chromatin ome nome 'of RNA and Gene to Protein different structures of RNA gma different protein structures and identification on		Assessment							
Lecture a COURSE S Week Lecture 1 Lecture 2 Lecture 3 Lecture 3 Lecture 4 Lecture 5 Lecture 6 Lecture 7 Lecture 8 Lecture 9 Lecture 9 Lecture 10 Lecture 11 Lecture 12 5	CHEDULE Course introdu Introduction to Molecular perc Application in The Structure Components of Significance of Supercoiling of Genomic Orga Eukaryotic gen Bacterial genor RNA based ger The Versatility Description of Description of DNA replicatio	Co-operative and collaborative Content uction molecular biology eption of living beings Biomedical Engineering of DNA Inucleic acid based on different structure 5' to 3' Inucleotides to Chromatin ome Inization: from Nucleotides to Chromatin Inization: from Nucleotides to Protein Inization: from Nucleotides to Chromatin Inization: from Nucleotides to Protein Inization: from Nucleotides to Chromatin Inization: from Nucleotides to Protein Inization: from Nucleotides to Protein Inization: from Structures of RNA Inization Inization: from Structures and identification Inization		Assessment							

[1				i by BME Department
Lecture 15	Proofreading and termin	nation			
6	DNA repair and recon				
Lecture 16	Types of mutations and	their phenotyp	ic consequences		CT-2
Lecture 17	General classes of DNA	damage			
Lecture 18	Repair of single base ch	nanges and stru	ctural distortions by removal	of DNA	
	damage				
	Double-strand break rep	air by removal	l of DNA damage		
7	Recombinant DNA tec	hnology and 1	nolecular cloning		
Lecture 19	Cutting and joining DN	A			
Lecture 20	Molecular cloning				
Lecture 21	Restriction fragment ler	ngth polymorph	nism (RFLP)		
	DNA sequencing				
8	Tools for analyzing ge	ne expression			
Lecture 22	Reporter genes				
Lecture 23	In vitro mutagenesis				
Lecture 24	-	gene transcript	ion: RNA expression and loca	lization	
			otein expression and localization		
9	Transcription	1	1		
Lecture 25	Mechanism of transcrip	tion			
Lecture 26	Transcription factors				
Lecture 27	Transcriptional coactiva	ators and corep	ressors		
10	Epigenetics and mono				
Lecture 28	Epigenetic markers	gene en			Midterm
Lecture 29	Genomic imprinting				
Lecture 30	Epigenetic control of tra	ansposable eler	nents		
11	RNA processing and p				
Lecture 31	Group I and group II se	-	5		
Lecture 32	Alternative splicing	ir spiteling intro	5115		
Lecture 32	RNA editing				
12	Translation				
Lecture 34	Initiation of translation				
Lecture 35	Elongation				
Lecture 35	Termination and post-tr	anslational con	trol		
13	1		in basic and applied researc	sh	
Lecture 37	Transgenic mice	ngamsms: use	in basic and applied researc	.11	
Lecture 37	Gene-targeted mouse m	odels			
Lecture 38	Applications of transger		nology		CT – 3, FINAL
Lecture 39	Genome analysis and				
Lecture 40	DNA typing and Editing		ilig		
Lecture 40 Lecture 41	Genomics and Proteom	-			
Lecture 42	Techniques in Gene seq	uencing			
ASSESSME	NT STRATEGY				
			CO	Bl	ooms Taxonomy
	Components	Gradina			-
(Components	Grading			

			Cour	rse Offered by BME Department
Continuous	Class Test/	20%	CO1, CO2	C1, C2, C3
assessment (40%)	Assignment 1-3			
	Class participation	5%	CO1	C1, C2
	Midterm	15%	CO3	C4
Final I	Exam	60%	CO1	C1, C2
			CO2	C3
			CO3	C4
Total Marks		100%		

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(CO = Course Outcome, C = Cognitive Domain, P= Psychomotor Domain, A= Affective Domain)

TEXT BOOKS

- 1. Fundamental Molecular Biology by Lizabeth A. Allison
- 2. Lehninger Principles of Biochemistry- 4th Edition, by Albert L. Lehninger, David L. Nelson, and Michael M. Cox.

REFERENCE BOOKS

- 1. Molecular Cell Biology by Lodish, Berk, Matsudaira, Kaiser Krieger, Scott, Zipursky, Darnell.
- 2. Introduction to Molecular Biology and Genetic Engineering by Oliver Brandenberg, Zephaniah Dhlamini Alessandra Sensi, Kakoli Ghosh, Andrea Sonnino

6.1.29 BME 404 Molecular Biology for Engineers Sessional

COURSE INFORMATION									
Course Code	: BME 404	Lecture Contact Hours	: 3.00						
Course Title	: Molecular Biology for	Credit Hours	: 1.50						
	Engineers Sessional		. 1.50						
PRE-REQUISI	 ГЕ								
Course Code: BN	ME 406								
Course Title: Mo	lecular Biology for Engineers								
CURRICULUM	I STRUCTURE								
Outcome Based	Education (OBE)								
SYNOPSIS/RA	ΓIONALE								
The course cover	s routinely used molecular biol	ogy techniques used in diagr	nostics and laboratory. Topics cover both						
DNA based assa	ys such as PCR, electrophoresi	s and protein-based assays s	such as ELISA and SDS-PAGE In-vitro						
cell culture techr	iques are also covered								
OBJECTIVE									
This course air methodologies.	ns to introduce the students	to basic molecular biolo	gy techniques, their applications and						

COU	RSE OUTCOMES & GENERIC SKILL	S						
No.	Course Outcome		loom's	РО	СР	CA	KP	Assessment
INO.		Ta	xonomy	10	Cr	CA	KI	Methods
CO1	Be able to extract , quantify and an nucleic acids (DNA/RNA) using amplific	-	C3, C4	4.5	-	1	1	T, Q, R
	techniques		- 7	y -				
CO 2	1	issays		4.5		1	1	TOD
CO2	(ELISA, flow cytometer)		C3, C4	4, 5	-	1	1	T, Q, R
CO3	Be able to apply cell culture technique	ies to	C3, C4	2, 5	_	1	1	T, Q, R
005	quantify and analyze cell growth			2, 5	-	1	1	1, Q, K
(CP- 0	Complex Problems, CA-Complex Activitie	es, KP-Knov	wledge Pro	ofile, T -	- Test;	PR – 1	Project; Q -	- Quiz; ASG –
Assig	nment; Pr – Presentation; R - Report; F – F	Final Exam)						
C1 - R	Remember C2 - Understand C3 - App	ply	C4 - Analy	yze	C5 -	Evalu	ate C	6 - Create

COURSE CONTENT

Extraction of DNA and RNA using commercially available DNA/RNA extraction kits. Identification of gene of interest using real-time PCR technique. Gene length quantification using gel electrophoresis. Protein extraction using kits and identification using SDS-PAGE techniques. Antigen/antibody detection using flow cytometry techniques. In-vitro cell culture in both 2D and 3D substrates with cell counting and differentiation using flow cytometry.

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
INU.	Course Learning Outcome		2	3	4	5	6	7	8	9	10	11	12
	Be able to extract , quantify and analyze												
CO1	nucleic acids (DNA/RNA) using				3	3							
amplification techniques													
CO2	Be able to conduct protein-based assays				2 2	2							
002	(ELISA, flow cytometer)				5	5							
CO3	Be able to apply cell culture techniques to		2			2							
005	quantify and analyze cell growth		3			3							
(Numeri	ical method used for mapping which indicate	s 3 as	high	, 2 as	s mee	diun	i, an	d 1 a	is low	leve	l of m	atching	;)

	G LEARNING STRATEGY	
Teaching an	d Learning Activities	Engagement (hours)
Face-to-Face	2 Learning	
Leo	oture	7
Pra	ctical / Tutorial / Studio	35
	dent-Centered Learning	-
Self-Directe	-	
	n-face-to-face learning	-
	vision of the previous and (or) subsequent lecture at home	15
	paration for final examination	10
Formal Asse		
	ntinuous Assessment	1
	o Test	1
Qu		0.75
Viv	'a	0.25
Total		70
TEACHIN	G METHODOLOGY	
Lecture and	discussion, Co-operative and collaborative method, Problem based method	
COURSE S	CHEDULE	
Week	Lecture Topics	Assessment
1 1	Introduction to general laboratory techniques and laboratory instruments	Assessment
1	routinely used in molecular biology labs	
2	Isolation of PBMCs from whole blood followed by cell staining	
3	Extraction of genomic DNA from PBMCs using different extraction	
5	techniques	
4	Extraction of total RNA from PBMCs using a commercial RNA	Report, Lab Test, Quiz
4	isolation kit	Viva
5	Amplification and analysis of the extracted DNA sample using PCR	
6	Amplification and analysis of the extracted DNA sample using RT-PCR	
7	Identification of PCR products using gel electrophoresis	
	Midterm Break	
	Mid Lab Test	
8		
9	Isolation of PBMCs from whole blood followed by total WBC culture	
	Isolation of PBMCs from whole blood followed by total WBC cultureQualitative assessment of total WBC culture followed by cell staining	Report, Lab Test, Quiz
9	Isolation of PBMCs from whole blood followed by total WBC cultureQualitative assessment of total WBC culture followed by cell stainingfor flow cytometry analysis	Report, Lab Test, Quiz Viva
9	Isolation of PBMCs from whole blood followed by total WBC cultureQualitative assessment of total WBC culture followed by cell staining for flow cytometry analysisQuantification of T/B cell surface markers using flow cytometer	
9 10	Isolation of PBMCs from whole blood followed by total WBC cultureQualitative assessment of total WBC culture followed by cell stainingfor flow cytometry analysis	Report, Lab Test, Quiz Viva
9 10 11	Isolation of PBMCs from whole blood followed by total WBC cultureQualitative assessment of total WBC culture followed by cell staining for flow cytometry analysisQuantification of T/B cell surface markers using flow cytometer	

			СО	Blooms Taxonomy
Comp	oonents	Grading		5
Continuous	Report	20%	CO1, CO2, CO3	C4, C3
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3	C4, C3
Final Exam Lab Test		20%	CO1, CO2, CO3	C4, C3
(60%)	Quiz	30%	CO1, CO2, CO3	C4, C3
(00%)	Viva	10%	CO1, CO2, CO3	C4, C3
Total	Marks	100%		
(CO = Cours	se Outcome, C =	= Cognitive Do	main, P = Psychomotor Doma	ain, A = Affective Domain)
TEXT BOO	KS			
1. Molecula	r Biomethods H	andbook, 2 nd Ec	lition, John M. Walker, Human	a Press
2. Fundame	ntal Molecular E	Biology, Lizabet	h A. Allison, Blackwell Publis	hing
REFERENC	CE SITE			
-				

6.1.30 BME 405 Healthcare Technology Management

COU	RSE INFO	RMATION						
Course Course	e Code e Title	: BME 405 : Healthcare Technology Management (HTM)	Lecture Contact Hou Credit Hours	urs	: 3.00			
PRE-I	REQUISIT	ĨE.						
Course	e Code: BN	1E 401						
Course	e Title: Dia	gnostic and therapeutic equipme	nt					
Course	e Code: BM	1E 300						
Course	e Title: Indu	ustrial Training						
CURF	RICULUM	STRUCTURE						
Outco	me Based E	Education (OBE)						
SYNC	OPSIS/RAT	TIONALE						
This c	ourse prov	ides students with a basic unde	rstanding of the princ	ciples	of heal	lthcare	technology	planning and
-		sessment, budgeting, acquisition			-	-	•	
-	-	osal, hospital planning and mana	• •	d mana	agemer	nt will	focus on me	edical devices,
clinica	ıl informati	on systems, and converged techr	ologies.					
OBJE	CTIVE							
1. To	o understan	d the basic guiding principles of	healthcare technology	v planr	ning an	d mana	agement	
	-	n methodology for improving t chnology through effective plann		l devi	ices, c	linical	information	n systems and
	-	ents better communicate with te		ns, reg	ulators	, admi	nistrators, a	nd technology
	ndors.							
COU	RSE OUTO	COMES & GENERIC SKILLS	5					
NT		0.04	Bloom's	DO	CD		ИD	Assessment
No.		Course Outcome	Taxonomy	PO	CP	CA	KP	Methods

				Cours	se Offe	red by BMI	E Department
CO1	Be able to understand the management administration and regulation of healthcar technology.		11	-	-	1	T, F
CO2	Be able to analyze the clinical effectiveness efficiency and safety of patient and surrounding individuals.		2, 8	-	-	6	T, F
CO3	Be able to evaluate and manage th information regarding identification of biomedical and hospital technology planning procurement and operation requirements.	of C5	4, 11	-	-	7	MID, F
CO4	Be able to manage environmenta considerations and sustainable engineerin solutions to healthcare.		7	-	-	7	T, F
(CP- 0	Complex Problems, CA-Complex Activities, K	P-Knowledge P	rofile, T	- Test	; PR –	Project; Q -	– Quiz; ASG –
Assign	nment; Pr – Presentation; R - Report; F – Final	Exam)					
C1 - R	Remember C2 - Understand C3 - App	ly C4 - Ana	alyze	C5 - 1	Evalua	te C	6 - Create

COURSE CONTENT

Healthcare Technology Overview: Introduction to healthcare technology management (HTM), Healthcare and introduction to digital and mobile health, Leveraging technology and innovation to improve healthcare, Hospital planning and management, Classification of hospitals and hospital systems, their role, functions, role of biomedical engineering, aspects of hospital services, Introduction to Norms and standards (e.g. HBN / FGI / AHA / ICRP / JCI / FDA / CE/ ISO), methods to monitor the standards, Hospital planning, location, orientation, budgeting, communication within the hospital and outside the hospital.

Safety measure in Healthcare Facility: Infection Control, Central Medical Gas System design, HVAC system, Concept of Ambulance services, Laundry services, Civil Assets, CSSD, Electrical factors in hospital design: voltage stabilizers, uninterrupted power supply for intensive care UNITS and computerized monitoring UNITS, safety precautions, interference of systems, protection, grounding of ECG, EEG, EMG and therapeutic equipment.

Equipment service and maintenance: Biomedical equipment services, their purchase, servicing and maintenance, condemned equipment disposal, training of men for medical equipment's, preventive and periodical maintenance procedures, life cycle of medical equipment.

Electronic Medical Record & Hospital Management Strategy for Healthcare: Computer based information management in hospitals, application, administration /discharge records of patients – patients billing, maintenance of patients' record, their history, and maintenance of inventory of medicines and drugs purchase, Hospital information system and picture archiving system (PACS), Telemedicine-Remote presence monitoring, companion diagnostics and outlook for personalized medicine.

Support services in Healthcare: Disaster management, Fire Fighting system, Elements of Safety, Orientation to Laboratory Safety, Radiation hazards, Radiation detection, Safety measures, Standards, Flammables and Explosives, Material Safety, Waste management.

12

11

3

Material	Safety, waste management.											
SKILL	MAPPING											
No.	Course Learning Outcome				PR	OGI	RAM	1 O U	JTCO	MES	(PO)	
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	
	Be able to understand the management,											
CO1	administration and regulation of											
	healthcare technology.											
CO2	Be able to analyze the clinical		2						2			1
002	effectiveness, efficiency and safety of		2						~			

								Со	urse	e Offe	red b	v BM	E Depa	rtment	
	patient and su	rrounding individuals.													
	Be able to	evaluate and manage the													
		regarding identification of													
CO3		and hospital technology								2			3		
-		ocurement and operation											-		
	requirements.														
	Be able to														
CO4	considerations	0							3						
	engineering so	olutions to healthcare.													
(Numer		d for mapping which indicate	s 3 as l	nigh,	2 as	me	dium	n, and	d 1 a	is low	leve	l of m	atching	g)	
TEAC	HING LEARNI	ING STRATEGY													
Teachin	ng and Learning	Activities									Eng	gagen	nent (ho	ours)	
Face-to	-Face Learning														
	Lecture												42		
	Practical / Tute	orial / Studio											-		
	Student-Centre	ed Learning											-		
Self-Di	rected Learning														
	Non-face-to-fa	ace learning											42		
		e previous and (or) subsequen	t lectui	e at	hom	e							21		
	-	r final examination									21				
Formal	Assessment														
Continuous Assessment											2				
Final Examination											3				
Total]	131		
TEAC	HING METHO	DOLOGY													
Lecture	e and discussion,	Co-operative and collaborativ	ve metl	hod,	Prol	olem	bas	ed m	etho	od					
COUR	SE SCHEDUL	Е													
	Week		Торіс	:								Ass	essmer	nt	
1		Introduction to Health	care	Tec	hnol	ogy	Μ	anag	gem	ent					
		(HTM)													
Lecture	: 1	HTM overview													
Lecture	2	Roles and functions of HTM	∕l in he	alth	care	facil	ities								
Lecture	23									CT -	- 1, Fin	al			
		Healthcare Quality Concepts													
2		ficatelicare Quality Conec	Introduction to quality concepts												
2 Lecture	: 4	Introduction to quality conc													
Lecture															
Lecture Lecture	: 5	Introduction to quality conc Aspects of quality concepts Dimensions of quality conc	epts												
	: 5	Introduction to quality conc Aspects of quality concepts Dimensions of quality conc Healthcare Regulations and	epts nd Sta												
Lecture Lecture Lecture	e 5 e 6	Introduction to quality conc Aspects of quality concepts Dimensions of quality conc	epts nd Sta												
Lecture Lecture Lecture 3 Lecture	2 5 2 6 2 7	Introduction to quality conc Aspects of quality concepts Dimensions of quality conc Healthcare Regulations and	epts nd Stan and sta	anda	rds	care	faci	lities	3						
Lecture Lecture Lecture 3 Lecture Lecture	2 5 2 6 2 7 2 8	Introduction to quality conc Aspects of quality concepts Dimensions of quality conc Healthcare Regulations an Overview of various norms	epts nd Stan and stan dards	anda	rds	care	faci	lities	3						
Lecture Lecture 3 Lecture Lecture Lecture	2 5 2 6 2 7 2 8	Introduction to quality conc Aspects of quality concepts Dimensions of quality conc Healthcare Regulations an Overview of various norms Uses of regulations and star	epts nd Stan and stan ndards rds	anda in he	rds	care	faci	lities	\$						
Lecture Lecture Lecture 3	2 5 2 6 2 7 2 8 2 9	Introduction to quality conc Aspects of quality concepts Dimensions of quality conc Healthcare Regulations an Overview of various norms Uses of regulations and star Methods to monitor standar	epts nd Stan and stan dards rds gemen	anda in he i t	rds ealth			lities	3						

Lecture 12	Electrical factors in hospital design	eu by BME Department
5	Overview of Hospitals	
Lecture 13	Introduction to hospital	
Lecture 14	Classification of hospitals and hospital systems	
Lecture 15	Roles and function of hospital departments	
6	Intensive Care Unit/ OT Module	Midterm, Final
Lecture 16	Overview of common apparatus in ICU and OT	
Lecture 17	Levels and types of care units	
Lecture 18	Medical OT setup (Budget and Planning)	
7	Hospital planning, Financial Management and Material	
	Management	
Lecture 19	Hospital planning: Location, Orientation, and Budgeting	
Lecture 20	Hospital planning: Location, Orientation, and Budgeting	
	(Continue)	
Lecture 21	Audit, Financial Management and Material Management	
	Midterm Break	
8	Biomedical Equipment Management – Part I	
Lecture 22	Biomedical equipment purchase	
Lecture 23	Planned replacement projects (planning, tender, procurement,	
	commissioning and discussion)	
Lecture 24	Managing equipment trials and servicing maintenance	
9	Biomedical Equipment Management – Part II	
Lecture 25	Healthcare technology assessment, advert event investigation	CT – 2, Final
	and medical device safety alert	
Lecture 26	Condemned equipment disposal, Training services	
Lecture 27	Preventive and periodic maintenance	
10	Life Cycle Management of Medical Equipment	
Lecture 28	Managing medical equipment over its life cycle (life cycle	
	medical equipment cost, maintenance cost, replacement	
	planning)	
Lecture 29	Approaches to financing the life cycle of medical equipment	
	(Capital-funded support, revenue funded support, renting,	
	leasing equipment etc.)	
Lecture 30	Extracting optimal benefit from medical equipment over its life	
	cycle (asset management: buy the right equipment; operation	
	and user support; maintenance)	
11	Electronic Medical Record & Hospital Management	
	Strategy	
Lecture 31	Computer controlled information management in hospitals	
Lecture 32	Maintenance of inventory medicine, patient record system	
Lecture 33	Patient billing, maintenance of patients' records and history	
12	Hospital Information System and Picture Archiving System	
	(PACS)	
Lecture 34	Overview of HIS, Laboratory Information System (LIS) and	CT – 3, FINAL
	Electronic Medical Health Record (EMR)	
Lecture 35	Significance of PACS, Overview of DICOM, PACS	
	Architecture for Imaging Modalities	

Lecture 36	PACS Architecture for Care Unit Equipment and Diagnosis	
	Equipment, Integration of PACS with HIS and EMR	
13	Support Services, Health Safety and Waste Management	
Lecture 37	Disaster management, firefighting system overview, basic	
	elements of safety regulations, Infectious Control	
Lecture 38	Safety regulation, laboratory safety, material safety, HVAC	
	system, CSSD unit	
Lecture 39	Radiation hazards and detection system, safety measures,	
	flammables and explosives; Waste management	FINAL
14	Digital and Mobile Health (Telemedicine)	FILAL
Lecture 40	Introduction to digital and mobile healthcare system	
Lecture 41	Leveraging technology and innovation to improve healthcare	
Lecture 42	iRobot and the importance of telemedicine in healthcare improvement, personalize medicine technology	

ASSESSMENT STRATEGY

			СО	Blooms Taxonomy			
Comp	ponents	Grading					
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO4	C2, C4, C2			
	Class Participation	5%	-	-			
	Midterm	15%	CO3	C5			
			CO 1	C2			
E:	Final Exam 60%		CO 2	C4			
Final	Exam	60%	CO 3	C5			
			CO 4	C2			
Total	Marks	100%		•			
(CO = Course Outcome, C = Cognitive Domain)							

TEXT BOOKS

1. Healthcare Technology Management - A Systematic approach by Blackett, Paul, McCarthy, Justin

2. Healthcare Technology Management Systems: Towards a New Organizational Model for Health Services by Rossana Rivas and Luis Vilcahuaman

REFERENCE SITE

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6.1.31 BME 407 Rehabilitation Engineering

COURSE INFORMATION

			: 3.00
Course Code	: BME 407	Lecture Contact Hours	: 3.00
Course Title	: Rehabilitation Engineering	Credit Hours	

PRE-REQUISITE

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course covers the major topics/subtopics that include impairments, disabilities and handicaps (identification and assessment); characterizing engineering concepts in sensory and motor rehabilitation; engineering concept in communication disorders; rehabilitation for locomotion, visual, speech & hearing; artificial limb and hands, prosthetic heart valves; externally powered and controlled orthotics and prosthetics; myoelectric hand and arm prostheses; Marcus intelligent hand prostheses, gait study and spinal rehabilitation.

OBJECTIVE

The goal of this course is to present rehabilitation engineering principles applied to compensate or enhance motor, sensory, and cognitive deficits. The focus of this course lies in the restoration and treatment of the human sensory and vegetative systems.

COUI	COURSE OUTCOMES & GENERIC SKILLS									
No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods			
CO1	Be able to identify human disorders (impairments, disabilities and handicaps)	C1	2	1	-	1,3	T, F			
CO2	Be able to investigate and evaluate human disorders (impairments, disabilities and handicaps)	C5	4	1	-	1,3	T, F			
CO3	Be able to select appropriate method(s) of rehabilitation	C4	5	1	-	1	MID, F			
CO4	Be able to develop suitable assistive technology in providing rehabilitation supports to the disable.	C6	3,7	1,3	-	1,3	T, F			
(CP- 0	Complex Problems, CA-Complex Activities, KI	-Knowledge P	rofile, T	– Test;	PR - 1	Project; Q	– Quiz; ASG –			
Assign	nment; Pr – Presentation; R - Report; F – Final I	Exam)								
C1 - R	Remember C2 - Understand C3 - Apply	C4 - Ana	lyze	C5 -	Evalua	te	C6 - Create			
		1								

COURSE CONTENT

Introduction to Rehabilitation Engineering, Types of physical impairments, Principles of Rehabilitation, Measurement and analysis of human movement, clinical practice of rehabilitation engineering, Motor, Sensor and Communication disorders, Characterizing engineering concepts in sensory and motor rehabilitation, Engineering concept in communication disorders, Rehabs for locomotion, visual, speech & hearing, Spinal rehabilitation, Rehabilitation Robotics, Major Limb Prosthetic Devices, Orthotic Devices, Types of orthotics and prosthetics, Intelligent prosthetic Knee, Prosthetic Hand, Restoration of Hand function, Restoration of standing and walking, Myo-electric Hand, Marcus intelligent hand prostheses.

	~	I. I. C. I				PR	OG	RAN	IOU	TCC	MES	5 (PO)		
No.	Course	Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to i	dentify human disorders		2										
CO1	impairments,	disabilities and handicaps)		3										
CO2	Be able to e	valuate human disorders				3								
(disabilities and handicaps)				5								
CO3	Be able to sele rehabilitation	ct appropriate method(s) of												
		levelop suitable assistive												
		providing rehabilitation			3				2					
	supports to the	disables. I for mapping which indicates												
_	NG LEARNII and Learning A	NG STRATEGY Activities									En	gagen	nent (ho	ours)
-	ice Learning									+		0 0-11	(11)
	ecture												42	
Р	ractical / Tuto	rial / Studio									-			
S	tudent-Centre	d Learning											-	
Self-Direc	ted Learning	-												
Non-face-to-face learning									42					
Revision of the previous and (or) subsequent lecture at home									21					
	-	final examination											21	
Formal As														
	Continuous Ass										2			
	inal Examinat	10n									3			
Total													31	
TEACHI	NG METHO	DOLOGY												
	d discussion,	Co-operative and collaborativ	/e mo	ethod	, Pro	blem	ı bas	ed m	ethc	od				
w	eek		Тор	oic								Ass	essme	nt
<u> </u>		Introduction to Rehabilita	-		ineer	ing				\rightarrow		1 100		•
Lecture 1		Basics of Impairment, Disa		0		0	Intr	oduc	tion	to				
		Rehabilitation Engineering	•	•		1,						CT -	- 1, Fii	nal
Lecture 2		History, Goals and Types of	f Reł	nabili	tatior	n Eng	ginee	ering						
Lecture 3		Assistive Technology and					-	-		on				
Rehabilitation Engineering														
2		Analysis of Human Motion												
Lecture 4		Rigid Body Motion												

Τ

Lecture 5		ea by BME Department
Lecture 5	Forms of Motion, Anatomical Reference Position, Reference Planes, Reference Axes	
Lecture 6	Joint Movements	
3	Sensory & Motor Rehabilitation	
Lecture 7	Basics of Human Senses	
Lecture 8	Sensory Rehabilitation, Neurological Rehabilitation	
Lecture 9	Principles Governing Neuroplasticity, Motor Rehabilitation	
4	Rehabilitation for Communication Disorders – Part I	
Lecture 10	Communication Process	
Lecture 11	Fundamentals of Communication Disorders	
Lecture 12	Autism, Causes, Characteristics, Types and Clinical Practices	
Lecture 12	of Speech Impairments	
5	Rehabilitation for Communication Disorders – Part II	
Lecture 13	Introduction to Language Impairments	
Lecture 14	Causes and Types of Language Impairments, Determining the	
Lecture 14	Presence of Communication Disorders	Midterm, Final
Lecture 15	Augmentative and Alternative Communication (AAC)	,
6	Rehabilitation for Locomotion Disorders	
Lecture 16	Introduction to Locomotion	
Lecture 17	Media for Locomotion – Supports & Problems; Exoskeleton,	
Lecture 17	Endoskeleton	
Lecture 18	Consequences of impaired musculoskeletal system on support	
Lecture 18	& locomotion and their solutions	
7	Rehabilitation for Visual Disorders - Part I	
/ Lecture 19	Introduction to visual disorder	
Lecture 20		
Lecture 21	Causes of visual impairments Goals and Assessment of visual rehabilitation	
Lecture 21	Midterm Break	
8	Rehabilitation for Visual Disorders - Part II	
o Lecture 22		
	Strategies for low vision management	
Lecture 23	Optical devices for visual rehabilitation	
Lecture 24	Non-optical Devices For visual rehabilitation	
9	Rehabilitation for Hearing Disorders – Part I	
Lecture 25	Basics of Hearing Process	CT – 2, Final
Lecture 26	Degree and Type of Hearing Impairments	C 1 = 2 , F mar
Lecture 27	Assessment and Risk Factors of Hearing Impairments	
10	Rehabilitation for Hearing Disorders – Part II	
Lecture 28	Non-Implantable Hearing Devices	
Lecture 29	Implantable Hearing Devices	
Lecture 30	Implantable Hearing Devices	
11	Artificial Limb – Part I	
Lecture 31	Overview of artificial limb	
Lecture 32	Characteristics and consideration of an Ideal Prosthesis	
Lecture 33	Types of orthoses and prostheses	
12	Artificial Limb – Part II	
Lecture 34	Terminal Devices	

Lecture 35	Prosthetic Suspension				
Lecture 36	Amputation & Prosthesis Fitting Procedure	CT – 3, FINAL			
13	Rehabilitation for Heart Valve Disorder				
Lecture 37	Symptoms and causes of Heart Valve disorder				
Lecture 38	Types of heart valves				
Lecture 39	Technical aspects of Heart valves	FINAL			
14	Rehabilitation for Spinal Disorder				
Lecture 40	Spinal Function and Injury				
Lecture 41	Risk Factors and Classification of Spinal Injury				
Lecture 42	Goal and therapies for Spinal Rehabilitation				
ASSESSMENT S	STRATEGY				

~		Grading	СО	Blooms Taxonomy				
Comp	Components							
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO2, CO4	C1, C5, C6				
(40%)	Class Participation	5%	CO3	C4				
	Midterm	15%	CO3	C4				
			CO 1	C1				
Einal	Final Exam 60%		CO 2	C5				
Fillal	Exam	60%	CO 3	C4				
			CO 4	C6				
Total	Marks	100%						
(CO = Course	(CO = Course Outcome, C = Cognitive Domain)							

TEXT BOOKS

1. Robbinson C.J., Rehabilitation Engineering. CRC press 1995

2. Gerald E. Miller, Artificial Organs, Morgan & Claypool Publishers, 2006

REFERENCE BOOKS

1. Bronzino. Joseph, Handbook of biomedical engineering. CRC; 2 Sub editions, 1999

2. BallabioE.etal, Rehabilitation Engineering. IOS press 1993.

REFERENCE SITE

https://classroom.google.com/u/0/c/NDQzMzQ1NDQzNjla

6.1.32 BME 409 Tissue Engineering

COURSE INFORMATION								
Course Code		: BME 409	Lecture Contact Hours	: 3.00				
Course Title		: Tissue Engineering	Credit Hours	: 3.00				
PRE-REQ	PRE-REQUISITE							
	Course	Code : BME 201	Course Code : BME 405					
Course Titile : Human Physiology			Course Titile : Molecu	lar Biology for Engineers				

CURRI	CULUM STRUCTURE						
	Outcome Based Education (OBE)						
SYNOP	SIS/RATIONALE						
	Although lives of thousands of people ar waiting for organ donations. In the last d discipline within reconstructive surgery, parts. Tissue engineering encompasses s material science, engineering, immunolo provides a general understanding of tissu theoretical information necessary to desi	lecade Ti with foc everal di ogy and tr ue growth	ssue engineerin us on in vitro f fferent science ransplantation.	ng has abricat s such The co	emerge ion of as biolourse in	ed as a living, ogy, ch n Tissue	new human spare emistry, e engineering
OBJEC	TIVES						
COUPS	 To able to impart basic knowledge To be able familiarize the students To be able to identify problems and 	with the	fabrication tech	nniques	s used i		
No.	Course outcome	POs	Bloom's Taxonomy	СР	CA	KP	Assessmen t Methods
CO1	Be able to understand the basic concepts of cell culture and critical components of bioreactor and tissue design	PO-1	C1-C2	1		1	T, F
CO2	Be able to explain basic principles of host response and tissue integration	PO-2	C2	3		1	T, Mid term exam
CO3	Be able to understand and judge papers, publications and lectures pertaining to the field of TE and have broad understanding of TE research	PO-1	C1, C2, C5	1		1	ASG, Pr
	(CP-Complex Problems, CA-Complex A Quize; ASG-Assignment; Pr-Presentaion			-	ile, T-	Test; Pl	R-Project; Q-
COURS	E CONTENT						

	Introduction
	Basic principles of Tissue Engineering
	Application of Tissue Engineering
	Challenges and ethical issues in Tissue Engineering
	Basic cells culture
	Cell culture, subculture, proliferation and storage
	Cell adhesion and migration
	3D cell culture
	Stem cell and differentiation
	Adult Stem Cells
	Hematopoetic Stem Cells
	Embryonic Stem Cells and induced pluripotent stem cells
	Extracellular matrix
	Composition of extracellular matrix
	Matrix metalloproteinases (MMPs) and Metalloproteinase (ADAM)
	Decellularization
	Vascularity, angiogenesis and Growth factors
	Principle of cell signalling and types of receptors
	Growth factors delivery and gene therapy
	Vascularity, angiogenesis and wound healing
	Scaffolds in tissue engineering
	Features of scaffold
	Materials for scaffold formation
	Cell-Biomaterial Interactions
	Tissue Engineering and host response
	Transplantation immunology and grafts (organ donation), Regulating factors of Transplantation and grafts, Clinical experience.
	Biofabrication and biomanufacture. In Vivo Synthesis of Tissues and Organs, in Vitro Control of Tissue Development and host response and control measurement in Bone tissue engineering, Cardiac tissue engineering, Neural tissue engineering and in Connective Tissue Engineering. Animal models, Organ-in-chip, Regulation, Commercialization and Ethics.
SKILL MA	PPING (CO-PO MAPPING)

	No.	(P	RO				00		$\frac{D}{S}$ (PC		epartn	
				1	2	3	4	5	6	7	8	9	10	11	12
	CO1	concepts of	Be able to understand the basic concepts of cell culture and critical components of bioreactor and tissue design												
	CO2		xplain basic principles of se and tissue integration		2										
	CO3														
		erical method ching)	l used for mapping which i	ndic	ates	3 as	s hig	;h, 2	as 1	ned	ium	and	1 as	low le	evel
Justification	on for CO-PO mapping														
Mapping	Corre Level match				J	ustif	ficat	tions	5						
CO1-PO1	2		The knowledge of basic r applied to describe the fu												be
CO2-PO2	3		Knowledge of analyzing are instrumental to ensure		-					-			• •	-	
CO3-PO1	3		Knowledge of updated re applications of modern to								ssed	in o	rder 1	to ens	ure
TEACHIN	G LEA	RNIN STRA	TEGY												
Teaching ar	nd Learn	ing Activitie	S										-	gagen urs)	nent
Pra	cture actical/T	ing utorial/Studio ntered Learn												42	
Self-Directe															
		to Face Leari	ning											42	
			s lecture at home											21	
Pre	eparatior	for the final	examination											21	
Formal Ass	essment														
		s assessment											2		
	al Exam	nination												3	
Fin															

Lecture and Di	scussion, Co-operative and collaborative method, Problem based method	
	-	
Week	Content	Assessment
1	Course Introduction	
Lecture 1	Basic Principles of Tissue Engineering	
Lecture 2	Application of Tissue Engineering	
Lecture 3	Challenges and Ethical Issues in Tissue Engineering	
2	Basic cells culture	
Lecture 4	Cell Culture, Subculture, Proliferation and Storage	
Lecture 5	Cell Adhesion and Migration	CT – 1 and
Lecture 6	3D Cell Culture	Midterm, Final
3	Stem cell and differentiation	
Lecture 7	Adult Stem Cells	
Lecture 8	Hematopoetic Stem Cells	
Lecture 9	Embryonic Stem Cells and Induced Pluripotent Stem Cells	
4	Extracellular matrix	
Lecture 10	Composition of Extracellular Matrix	
Lecture 11	Matrix Metalloproteinases (MMPs) and Metalloproteinase (ADAM)	
Lecture 12	Decellularization	
5	Vascularity, angiogenesis and Growth factors	
Lecture 13	Principle of Cell Signaling and Types of Receptors	
Lecture 14	Growth Factors Delivery and Gene Therapy	
Lecture 15	Vascularity, Angiogenesis and Wound Healing	
6	Tissue Engineering and host response	
Lecture 16	Transplantation Immunology and Grafts (Organ Donation)	Midterm, Final
Lecture 17	Regulating Factors of Transplantation and Grafts	
Lecture 18	Clinical Aspects	
7	Issues in Tissue Engineering	
Lecture 19	Animal Models	
Lecture 20	Organ-in-chip	
Lecture 21	Regulation, Commercialization and Ethics	
	MIDTERM	
8	Tissue Engineering Scaffolds & Bioreactors	
Lecture 22	Features of Scaffold	
Lecture 23	Materials for Scaffold Formation	

Lecture 24	Bioreactors for T	issue Engineer	ring						
9	Scaffold Fabrica	tion Techniq	ues		-				
Lecture 25	Fabrication Tech	niques – Fund	amentals		-				
Lecture 26	Rapid Prototypin	g Techniques	(Processes)		-				
Lecture 27	Rapid Prototypin	g Techniques	(Attributes)		-				
10	Scaffold Design	and Cell-Scaf	fold Interactions		-				
Lecture 28	Scaffold Design				CT – 2, FINAL				
Lecture 29	Scaffold Degrada	ition			-				
Lecture 30	Cell-Scaffold Inte	eraction			-				
11	Bone Tissue Eng	gineering			-				
Lecture 31	In Vivo Synthesis	s of Tissues an	nd Organs						
Lecture 32	In Vitro Control	of Tissue Deve	elopment						
Lecture 33	Host Response an	nd Control Me	asurement						
12	Cardiac Tissue	Engineering							
Lecture 34	In Vivo Synthesis	s of Tissues an	nd Organs						
Lecture 35	In Vitro Control	of Tissue Deve	elopment		-				
Lecture 36	Host Response an	nd Control Me	asurement						
13	Neural Tissue E	ngineering							
Lecture 37	In Vivo Synthesis	s of Tissues an	nd Organs						
Lecture 38	In Vitro Control	of Tissue Deve	elopment		CT – 3, FINAL				
Lecture 39	Host response an	d control meas	surement		-				
14	Skin Tissue Eng	ineering							
Lecture 40	In Vivo Synthesis	s of Tissues an	nd Organs						
Lecture 41	In Vitro Control	of Tissue Deve	elopment						
Lecture 42	Host Response an	nd Control Me	asurement		-				
ASSESSMENT S	TRATEGY				1				
			СО	Blo	oms Taxonomy				
Compo	nents	Grading							
	Class Test/		CO1, CO2		C1, C2, C3				
	Assignment 1-3	20%							
assessment (40%)									
	Class participation	5%	CO2		C3				
	Mid Term	15%	CO3		C1, C2, C3				
			CO1		C1, C2				

Final Exam	60%	CO2	C3									
		CO3	C1, C2, C3									
Total Marks	100%											
(CO = Course Outcome, C = Cognitive Domain, P= Psychomotor Domain, A= Affective Domain)												
TEXT BOOKS												
Principles of Tissue Engineering, by Robert Lanza, Robert Langer and Joseph P Vcanti.												
REFERENCE BOOKS												
_	1. Introduction to Tissue Engineering: Applications and Challenges (IEEE Press Series on Biomedical Engineering) 1 st Edition by Ravi Birla											

6.1.33 BME 412 Biomedical Engineering Design Sessional II

COU	KSE INFU	RMATION										
Cours	se Code	: BME 412	Le	cture Contact H	ours	: 3.00)					
Cours	e Title	: Biomedical Engine	-	edit Hours		: 1.50						
		Design Sessional II				. 1.50	,					
PRE-	REQUISIT	`E										
	e Code: BN											
		medical Engineering	Design Session	al I								
		STRUCTURE	0									
Outco	me Based H	Education (OBE)										
SYNC	OPSIS/RAT	TIONALE										
This c	course cove	rs the application of o	design tools to	model prototype	es and d	levelop	the ind	ividual p	roject ideas and			
full co	ompletion of	f an individual projec	t.									
	ECTIVE											
	im of this co	ourse is to enhance stu	ıdent's idea abo	ut project and d	evelop t	heir cap	pabilitie	s of proje	ect management.			
The ai		COMES & GENERI	C SKILLS	ut project and de					Assessment			
The ai	RSE OUT(COMES & GENERI Course Outcome	C SKILLS	Bloom's Taxonomy	PO	heir cap	CA	s of proje KP				
The ai	RSE OUTC	COMES & GENERI	C SKILLS e g problems in	Bloom's Taxonomy					Assessment			
The ai	RSE OUTC Be able biomedica Be able t	COMES & GENERI Course Outcome to identify existing	c skills e g problems in calthcare sector plement novel	Bloom's Taxonomy C3	PO	СР	CA	KP	Assessment Methods			
The air COU No.	RSE OUTO Be able biomedic: Be able t solutions Be able problem	COMES & GENERI Course Outcome to identify existing al research and the he o formulate and im to the identified prob to effectively com and the results of through scientific with	C SKILLS e g problems in calthcare sector plement novel lem municate the the proposed	Bloom's Taxonomy C3 C4	PO 3, 5	CP 1	CA -	КР 1	Assessment Methods T, Q, R T, Q, R,			
The air COUINo.	RSE OUTO Be able biomedica Be able t solutions Be able problem solution presentati	COMES & GENERI Course Outcome to identify existing al research and the he o formulate and im to the identified prob to effectively com and the results of through scientific with	C SKILLS e g problems in ealthcare sector plement novel lem municate the the proposed riting and oral	Bloom's Taxonomy C3 C4 C4 C6	PO 3, 5 2, 5 3	CP 1 1,3	CA - -	KP 1 1, 2 5	Assessment Methods T, Q, R T, Q, R, ASG T, Q, R			

COURSE CONTENT

As the follow-up course to Biomedical Engineering I Design Sessional, this course introduces the students to independent research. In the first few weeks students are teamed into groups and work to define a problem in a certain biomedical area. The problem is then vetted by the instructor(s) who help the students to generate potential solutions to the problem and create a project plan. The students then translate these potential solutions from paper to prototype with a strong emphasis of characterization and validation. Apart from problem identification, problem solving, testing and validation, students undergo rigorous training in effective technical communication (both oral and written).

No.	Course Learning Outcome				PR	OG	RAN	101	JTCC	OMES	5 (PO)		
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to identify existing problems in												
CO1	biomedical research and the healthcare			2		3							
	sector												
CO2	Be able to formulate and implement		2			3							
002	novel solutions to the identified problem		2										
	Be able to effectively communicate the												
CO3	problem and the results of the proposed			3									
005	solution through scientific writing and oral			5									
	presentation												
(Numer	ical method used for mapping which indicate	s 3 as	s higł	n, 2 as	s me	diun	ı, an	d 1 a	ıs lov	v leve	l of m	atchin	g)
TEACH	HING LEARNING STRATEGY												
	g and Learning Activities									En	gagen	nent (h	ours)
Face-to-	-Face Learning												,
	Lecture											7	
	Practical / Tutorial / Studio											35	
	Student-Centered Learning											-	
Self-Di	rected Learning												
	Non-face-to-face learning											-	
	Revision of the previous and (or) subsequen	t lect	ure a	t hon	ne							15	
	Preparation for final examination											10	
Formal	Assessment												
	Continuous Assessment											1	
	Lab Test											1	
	Quiz										().75	
	Viva										().25	
												70	
Total												, 0	

COURSE SC	CHEDULE								
Week		Le	ecture Topics		Assessment				
1	Introduction,	Course overview	v, Evaluation process, Form group						
2	Discussion on	Primarily propo	osed projects and project scope						
3	Discussion on	Selected project	t idea and design consideration						
4	Budget and tir design require		on, Define research gap and project	scope,	Report, Assignment, Presentation, Viva				
5			sting, engineering analysis		,				
6	-	n and simulation							
7		of design with	ational						
	validation test	ing	Midterm Break						
8	Presentation of	n Project update							
9			nd troubleshooting		Report, Assignment,				
10		fication and vali	—		Presentation, Viva				
10		Submission and I	-		Trebentation, Tra				
12	Project Subm		mplete documentation (Drawing	, user					
13	Presentation	t and design mst	ory mey						
13	Project Showe	asina							
	NT STRATEGY	-							
			~~~	-					
Comp	oonents	Grading	CO	В	looms Taxonomy				
Continuous	Report	20%	CO1, CO2, CO3		C4, C5, C3				
Assessment (40%)	Class Participation	20%	CO1, CO2, CO3		C4, C5, C3				
Final Exam	Lab Test	20%	CO1, CO2, CO3		C4, C5, C3				
(60%)	Quiz	30%	CO1, CO2, CO3		C4, C5, C3				
· · · ·	Viva	10%	CO1, CO2, CO3		C4, C5, C3				
	Marks	100%							
(CO = Cours	se Outcome, C =	Cognitive Don	nain, P = Psychomotor Domain, A	A = Affe	ctive Domain)				
TEXT BOO	KS								
1. Robbinson	C.J., Rehabilitat	ion Engineering	. CRC press 1995						
2. Gerald E. N	Miller, Artificial	Organs, Morgan	& Claypool Publishers, 2006						
REFERENC	CE BOOKS								
	-		engineering. CRC; 2 Sub editions,	1999					
<b>A D 11 1 ' D</b>	atal Dahahilitati	n Enginaging	IOS press 1993.						

# 6.1.34 BME 400 Final Year Design and Research Project

COURS	E INFOI	RMATION						
Course C Course T		: BME 400 : Final Year Design and Research Project	Lecture Contact H Credit Hours	ours	: 12.00 : 6.00	)		
PRE-RE	QUISIT	E						
GERM 3	52: Fund	amentals of Research Methodolog	gy (Sessional)					
CURRIC	CULUM	STRUCTURE						
Outcome	Based E	ducation (OBE)						
SYNOPS	SIS/RAT	IONALE						
courses to project. I contributo	o design t is also e in fourt	eering problem. Students will be a a new integrated solution, validate expected to enhance student's leat h industrial revolution.	tion and proper eva	luation of ou	tcomes	at diffe	erent sta	age of th
OBJECT	ΓIVE							
<ol> <li>To ref.</li> <li>To construct on the second seco</li></ol>	each the a ompare t ssess pro erform re evelop st nhance s	propriate solution technique to add ability to evaluate the performance the outcomes with the latest scient fessional, ethical and social impace esearch tasks using proper project udent's leadership ability through tudent's communication skill thro of the environmental and sustainab	e of proposed solution ific development. ets of the designed s management praction teamwork. ugh presentation and	on. olutions. ces. d technical re	-			
LEARN	ING OU	TCOMES & GENERIC SKILL	'S					
No.		Course Outcomes	Correspo nding PO No.	Bloom's Taxonom y	KP	СР	CA	Assess ment Metho ds
CO1	formula	e to <b>identify</b> the research gap tte a research problem relate ical engineering.		C4	3,4	1	1	IR
CO2	product	e to <b>design</b> an appropriate engine /service solution that meets d technical standard and specificat	the PO3	C6	5	1	2	PR, PP
CO3	-	icient in <b>investigating</b> the perform designed engineering product/se		C5, P5	8	3		DR, II

CO4 product/service solution with standard PO3 C6 5 1 2	FR,
	FPr, FD
(1) in the process of project design development $(2)$ $(2)$ $(2)$ $(2)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $(4)$ $($	R, ID, FD
CO6Be capable in understanding the ethical values and professional responsibilities to the society in the different phases of the designed project.PO8A4752FH	R, FPr
CO7Be able to <b>demonstrate</b> the understanding of the project impact on environmental and sustainability.PO7C274PI	R, PPr
CO8Be able to assess societal, health, safety, legal and cultural issue related to the designed project.PO6C574FI	R, FPr
1 (1) A bility to work independently and in a feam P(1) A bility to work independently and in a feam P(1)	FPr, FD
CO10Be able to develop communication skill through technical report writing and presentation.PO10A21FI	R, FPr
	R, PPr R, FPr
CO12Be able to verify the designed problem technological, geographical and cultural adaptation in broader context.PO12A54	FR
	R, PPr R, FPr
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile; IR- Initial Report, Proposal Report Proposal Presentation – PPr, Designed Report – DR, Initial Demonstration – ID, FR-Final Report, FPr Presentation, FD- Final Demonstration	
COURSE CONTENT	
Every student will be required to undertake a suitable Final Year Design and Research Project during Level-4 ( I&II or Spring & Fall Term) in consultation with the Head of the Department and the faculty guide (or Super and submit the project or thesis at the end of Level-4 (Fall Semester) on dates announced by the institute (depart	visor)
CO-PO MAPPING	
No.         Course Outcome         PROGRAM OUTCOMES (PO)	

				1			Cou	rse (	Jjjere	ed by	BME	Depart	ment
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to <b>identify</b> the research gap and formulate a research problem related to biomedical engineering.		3										
CO2	Be able to <b>design</b> an appropriate engineering product/service solution that meets the required technical standard and specifications.			3									
CO3	Be proficient in <b>investigating</b> the performance of the designed engineering product/service prototype.				3								
CO4	Be able to <b>evaluate</b> the designed product/service solution with standard scientific specification and communicate the final outcomes.			3									
CO5	Be able to <b>integrate</b> relevant engineering tools in the process of project design, development and implementation.					3							
CO6	Be capable in <b>understanding</b> the ethical values and professional responsibilities to the society in the different phases of the designed project.								3				
CO7	Be able to <b>demonstrate</b> the understanding of the project impact on environmental and sustainability.											3	
CO8	Be able to <b>assess</b> societal, health, safety, legal and cultural issue related to the designed project.						3						
CO9	Be able to <b>demonstrate</b> leadership skills, ability to work independently and in a team through project development phases.									3			
CO10	Be able to <b>develop</b> communication skill through technical report writing and presentation.										3		
CO11	Be able to <b>conduct</b> financial investment analysis and estimate the project cost.											3	
CO12	Be able to <b>verify</b> the designed problem technological, geographical and cultural adaptation in broader context.												2
CO13	Be <b>competent</b> in understanding of project time, stakeholder and risk management and able to prepare detail project work breakdown structure (WBS).											3	

EACHING LE	ARNING STRA	TEGY			
Feaching and Learning Activities					Engagement (hours)
ace-to-Face Le	arning				
Practical / Tutorial / Studio					56
elf-Directed Le	earning				
Project Supervi	-	kground Resear	ch Work under the supervis	sion of	84
Project work/Simulation practice at Lab					84
Preparation of report and presentation and demonstration					40
ormal Assessm	ent				
Demonstration					3
Presentation				3	
Total				270	
EACHING MI	ETHODOLOGY				
ecture and Disc	ussion, Co-operati	ive and Collabora	ntive Method, Problem Based M	lethod	
ecture and Disc		ive and Collabora	ntive Method, Problem Based M	lethod	
		ive and Collabora	ntive Method, Problem Based M	lethod	
SSESSMENT	STRATEGY		ative Method, Problem Based M		ooms Taxonomy
SSESSMENT	STRATEGY onents	Grading			ooms Taxonomy
SSESSMENT	STRATEGY				ooms Taxonomy C4
SSESSMENT	STRATEGY onents Initial Report (IR) Proposal	Grading	СО		
SSESSMENT	STRATEGY Onents Initial Report (IR) Proposal Report (PR)	Grading 10%	<b>CO</b> CO 1		C4
SSESSMENT	STRATEGY onents Initial Report (IR) Proposal	Grading	CO 1 CO 2		C4 C4
SSESSMENT Comp	STRATEGY onents Initial Report (IR) Proposal Report (PR) and Proposal Presentation (PPr)	Grading 10%	CO 1 CO 1 CO 2 CO 7 CO 13 CO 11		C4 C4 C2
SSESSMENT Comp	STRATEGY Initial Report (IR) Proposal Report (PR) and Proposal Presentation (PPr) Designed	Grading 10% 30%	CO 1 CO 1 CO 2 CO 7 CO 13		C4 C4 C2 C3, P4, A3
SSESSMENT Comp	STRATEGY onents Initial Report (IR) Proposal Report (PR) and Proposal Presentation (PPr)	Grading 10%	CO 1 CO 1 CO 2 CO 7 CO 13 CO 11		C4 C2 C3, P4, A3 C2, P2, A3
SSESSMENT Comp	STRATEGY STRATEGY Initial Report (IR) Proposal Report (PR) and Proposal Presentation (PPr) Designed Report – (DR) Initial	Grading 10% 30%	CO 1 CO 1 CO 2 CO 7 CO 13 CO 11 CO 3		C4 C2 C3, P4, A3 C2, P2, A3 C5, P5
SSESSMENT Comp	STRATEGY Initial Report (IR) Proposal Report (PR) and Proposal Presentation (PPr) Designed Report – (DR)	Grading 10% 30%	CO 1 CO 1 CO 2 CO 7 CO 13 CO 11 CO 3 CO 5		C4 C2 C3, P4, A3 C2, P2, A3 C5, P5 P4, A4
		Co	ourse Offered by BME Department		
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		CO 6	A4		
		CO 8	C5		
		CO 9	A5		
		CO 10	A2		
		CO 11	C2, P2, A3		
		CO 12	A5		
		CO 13	C3, P4, A3		
Final demonstration	1.50 /	CO 5	P4, A4		
Final demonstration	15%	CO 6	A4		
Total Marks	100%				
(CO = Course Outcome	, C = Cognitive	Domain, P = Psychomotor Do	omain, A = Affective Domain)		
REFERENCE BOOKS					
Books as per the guideline of Fac	culty Guide or S	upervisor.			

# 6.2 <u>Elective Course Offered</u>

# 6.2.1 Group-I (Instrumentation)

# 6.2.1.1 BME 411 Physiological Control System

C		RMATION				1				
	e Code	: BME 411		ture Contact H	ours	: 3.00	)			
Cours	e Title	: Physiological Control Systems	Cred	lit Hours		: 3.00	)			
PRE-	REQUISIT	Έ								
BME	201:Human	physiology								
CURI	RICULUM	STRUCTURE								
Outco	me Based F	ducation (OBE)								
SYNC	DPSIS/RAT	IONALE								
needs behavi systen	a deep con ior and its n to provide	es. Modeling a system reg cept about control system. control, this subject merge the students a sufficient kn	Since bio s the conc	medical devic ept of enginee	es are f ring co	fully control s	oncerno ystem	ed with and phy	our ysiol	physiologic ogical contro
OBJE	CTIVE									
		lerstand the key strategies t						• 1		
3. Be 4. Be	e able to dev e able to app	derstand the key strategies t velop an understanding for o bly linear control theory to n COMES & GENERIC SK	control sys	tem theory as a	applied	to hum		rsiology	•	
3. Be 4. Be	e able to dev e able to app	velop an understanding for only linear control theory to n	control sys	tem theory as a	applied	to hum		rsiology KP		Assessmer Methods
3. Be 4. Be COUI No.	e able to dev e able to app RSE OUTC Be able to	velop an understanding for only linear control theory to a <b>COMES &amp; GENERIC SK</b>	control sys model and ILLS d laws to	tem theory as a analyze biolog Bloom's	applied fical sys	to hum stems.	an phy			
3. Be 4. Be COUI No. CO1	e able to dev e able to app RSE OUTC Be able to analyze a Be able to	velop an understanding for on oly linear control theory to a <b>COMES &amp; GENERIC SK</b> Course Outcome <b>apply</b> various concepts an	control sys model and ILLS d laws to s. egies that	tem theory as a analyze biolog Bloom's Taxonomy	applied ical sys	to hum stems.	an phy CA	KP		Methods
3. Be 4. Be COUI No. CO1 CO2	e able to dev e able to app RSE OUTC Be able to analyze a Be able to the body to Be able	velop an understanding for on oly linear control theory to a <b>COMES &amp; GENERIC SKI</b> Course Outcome <b>Course Outcome</b> <b>Course Ou</b>	control sys model and ILLS d laws to s. egies that ding of	tem theory as a analyze biolog Bloom's Taxonomy C3	applied cical system PO 2	to hum stems. CP 1	CA	KP 1,3		Methods T, F
3. Ве 4. Ве СОШ	e able to dev e able to app RSE OUTC Be able to analyze a Be able to the body to Be able control sy physiolog Be able to	velop an understanding for on oly linear control theory to a <b>COMES &amp; GENERIC SKI</b> Course Outcome <b>Course Outcome</b> <b>Course Ou</b>	control sys model and ILLS d laws to s. egies that ding of o human	tem theory as a analyze biolog Bloom's Taxonomy C3 C2	applied cical system PO 2 1	to hum stems. CP 1 1	CA - -	KP 1,3 1	,	Methods T, F T, F
3. Be 4. Be COUI No. CO1 CO2 CO3 CO4 (CP- C	e able to dev e able to app RSE OUTO Be able to analyze a Be able to the body to Be able control sy physiolog Be able to and <b>analy</b> Complex Pr	relop an understanding for on only linear control theory to a <b>COMES &amp; GENERIC SKI</b> Course Outcome <b>apply</b> various concepts an variety of dynamic systems of understand the key strated uses to regulate its function. to develop an understant system theory as applied to y. <b>apply</b> linear control theory ze biological systems. oblems, CA-Complex Activ	d laws to d l	tem theory as a analyze biolog Bloom's Taxonomy C3 C2 C2 C2 C2 C3, C4 Knowledge Pro	PO 2 1 2,3	to hum stems. CP 1 1 1 1,3	CA - - -	KP 1,3 1 1,3		Methods T, F T, F MID, F T, F
3. Be 4. Be COUI No. CO1 CO2 CO3 CO4 (CP- C	e able to dev e able to app RSE OUTO Be able to analyze a Be able to the body to Be able control sy physiolog Be able to and <b>analy</b> Complex Pr	velop an understanding for on obly linear control theory to a <b>COMES &amp; GENERIC SKI</b> Course Outcome <b>apply</b> various concepts an variety of dynamic systems of understand the key strate uses to regulate its function. to develop an understant ystem theory as applied to y. <b>apply</b> linear control theory ze biological systems.	d laws to d l	tem theory as a analyze biolog Bloom's Taxonomy C3 C2 C2 C2 C2 C3, C4 Knowledge Pro	PO 2 1 2,3	to hum stems. CP 1 1 1 1,3	CA - - -	KP 1,3 1 1,3		Methods T, F T, F MID, F T, F

### **COURSE CONTENT**

**Introduction to physiological modelling:** what is a model and why model, multi-scale organization of living organisms: cell to organ Homeostasis. Examples of physiological control systems

**Tools for modelling physical systems:** Review of linear systems, Laplace transform, Fourier series and Fourier transform, and system response in the time and frequency domains, transfer function, open-loop control, feedback control, and stability of systems, steady-state and transient analysis, design of PID controllers.

**Physiology of cardiovascular systems:** Key events in the cardiac cycle, blood pressure and flow, vascular impedance, lumped parameter models, Windkessel model of circulation, cardiac mechanics.

**Physiology of Endocrine system:** Enzymes and hormones, Michaelis-Menten enzyme kinetics, examples of endocrine control: glucose-insulin system, thyroid hormone system,

**Physiology of Nervous System:** Anatomy and physiology of nerves, action potentials, Hodgkin-Huxley model, **Physiology of Respiratory System:** Respiratory mechanics, lung models.

**Physiology of Musculoskeletal System:** Muscle anatomy and physiology. How muscles contract. Hill model of muscle contraction, Muscle stretch reflex.

**Modeling complex physiological systems:** Regulation of cardiac output: Starling's law, pressure-volume curves, coupled model of cardiopulmonary system, Blood pressure regulation: Baroreceptor reflex, kidney for blood pressure regulation, Blood glucose regulation: insulin control of glucose, glucose utilization in muscle.

No.	Course Learning Outcome				PR	OG	RAN	1 O L	JTCC	OMES	5 (PO)	)	
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to <b>apply</b> various concepts and laws to analyze a variety of dynamic systems.		3										
CO2	Be able to <b>understand</b> the key strategies that the body uses to regulate its function.	3											
CO3	Be able to develop an <b>understanding</b> for control system theory as applied to human physiology.	3											
CO4	Be able to <b>apply</b> linear control theory to model and <b>analyze</b> biological systems.		3	3									
(Nume	rical method used for mapping which indicate	s 3 as	s higł	n, 2 a	s me	diun	i, an	d 1 a	as low	v leve	l of n	natching	g)
TFAC	HING LEARNING STRATEGY												
_	ng and Learning Activities									En	gagen	nent (ho	ours)
Face-to	-Face Learning												
	Lecture											42	
Practical / Tutorial / Studio								-					
Student-Centred Learning									-				
Self-Di	rected Learning												
	Non-face-to-face learning											42	
	Revision of the previous and (or) subsequen	t lect	ure a	t hon	ne					21			
	Preparation for final examination									21			

Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

# TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

## **COURSE SCHEDULE**

Week	Торіс	Assessment
1	Introduction to physiological modeling	
Lecture 1	Course Introduction. What is a model and why model?	
Lecture 2	Multi-scale organization of living organisms: Cell to organ Homeostasis	
Lecture 3	Examples of physical control systems and physiological control systems. Difference between Physical and Physiological Control System	CT – 1, Final
2	Tools for modeling physical systems	
Lecture 4	Review of linear systems	
Lecture 5	Fourier series analysis	
Lecture 6	Fourier transform analysis	
3	Tools for modeling physical systems	
Lecture 7	Mathematical explanation of Laplace transform	
Lecture 8	System response in the time Domain and frequency domains	
Lecture 9	Open loop control and feedback control System	
4	Transfer function analysis	
Lecture 10	Ordinary differential equation solving by Laplace transform and inverse Laplace transformation	
Lecture 11	Transfer function calculation of electrical system	
Lecture 12	Mechanical to electrical analogous circuit analysis	
5	Transfer function analysis	
Lecture 13	Electrical to mechanical analogous circuit analysis	
Lecture 14	Mechanical Translational Circuit	
Lecture 15	Development of a practical application of transfer function based on some physiological control system	Midterm, Final
6	Control system stability analysis	
Lecture 16	Stability of systems	
Lecture 17	Steady-state analysis	
Lecture 18	System's transient state analysis	
7	Control system stability analysis	
Lecture 19	Design of a Proportional and Integral Controller	

Lecture 20	Desig	n of a Differenti	al controller	
Lecture 21	Desig	gn of a PID contr	oller with physiological example	es
	I		Midterm	
8	Phys	iology of cardio	vascular systems	
Lecture 22	Basic	anatomy of Hea		
	Key	events in the card	liac cycle	
Lecture 23	Blood	d pressure and flo	ЭW	
Lecture 24	Vasci	ular impedances	in heart	
9	Phys	iology of cardio	vascular systems	
Lecture 25	Lum	bed parameter mo	odels	CT – 2, Final
Lecture 26				
Lecture 27				
10				
Lecture 28				
Lecture 29				
Lecture 30				
11	Phys	iology of Nervou	us and Respiratory system	
Lecture 31				
Lecture 32				
Lecture 33	Respi	ratory mechanic	s and lung models	
12	Phys	iology of Muscu	loskeletal System:	
Lecture 34	Musc	le anatomy and p	physiology	
Lecture 35	How	muscles contract	t	
Lecture 36	Hill r	nodel of muscle	contraction	CT – 3, FINAL
	Musc	le stretch reflex.		
13	Mod	eling complex pl	hysiological systems	
Lecture 37	Starli	ng's law of Card	liac output Regulation	
	Press	ure volume curve	es	
Lecture 38	coupl	ed model of card	liopulmonary system	
Lecture 39	Blood	l pressure regula	tion and Baroreceptor reflex	FINAL
14	Mod	eling complex pl	hysiological systems	
Lecture 40	Kidno	ey for blood pres	sure regulation,	
Lecture 41				
Lecture 42	Gluce	ose utilization me	echanism in muscle	
ASSESSMEN	T STRATEGY			
			СО	Blooms Taxonomy
Comp	onents	Grading		DIOOIIIS TAXOIIOIIIY
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO3	C2, C3

			Č,	
	Class Participation	5%	CO3	C3
	Midterm	15%	CO2	C4
			CO 1	C2
Einal	Europe	60%	CO 2	C2
r inai	Final Exam		CO 3	C3
			CO 4	C3, C4
Total	Marks	100%		
(CO = Course	e Outcome, C = O	Cognitive Doma	in, P= Psychomotor domain, A	= Affective Domain)
TEXT BOOK	KS			
		•	ems: Analysis, Simulation, and s, ISBN 0-7803-3408-6.	1 Estimation, IEEE Engineering in
REFERENC	E BOOKS			
2. R.C. Dorf	and R.H. Bishop,	Modern Control	Systems, 12th Edition, Prentice	Hall.
REFERENC	E SITE			

# 6.2.1.2 BME 413 Virtual Bioinstrumentation

COURS	SE INFO	RMATION							
						: 3.00	)		
Course	Code	: BME 413	Lecture	e Contact H	ours	: 3.00	)		
Course	Title	: Virtual Bioinstrumentation	Credit	Hours					
PRE-R	EQUISIT	Γ <b>Ε</b>	•						
BME 20	07: Biome	edical Instrumentation and Measured	urements						
CURRI	ICULUM	STRUCTURE							
Outcom	ne Based I	Education (OBE)							
SYNOF	PSIS/RA7	FIONALE							
To impa	art adequa	te knowledge on Virtual Instrum	nentation	for acquisi	ition and	d analy	sis of s	signals in m	edical system,
to educa	ate about	the basic concepts of VI, progra	amming	concepts of	f VI, en	able th	em to	implement	VI in medical
systems	and desig	gn Virtual Biomedical Instrumen	nts.						
OBJEC	CTIVE								
1. Be	able to	understand the concept of v	virtual in	nstruments,	its im	portan	ce and	applicatio	ons of virtual
inst	rumentati	on.							
2. Be a	able to <b>lea</b>	rn about data acquisition concep	pt, hardw	are and sof	tware.				
3. Be a	able to <b>de</b>	sign and test virtual biomedical	instrume	nts.					
4. Be a	able to <b>de</b>	velop virtual biomedical instrum	nents.						
COURS	SE OUTO	COMES & GENERIC SKILLS	5						
No.		Course Outcome		Bloom's	РО	СР	CA	KP	Assessment
110.		Course Outcome	Т	axonomy	ΓU	Cr	CA	КГ	Methods

CO1	Be able to <b>understa</b> instruments, its impo- virtual instrumentation	rtance and ap	•	C2	1	1	-	1	T, F	
CO2	concepts, hardware and software.			C2	1	1	-	1	T, F	
CO3	CO3 Be able to <b>design</b> and <b>test</b> virtual biomedical instruments.			C4,C5	2	1	-	1,3	MID, F	
CO4	Be able to <b>deve</b> instruments.	lop virtual	biomedical	C6	2,3	1,3	-	1,3	T, F	
(CP- 0	Complex Problems, CA	-Complex A	ctivities, KP-	Knowledge Provide Received Free Section 1997	ofile, T	- Test;	PR –	Project; Q	– Quiz; ASG –	
Assign	Assignment; Pr – Presentation; R - Report; F – Final Exam)									
C1 - R	C1 - Remember C2 - Understand C3 - Appl				C4 - Analyze		Evalua	te C	C6 - Create	

### **COURSE CONTENT**

**INTRODUCTION TO VIRTUAL INSTRUMENTATION (VI):** Review of Virtual Instrumentation, Historical perspective, Need of VI, Advantages of VI, Define VI, block diagram & architecture of VI, data flow techniques, graphical programming in data flow, comparison with conventional programming.

**VI PROGRAMMING Techniques:** Programming Techniques, VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input.

HARDWARE ASPECTS OF VI SYSTEM: Data Acquisition basics: , Analog input: sampling rate, multiplexing, resolution, relative accuracy, noise, Analog output, Triggers, Real-Time system integration, Digital I/O. Timing I/O, ADC, DAC; PC-Based DAQ System: PC, transducers and signal conditioners, DAQ Hardware, , DIO, Counters & timers, Multichannel analog DAQ system, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation.

**COMMON INSTRUMENT INTERFACE:** Common Instrument Interfaces for Current loop, RS 232C/Rs 485, GPIB, System basics, interface basics: USB, PCMCIA, VXI, SCXI, PXI etc, networking basics for office & industrial application, VISA and IVI.

**VI ANALYSIS TOOLS:** Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, Windowing and filtering.

**APPLICATIONS of VI:** Application of VI in process control designing of equipment like oscilloscope, Digital multimeter, Design of digital Voltmeters with transducer input Virtual Laboratory, Web based Laboratory, Image acquisition & processing, Motion Control, VI based temperature monitor, VI based cardiac monitor, Multi-channel data acquisition using LABVIEW, ECG acquisition for long term monitoring of heart rate using VI, ECG signal processing and its importance using wavelet transform. Bio-Informatics and NI LabVIEW technology in drug discovery process. Testing of Medical Instruments.

No.	Course Learning Outcome				PR	OG	RAM	1 O U	JTCC	OMES	5 (PO)			
NO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	Be able to <b>understand</b> the concept of virtual instruments, its importance and applications of virtual instrumentation	3												
CO2	Be able to <b>learn</b> about data acquisition concept, hardware and software.	3												
CO3	Be able to <b>design</b> and <b>test</b> virtual biomedical instruments.		3											
CO4	Be able to <b>develop</b> virtual biomedical instruments.		3	3										
(Numer	ical method used for mapping which indicate	s 3 as	s high	n, 2 as	s me	dıun	ı, an	dla	is lov	v leve	l of m	latchin	g)	
	HING LEARNING STRATEGY													
	g and Learning Activities									En	gagen	nent (h	ours)	
Face-to-	-Face Learning											10		
										42				
	Practical / Tutorial / Studio Student-Centred Learning									-				
Salf Di	rected Learning											-		
Sell-Di	Non-face-to-face learning											42		
	Revision of the previous and (or) subsequen	it lect	ure a	t hon	ie.					42				
	Preparation for final examination		uie u	. 11011								21		
Formal	Assessment													
	Continuous Assessment											2		
Final Examination										3				
Total								131						
TEAC	HING METHODOLOGY													
Lecture	and discussion, Co-operative and collaborati	ve m	ethod	, Pro	blem	ı bas	ed n	netho	od					
	SE SCHEDULE			,										

Week	Торіс	Assessment
1	INTRODUCTION TO VIRTUAL INSTRUMENTATION (VI)	
Lecture 1	Review of Virtual Instrumentation, Historical perspective, Need of	
	VI, Advantages of VI, Define VI	
Lecture 2	Block diagram & architecture of VI	
Lecture 3	Data flow techniques, graphical programming in data flow,	CT – 1, Final
	comparison with conventional programming.	
2	HARDWARE ASPECTS OF VI SYSTEM	
Lecture 4	Data Acquisition (DAQ) basics	
Lecture 5		
Lecture 6	Analog to Digital Converter (ADC)	
3	HARDWARE ASPECTS OF VI SYSTEM	
Lecture 7	Analog to Digital Converter (ADC)	
Lecture 8	Digital to Analog Converter (DAC)	
Lecture 9		
4	HARDWARE ASPECTS OF VI SYSTEM	
Lecture 10	PC-Based DAQ System: PC, transducers and signal conditioners,	
Lecture 11	DAQ	
	Hardware	
Lecture 12	Multichannel analog DAQ system	
5	HARDWARE ASPECTS OF VI SYSTEM	
Lecture 13	DIO, DMA for DAQ	
Lecture 14	Counters, timers, interrupts for DAQ	
Lecture 15	PC Hardware structure, Software and Hardware Set up for VI.	Midterm, Final
6	COMMON INSTRUMENT INTERFACE	
Lecture 16	Common Instrument Interfaces for Current loop, RS 232C/Rs 485,	
Lecture 17	GPIB, System basics	
Lecture 18	Interface basics: USB, PCMCIA	
7	COMMON INSTRUMENT INTERFACE	
Lecture 19	Interface basics: VXI, SCXI, PXI etc	
Lecture 20	networking basics for office & industrial application,	
Lecture 21	VISA and IVI.	
	Midterm	
8	VI PROGRAMMING Techniques	
Lecture 22	Programming Techniques, VIS & Sub VIS	
Lecture 23	Loops & charts, string & file input.	
Lecture 24	arrays, clusters	
9	VI PROGRAMMING Techniques	
Lecture 25	Graphs, waveforms	
Lecture 26	case & sequence structures	CT – 2, Final
Lecture 27	formula modes, local and global variable	
10	VI ANALYSIS TOOLS	
Lecture 28	Use of Analysis tools: Fourier transforms, power spectrum,	
LUIUIE 20	correlation methods, Windowing and filtering.	
	Use of Analysis tools: power spectrum, correlation methods	

		by BME Depuriment
Lecture 30	Use of Analysis tools: Windowing and filtering.	
11	APPLICATIONS of VI	
Lecture 31	Application of VI in process control designing of equipments like	
	oscilloscope, Digital multimeter	
Lecture 32	Design of digital Voltmeters with transducer input Virtual Laboratory	
Lecture 33	Web based Laboratory	
12	APPLICATIONS of VI	CT – 3, FINAL
Lecture 34	Image acquisition & processing	
Lecture 35	Motion Control	
Lecture 36	VI based temperature monitor	
13	APPLICATIONS of VI	
Lecture 37	VI based cardiac monitor	
Lecture 38	Multi-channel data acquisition using LABVIEW	
Lecture 39	ECG acquisition for long term monitoring of heart rate using VI	
14	APPLICATIONS of VI	
Lecture 40	ECG signal processing and its importance using wavelet transform.	FINAL
Lecture 41	Bio-Informatics and NI labVIEW technology in drug discovery	
	process.	
Lecture 42	Testing of Medical Instruments.	

# ASSESSMENT STRATEGY

Comr	oonents	Grading	СО	Blooms Taxonomy
Com		Oradilig		
	Class Test/			
C I	Assignment	20%	CO1, CO3	C2, C4,C5
Continuous Assessment	1-3			
	(40%) Class Participation 5%		CO3	C4,C5
(40%)			003	04,03
	Midterm	15%	CO2	C2
			CO 1	C2
Final	Exam	60%	CO 2	C2
rinai	Exam	0070	CO 3	C4,C5
			CO 4	C6
Total	Marks	100%		

### (CO = Course Outcome, C = Cognitive Domain, P= Psychomotor domain, A= Affective Domain)

### **TEXT BOOKS**

1. Olansen Jon B. and Rosow Eric, "Virtual Bio-Instrumentation Biomedical, Clinical, and Healthcare Applications in LabVIEW", National instrument Virtual instrument series

2. Gary Jonson, "Labview Graphical Programming", Second Edition, McGraw Hill, New York, Fourth edition 2006 **REFERENCE BOOKS** 

- 3. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newness, 2000.
- 4. R. S. Khandpur "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.

**REFERENCE SITE** 

# 6.2.1.3 BME 415 Biophotonics

	RSE INFOR				: 3.00	)		
	e Code e Title	: BME 415	Lecture Contact Iours Credit Hours		: 3.00			
PRE-	REQUISITI	E						
CURI	RICULUM	STRUCTURE						
Outco	me Based Ec	ducation (OBE)						
SYNC	OPSIS/RAT	IONALE						
applic	ations in diff	igned for delivering the knowledg ferent fields of biomedical engineer	-	ical pro	operties	of pho	otobiology	and their wid
	ECTIVE							
2. To bi	o connect the omedical eng	fundamental principles of biophoto e students learning about the wide gineering. OMES & GENERIC SKILLS		differe	nt optic	cal devi	ices in diff	ferent fields o
No.		Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessmer Methods
CO1	knowledge	to <b>understand</b> the fundamenta about the photobiology	C2	1	1	-	1,3	T, MID
		familiarize with different optica	1 C2	1	1,3	-	1,3	
CO2	devices in	biomedical engineering domain	0.2	1	1,0			MID, F
	Be able to	biomedical engineering domain learn about the working principles t optical devices		1	1,2	-	1,2	MID, F MID, F
CO3	Be able to of differen Be able	learn about the working principles	s C2			-	1,2	
CO3 CO4 (CP- 0	Be able to of differen Be able biophotoni Complex Pro	<b>learn</b> about the working principles t optical devices to <b>apply</b> the knowledge of cs in different medical applications blems, CA-Complex Activities, Kl	S C2 f C3 P-Knowledge Pro-	1	1,2	-	1,2	MID, F T, F
Assig	Be able to of differen Be able biophotoni Complex Pro	<b>learn</b> about the working principles t optical devices to <b>apply</b> the knowledge of cs in different medical applications	s C2 f C3 P-Knowledge Pro Exam)	1 1 ofile, T	1,2 1,3 – Test;	-	1,2 Project; Q -	MID, F T, F

Introduction to Biophotonics: Photonics in medical applications, properties of light and matter, light-matter interactions, interaction of light with cells, interaction of light with tissues; Laser Technology: Principles of Lasers, Laser-tissue Interaction, Lasers for biophotonics, laser safety; Optical Fiber and Light: Optical fiber construction, principles of light propagation in optical fiber, losses and dispersion in fiber optics. Instrumentation in Photonics: Instrumentation for absorption, Scattering, and Emission, high pressure arc lamp, LEDs, Optical detectors; Photonics

in Bioimaging: An overview of optical imaging, Simple and compound microscope, Fluorescence Microscopy, Fluorescence Resonance Energy Transfer (FRET) Imaging, Fluorescence Lifetime Imaging Microscopy (FLIM), Raman Scattering Microscopy.

**Medical application of lasers:** Thermal interaction between laser and Tissue, Application of Lasers in therapy and diagnosis, Surgical Applications of Lasers, Lasers in Dentistry and urology, Laser Tissue Contouring and Restructuring, Tissue welding, Laser Tissue Regeneration, Laser Tweezers and Laser Scissors; **Endoscopy:** Angioscope, Videoscopy, Fluorescence endoscopy, Endoscopic therapy; **Optical Biosensors:** Principles of Optical Biosensing, Optical Transduction, Fluorescence Sensing, Fiber-Optic Biosensors, Evanescent Wave Biosensors, Surface Plasmon Resonance Biosensors; **Microarray Technology:** DNA Microarray Technology, cell and tissue microarray technology, **Light-Activated Therapy:** Basic mechanism of Photodynamic Therapy, Applications of Photodynamic Therapy, Two-Photon Photodynamic Therapy.

No.	Course Learning Outcome PROGRAM OUTC					JTCC	OMES	5 (PO)					
INO.		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to <b>understand</b> the fundamental knowledge about the photobiology 2												
CO2	Be <b>familiarized</b> with different optical devices in biomedical engineering domain 3												
CO3	Be able to learn about the working principles of different optical devices 3												
CO4	Be able to <b>apply</b> the knowledge of biophotonics in different medical 2 applications												
Numeri	cal method used for mapping which indicates	3 as	high,	2 as	med	lium	, and	l 1 as	s low	level	of ma	atching	)
TEACH	HING LEARNING STRATEGY												
	g and Learning Activities									En	gagen	nent (ho	ours)
Face-to-	Face Learning												
	Lecture											42	
Practical / Tutorial / Studio							-						
Student-Centred Learning								-					
Self-Dir	ected Learning												
Non-face-to-face learning								42					
Revision of the previous and (or) subsequent lecture at home								21					
Preparation for final examination								21					
Formal	Assessment												
Continuous Assessment								2					
Final Examination									3				
Total												131	
TEACH	HING METHODOLOGY												
Lecture	and discussion, Co-operative and collaborati	ve m	ethod	, Pro	blem	ı bas	ed n	netho	od				
COUR	SE SCHEDULE												

Week	Торіс	Assessment
1	Introduction to Biophotonics	
Lecture 1	Photonics in medical applications, properties of light and matter	
Lecture 2	light-matter interactions	
Lecture 3	Interaction of light with cells, interaction of light with tissues	
2	Laser Physics	
Lecture 4	Principles of Lasers, ,	CT – 1, Final
Lecture 5	Laser-tissue Interaction	
Lecture 6	Lasers for biophotonics, laser safety	
3	Optical Fiber and Light	
Lecture 7	Optical fiber construction,	
Lecture 8	Principles of light propagation in optical fiber	
Lecture 9	Losses and dispersion in fiber optics	
4	Instrumentation in Photonics	
Lecture 10	Instrumentation for absorption	
Lecture 11	Instrumentation for Scattering	
Lecture 12	Instrumentation for Emission	
5	Instrumentation in Photonics	
Lecture 13	high pressure arc lamp	
Lecture 14	LED- Ortical detectors	
Lecture 15	LEDs, Optical detectors	
6	Photonics in Bioimaging	Midterm, Final
Lecture 16	An overview of optical imaging	
Lecture 17	Simple and compound microscope	
Lecture 18	Fluorescence Microscopy	
7	Photonics in Bioimaging	
Lecture 19	Fluorescence Resonance Energy Transfer (FRET) Imaging	
Lecture 20	Fluorescence Lifetime Imaging Microscopy (FLIM)	
Lecture 21	Raman Scattering Microscopy	
	Midterm Break	
8	Medical application of lasers	
Lecture 22	Thermal interaction between laser and Tissue	
Lecture 23	Application of Lasers in therapy	
Lecture 24	Application of Lasers in diagnosis	
9	Medical application of lasers	
Lecture 25	Surgical Applications of Lasers	
Lecture 26	Lasers in Dentistry and urology	CT – 2, Final
Lecture 27	Laser Tissue Contouring and Restructuring	
10	Medical application of lasers	
Lecture 28	Tissue welding, Laser Tissue Regeneration	
Lecture 29	Laser Tweezers	
Lecture 30	Laser Scissors	
11	Endoscopy	
Lecture 31	Angioscope, Videoscopy	
Lecture 32	Fluorescence endoscopy	

Lecture 33	Endoscopic therapy	
12	Optical Biosensors	CT – 3, FINAL
Lecture 34	Principles of Optical Biosensing, Optical Transduction	
Lecture 35	Fluorescence Sensing, Fiber-Optic Biosensors	
Lecture 36	Evanescent Wave Biosensors, Surface Plasmon Resonance	
	Biosensors	
13	Microarray Technology	
Lecture 37	DNA Microarray Technology	
Lecture 38	Cell and tissue microarray technology	
Lecture 39	Cen and fissue increanay technology	FINAL
14	Light-Activated Therapy	FINAL
Lecture 40	Basic mechanism of Photodynamic Therapy	
Lecture 41	Applications of Photodynamic Therapy	
Lecture 42	Two-Photon Photodynamic Therapy	
ACCECCMENT	STDATECV	

# ASSESSMENT STRATEGY

			СО	Blooms Taxonomy
Comp	oonents	Grading	CO	Bioonis Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO2	C1, C2
(40%) Class Participation		5%	CO3	C2
	Midterm	15%	CO2	C1
E:1		(00/	CO 1	C2
Final	Exam	60%	CO 2	C2
Total	Marks	100%		

(CO = Course Outcome, C = Cognitive Domain)

# **TEXT BOOKS**

1. Introduction to Biophotonics", Paras N. Prasad , A. John Wiley and Sons, Inc. Publications, 2003.

2. Laser-Tissue Interaction Fundamentals and Applications, Markolf H.Niemz, Springer, 2007

# **REFERENCE BOOKS**

3. Lasers and Optical Fibers in Medicine, Abraham Katzir, Academic Press Inc.

**REFERENCE SITE** 

# 6.2.1.4 BME 417 Equipment in Radiology and Radiotherapy

CURRICULU         Outcome Base         SYNOPSIS/R         The course is         Radiotherapy         OBJECTIVE         1.       Be able to         2.       Be able to         3.       Be able to         3.       Be able to         4.       Be able to         COURSE OU         No.       Be all         CO1       Be able         Radiat       CO2         Be able       Be able	ves and Oscillations, Optics and M <b>M STRUCTURE</b> d Education (OBE) <b>ATIONALE</b> designed to give the basic conce equipment. understand the basics of Radiation understand the principles of Radia learn the principles of Radiotheraj analyze the Quality Assurance tec	epts of Radia n physics ntion measur py equipmen hniques of R	urs ics ation phy ing instru	ysics, Ra uments	: 3.00 : 3.00	)	urement in	nstruments and
PRE-REQUIA         PHY 125: Wa         CURRICULU         Outcome Base         SYNOPSIS/R         The course is         Radiotherapy         OBJECTIVE         1. Be able to         2. Be able to         3. Be able to         4. Be able to         COURSE OU         No.         CO1       Be all         Radiat         CO2       Be all         Radiat         CO3       Be all	and Radiotherapy SITE ves and Oscillations, Optics and M IM STRUCTURE d Education (OBE) ATIONALE designed to give the basic conce equipment. understand the basics of Radiation understand the principles of Radiation analyze the Quality Assurance tec	Iodern Physi ppts of Radia n physics ation measur py equipmen hniques of R	ics ation phy ing instru	uments			urement in	nstruments and
PHY 125: Wa         CURRICULU         Outcome Base         SYNOPSIS/R         The course is         Radiotherapy         OBJECTIVE         1. Be able to         2. Be able to         3. Be able to         3. Be able to         COURSE OU         No.         CO1       Be al         Radiat         CO2       Be ab         Radiat         CO3       Be a	ves and Oscillations, Optics and M <b>M STRUCTURE</b> d Education (OBE) <b>ATIONALE</b> designed to give the basic conce equipment. understand the basics of Radiation understand the principles of Radia learn the principles of Radiotheraj analyze the Quality Assurance tec	epts of Radia n physics ntion measur py equipmen hniques of R	ation phy ing instru nt.	uments	adiation	n measu	urement in	nstruments and
CURRICULU         Outcome Base         SYNOPSIS/R         The course is         Radiotherapy         OBJECTIVE         1.       Be able to         2.       Be able to         3.       Be able to         3.       Be able to         4.       Be able to         COURSE OU       No.         CO1       Be all         Radiat       Radiat         CO2       Be able         Be able       Be able	M STRUCTURE d Education (OBE) ATIONALE designed to give the basic conce equipment. understand the basics of Radiation understand the principles of Radiation analyze the Quality Assurance tec	epts of Radia n physics ntion measur py equipmen hniques of R	ation phy ing instru nt.	uments	adiation	n measu	urement in	nstruments and
Outcome Base         SYNOPSIS/R         The course is         Radiotherapy         OBJECTIVE         1. Be able to         2. Be able to         3. Be able to         6000000000000000000000000000000000000	d Education (OBE) <b>ATIONALE</b> designed to give the basic conce equipment. understand the basics of Radiation understand the principles of Radia learn the principles of Radiotheran analyze the Quality Assurance tec	n physics tion measur by equipmen hniques of R	ing instru	uments	adiation	n meası	urement in	nstruments an
SYNOPSIS/R         The course is         Radiotherapy         OBJECTIVE         1. Be able to         2. Be able to         3. Be able to         3. Be able to         4. Be able to         COURSE OU         No.         CO1       Be able         Radiat         CO2       Be able         Radiat         CO3       Be able	ATIONALE designed to give the basic conce equipment. understand the basics of Radiation understand the principles of Radia learn the principles of Radiotheraj analyze the Quality Assurance tec	n physics tion measur by equipmen hniques of R	ing instru	uments	adiation	n measi	arement in	nstruments an
The course is Radiotherapy <b>OBJECTIVE</b> 1. Be able to 2. Be able to 3. Be able to 4. Be able to <b>COURSE OU</b> No. CO1 Radiat CO2 Be ab Radiat CO3 Be ab	designed to give the basic conce equipment. understand the basics of Radiation understand the principles of Radia learn the principles of Radiotheran analyze the Quality Assurance tec	n physics tion measur by equipmen hniques of R	ing instru	uments	adiation	n meası	arement in	nstruments an
Radiotherapy         OBJECTIVE         1. Be able to         2. Be able to         3. Be able to         4. Be able to         COURSE OU         No.         CO1       Be all         Radiat         CO2       Be all         Radiat         CO3       Be all	equipment. understand the basics of Radiation understand the principles of Radia learn the principles of Radiotheran analyze the Quality Assurance tec	n physics tion measur by equipmen hniques of R	ing instru	uments				
OBJECTIVE       1. Be able to       2. Be able to       3. Be able to       4. Be able to       COURSE OU       No.       CO1     Be able       Radiat       CO2     Be able       CO3     Be able	understand the basics of Radiation understand the principles of Radia learn the principles of Radiothera analyze the Quality Assurance tec	ition measur by equipmen hniques of R	nt.					
1. Be able to         2. Be able to         3. Be able to         4. Be able to         COURSE OU         No.         CO1         Be able         CO2         Be able         CO3         Be able	understand the principles of Radia learn the principles of Radiothera analyze the Quality Assurance tec	ition measur by equipmen hniques of R	nt.					
2. Be able to 3. Be able to 4. Be able to COURSE OU No. CO1 Be al Radiat CO2 Be ab Radiat	understand the principles of Radia learn the principles of Radiothera analyze the Quality Assurance tec	ition measur by equipmen hniques of R	nt.					
3. Be able to 4. Be able to COURSE OU No. CO1 Be al Radiat CO2 Be ab Radiat	learn the principles of Radiotherap analyze the Quality Assurance tec	py equipmen hniques of R	nt.					
COURSE OU       No.       CO1     Be al       Radiat       CO2     Be ab       Radiat       CO3     Be a	• • •	-	<b>1</b> ¹ 1					
No. CO1 Be al Radiat CO2 Be ab Radiat CO3 Be a		-	Cadiother	apy Equ	ipment	t		
CO1 Be al Radiat CO2 Be ab Radiat	TCOMES & GENERIC SKILL	'S			-			
CO1 Radiat Be ab CO2 Radiat	Course Outcome		oom's	РО	СР	CA	KP	Assessmen Methods
CO2 Radiat	ole to <b>understand</b> the basics ion physics	s of	C2	1	1	-	1	T, F
CO3	le to <b>understand</b> the principle ion measuring instruments		C2	1	1	-	1	T, F
	ble to <b>learn</b> the principles herapy equipment.	of (	C3	1	1	-	1,3	MID, F
technie technie	e to <b>analyze</b> the Quality Assur jues of Radiotherapy Equipment		C4	2,3	1,3	-	1,3	T, F
CO5 from	e to <b>critically review</b> recent art the scientific literature and <b>iden</b> f research opportunities.		C6	3,9,12	5	5	5	PR, Pr, R
		s, KP-Know	vledge Pr	ofile. T -	– Test:	<u>PR – P</u>	roject: O	– Quiz: ASG
· •			81	., -	,		j -, K	,
C1 - Remember	Problems, CA-Complex Activitie r – Presentation; R - Report; F – F	mai L'nami,		lyze	C5 - 1	Evaluat	e C	C6 - Create

**BASIC RADIATION PHYSICS:** Introduction to Radiology and radiotherapy, Overview of atomic and nuclear structure, Electron interactions, Photon interactions

**DOSIMETRIC PRINCIPLES, QUANTITIES AND UNITS:** Photon fluence and energy fluence, KERMA, CEMA, absorbed dose, stopping power, Relationships between various dosimetric quantities, Cavity theory

**RADIATION DOSIMETERS**: Properties of dosimeters, Ionization chamber dosimetry systems, Film dosimetry, Luminescence dosimetry, Semiconductor dosimetry, Other dosimetry systems, primary standards

**RADIATION MONITORING INSTRUMENTS:** Operational quantities for Radiation monitoring, Ionization chambers, Proportional counters, Neutron area survey meters, Geiger–Müller counters, Scintillator detectors, Semiconductor detectors, Commonly available features of area survey meters, Calibration of survey meters, Properties of survey meters

**RADIATION MONITORING INSTRUMENTS:** Individual monitoring: Film badge, Thermoluminescence dosimetry badge, Radiophotoluminescent glass dosimetry systems, Optically stimulated luminescence systems, Direct reading personal monitors, Calibration of personal dosimeters, Properties of personal monitors.

**TREATMENT MACHINES FOR EXTERNAL BEAM RADIOTHERAPY:** X-RAY beams and X-RAY units, GAMMA-RAY beams and GAMMA RAY units, Particle accelerators: Betatron, Cyclotron, Microtron, LINAC generations, Safety of LINAC installations, Linac treatment head, Production of clinical photon beams in a LINAC, Beam collimation, Components of modern LINACs, Configuration of modern LINACs, Radiofrequency power generation system, Microwave power transmission, Accelerating waveguide, Injection system, Auxiliary system, Electron beam transport, Production of clinical electron beams in a LINAC, Dose monitoring system, Radiotherapy with protons, neutrons and Heavy ions, Introduction of Simulator, Description of the Standard Simulator, Special Features, Simulators and Computed Tomography simulators

**QUALITY ASSURANCE OF EXTERNAL BEAM RADIOTHERAPY:** Quality assurance in radiotherapy, Quality control, Quality standards, Need for quality assurance in radiotherapy, Requirements on accuracy in radiotherapy, Managing a quality assurance programme, quality assurance programme for equipment, Treatment delivery, and Quality audit.

**BRACHYTHERAPY-PHYSICAL AND CLINICAL ASPECTS:** Introduction and photon source characteristics, Clinical use and dosimetry systems, Dose distributions around sources, Dose calculation procedures, Commissioning of brachytherapy computer, Treatment planning systems, Source commissioning, Quality Assurance.

**SPECIAL PROCEDURES AND TECHNIQUES IN RADIOTHERAPY:** Image guided radiotherapy, Overview of Stereotactic irradiation, Total body irradiation, Total skin electron irradiation, Intraoperative radiotherapy, Endocavitary Rectal irradiation, Conformal radiotherapy

No.	Course Learning Outcome		Course Learning Outcome PROGRAM OUTCOMES (PO)										
110.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to <b>understand</b> the basics of	3											
001	Radiation physics	5											
CO2	Be able to <b>understand</b> the principles of	3											
002	Radiation measuring instruments	5											
CO3	Be able to learn the principles of	3											
005	Radiotherapy equipment.	5											
CO4	Be able to <b>analyze</b> the Quality Assurance		3	1									
004	techniques of Radiotherapy Equipment		5	1									
	Be able to <b>critically review</b> recent articles												
CO5	from the scientific literature and <b>identify</b>			3						3			2
	areas of research opportunities.												
(Numer	ical method used for mapping which indicate	s 3 as	high	, 2 as	s mee	dium	n, an	d 1 a	s low	leve	l of m	atching	;)

TEACHING LEAR	RNING STRATEGY	
Teaching and Learn	ing Activities	Engagement (hours)
Face-to-Face Learni	ng	
Lecture	42	
Practical /	-	
Student-Ce	entred Learning	-
Self-Directed Learn	•	
	o-face learning	42
	f the previous and (or) subsequent lecture at home	21
1	n for final examination	21
Formal Assessment		
	s Assessment	2
Final Exan	ination	3
Total		131
TEACHING MET	HODOLOGY	
Lecture and discuss	ion, Co-operative and collaborative method, Problem based method	
COURSE SCHED	ULE	
Week	Торіс	Assessment
1	Basic radiation physics	
Lecture 1	Introduction to Radiology and radiotherapy, Overview of	
	atomic and nuclear structure, Classification of radiation	
Lecture 2	Electron interactions	
Lecture 3	Photon interactions	CT – 1, Final
2	Dosimetric principles, quantities and units	
Lecture 4	Photon fluence and energy fluence, KERMA, CEMA, absorbed	
	dose, stopping power	
Lecture 5	Relationships between various dosimetric quantities	
Lecture 6	Cavity theory	
3	Radiation Dosimeters	
Lecture 7	Properties of dosimeters, Ionization chamber dosimetry	
	systems	
Lecture 8	Film dosimetry, Luminescence dosimetry	
Lecture 9	Semiconductor dosimetry, Other dosimetry systems, primary	
	standards	
4	Radiation monitoring instruments	
Lecture 10	Operational quantities for Radiation monitoring, Ionization	
	chambers	
Lecture 11	Proportional counters, Neutron area survey meters,	
Lecture 12	Geiger–Müller counters	
5	Radiation monitoring instruments	
Lecture 13	Scintillator detectors, Semiconductor detectors	
Lecture 14	Commonly available features of area survey meters, Properties	
	,F	Midterm, Final

Τ

Lecture 15	Calibration of survey meters	red by BME Department
6	Radiation monitoring instruments	
Lecture 16	Individual monitoring: Film badge, Thermoluminescence	
Lecture 16	dosimetry badge	
Lecture 17	Radiophotoluminescent glass dosimetry systems,	
	Optically stimulated luminescence systems,	
Lecture 18	Direct reading personal monitors, Calibration of personal dosimeters, Properties of personal monitors	
7	Treatment machines for External Beam Radiotherapy	
Lecture 19	X-RAY beams and X-RAY units, GAMMA-RAY beams and GAMMA RAY units	
Lecture 20 Lecture 21	Particle accelerators: Betatron, Cyclotron, Microtron	
	Midterm	
8	Treatment machines for External Beam Radiotherapy	
Lecture 22	LINAC principle, LINAC treatment head, Safety of LINAC installations	
Lecture 23	Production of clinical photon beams in a LINAC, Beam collimation	
Lecture 24	Components of modern LINACs , Configuration of modern LINACs	CT – 2, Final
9	Treatment machines for External Beam Radiotherapy	
Lecture 25	Radiofrequency power generation system, Microwave power transmission, Accelerating waveguide	
Lecture 26	Injection system, Auxiliary system, Electron beam transport	
Lecture 27	Production of clinical electron beams in a LINAC, Dose monitoring system	
10	Treatment machines for External Beam Radiotherapy	
Lecture 28	Radiotherapy with protons, neutrons and Heavy ions	
Lecture 29	Introduction of Simulator, Description of the Standard Simulator, Special Features	
Lecture 30	Simulators and Computed Tomography simulators	
11	QUALITY ASSURANCE of External Beam Radiotherapy	
Lecture 31	Quality assurance in radiotherapy, Quality control, Quality standards, Need for quality assurance in radiotherapy, Requirements on accuracy in radiotherapy	
Lecture 32	Managing a quality assurance programme, quality assurance programme for equipment	
Lecture 33	Treatment delivery, Quality audit	
12	Brachytherapy: Physical and Clinical aspects	CT – 3, FINAL
Lecture 34	Introduction and photon source characteristics	
Lecture 35	Clinical use and dosimetry systems	
Lecture 36	Dose distributions around sources, Dose calculation procedures	
13	Brachytherapy: Physical and Clinical aspects	
Lecture 37	Commissioning of brachytherapy computer Treatment planning systems	FINAL
Lecture 38	Source commissioning, Quality Assurance	

Lecture 39	Brachytherapy versus External Beam Radiotherapy
14	Special procedures and techniques in radiotherapy +
	<b>Radiation Protection &amp; Safety</b>
Lecture 40	Image guided radiotherapy
Lecture 41	Overview of Stereotactic irradiation, Total body irradiation,
	Total skin electron irradiation, Intraoperative radiotherapy,
	Endocavitary Rectal irradiation, Conformal radiotherapy
Lecture 42	Radiation protection and safety in radiotherapy: Overview

## ASSESSMENT STRATEGY

			СО	Blooms Taxonomy
Comp	onents	Grading		
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO3	C2, C4
Assessment (40%)	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C4
			CO 1	C2
T:	<b>E</b>	600/	CO 2	C2
Final	Exam	60%	CO 3	C2
			CO 4	C4
Total	Marks	100%		
(CO = Course	e Outcome, C = C	Cognitive Domain,	P= Psychomotor domain,	A= Affective Domain)
TEXT BOOK	KS			
1. E.B. Pod	lgorsak, Radiatior	Oncology Physics	: A Handbook for Teachers	and Students, IAEA 2005.
REFERENCI	E BOOKS			
2. Faiz M.	Khan John P (	tibbons. The Phys	ics of Radiation Therapy.	5th Edition, Lippincott Williams a

**REFERENCE SITE** 

Wilkins.

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# 6.2.2 Group-II (Regenerative Medicine)

# 6.2.2.1 BME 419 Drug Development and Delivery System

COU	RSE INFO	RMATION							
Course	e Code	: BME 419	Lect	ture Contact I	Hours	: 3.00	)		
Course	e Title	: Drug development and delivery systems	Crea	lit Hours		: 3.00			
	REQUISIT								
	203: Bioche								
	303: Bioma								
		STRUCTURE ducation (OBE)							
	DPSIS/RAT								
		course is to prepare stude	ents for an a	andomia and	inductri	al cara	or in n	armaaa	tics and/or drug
-		ncepts in medicinal chem					-		-
		alysis all the way through							
		is also explored in suffic			Jiiiiici cia	IIIZatio	11 15 00	vereu. Di	lug denvery and
-	CTIVE	is also explored in suffic							
		understand drug design	hased on fur	octions and ac	tivity				
		<b>ize</b> and test drugs for safe			•	v			
	-	derstand and appreciate t		-		•	lrug cor	nmercial	ization
		n and develop drug deliv				-	-	lilleretur	
		in und develop and g denv	ery systems	una ungetea	ar ag aon	, or y in	lethous		
COU	RSE OUTC	COMES & GENERIC SI	KILLS						
No.		Course Outcome		Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1		e to <b>understand</b> drug de ons and activity	sign based	C2	1	1	-	1	T, MID, F
CO2	Be able to	o optimize and test drugs	for safety,	C4, C5	3,6	3	1	1,3	T, MID, F
002		and biological activity		04, 05	5,0	5	1	1,5	1, 11112, 1
		to understand and appr							
CO3		clinical trial and testing	g for drug	C2	1	-	1	-	T,F
	commerci								
CO4		b design and develop dru		C4, C6	2	1	1	1,3	T, F
		nd targeted drug delivery to critically <b>review</b> rece							
CO5		scientific literature and		C6	3 0 12	5	5	5	
CUS		areas of research opportur	-	0	3,9,12			5	PR, Pr, R
		oblems, CA-Complex Ac		Vnowladas T	profile T	Taati	י סס	Draiaat: C	
	-	Presentation; R - Report;		-	iome, i	- rest;	г л – 1	Tojeci, Ç	y – Quiz; ASO –
	lemember		F = F  inal  E X C3 - Apply	C4 - An	alvze	C5	Evalua	te	C6 - Create
CI - K	Cinember		C3 - Appiy	04 - All	aryze	05-	E valua		Co-Create
~ ~	RSE CONT								

The course covers the following modules: drug design, drug development, drug toxicity, selectivity, structure activity relationships. drug dosage, drug safety and standards, clinical trials and product validation, drug delivery methods, targeted drug delivery, chemotherapy and cancer therapeutics.

SKILL	MAPPING													
No.	Cour	se Learning Outcome				PR			1 O U		MES	<u>`</u>		
110.		-	1	2	3	4	5	6	7	8	9	10	11	12
CO1	based on fu	to <b>understand</b> drug design nctions and activity	3											
CO2	safety, effic	<b>optimize</b> and test drugs for eacy, and biological activity			3			1						
CO3		nderstand and appreciate the ical trial and testing for drug zation	3											
CO4	delivery sy delivery met			3										
CO5	from the science from t	itically <b>review</b> recent articles entific literature and identify as of research opportunities.			3						3			12
·		ed for mapping which indicates	s 3 as	s high	n, 2 as	s me	diun	n, an	d 1 a	is lov	v leve	l of m	atching	g)
-		ING STRATEGY								-				
	ig and Learning										Eng	gagem	nent (ho	ours)
Face-to	-Face Learning												10	
	Lecture Practical / Tutorial / Studio									42				
	Student-Centr												-	
Self-Di	rected Learning	*											-	
Sell-Di	Non-face-to-f												42	
		e previous and (or) subsequent	lect	ure a	hom	ie							21	
		or final examination											21	
Formal	Assessment													
	Continuous A	ssessment											2	
	Final Examina	ation											3	
Total												]	131	
TEAC	HING METHO	DDOLOGY												
Lecture	e and discussion	, Co-operative and collaborativ	ve m	ethod	, Pro	blem	n bas	ed n	netho	od				
COUR	SE SCHEDUI	.E												
	Week	С	onte	nt								Asse	essmen	t
1		Motivation and course intr	oduc	tion										
Lecture	e 1	Motivation course												
Lecture	2	Introduction to drug develop	ment											
Lecture	23	Drug discovery												
2		Drug development												

Lecture 4	Drug development methods and protocol	fered by BME Department CT – 1 and Midterm,
Lecture 5	Target identification, bioinformatics and biological databases	Final
Lecture 6	Bioinformatics and biological databases	
3	Drug development continued	
Lecture 7	Computer aided drug design	
Lecture 8	Lead generation strategies	
Lecture 9	Lead optimization strategies	
4	Pharmacology	
Lecture 10	Pharmacodynamics and Pharmacokinetics	
Lecture 11	Biological activity of drugs	
Lecture 12	Biological activity of drugs	
5	Drug metabolism	
Lecture 13	Introduction to medicinal chemistry	
Lecture 14	Enzyme kinetics	
Lecture 15	Structure Activity Relationships	
6	Drug metabolism continued	
Lecture 16	Structure Activity Relationships	Midterm, Final
Lecture 17	Drug action mechanism	Mildterm, Final
Lecture 18	Drug action stability	
7	Selective toxicity of drugs	
Lecture 19	Toxicology assessment of novel drugs,	
Lecture 20	In-vitro and in-vivo toxicity (animal models)	
Lecture 21	Drug dosage and toxicity, mechanism of toxicity	
	MIDTERM	
8	Drug safety and testing	
Lecture 22	Drug safety protocols and regulatory standards around the world	
Lecture 23	In-vitro testing	
Lecture 24	In-vivo testing	
9	Clinical trials and commercialization	
Lecture 25	Pre-clinical studies	CT – 2, FINAL
Lecture 26	Multiphase clinical trials	
Lecture 27	Drug manufacturing process and commercialization	
10	Drug delivery techniques 1	
Lecture 28	Administration of drugs - oral	
Lecture 29	Administration of drugs - intravenous, subcutaneous	
Lecture 30	Administration of drugs – other methods	
11	Drug delivery techniques 2	
Lecture 31	Surface modification and chemistry used in drug delivery	
Lecture 32	Polymeric drug delivery methods	
Lecture 33	Liposomal drug delivery	
12	Drug delivery techniques 3	CT – 3, FINAL
Lecture 34	Introduction to gene therapy	
Lecture 35	Gene therapy drug delivery	
Lecture 36	Immunotherapy - Car-T cells and molecular antibody therapy	
13	Drug delivery techniques 4	

Drug carriers and molecular carriers	
Nanoparticle as the drug carrier	
Stability of nanoparticles as drug carrier	FINAL
Targeted drug delivery for cancer	
Chemotherapy and cancer therapeutics	
Nanoparticle mediated cancer therapy	
Nanoparticle mediated cancer therapy	
-	Nanoparticle as the drug carrier         Stability of nanoparticles as drug carrier         Targeted drug delivery for cancer         Chemotherapy and cancer therapeutics         Nanoparticle mediated cancer therapy

# FINAL EXAMINATION

# ASSESSMENT STRATEGY

Comp	oonents	Grading	СО	Blooms Taxonomy
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3, CO4	C2, C4, C5, C6
(40%)	Class Participation	5%	CO1, CO2, CO3, CO4	C2, C4, C5, C6
	Midterm	15%	CO1, CO2	C2, C4, C5
			CO 1	C2
Final Exam		60%	CO 2	C4, C5
		0070	CO 3	C2
			CO 4	C4, C6
Total	Marks	100%		
(CO = Course	e Outcome, C = O	Cognitive Doma	uin)	
TEXT BOOK	KS			
1. Rece	nt advances in no	vel drug carrier	systems, Ali Demer Sezer, 2012,	InTech Open
2. Intro	duction to medicin	nal chemistry, G	raham L. Patrick, 1995, Oxford V	University Press
REFERENC	E BOOKS			
1. Drug	discovery and de	velopment, Izet	M. Kapetanovic, 2011, InTech C	pen
2. Basic	e principles of dru	g discovery and	development, Benjamin E. Blass	, 2015, Elsevier
3. Com	putational drug de	sign, David C. Y	Young, 2009, Wiley Online Book	[S
REFERENC	E SITE			
-				

# 6.2.2.2 BME 421 Nanotechnology in Biomedicine

COURSE INFO	ORMATION								
Course Code	: BME 421	Lecture Contact Hours	: 3.00						
Course Title	: Nanotechnology in Biomedicine	Credit Hours	: 3.00						
PRE-REQUISITE									
BME 303: Biom	naterials								
CURRICULU	M STRUCTURE								
Outcome Based	Education (OBE)								

### SYNOPSIS/RATIONALE

The goal of this course is to introduce students to the world of nanotechnology and its application in biology and medicine. Topics include solid state theory in physics and the fundamentals of nano sciences, optical, mechanical and electrical properties of nanoparticles. Fabrication, characterization and applications of nanotechnology in MEMS, NEMS is also covered

### **OBJECTIVE**

- 1. Be able to **understand** the fundamentals of nanotechnology
- 2. Be able to **synthesize** nanoparticles and nanosystems
- 3. Be able to **characterize** the properties of nanoparticles and nanosystems
- 4. Be able to **design** and **develop** nanosystems for applications in biology

CO1 E	Course Outcome		Taxonomy					Methods	
	Be able to <b>understand</b> the fundamentals of nanotechnology			C2	1	1	-	1	T, MID
$CO_2$	Be able to <b>synthesize</b> nanoparticles and nanosystems			C3	1,2	1	1	1	T, MID, F
CO3 =	Be able to <b>characterize</b> the properties of nanoparticles and nanosystems			C5	1.2	1	1	2	T, MID, F
(1)4	Be able to <b>design</b> and <b>develop</b> nanosystems for applications in biology			C4, C6	3,6	1	1	2	T, MID, F
CO5 f	from the	critically <b>review</b> rec scientific literature a reas of research opportu	nd identify	C6	3,9,12	5	5	5	PR, Pr, R
	-	blems, CA-Complex A Presentation; R - Report		-	rofile,T -	- Test;	PR – I	Project; Q	– Quiz; ASG –
C1 - Ren	nember	C2 – Understand	C3 - Apply	C4 - An	alyze	C5 –	Evalua	te (	C6 - Create

The course covers the following modules: solid state physics, properties of nano particles (optical, electrical, mechanical), quantum dots, carbon nanotubes, preparation and fabrication of nanoparticles, characterization of nanoparticles, applications of nanotechnology in medicine, MEMs, NEMs, nanoparticle mediated drug delivery, lab-on-chip and microfluidics technologies used in therapy, diagnostics and prognostics.

	PROGRAM O										MES	5 (PO)	)		
No.	Cour	se Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	Be able to <b>u</b> of nanotechn	<b>nderstand</b> the fundamentals ology	3												
CO2	nanosystems	ynthesize nanoparticles and	3	3											
CO3		aracterize the properties of and nanosystems	3	3											
CO4		to <b>design</b> and <b>develop</b> for applications in biology			3			1							
CO5	from the scie	itically <b>review</b> recent articles entific literature and identify as of research opportunities.			3						3			3	
(Numer	ical method use	ed for mapping which indicate	s 3 as	s high	i, 2 as	s mee	diun	n, an	d 1 a	is low	leve	l of m	natching	g)	
		ING STRATEGY													
	g and Learning										Eng	gagen	nent (h	ours)	
Face-to-	Face Learning												40		
	Lecture												42		
	Practical / Tu										-				
~ 10 5 !	Student-Centr									_	-				
Self-Dır	ected Learning												4.0		
	Non-face-to-f	-									42 21				
		e previous and (or) subsequen	t lect	ure a	t hom	ne									
<b>F</b> 1	-	or final examination								_			21		
Formal	Assessment												•		
	Continuous A										2 3				
TT + 1	Final Examin	ation								_	-				
Total													131		
TEACH	HING METHO	DDOLOGY													
Lecture	and discussion	, Co-operative and collaborati	ve me	ethod	, Pro	blem	bas	ed n	netho	od					
COURS	SE SCHEDUL														
	Week		onte									Asse	essmen	it	
		Motivation and course introduction													
1					Introduction to nanomaterials and nanotechnology										
1 Lecture	1	Introduction to nanomaterial	s and	nanc											
1 Lecture	1		s and	nanc				nthe	sizir	ıg					
1 Lecture Lecture	1 2	Introduction to nanomaterial Top-down and bottom unanoparticles	s and ıp a	nanc pproa	aches	to	sy	nthe	sizir	ıg	СТ	- 1 ai	nd Mic	lterm,	
1 Lecture Lecture Lecture	1 2	Introduction to nanomaterial Top-down and bottom unanoparticles Overview of quantum mecha	s and ıp a	nanc pproa	aches	to	sy	nthe	sizir	ıg	СТ		nd Mic Final	lterm,	
1 Lecture Lecture Lecture 2	1 2 3	Introduction to nanomaterial Top-down and bottom unanoparticles Overview of quantum mecha Solid-state physics	s and p a nics	nanc pproa in na	notec	to hnol	sy	nthe	sizir	ıg	СТ			lterm,	
1 Lecture Lecture 2 Lecture	1 2 3 4	Introduction to nanomaterial Top-down and bottom unanoparticles Overview of quantum mecha Solid-state physics Solid state physics fundament	s and ip a inics itals i	nanc pproa in na n nai	notec	to hnol	sy ogy	nthe	sizir	ıg	СТ			lterm,	
	1 2 3 4 5	Introduction to nanomaterial Top-down and bottom unanoparticles Overview of quantum mecha Solid-state physics Solid state physics fundament Thermal consideration in nan	s and p a nics ntals i	nanc pproa in na n nan ticle	notec noscie devel	to hnol ence opm	sy ogy ent		sizir	ng	СТ			lterm,	
1 Lecture Lecture 2 Lecture Lecture	1 2 3 4 5	Introduction to nanomaterial Top-down and bottom unanoparticles Overview of quantum mecha Solid-state physics Solid state physics fundament	s and ip a inics itals i nopar nopa	nanc pproa in na n nan ticle	notec noscie devel	to hnol ence opm	sy ogy ent		sizir	ng	СТ			lterm,	

T 4 O		tered by BME Department
Lecture 8	Surface and bulk properties of nanoparticles	
Lecture 9	Nanoscale interactions	
4	Properties of nanoparticles	
Lecture 10	Mechanical properties of nanomaterials	
Lecture 11	Electrical properties of nanoparticles - conductivity and	
	resistivity	
Lecture 12	Classification of nanomaterials based on conductivity	
5	Properties of nanoparticles	
Lecture 13	Optical properties of nanoparticles	
Lecture 14	Thermal properties of nanomaterials	
Lecture 15	Magnetic nanoparticles and their properties	
6	Characterization of nanosystems	
Lecture 16	X-Ray diffraction, X-ray absorption spectroscopy, NMR	
Lecture 17	Plasmonic nanoparticles, SERS and RAMAN spectroscopy	Midterm, Final
Lecture 18	Electron microscopy, Dynamic light scattering, photoelectric	
	emission scattering	
7	Fabrication of nanosystems	
Lecture 19	Lithography techniques for fabricating nanosystems	
Lecture 20	Procedures used in lithography	
Lecture 21	Procedures used in lithography	
	MIDTERM	
8	MEMS and NEMS	
Lecture 22	Introduction to MEMS and NEMS technology	
Lecture 23	Microfluidics applications of MEME and NEMS	
Lecture 24	Etching and bonding in MEMS/NEMS	
9	Synthesis and preparation of nanomaterials	
Lecture 25	Sol-gel method, Chemical Vapor Deposition (CVD), Physical	
Lecture 25	Vapor Deposition (PVD)	CT – 2, FINAL
Lecture 26	Bonding, characteristics of Carbon nanoparticles – Fullerene	,
Lecture 20	and nanotubes	
L		
Lecture 27	Synthesis and properties of Carbon nanoparticles – Fullerene	
10	and nanotubes	
10	Nanowires and Quantum dots	
Lecture 28	Nanowires, nanowells, nanocomposites	
Lecture 29	Quantum dots – physics, structure and size dependence	
Lecture 30	Quantum dots – therapeutic and detection of diseases	
11	Molecular Devices	
Lecture 31	DNA nanotechnology, molecular and supramolecular switches	
Lecture 32	Protein, glyco, lipid nanotechnology	
Lecture 33	Biobots and bionanomachines	
12	Nanosensors	CT – 3, FINAL
Lecture 34	Nanosensors in cancer therapy	
Lecture 35	Nanosensors in cancer diagnostics	
Lecture 36	Nanosensors in point of care diagnostics	
13	Nanotechnology applications	

Lecture 38	Nanotechnology	in tissue eng	ineering	
Lecture 39	Nanotechnology	in drug targe	eting	FINAL
14	Nanotechnology	application	IS	
Lecture 40	Cellular uptake a	nd interactio	n of nanomaterials	
Lecture 41	In-vitro studies, 1	nanotoxicolo	gy	
Lecture 42	Revision			
ASSESSME	ENT STRATEGY			
			СО	Blooms Taxonomy
	Components	Grading		Bioonis Tuxonomy
	Class Test/ Assignment	20%	CO1, CO2, CO3, CO4	C2, C3
Continuous	1-3	2070	001, 002, 003, 004	02, 03
Assessment	Class	5%	CO1, CO2, CO3, CO4	C2, C3, C4, C5, C6
(40%)	Participation/Assignment	570	001,002,000,001	02, 03, 01, 00, 00
	Midterm	15%	CO1, CO2	C1, C2
			CO 1	C2
	Final Exam	60%	CO 2	C3
	ғшағ елаш	00%	CO 3	C5
			CO 4	C4, C6

#### **TEXT BOOKS**

1. Di Ventra, Massimiliano; Evoy, Stephane; Heflin, James R., Introduction to Nanoscale Science and Technology, Springer publications, 2004 (UNITS I, II, III & IV)

2. VinodLabhasetwar, Diandra L. Leslie-Pelecky, Biomedical Applications Of Nanotechnology, Wiley-Interscience A John Wiley & Son, Inc., Publication, 2007 (UNIT V)

### **REFERENCE BOOKS:**

1. Chattopadhyay, Introduction to Nanoscience and Naotechnology, PHI, 2009

2. B.k. Parthasarathy, NanoscienceAnd Nanotechnology, Gyan Books, 2007

3. Vicki H. Grassian, Nanoscience And Nanotechnology: Environmental And Health Impacts (Hardcover - 2008), John Wiley & Sons

4. T. Pradeep, Nano - The essentials, McGraw-Hill publishers, 2008

5. Bhushan, Bharat (Ed.), Springer Handbook of Nanotechnology, Springer publications, 2nd rev. and extended ed., 2007

6. Tuan Vo-Dinh, Nanotechnology in Biology and Medicine: Methods, Devices, and Applications, CRC Press, Jan 2007

**REFERENCE SITE** 

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# 6.2.2.3 BME 423 Artificial Organ Development

COURSE INFO	COURSE INFORMATION										
Course Code	: BME 423	Lecture Contact Hours	: 3.00								
Course Title	: Artificial Organ Development	Credit Hours	: 3.00								

### **PRE-REQUISITE**

BME 303 – Biomaterials; BME 203 – Biofluid Mechanics and Heat Transfer; BME 407 – Rehabilitation Engineering **CURRICULUM STRUCTURE** 

#### Outcome Based Education (OBE)

#### SYNOPSIS/RATIONALE

The course covers the following modules: introduction to artificial organs, rheological properties of blood, blood viscosity variation, artificial kidney, hemodialyzers, artificial heart-lung machine, audiometry, and hearing aids.

#### OBJECTIVE

1. To identify and analyze the factors and parameters influencing blood flow

2. To explain and examine the mechanism of dialysis of kidney, gas exchange in lungs, and sound conduction in ear

3. To design and develop artificial kidney, artificial heart-lung machine, and hearing aids

### **COURSE OUTCOMES & GENERIC SKILLS**

	NSE OUTCO	UNIES & GENERIC	SKILLS						
No.		Course Outcome		Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1		<b>apply</b> the factors and blood flow	parameters	C3	3	-	-	1	T, MID, F
CO2	dialysis of	o <b>understand</b> the me kidney, gas exchange i luction in ear	C2	1	-	-	3	T, MID, F	
CO3		<b>analyze</b> the working m dney, artificial heart-lu g aids		C4	3	-	-	4	T, F
CO4	from the	o critically <b>review</b> rec scientific literature a eas of research opportu	nd identify	C6	3,9,12	5	5	5	PR, Pr, R
(CP- 0	Complex Pro	blems, CA-Complex A	ctivities, KP-	Knowledge P	Profile,T -	– Test;	PR - 1	Project; (	Q – Quiz; ASG –
Assign	nment; Pr – F	Presentation; R - Report	t; F – Final Ex	xam)					
C1 - R	Remember	C2 – Understand	C3 - Apply	C4 - An	alyze	C5 –	Evalua	ite	C6 - Create
COLI	RSE CONTI	FNT	•	•		•			

#### **COURSE CONTENT**

Introduction to Artificial Organs: Biomaterials used in artificial organs and prostheses, inflammation, rejection, correction.

Rheological properties of blood, blood viscosity variation: effect of shear rate, hematocrit, temperature and protein contents. Casson equation, flow properties of blood through the blood vessels, problems associated with extracorporeal blood flow.

Artificial Kidney: Brief of kidney filtration, basic methods of artificial waste removal, hemodialysis, equation for artificial kidney and middle molecule hypothesis.

Hemodialysers: flat plate type, coil type and hollow fiber. Analysis of mass transfer in dialyers (cross current & cocurrent flow), regeneration of dialysate, membrane configuration, wearable artificial kidney machine, separation of antigens from blood in ESRD patients.

Artificial Heart-lung Machine: Brief of lungs gaseous exchange / transport, artificial heart-lung devices.

Oxygenators: bubble, film oxygenators and membrane oxygenators. Gas flow rate and area for membrane oxygenators. Liver support system, artificial pancreas, blood and skin.

Audiometry: air conduction, bone conduction, masking, functional diagram of an audiometer.

Hearing aids: different types, receiver amplifiers. Opthalmoscope, retinoscope, I.A.B.P principle and application.

		PROGRAM OUTCOMES (PO)												
No.	Course Learning Outcome	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								9	10	11	12	
	Be able to <b>apply</b> the factors and		-			-		7	8		10		12	
CO1	parameters influencing blood flow			3										
	Be able to <b>understand</b> the mechanism of													
CO2	dialysis of kidney, gas exchange in lungs,	3												
	and sound conduction in ear													
	Be able to <b>analyze</b> the working													
CO3	mechanism of artificial kidney, artificial			3										
	heart-lung machine, and hearing aids	achine, and hearing aids												
	Be able to critically <b>review</b> recent articles													
CO5	from the scientific literature and identify			3						3			2	
	relevant areas of research opportunities.													
(Numer	ical method used for mapping which indicate	es 3 as	s higł	n, 2 a	s me	diun	n, an	d 1 a	is lov	v leve	l of n	natching	g)	
TEACH	HING LEARNING STRATEGY													
Teachin	g and Learning Activities									En	gagen	nent (h	ours)	
Face-to-	Face Learning													
	Lecture											42		
	Practical / Tutorial / Studio											-		
	Student-Centred Learning											-		
Self-Dir	rected Learning													
	Non-face-to-face learning									42				
	Revision of the previous and (or) subsequen	nt lect	ure a	t hon	ne					21				
F 1	Preparation for final examination Assessment									21				
Formal	Continuous Assessment									2				
	Final Examination									2 3				
Total	T mai Examination									131				
												1.5.1		
	HING METHODOLOGY													
Lecture	and discussion, Co-operative and collaboration	ve m	ethod	, Pro	blem	ı bas	ed n	netho	od					
COUR	SE SCHEDULE													
	Week	Conte	nt							Assessment				
1	Motivation and course intr	oduc	tion											
Lecture	1 Motivation course													
Lecture	2 Introduction to Artificial Or	Introduction to Artificial Organs								-				
Lecture 3 Biomaterials used and the body's response to them														
2	1									СТ	<b>– 1 a</b>	nd Mic	lterm,	
Lecture	4 Rheological properties of bl	Rheological properties of blood									I	Final		
Lecture		Blood viscosity variation: effect of shear rate and hematocrit												
Lecture	6 Blood viscosity variation:	Blood viscosity variation: effect of temperature and protein							in					
	contents													
3	Properties of blood contin	ued												
Lecture	1													
Lecture	1 1	-												
Lecture	9 problems associated with ex	traco	rpore	al blo	od f	low								

4	Artificial Kidney	
Lecture 10	Brief of kidney filtration	
Lecture 11	basic methods of artificial waste removal and hemodialysis	
Lecture 12	equation for artificial kidney and middle molecule hypothesis	
5	Hemodialysers	
Lecture 13	Flat plate type	
Lecture 14	Coil type	
Lecture 15	Hollow fiber type	
6	Hemodialysers continued	Midterm, Final
Lecture 16	Analysis of mass transfer in dialysers: cross current flow	
Lecture 17	Analysis of mass transfer in dialysers: concurrent flow	
Lecture 18	regeneration of dialysate	
7	Hemodialysers	
Lecture 19	membrane configuration	
Lecture 20	wearable artificial kidney machine	
Lecture 21	separation of antigens from blood in ESRD patients	
	MIDTERM	
8	Artificial Heart-lung Machine	
Lecture 22	Brief of lungs gaseous exchange / transport	
Lecture 23	Artificial heart-lung devices	
Lecture 24	Artificial heart-lung devices	
9	Oxygenators	
Lecture 25	Artificial heart-lung devices	
Lecture 26	Bubble oxygenators	CT – 2, FINAL
Lecture 27	Film oxygenators	
10	Oxygenators continued	
Lecture 28	Membrane oxygenators	
Lecture 29	Membrane oxygenators	
Lecture 30	Gas flow rate and area for membrane oxygenators	
11	Artificial liver, pancreas, blood, and skin	
Lecture 31	Liver support system	
Lecture 32	Artificial pancreas	
Lecture 33	Artificial blood and skin	
12	Audiometry	
Lecture 34	Air conduction and bone conduction	
Lecture 35	Masking	
Lecture 36	Functional diagram of an audiometer	CT – 3, FINAL
13	Hearing aids	
Lecture 37	Types of hearing aids	
Lecture 38	Types of hearing aids	
Lecture 39	Receiver amplifiers	
14	Optical diagnosis and I.A.B.P.	
Lecture 40	Opthalmoscope and Retinoscope	
Lecture 41	I.A.B.P principle and application	
Lecture 42	I.A.B.P principle and application	
	FINAL EXAMINATION	

ASSESSMEN	T STRATEGY			
Comp	oonents	Grading	СО	Blooms Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3	C2. C3, C4
(40%)	Class Participation	5%	CO3	C4
	Midterm	15%	CO1, CO2	C2, C3
			CO 1	C3
Final	Final Exam		CO 2	C2
			CO 3	C4
Total	Total Marks 100%			
(CO = Course	e Outcome, C = 0	Cognitive Domai	n)	
TEXT BOOK	KS			
1. Artificial	Organs (Volume	4 of Synthesis le	ctures on biomedical engineer	ring) by Gerald E. Miller, Morgan &
Claypool I	Publishers, 2006.	-	-	
2. Biomedica	al Engineering an	d Design Handboo	ok Volume 2 by Myer Kutz, th	e McGraw-Hill Companies, Inc, 2009.
REFERENCI	E BOOKS			
3. Biomedica	l Engineering Ha	ndbook volume 2	by Joseph D. Bronzino, Sprin	nger Science & Business Media, 2000.
REFERENCI	E SITE			
-				

# 6.2.2.4 BME 425 Bioinformatics

COURSE INFORMATION									
			: 3.00						
Course Code Course Title	: BME 425 : Bioinformatics	Lecture Contact Hours Credit Hours	: 3.00						
PRE-REQUISI	ΓΕ								
BME 301: Statis	tics and Numerical methods for	Biomedical Engineers							
CURRICULUM	I STRUCTURE								
Outcome Based	Education (OBE)								
SYNOPSIS/RA	TIONALE								
This course intro	This course introduces students to basic concepts of molecular biology including the central dogma of biology, DNA								
replication, transcription, translation, and nucleic acid and protein analytical tools. Introduction to basic bioinformatics									
algorithms for pair-wise and multiple sequence alignment, statistical significance testing, Bayesian theorem,									
predictive modeling and phylogenetic analysis is covered. Students will also learn to use currently existing database									
retrieval systems and online bioinformatics tools through in-class exercises and assignments.									

## **OBJECTIVE**

- 1. Be able to understand the basic concepts of molecular biology and biological sequences that are routinely used in bioinformatics
- 2. Be able to recreate and construct basic search and alignment algorithms used in bioinformatics
- 3. Be able to apply and use currently existing sequence databases and bioinformatics tools
- 4. Be able to analyze and conduct phylogenetic based algorithm in ancestral studies

#### **COURSE OUTCOMES & GENERIC SKILLS** Bloom's Assessment PO CP CA KP No. Course Outcome Taxonomy Methods Be able to understand the basic concepts of CO1 molecular biology and biological sequences C2 1 1 T, MID _ that are routinely used in bioinformatics Be able to recreate and construct basic search CO2 and alignment algorithms C6 2,4 1 1 1, 2 T, MID, F used in bioinformatics Be able to apply and use currently existing CO3 C3 1.2 1 2 ASG _ sequence databases and bioinformatics tools Be able to **analyze** and conduct phylogenetic CO4 2 C4 1 1 1 T,F based algorithm in ancestral studies (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T - Test; PR - Project; Q - Quiz; ASG -Assignment; Pr – Presentation; R - Report; F – Final Exam) C1 - Remember C2 - Understand C3 - Apply C4 - Analyze C5-Evaluate C6 - Create

### COURSE CONTENT

The course covers the following modules: molecular genetics, central dogma, gene and sequence analysis techniques, gene sequencing, BLAST, sequence alignment, protein structure visualization, structure analysis, multiple sequence analysis techniques, phylogenetic analysis, online database and bioinformatic tools.

No.	Course Learning Outcome		PROGRAM OUTCOMES (PO)											
INO.			2	3	4	5	6	7	8	9	10	11	12	
	Be able to <b>understand</b> the basic concepts													
CO1	of molecular biology and biological sequences that are routinely used in bioinformatics	3												
CO2	Be able to <b>recreate</b> and <b>construct</b> basic search and alignment algorithms used in bioinformatics		3		2									
CO3	Be able to <b>apply</b> and use currently existing sequence databases and bioinformatics tools	3	2											
CO4	Be able to <b>analyze</b> and conduct phylogenetic based algorithm in ancestral studies	3	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching)

	RNING STRATEGY	
Teaching and Learn	ing Activities	Engagement (hours)
Face-to-Face Learni	ng	
Lecture		42
	Tutorial / Studio	-
Student-Ce	entred Learning	-
Self-Directed Learn	-	
	o-face learning	42
	f the previous and (or) subsequent lecture at home	21
=	n for final examination	21
Formal Assessment		-
	s Assessment	2
Final Exan	nination	3
Total		131
TEACHING MET	HODOLOGY	
Lecture and discuss	ion, Co-operative and collaborative method, Problem based method	
COURSE SCHED	ULE	
XX7 I	Contrad.	
Week	Content	Assessment
1 Lecture 1	Motivation and course introduction	
Lecture 1	Motivation course – Need for bioinformatics in biological sequence analysis	
Lecture 2	The central dogma of biology – DNA	
Lecture 3	The central dogma of biology- RNA	CT – 1 and Midterm,
<b>2</b>		Final
Lecture 4	Molecular genetics tools and analysis           Analyzing and sequencing nucleic acids	1 mai
Lecture 5	Structure and hierarchy of proteins	
Lecture 6	Proteomics and genomics in bioinformatics	
	-	
3	Pairwise alignment and dotplots	
Lecture 7	Biological databases and information retrieval	
Lecture 8	Sequence alignment with dot matrix	
Lecture 9	Alignment visualization with dot matrix tools	
4	Optimal alignment – dynamic programming	
Lecture 10	Dot matrix tools – examples and application	
Lecture 11	Optimal alignment using dynamic programming method –	
1.	nucleic acids	
Lecture 12	Optimal alignment using dynamic programming method -	
-	proteins	
5	Optimal alignment – global and local alignment	
Lecture 13	Global (Needleman-Wunch) and local (Smith-Waterman)	
	alignment techniques	Midterm, Final
Lecture 14	Affine gap penalty models in dynamic programming – use and	
	examples	

Lecture 15	Introduction to statistical significance testing	
6	Statistical significance of alignment	
Lecture 16	Statistical significance of global alignment	
Lecture 17	Erdo Renyi theorem	
Lecture 18	Statistical significance of local alignment	
7	Scoring matrices	
Lecture 19	Nucleotide identity scoring matrix	
Lecture 20	BLOSUM matrix	
Lecture 21	Construction of BLOSUM matrix from BLOCKS database	
	MIDTERM	
8	Scoring matrices	
Lecture 22	Accepted point mutation and PAM matrices	
Lecture 23	Constructing PAM matrices	
Lecture 24	Alignment visualization and scoring exercise	
9	Biological Sequence Retrieval	
Lecture 25	FASTA and BLAST algorithm	
Lecture 26	Different modes of sequence searches using NCBI-BLAST tool	CT – 2, FINAL
	(PSI-BLAST, PHI-BLAST)	
Lecture 27	Sequence retrieval and analysis using BLAST	
10	Multiple sequence alignment	
Lecture 28	PSI-BLAST, KlustalW and progressive alignment	
Lecture 29	Multiple sequence alignment with KlustalW	
Lecture 30	Position specific scoring matrices, PROSITE database	
11	Introduction to phylogenetics	
Lecture 31	Introduction to phylogenetics	
Lecture 32	Drawing tree diagrams	
Lecture 33	Introduction to tree building methods	
12	Constructing phylogenetics tree 1	CT – 3, FINAL
Lecture 34	Stepwise clustering 1	
Lecture 35	Stepwise clustering 2	
Lecture 36	Fitch Margoliash method	
13	Constructing phylogenetics tree 2	
Lecture 37	Maximum parsimony and maximum likelihood method	
Lecture 38	Ancestral studies using phylogeny	
Lecture 39	Phylogenetic tools and software based exercise	
14	Gene prediction	
Lecture 40	Modeling genes	FINAL
Lecture 41	Finding protein coding areas of the gene	
Lecture 42	Revision	
	FINAL EXAMINATION	

	Components	Grading	СО	Blooms Taxonomy			
Continuous	Class Test/ Assignment 1-3	20%	CO1, CO2, CO4	C2, C3, C6			
Assessment (40%)	Class Participation/Assignment	5%	CO3	C3			
	Midterm	15%	CO1, CO2	C2, C6			
			CO 1	C2			
	Final Exam		CO 2	C6			
T iliai Exaili		60%	CO 3	C3			
			CO 4	C4			
Total Marks 100%							
(CO = Cour	se Outcome, C = Cognitive	Domain)					
REFEREN	CE BOOKS						
. Underst	anding Bioinformatics, Jeren	ny Baum (200	8), Taylor and Francis, NY	, USA			
. An Intro	oduction to Bioinformatics A	lgorithms - by	V Neil C. Jones, Pavel A. Pe	evzner			
REFEREN	CE BOOKS						
	nis, A.D., and Ouellette, B.F. , 3rd ed., John Wiley and So	· ,	informatics -A Practical G	uide to the Analysis of Genes and			
2. Mount, N.Y.	D.W. (2004) Bioinformatics:	Sequence an	d Genome Analysis, 2nd ec	l., Cold Spring Harbor Lab. Press,			
3. Online s	sequence databases and bioin	formatic tools	5				
REFEREN	CE SITE						

# 6.2.3 Group-III (Imaging)

# 6.2.3.1 BME 427 Advanced Biomedical Signal Processing

# COURSE INFORMATION

Course Code Course Title       : BME 427 : Advanced Biomedical Signal Processing       Lecture Contact Hours Credit Hours       : 3.00         PRE-REQUISITE	000							: 3.00	)		
BME 305: Biomedical Signal Processing         MATH 231: Complex Variable and Linear Algebra         CURRICULUM STRUCTURE         Outcome Based Education (OBE)         SYNOPSIS/RATIONALE         This course is designed to provide strong foundation of theoretical knowledge in advanced signal processing techniques to implement them in complex biosignal analysis for solving associated real-life problems.         OBJECTIVE         I. To provide the knowledge about the different advanced signal processing techniques for non-stationary signals         COURSE OUTCOMES & GENERIC SKILLS         No.       Course Outcome       Bloom's Taxonomy       PO       CP       CA       KP       Assessment Methods         Methods is advanced signal processing techniques for non-stationary signals         CO1       advanced signal processing techniques       C2       1       1       -       1,3       T, F         Be able to apply the advanced signal processing techniques       C3       1       1,3       -       1,2       MID, F         appropriately       Be able to apply the advanced signal and systems       C3       1       1       -       1,3       T, F         Be able to apply the advanced signal processing techniques       C3       1       1       -       1,2       MID		ourse Code : Advanced Biomedical Signal									
MATH 231: Complex Variable and Linear Algebra         CURRICULUM STRUCTURE         Outcome Based Education (OBE)         SYNOPSIS/RATIONALE         This course is designed to provide strong foundation of theoretical knowledge in advanced signal processing techniques to implement them in complex biosignal analysis for solving associated real-life problems.         OBJECTIVE         I. To provide the knowledge about the different advanced signal processing techniques for non-stationary signals 2. To prepare the students skilled to reveal the complex meaning of different biosignals and systems.         COURSE OUTCOMES & GENERIC SKILLS         No.       Course Outcome       Bloom's Taxonomy       PO       CP       CA       KP       Assessment Methods         COURSE OUTCOMES & GENERIC SKILLS         No.       Course Outcome       Bloom's Taxonomy       PO       CP       CA       KP       Assessment Methods         CO2         Be able to <b>understand</b> the steps of different davanced signal processing techniques       C3       1       1,3       -       1,2       MID, F         GO2       Be able to <b>anake decision</b> about problem processing techniques       C3       1       1       -       1,2       T, F         GO3       Be able to <b>anake decision</b> about problem based	PRE-	REQUISIT	E								
Outcome Based Education (OBE)         SYNOPSIS/RATIONALE         This course is designed to provide strong foundation of theoretical knowledge in advanced signal processing techniques to implement them in complex biosignal analysis for solving associated real-life problems.         OBJECTIVE         I. To provide the knowledge about the different advanced signal processing techniques for non-stationary signals         COURSE OUTCOMES & GENERIC SKILLS         No.       Course Outcome       Bloom's Taxonomy       PO       CP       CA       KP       Asseessment Methods         OUTCOMES & GENERIC SKILLS         No.       Course Outcome       Bloom's Taxonomy       PO       CP       CA       KP       Asseessment Methods         OUTCOMES & GENERIC SKILLS         Be able to understand the steps of different advanced signal processing techniques         C3       1       1,3       -       1,2       MID, F         appropriately         Be able to make decision about problem based signal processing techniques       C3       1       1       -       1,2       T, F         Be able to make decision about problem based signal processing techniques       C4       2       1,2 <td< td=""><td>BME</td><td>305: Biomed</td><td>dical Signal Processing</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	BME	305: Biomed	dical Signal Processing								
Outcome Based Education (OBE)         SYNOPSIS/RATIONALE         This course is designed to provide strong foundation of theoretical knowledge in advanced signal processing techniques to implement them in complex biosignal analysis for solving associated real-life problems.         OBJECTIVE         I. To provide the knowledge about the different advanced signal processing techniques for non-stationary signals         2. To prepare the students skilled to reveal the complex meaning of different biosignals and systems.         COURSE OUTCOMES & GENERIC SKILLS         No.       Course Outcome       Bloom's Taxonomy       PO       CP       CA       KP       Assessment Methods         COI       Be able to <b>understand</b> the steps of different advanced signal processing techniques       C2       1       1       -       1,3       T, F         De able to <b>analyze</b> the advanced signal processing techniques       C3       1       1,3       -       1,2       MID, F         appropriately       Be able to <b>analyze</b> different biosignals and systems to reveal the complex meaning of different biosignals and systems       C4       2       1,2       -       1,3       T, F         Be able to analyze different biosignals and systems       Be able to critically review recent articles from the scientific literature and identify relevant areas of research opportunities, (CP- Complex Problems, CA-Complex Activitites, KP-Knowledge Profile, T – Test; PR – Project; Q –	MATE	H 231: Com	plex Variable and Linea	ar Algebra							
SYNOPSIS/RATIONALE         This course is designed to provide strong foundation of theoretical knowledge in advanced signal processing techniques to implement them in complex biosignal analysis for solving associated real-life problems.         OBJECTIVE         1. To provide the knowledge about the different advanced signal processing techniques for non-stationary signals and systems.         COURSE OUTCOMES & GENERIC SKILLS         No.       Course Outcome       Bloom's Taxonomy       PO       CP       CA       KP       Assessment Methods         COURSE OUTCOMES & GENERIC SKILLS         No.       Course Outcome       Bloom's Taxonomy       PO       CP       CA       KP       Assessment Methods         CO1       Be able to <b>understand</b> the steps of different davanced signal processing techniques       C2       1       1       -       1,3       T, F         Be able to <b>angly</b> the advanced signal processing techniques       C3       1       1,3       -       1,2       MID, F         appropriately         Be able to <b>make decision</b> about problem based signal processing techniques         C3       1       1       -       1,2       T, F         d	CURI	RICULUM	STRUCTURE								
This course is designed to provide strong foundation of theoretical knowledge in advanced signal processing techniques to implement them in complex biosignal analysis for solving associated real-life problems.OBJECTIVECOURSE OUTCOMES & GENERIC SKILLSNo.Course OutcomeBloom's TaxonomyPOCPCAKPAssessment MethodsCOURSE OUTCOMES & GENERIC SKILLSNo.Course OutcomeBloom's TaxonomyPOCPCAKPAssessment MethodsCOURSE outcomeBloom's TaxonomyPOCPCAKPAssessment MethodsCOURSE outcomeC211-1,3T, FBe able to <b>understand</b> the steps of different advanced signal processing techniquesC311,3-1,2MID, FBe able to <b>apply</b> the advanced signal processing techniques to different biosignals appropriatelyC311-1,2T, FBe able to <b>analyze</b> different biosignals and systems to reveal the complex meaning of different biosignals and systemsC421,2-1,3T, FBe able to critically review recent articles from the scientific literature and identify relevant areas of research opportunities.C63,9,12555PR, Pr, RCOPCPCmplex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG –Assignment; Pr – Presentation; R - Report; F –	Outco	me Based E	ducation (OBE)								
techniques to implement them in complex biosignal analysis for solving associated real-life problems.OBJECTIVEI. To provide the knowledge about the different advanced signal processing techniques for non-stationary signalsC. To prepare the students skilled to reveal the complex meaning of different biosignals and systems.COURSE OUTCOMES & GENERIC SKILLSNo.Course OutcomeBloom's TaxonomyPOCPCAKPAssessment MethodsC01Be able to understand the steps of different advanced signal processing techniquesC211-1,3T, FC02Be able to apply the advanced signal processing techniques to different biosignalsC311,3-1,2MID, FC03Be able to make decision about problem different biosignals and systems to reveal the complex meaning of different biosignals and systemsC421,2-1,3T, FC03Be able to critically review recent articles from the scientific literature and identify relevant areas of research opportunities.C63,9,12555PR, Pr, RC04C9- Croplex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)C4 - AnalyzeC5 - EvaluateC6 - Create	SYNC	DPSIS/RAT	IONALE								
I. To provide the knowledge about the different advanced signal processing techniques for non-stationary signalsCourse outcome techniquesBloom's TaxonomyPOCPCAKPAssessment MethodsCOURSE OUTCOMES & GENERIC SKILLSNo.Course OutcomeBloom's TaxonomyPOCPCAKPAssessment MethodsCO1Be able to understand the steps of different advanced signal processing techniquesC211-Be able to apply the advanced signal processing techniquesC311Assessment MethodsCO2processing techniquesC211Assessment MethodsCO2Be able to apply the advanced signal processing techniquesC311-CO3Be able to analyze different biosignals and systemsC311C311CO3Be abl				•				-			
Be       able       to inferent biosignals       and systems         CO3       Be able       to analyze       Canalyze	OBJE	CTIVE									
TaxonomyMethodsCO1Be able to understand the steps of different advanced signal processing techniquesC211-1,3T, FBe able to apply the advanced signal processing techniques to different biosignals appropriatelyC311,3-1,2MID, FCO3Be able to make decision about problem based signal processing techniquesC311-1,2T, FCO3Be able to analyze different biosignals and systems to reveal the complex meaning of different biosignals and systemsC421,2-1,3T, FBe able to critically review recent articles relevant areas of research opportunities.C63,9,12555PR, Pr, R(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)C4 - AnalyzeC5 - EvaluateC6 - Create	COU		OMES & GENERIC S	-	Bl	oom's					Assessment
CO1advanced signal processing techniquesC211-1,31, FBe able to <b>apply</b> the advanced signal processing techniques to different biosignals appropriatelyC311,3-1,2MID, FCO3Be able to <b>make decision</b> about problem based signal processing techniquesC311-1,2T, FCO3Be able to <b>analyze</b> different biosignals and systems to reveal the complex meaning of different biosignals and systemsC421,2-1,3T, FBe able to critically review recent articles from the scientific literature and identify relevant areas of research opportunities.C63,9,12555PR, Pr, R(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Presentation; R - Report; F – Final Exam)C4 - AnalyzeC5 - EvaluateC6 - Create	110.					conomy	10	CI	CA	KI	Methods
CO2processing techniques to different biosignals appropriatelyC311,3-1,2MID, FCO3Be able to make decision about problem based signal processing techniquesC311-1,2T, FCO4signal processing techniquesC311-1,2T, FBe able to analyze different biosignals and systems to reveal the complex meaning of different biosignals and systemsC421,2-1,3T, FBe able to critically review recent articles from the scientific literature and identify relevant areas of research opportunities.C63,9,12555PR, Pr, R(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)C4 - AnalyzeC5 - EvaluateC6 - Create	CO1	advanced	signal processing techni	iques		C2	1	1	-	1,3	T, F
CO3based signal processing techniquesC311-1,2T, FBe able to analyze different biosignals and systems to reveal the complex meaning of different biosignals and systemsC421,2-1,3T, FBe able to critically review recent articles from the scientific literature and identify relevant areas of research opportunities.C63,9,12555PR, Pr, R(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)C4 - AnalyzeC5 - EvaluateC6 - Create	CO2	processing	techniques to different	-		C3	1	1,3	-	1,2	MID, F
CO4       systems to reveal the complex meaning of different biosignals and systems       C4       2       1,2       -       1,3       T, F         Be able to critically review recent articles from the scientific literature and identify relevant areas of research opportunities.       C6       3,9,12       5       5       5       PR, Pr, R         (CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)       C1 - Remember       C2 - Understand       C3 - Apply       C4 - Analyze       C5 - Evaluate       C6 - Create	CO3			-	1	C3	1	1	-	1,2	T, F
CO5from the scientific literature and identify relevant areas of research opportunities.C63,9,12555PR, Pr, R(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)C1 - RememberC2 - UnderstandC3 - ApplyC4 - AnalyzeC5 - EvaluateC6 - Create	CO4	systems to reveal the complex meaning of			C4	2	1,2	-	1,3	T, F	
Assignment; Pr – Presentation; R - Report; F – Final Exam)C1 - RememberC2 - UnderstandC3 - ApplyC4 - AnalyzeC5 - EvaluateC6 - Create	CO5	from the scientific literature and identify C6		C6	3,9,12	5	5	5	PR, Pr, R		
C1 - Remember C2 - Understand C3 - Apply C4 - Analyze C5 - Evaluate C6 - Create	<b>`</b>	-	· 1	-		e	rofile, T	– Test;	PR - 1	Project; (	Q – Quiz; ASG –
							lvze	C5 -	Evalua	te	C6 - Create
COURSE CONTENT											
	COU	RSE CONT	ENT								
**Biomedical signal recording system:** Review on Biomedical signals and system, spectral characteristics of biomedical signals, bio-sensors and acquisition of biomedical signals, sampling, quantization and encoding, multirate data acquisition systems, compressed sensing; time-domain analysis of biomedical signals; **Statistical analysis of biosignals:** Biomedical signals using higher order higher order statistics (HOS), Principal component analysis (PCA), Independent component analysis (ICA), Common spatial pattern (CSP), Singular value decomposition (SVD), Singular spectrum analysis (SSA) etc. Estimation of power spectrum and correlation analysis.

Time-frequency domain analysis of biomedical signals: short-time Fourier transform, wavelet transform, empirical mode decomposition; Digital filters for processing biomedical signals: different types of artifacts and noise, filters in time-domain and frequency-domain, time-frequency domain-based filtering; Event detection and feature extraction: signal segmentation, envelope extraction, temporal and spectral features, statistical features, pattern classification using neural networks and support vector machine; Modeling biomedical systems: autoregressive model, pole-zero and spectral modeling, Linear mixture modelling, applications of biomedical systems.

#### SKILL MAPPING

No.	o. Course Learning Outcome PROGRAM OUTCOMES (PO)												
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to <b>understand</b> the steps of different advanced signal processing techniques	2											
CO2	Be able to <b>apply</b> the advanced signal processing techniques to different biosignals appropriately	2											
CO3	Be able to <b>make decision</b> about problem based signal processing techniques	3											
CO4	Be able to <b>analyze</b> different biosignals and systems to reveal the complex meaning of different biosignals and systems	3											
CO5	Be able to critically <b>review</b> recent articles from the scientific literature and identify relevant areas of research opportunities.			3						3			3
(Numer	ical method used for mapping which indicates	s 3 as	s high	i, 2 as	s me	dium	ı, an	d 1 a	ıs low	/ leve	l of m	atching	g)
TEACE	HING LEARNING STRATEGY												
Teachin	g and Learning Activities									En	gagen	nent (ho	ours)
Face-to-	Face Learning												
	Lecture											42	
	Practical / Tutorial / Studio											-	
	Student-Centred Learning											-	
Self-Dir	rected Learning												
	Non-face-to-face learning											42	
	Revision of the previous and (or) subsequen	t lect	ure a	t hon	ne							21	
	Preparation for final examination											21	
Formal	Assessment												
	Continuous Assessment											2	
	Final Examination											3	
Total												131	

Week	Торіс	Assessment
1	Biomedical signal recording system	
Lecture 1	Review on Biomedical signals and system	
Lecture 2	Spectral characteristics of biomedical signals	
Lecture 3	Bio-sensors and acquisition of biomedical signals	
2	CT – 1, Final	
Lecture 4	Sampling, quantization and encoding	
Lecture 5	Multi-rate data acquisition systems, compressed sensing	
Lecture 6	time-domain analysis of biomedical signals	
3	Statistical analysis of biosignals	
Lecture 7		
Lecture 8	Biomedical signals using higher-order statistics (HOS)	
Lecture 9		
4	Linear Transformation	
Lecture 10	Principal component analysis (PCA)	
Lecture 11	Principal component analysis (PCA)	
Lecture 12	Independent component analysis (ICA)	
5	Linear Transformation	
Lecture 13	Independent component analysis (ICA)	
Lecture 14	Common spatial pattern (CSP)	
Lecture 15	Common spatial pattern (CSP)	
6	Linear Transformation	Midterm, Final
Lecture 16	Singular value decomposition (SVD)	
Lecture 17	Singular value decomposition (SVD)	
Lecture 18	Singular spectrum analysis (SSA)	
7	Linear Transformation	
Lecture 19	Singular spectrum analysis (SSA)	
Lecture 20	Estimation of power spectrum and correlation analysis	
Lecture 21	Estimation of power spectrum and correlation analysis	
	Midterm Break	
8	Time-frequency domain analysis of biomedical signals:	
Lecture 22	Short-time Fourier transform	
Lecture 23	Short-time Fourier transform	
Lecture 24	Wavelet transform	
9	Time-frequency domain analysis of biomedical signals	
Lecture 25	Wavelet transform	
Lecture 26	Empirical mode decomposition	CT – 2, Final
Lecture 27	Empirical mode decomposition	
10	Digital filters for processing biomedical signals	
Lecture 28	Different types of artifacts and noise	
Lecture 29	Filters in time-domain and frequency-domain	
Lecture 30	Time-frequency domain-based filtering	
11	Event detection and feature extraction	
Lecture 31	Signal segmentation	
Lecture 32	Envelope extraction	

Course	Offered	bv BME	Department
course	0,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Cy Dinie	Department

Lecture 33	Temporal and spectral features	
12	Event detection and feature extraction	
Lecture 34	Statistical features	
Lecture 35	Pattern classification using neural networks	
Lecture 36	Pattern classification using support vector machine	CT – 3, FINAL
13	Modeling biomedical systems	
Lecture 37	Autoregressive model	
Lecture 38	Pole-zero and spectral modeling	
Lecture 39	Pole-zero and spectral modeling	FINAL
14	Biomedical Signal Processing	FINAL
Lecture 40	Linear mixture modelling	
Lecture 41	Applications of biomedical systems	
Lecture 42	Applications of biomedical systems	

#### ASSESSMENT STRATEGY

			СО	Blooms Taxonomy
Comp	oonents	Grading	60	Bioonis Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C4
	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C3
			CO 1	C2
Einal	Exam	60%	CO 2	C3
rinai	Exam	00%	CO 3	C2
			CO 4	C4
Total	Marks	100%		
(CO = Course	e Outcome, C =	Cognitive Doma	in)	

#### **TEXT BOOKS**

1. Emmanuel Ifeachor and Barrie Jervis, "Digital Signal Processing: A Practical Approach," Second Edition, Pearson Publications, 2002.

2. Amine Nait-Ali, "Advanced Biosignal Processing," Springer, 2009.

#### **REFERENCE BOOKS**

- 3. K J Blinowska and J Zygierewicz, "Practical Biomedical Signal Analysis Using MATLAB," CRC Press, 2012.
- 4. S. R. Devasahayam, "Signals and Systems in Biomedical Engineering: Signal Processing and Physiological Systems Modeling," Second Edition, Springer Publication, 2013.

### **REFERENCE SITE**

# 6.2.3.2 BME 429 Nuclear Medicine

		RMATION				: 3.00	)		
						. 5.00	)		
	e Code	: BME 429		ture Contact H	ours	: 3.00	)		
Course	e Title	: Nuclear Medicine	Cree	dit Hours					
	REQUISIT								
PHY 1	25 & 103:	Physics I and II							
BME 3	307 – Medie	cal Imaging							
CURF	RICULUM	STRUCTURE							
Outcon	me Based E	ducation (OBE)							
SYNO	PSIS/RAT	IONALE							
The co	ourse introc	luces the students to th	ne physics of	radionucleotic	de and	radion	ucleotic	le decay,	radionucleotic
		tection. Emphasis is gi							
-	-	cleotide detection using							Few key nucles
imagir	ng methods,	namely, SPECT, SPEC	T-CT, PET, F	PET-CT are co	vered in	suffic	ient det	ails.	
OBJE	CTIVE								
1. Be	e able to <b>un</b>	lerstand the basic conc	epts of radion	ucleotide deca	y and ra	adioact	ive equ	ilibrium	
2. Be	e able to <b>des</b>	cribe the physics and w	orking princip	ples of instrum	ents us	ed in n	uclear r	nedicine	
3. Be	e able to <b>ap</b>	oly fundamental concept	ts learnt in the	e course to add	ress issu	ues in r	nuclear	imaging	
4. Be	e able to <b>un</b>	dertake quality control	and testing of	instruments us	sed in n	uclear	medicii	ne	
COUR	RSE OUTC	OMES & GENERIC S	SKILLS						
No.		Course Outcome		Bloom's	РО	СР	CA	KP	Assessmen
INO.		Course Outcome		Taxonomy	PO	CP	CA	Kľ	Methods
	Be able to	understand the basic	concepts of						
CO1	radionucle equilibriu		radioactive	C2	1	-	-	1	T, MID
	Be able to	describe the physics a	and working						
CO2	principles	of instruments used	in nuclear	C1, C2	1	1	1	1	T, MID, F
	medicine								
	Be able to	apply fundamental con	ncepts learnt						
CO3	in the co	urse to address issues	in nuclear	C3, C4	2	-	1	2	ASG
	imaging								
	Be able 1	to <b>undertake</b> quality	control and						
CO4		f instruments used		C3, C4	2	1	1	2	T,F
	medicine								
	Complex Pro	oblems, CA-Complex A	ctivities, KP-	Knowledge Pr	ofile,T	– Test;	PR – I	Project; Q	– Quiz; ASG
(CP- C	-	Presentation; R - Report		-	,	,		5 / 1	<b>`</b>
	nment; Pr –			/					
Assign	nment; Pr –	C2 – Understand	C3 - Apply	C4 - Ana	lvze	C5 –	Evalua	te (	C6 - Create

Planar Scintigraphy: Introduction of Nuclear medicine: Planar scintigraphy, Radioactivity and radiotracer halflife, Properties of radiotracers for nuclear medicine, The technetium generator, The distribution of technetiumbased radiotracers within the body, The gamma camera, Image characteristics, Clinical applications of planar scintigraphy

SPECT and PET/CT: Single photon emission computed tomography (SPECT), Data processing in SPECT, SPECT/CT, Clinical applications of SPECT and SPECT/CT, Positron emission tomography (PET), Radiotracers used for PET/CT, Handling and Operation of PET/CT, Two-dimensional and three-dimensional PET imaging, PET/CT, Data processing in PET/CT, Image characteristics, Time-of flight PET, Clinical applications of PET/CT.

#### SKILL MAPPING

No.	Course	Learning Outcome				PR	ROGRAM OUTCOMES (PO)							
INO.	Course	Be able to <b>understand</b> the basic concepts						7	8	9	10	11	12	
	Be able to <b>und</b>	erstand the basic concepts												
CO1	of radionucleor	tide decay and radioactive	3											
	equilibrium													
	Be able to d	escribe the physics and												
CO2	working princip	ples of instruments used in	3											
	nuclear medicin	ne												
	Be able to ap	ply fundamental concepts												
CO3	learnt in the c	ourse to address issues in		3										
	nuclear imaging	g												
	Be able to <b>und</b>	ertake quality control and												
CO4	testing of inst	truments used in nuclear		3										
	medicine													
(Numer	rical method used	for mapping which indicate	s 3 as	s high	i, 2 a	s me	diun	i, an	d 1 a	is low	leve	l of n	hatching	g)
TEAC	HING LEARNIN	IG STRATEGY												
Teachir	ng and Learning A	Activities									En	gagen	nent (h	ours)
Face-to	-Face Learning													
	Lecture												42	
	Practical / Tutor	rial / Studio											-	
	Student-Centred	l Learning											-	
Self-Di	rected Learning													
	Non-face-to-fac	e learning											42	
	Revision of the	previous and (or) subsequen	t lect	ure a	t hon	ne							21	
	Preparation for	final examination											21	
Formal	Assessment													
	Continuous Ass	essment											2	
	Final Examinati	on									3			
Total													131	
TEAC	HING METHOD	OOLOGY												
Lecture	and discussion, G	Co-operative and collaborativ	ve m	ethod	, Pro	blem	ı bas	ed n	netho	od				
COUR	SE SCHEDULE													
	Week		Con	tent								A	sessme	ent
		Motivation and course in										1 1 1	5 2 5 5 111	•

Lecture 1	Introduction and Motivation	
Lecture 2	Overview on Medical Imaging	
Lecture 3	Introduction and history of nuclear medicine	
2	Nuclear Medicine	CT – 1 and Midterm,
Lecture 4	Radionucleotide decay and the fundamental decay equation	Final
Lecture 5	Photon beam attenuation	
Lecture 6	Beams and procedures used in nuclear medicine and	
	radiopharmaceuticals	
3	Radioactive equilibrium	
Lecture 7	Radioactive equilibrium – decay and transmutation	
Lecture 8	Activity and half-life of radionucleotides, carrier free specific	
	activity	
Lecture 9	Radioactivity in equilibrium – Bateman equations, secular and	
	transient equilibrium	
4	Radionucleotide production	
Lecture 10	Methods for producting radionucleotides	
Lecture 11	Nuclear reactor, nuclear fission, neutron activated produced	
	radionucleotides	
Lecture 12	Accelerator produced radionucleotides, radioisotopes,	
	conventional vs nuclear imaging	
5	Radionucleotide generators	
Lecture 13	Ideal nuclear generators and construction of nuclear generators	
Lecture 14	Activity of radionucleotides inside generators	
Lecture 15	Essential steps in accelerator-based radionucleotide production	
6	Radionucleotide production rates and cyclotron	
Lecture 16	Production rates and cross-sections	
Lecture 17	Proton generation rate, medical cyclotron	Middaum Final
Lecture 18	Basic working principles and construction method of a simple	Midterm, Final
	cyclotron	
7	Cyclotron - continued	
Lecture 19	Output energy, heat deposition, stopping power (Bethe	
	Equation)	
Lecture 20	Maintenance of cyclotron	
Lecture 21	Revision	
	MIDTERM	
8		
Lecture 22	Gamma Camera	
Lecture 23	Gamma Camera – Introduction and working principles	
Lecture 24	Collimator, collimator efficiency and collimator resolution,	
	collimator sensitivity	
9	Scintillator, pre-amplifier, amplifier	
Lecture 25	Gamma Camera QC	CT – 2, FINAL
Lecture 26	Photomultiplier tubes and other components of Gamma Camera	
Lecture 27	Energy calculations and Compton Band	
10	Pulse height spectrometry	
Lecture 28	Gamma Camera QC 2	

T ( 20	00	eu by BME Depuriment
Lecture 29	Image non-uniformity and corrections. Image non-linearity,	
	uniformity profile	
Lecture 30	Gamma Camera tuning, intrinsic uniformity	
11	Design and Performance characteristics of Parallel Hole	
	Collimators, septal thickness	
Lecture 31	Radiation protection	
Lecture 32	Types of radiation detectors and comparison with gamma	
	camera	CT – 3, FINAL
Lecture 33	Occupational dose limits	
12	SPECT/SPECT CT imaging	
Lecture 34	Calculations and examples of dosage and limits	
Lecture 35	Principles and workflow of SPECT imaging	
Lecture 36	Principles and working principles of SPECT-CT imaging	
13	PET/PET CT imaging	
Lecture 37	Principles and workflow of PET imaging	
Lecture 38	Principles and workflow of PET-CT imaging	
Lecture 39	Image construction and processing of PET-CT images	
14	Non imaging devices	
Lecture 40	Dose calibrators, QC of dose calibrators, thyroid uptake probe	FINAL
Lecture 41	Standard uptake value and noise equivalent count rate	
Lecture 42	Revision	
	FINAL EXAMINATION	

#### FINAL EXAMINATION

#### ASSESSMENT STRATEGY

	Components	Grading	СО	Blooms Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3, CO4	C1, C2, C3, C4
	Class Participation/Assignment	5%	CO1, CO2, CO3, CO4	C1, C2, C3, C4
	Midterm	15%	CO1, CO2	C1, C2
			CO 1	C1
	Final Exam	60%	CO 2	C1, C2
	Fillal Exam	0070	CO 3	C3. C4
			CO 4	C3, C4
	Total Marks	100%		
(CO = Cours	se Outcome, C = Cognitive	Domain)		

#### **TEXT BOOKS**

1. The Essential Physics of Medical Imaging by J.T. Bushberg, J.A. Seibert

2. Physics and Radiobiology of Nuclear Medicine by Gopal B. Saha

#### **REFERENCE BOOKS**

1. Nuclear Medicine Physics: A Handbook for Teachers and Students, International atomic energy agency Vienna, 2014

#### **REFERENCE SITE**

# 6.2.3.3 BME 431 Biomedical Data Science

COU	RSE INFO	RMATION						
					: 3.00	)		
Cours	e Code	: BME 431	Lecture Contact H	ours	: 3.00	)		
	e Title	: Biomedical Data Science	Credit Hours		. 5.00	,		
PRE-	REQUISIT	`E						
Cours	e Code: CS	E 291						
Cours	e Title: Cor	nputer Programming						
Cours	e Code: CS	E 292						
Cours	e Title: Cor	nputer Programming Lab						
Cours	e Code: BM	IE 301						
Cours	e Title: Stat	istics and Numerical Methods fo	or Biomedical Engin	eers				
Cours	e Code: BM	IE 313						
Cours	e Title: Bio	medical Image Processing						
Cours	e Code: BM	IE 314						
Cours	e Title: Bio	medical Image Processing Session	onal					
CUR	RICULUM	STRUCTURE						
Outco	me Based F	Education (OBE)						
SYNC	OPSIS/RAT	TIONALE						
Artific differe <b>OBJE</b> 1. To 2. To	cial Intellig ent aspects o ECTIVE o identify an o apply the	È medical imaging, bioinformat ence. Student will undergo gra of machine learning and deep lea nd understand fundamentals of an fundamental concepts of mach	nded coding assign arning in solving pro rtificial intelligence.	ments, blems o	which of varic	will er ous dorr	nable them nains.	to implement
	ience.		- 1					
	-	e various machine learning algo						
		arious deep learning architecture						
		JUILD & GENERIC SRILLS	Bloom's					Assessment
No.		Course Outcome	Taxonomy	PO	CP	CA	KP	Methods
	Be able	to identify and underst	· ·					
CO1		tals of fundamentals of artif		1	1	_	3	T, F
	intelligen						-	_,_
	-	apply the fundamental concept	ts of					
CO2		learning and deep learning in		2	1,3	_	3	T, F
002		f biomedical data science.		_	1,0		U	-,-
		to <b>analyze</b> the various mac	hine					
CO3	learning a	-	C4	2	1	-	5	MID, F
	1 rearning a	Igorithms						
	-	-	ning					
CO4	-	to evaluate various deep learn	ning C5	3	1,3	-	5	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG –										
Assignment; Pr – P	Assignment; Pr – Presentation; R - Report; F – Final Exam)									
C1 - Remember C2 - Understand C3 - Apply C4 - Analyze C5 - Evaluate C6 - Create										

#### **COURSE CONTENT**

**Introduction to Python for Data Science:**Data Types, Loops, Functions, Reading and Writing Files, Object Oriented programming, Threading, Multiprocess, Libraries: numpy, matplotlib, Pandas, OpenCV, Sklearn, Tensorflow, sea born. Dealing with null values. **Pattern Recognition:** Data clustering, Supervised Learning, Unsupervised Learning, Introduction to Fuzzy logic. **Machine Learning:** Architecture (Feature Extraction, Training, Testing, Validation), Semi Supervised Learning, Linear Regression, Logistic Regression, kNN, Decision Tree, Random Forest, Naïve Bayes Classifier, Support vector machine, ANN, Over Fitting and Regularization. **Deep Learning:** Architecture, Activation Functions, Perceptrons, Multi-Layer Perceptrons, CNN, RNN. LSTM, Data Augmentations, Transfer Learning, Self attention, Encoder-Decoder, Introduction to different pertained network.

#### SKILL MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
	Be able to identify and understand												
CO1	fundamentals of fundamentals of artificial	3											
	intelligence												
	Be able to <b>apply</b> the fundamental concepts												
CO2	of machine learning and deep learning in		3										
	the domain of biomedical data science.												
CO3	Be able to analyze the various machine		3										
COS	learning algorithms.		3										
CO4	Be able to <b>evaluate</b> various deep learning			3									
004	architectures.			3									
						1.		41.	a 1 arr	7 10000	1		``
	rical method used for mapping which indicates	s 3 as	high	i, 2 as	s me	dium	1, an	u i a			1 01 m	latchin	g)
TEAC	HING LEARNING STRATEGY	s 3 as	high	1, 2 as									
<b>TEAC</b> Teachir	HING LEARNING STRATEGY ng and Learning Activities	s 3 as	high	1, 2 as			ı, an					nent (h	
<b>TEAC</b> Teachir	HING LEARNING STRATEGY	s 3 as	high	1, 2 as	<u> </u>		ı, an				gagen		
<b>TEAC</b> Teachir	HING LEARNING STRATEGY ng and Learning Activities -Face Learning	s 3 as	s high	ı, 2 as			ı, an				gagen	nent (h	
<b>TEAC</b> Teachir	HING LEARNING STRATEGY ng and Learning Activities -Face Learning Lecture	s 3 as	s high	ı, 2 as			ı, an				gagen	nent (h	
TEACI Teachir Face-to	HING LEARNING STRATEGY ng and Learning Activities -Face Learning Lecture Practical / Tutorial / Studio	s 3 as	s high	, 2 as			ı, an				gagen	nent (h	
TEACI Teachir Face-to	HING LEARNING STRATEGY ng and Learning Activities -Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	s 3 as	high	ı, 2 as			ı, an				gagen	nent (h	
TEACI Teachir Face-to	HING LEARNING STRATEGY ng and Learning Activities -Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning rected Learning						, an				gagen	nent (h 42 -	
TEACI Teachir Face-to	HING LEARNING STRATEGY ng and Learning Activities -Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning rected Learning Non-face-to-face learning						, an				gagen	nent (h 42 - 42	
TEACI Teachir Face-to Self-Di	HING LEARNING STRATEGY ng and Learning Activities -Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning rected Learning Non-face-to-face learning Revision of the previous and (or) subsequen										gagen	nent (h 42 - - 42 21	
TEACI Teachir Face-to Self-Di	HING LEARNING STRATEGY ng and Learning Activities -Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning rected Learning Non-face-to-face learning Revision of the previous and (or) subsequen Preparation for final examination Assessment Continuous Assessment										gagen	nent (h 42 - - 42 21	
TEACI Teachir Face-to Self-Di	HING LEARNING STRATEGY ng and Learning Activities -Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning rected Learning Non-face-to-face learning Revision of the previous and (or) subsequen Preparation for final examination Assessment						, an				gagen	nent (h 42 - 42 21 21	

#### TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

#### **COURSE SCHEDULE**

Week	Торіс	Assessment
1	Motivation and course introduction	
Lecture 1	Introduction to Artificial Intelligence	
Lecture 2	Artificial Intelligence in Healthcare	
Lecture 3	Artificial Intelligence in Healthcare (continue)	
2	Basic Python Programming	CT – 1, Final
Lecture 4	Data Types, Loops, Functions, Reading and Writing Files	
Lecture 5	Object Oriented programming	
Lecture 6	Threading, Multiprocess, Libraries: numpy, matplotlib	
3	Python Programming for Data Science And computer Vision	
Lecture 7	Introduction to Pandas, Introduction to OpenCV	
Lecture 8	Introduction to Sklearn	
Lecture 9	Introduction to Tensorflow	
4	Basic Data Processing and Data Visualization	
Lecture 10	Data Preprocessing: Dealing with null values, Image resizing,	
	introduction to dimensionality reduction	
Lecture 11	Introduction to sea born: Heat Map, Box Plotm Scatter Plot, 3D	
	plot, Linear Plot, Line Plot	
Lecture 12	Introduction to sea born: Swarmplot, barplot, Distribution Plot,	
	Regression Plot	
5	Introduction to Pattern Recognition	
Lecture 13	Supervised Learning, Unsupervised Learning, Semi Supervised	Midterm, Final
	Learning	
Lecture 14	Data Clustering	
Lecture 15	Fundamental Concepts of Fuzzy Systems	
6	Machine Learning Algorithms 1	
Lecture 16	Linear Regression	
Lecture 17	Logistic Regression	
Lecture 18	Logistic Regression (Continue)	
7	Machine Learning Algorithms 2	
Lecture 19	KNN	
Lecture 20	Decision Tree, Random Forest, Naïve Bayes Classifier	
Lecture 21	Support Vector Machine	
	Midterm Break	
8	Machine Learning Advanced Concepts	
Lecture 22	Machine Learning Architecture (Training, Testing and	
	Validation)	
Lecture 23	Over Fitting and Regularization	
Lecture 24	Artificial Neural Networks	
9	Introduction to Neural Networks	
Lecture 25	Perceptron, Introduction to Activation Functions, Different	CT – 2, Final
	Activation Functions	

Lecture 26	N	Iultilayer Perceptron		urse Offered by BME Depart					
Lecture 27	Ν	Iultilayer Perceptron (	(Continue)						
10		Different Neural Ne Iodels 1	twork Architectures and Se	quential					
Lecture 28			ution Neural Networks, Basic Cor Padding, CNN Layers, Pooling L	-					
Lecture 29		Different Types of CN		<u> </u>					
Lecture 30	Ľ	Different Types of CN	N: Inception						
11		Different Neural Ne Iodels 2	twork Architectures and Se	quential					
Lecture 31	D	Different Types of CN	N: ImageNet						
Lecture 32	Ľ	Different Types of CN	N: Yolo						
Lecture 33	Ľ	ata Augmentation							
12		)ifferent Neural Ne Iodels 3	twork Architectures and Se	quential					
Lecture 34	S	equential processing v	ent Neural Networks and basic pr with RNN, Bi Directional RNN	inciples, CT – 3, FINA	L				
Lecture 35		ntroduction to LSTM							
Lecture 36			with LSTM, Existing LSTM librar	ies					
13			es in Neural Network						
Lecture 37		ransfer Learning							
Lecture 38			er-Decoder Architecture						
Lecture 39		ransformer Model							
14 Lecture 40		Computer Vision in H		FINAL					
	S	can	Scans and Nuclear Medicine Di						
Lecture 41		irtual Reality in Heal							
Lecture 42		ecent works in Biome	edical DataScience						
ASSESSMEN	NT STRAT	EGY							
Comp	ponents	Grading	со	Blooms Taxonomy					
Continuous Assessment	Class Te Assignm 1-3	ent 20%	CO1, CO2, CO3, CO4	C1,C2,C3, C4, C5					
(40%)	Class Participa	5%	CO1	C1,C2					
	Midter	m 15%	CO1,CO2, CO3	C1,C2,C3, C4					
			CO 1	C1, C2					
Final	Exam	60%	CO 2	C3	C3				
1 1141			CO 3	C4					
			CO 4	C5					
	Marks	100%	• >						
	,	C = Cognitive Doma	ain)						
TEXT BOOK			1. G (2006) D 1' G 1	<b>X</b> 7 1					
	-	-	ishop, C. (2006), Berlin: Springer	-Verlag					
-		tinon, Francois Cholle	t, 2017, Manning Publication						
REFERENC	E BOOKS								

Speech and Language Processing, Dan Jurafsky and James H. Martin, 2019, Pearson
 Head First Python, Paul Barry, 2010, O'Reilly

### **REFERENCE SITE**

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# 6.2.4 Group-IV (Biomechanics and Rehabilitation Engineering)

# 6.2.4.1 BME 433 Applied Biofluid Mechanics

	KSE INFU	RMATION						
					: 3.00	)		
Course	e Code	: BME 433	Lecture Contact H	[ours	: 3.00	)		
Course	e Title	:Applied Biofluid Mechanics	Credit Hours					
	REQUISIT							
	e Code: BN							
		fluid Mechanics and Heat Transf	er					
		STRUCTURE						
		Education (OBE)						
	DPSIS/RAT			• 1	1 1 .	- 41		6 1 - 1 1
		provide a discussion of the flui	-	-	•	-	-	
•		g the heart and circulatory system eology, mechanics of circulation	-	-			-	
		blved or suspended solutes. Emp	· 1	1 0	-			1
		gh the arterial system and air flow						
	CTIVE	gi the arterial system and an now	v unough the pullic	Jildi y Sy.	stem, t			in disease.
		to develop student's basic know	vladge of fluid ma	abanias	and hi	ofluida	to an adve	nca laval Tha
		the understanding of the underly	•					
	-	ems. Based on the assumptions				-	-	-
	-	olutions applied to a wide variet						
		and laboratory setups as used for		-				-
					SIVILLI	cant or	iective is t	to reinforce the
		nowledge in calculus, different	-	-	-		-	
	-	nowledge in calculus, different uid Dynamics (CFD) and MATL	ial equations, and	enginee	ring as	s it ap	plies to flu	uid mechanics.
	utational Fl	nowledge in calculus, different uid Dynamics (CFD) and MATL	ial equations, and	enginee	ring as	s it ap	plies to flu	uid mechanics.
Comp (CAE)	utational Fl ).	-	ial equations, and AB will be introdu	enginee	ring as	s it ap	plies to flu	uid mechanics.
Comp (CAE)	utational Fl ).	uid Dynamics (CFD) and MATL	ial equations, and AB will be introdu	enginee	ring as	s it ap	plies to flu	uid mechanics.
Comp (CAE) COU	utational Fl ). RSE OUTC	uid Dynamics (CFD) and MATL	ial equations, and AB will be introdu Bloom's Taxonomy	enginee ced to en	ring as mphasi	s it apj ize Con	plies to flu nputer Aid	uid mechanics. ed Engineering Assessment
Comp (CAE) COU	utational Fl ). RSE OUTC Be able t of the go	uid Dynamics (CFD) and MATL COMES & GENERIC SKILLS Course Outcome o gain fundamental understand verning physics behind the pulsa	ial equations, and AB will be introdu Bloom's Taxonomy	enginee ced to en	ring as mphasi	s it apj ize Con	plies to flu nputer Aid	uid mechanics. ed Engineering Assessment
Comp (CAE) COUI No.	utational Fl ). RSE OUTO Be able t of the go flow and	uid Dynamics (CFD) and MATL COMES & GENERIC SKILLS Course Outcome o gain fundamental understand verning physics behind the pulsa cardiovascular system.	ial equations, and AB will be introdu Bloom's Taxonomy ling atile C2	enginee ced to en PO	ring as mphasi CP	s it apj ize Con	blies to flu nputer Aid KP	Assessment Methods
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Comp (CAE) COUI No. CO1 CO2	Be able t of the go flow and Be able t fluid mea system an Be able devices th flow inside	uid Dynamics (CFD) and MATL COMES & GENERIC SKILLS Course Outcome o gain fundamental understand verning physics behind the pulsa cardiovascular system. o formulate the solution related chanics problems in human b id solve by engineering concepts. to evaluate artificial organs hat are exposed, or work based le human body.	ial equations, and AB will be introdu Bloom's Taxonomy ling atile C2 d to ody C6 and the C5	enginee ced to en PO 1 3	ring as mphasi CP 1 1,3	s it apj ize Con	KP 1,3	Assessment Methods T, F T, F
Comp (CAE) COUI No. CO1 CO2 CO3	Be able t of the go flow and Be able t fluid means system an Be able devices th flow insic Be able	uid Dynamics (CFD) and MATL COMES & GENERIC SKILLS Course Outcome o gain fundamental understand verning physics behind the pulsa cardiovascular system. o formulate the solution related chanics problems in human b id solve by engineering concepts. to evaluate artificial organs hat are exposed, or work based le human body. to analyze biofluid mechan	ial equations, and AB will be introdu Bloom's Taxonomy ling atile C2 d to ody C6 and the C5 nics	enginee ced to en PO 1 3 4	ring as mphasi CP 1 1,3 1	s it apj ize Con	kP 1,3	Assessment Methods T, F T, F MID, F
Comp (CAE) COUI No. CO1 CO2	Be able t of the go flow and Be able t fluid mea system an Be able devices th flow insic Be able problems	uid Dynamics (CFD) and MATL COMES & GENERIC SKILLS Course Outcome o gain fundamental understand verning physics behind the pulsa cardiovascular system. o formulate the solution related chanics problems in human b id solve by engineering concepts. to evaluate artificial organs nat are exposed, or work based le human body. to analyze biofluid mechan in human body to impr	ial equations, and AB will be introdu Bloom's Taxonomy ling atile C2 d to ody C6 and the C5 nics	enginee ced to en PO 1 3	ring as mphasi CP 1 1,3	s it apj ize Con	KP 1,3	Assessment Methods T, F T, F
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									Сог	ırse	e Offe	ered b	y BMI	E Depa	rtment
1	relevant are	eas of research opportu	nities.												
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	-	Presentation; R - Report				uge I	10111	ic, 1	- 10	5ι, 1	K –	rioje	ι, Q ·	– Quiz	, ASU –
C1 - Rei		C2 - Understand	C3 - Apply			- An	alvz	e	C5	- E	valua	nte	C	6 - Cre	eate
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		: Circulatory system p	<i>e.</i>												2
		Blood properties, Hem						-	-						
• 1	-	e flow in an elastic tul	0.							•					
-		ics in arteries and veins	-		-									•	•
	-	on of blood flow: Stroke	-										-		
		Diseases, Synovial fluid		•	•			•			•		•		
flow (A	rthritis), K	nee and Hip injury; B	iofluid dyna	mics	s of t	he hi	ıman	ı bra	in: C	erel	brosp	oinal f	luid, (	Cerebr	al blood
flow, Bl	lood brain	barrier, Brain diseases	; Respiratory	/ bic	ofluid	mec	hani	cs: F	Respii	ato	ry sy	stem	physio	ology .	Alveolar
		ow in the lungs, Me	chanics of	brea	thing	, Ga	s ex	char	nge a	nd	trans	sport;	Flow	and	pressure
		iques in human body.													
SKILL	MAPPINO	Ĵ													
No.	C	ourse Learning Outcor	ne										(PO)		
		_		1	2	3	4	5	6	7	8	9	10	11	12
	Be ab	U	ndamental												
CO1	behind	<b>nding</b> of the governing the pulsatile flo		3											
		the pulsatile flo scular system.	ow and												
		o <b>formulate</b> the soluti	on related												
		mechanics problems													
CO2		stem and solve by er				2									
	concepts.	-	0 0												
	-	to evaluate artificial o	rgans and												
CO3	devices t	hat are exposed, or w	ork based				2								
		inside human body.													
		to analyze biofluid 1													
CO4	-	in human body to	improve		3										
	healthcar														
CO5		o <b>critically</b> review rece scientific literature an				3						3			2
005		areas of research oppor	-			3						3			2
Numer		l used for mapping whi		3 95	high	2 2	me	lium	and	1 a	s lov	v leve	l of m	atchin	<u></u>
		RNING STRATEGY		<i>J</i> 43		., <i>2</i> ui		aru11.	., and	u	.5 101		111		<i></i>
		ning Activities										Eng	gagem	ent (he	ours)
	Face Learn	-												(	9
	Lecture	-												42	
	Practical /	Tutorial / Studio												-	
	Student-C	entred Learning												-	
Self-Dir	ected Learn	-													
		to-face learning												42	
	Revision of	of the previous and (or)	) subsequent	lect	ure at	t horr	ne							21	

Preparation	for final examination	ed by BME Departmen 21
Formal Assessment		21
Continuous	Assessment	2
Final Exami		3
Total		131
		151
TEACHING METH		
	on, Co-operative and collaborative method, Problem based method	
COURSE SCHEDU Week		A
<u>wеек</u>	Topic Overview of Fluid mechanics	Assessment
Lecture 1	Review of basic fluid mechanics	
Lecture 2	Biorheology	
Lecture 3	Constitutive equations	CT – 1, Final
2	Biofluid Properties and Circulatory System	<b>CI</b> – 1, Fillal
Lecture 4	Non-Newtonian fluid models	
Lecture 5	Circulatory system physiology	
Lecture 6	Function of circulatory system	
3	Circulation and it's Function	
Lecture 7	Function of circulatory system	
Lecture 8	circulation in heart, blood and lymphatic vessels	
Lecture 9	Blood properties	
4	Hemorheology and Pulsatile Flow	
Lecture 10	Hemorheology	
Lecture 11	Models for blood flow: Steady and pulsatile flow in rigid tube	
Lecture 12	Pulsatile flow in an elastic tube	
5	Wave Propagation and Circulatory System Applications	
Lecture 13	Wave propagation in rigid body	
Lecture 14	Wave propagation in elastic body	
Lecture 15	Application of wave propagation in circulatory system	
6	Blood Flow Dynamics and Heart Valve	Midterm, Final
Lecture 16	Blood flow dynamics in arteries and veins	
Lecture 17	Flow in specific vessels and arteries (Coronary artery disease)	
Lecture 18	Flow in specific vessels and arteries (Carotid artery disease)	
7	Blood Flow Dynamics and Heart Valve	
Lecture 19	Overview of heart valves and their functions	
Lecture 20	Heart-valve hemodynamic	
Lecture 21	Heart valve disease and flow analysis for analyzing heart valve	
	Midterm Break	
8	Disease Related to Blood Flow	
Lecture 22	Overview of diseases related to blood flow obstruction	
Lecture 23	Obstructive coronary artery diseases (Stenosis)	
Lecture 23	Tortuosity and Eccentricity in coronary artery disease	
Lociule 27	progression	
9	Disease Related to Blood Flow	
Lecture 25	Overview and causes of stroke	CT – 2, Final

ASSESSMENT S		
Lecture 42	Review	
Lecture 41	Ultrasonic and Electromagnetic flow measurement techniques	
	body	
Lecture 40	Overview of different flow measurement techniques in human	
14	Flow Measurement Techniques	FINAL
Lecture 39	Gas exchange and transport principles	
Lecture 38	Mechanics of breathings	
Lecture 37	Alveolar ventilation and air flow in lungs	
13	Respiratory System Fluid Dynamics	*
Lecture 36	Biofluid mechanics involved in brain disease	CT – 3, FINAL
Lecture 35	Blood brain barrier	
Lecture 34	Cerebrospinal fluid and cerebral blood flow dynamics	
<b>12</b>	Brain Fluid Dynamics	
Lecture 32	Arthritis, Knee and Hip Injury	
Lecture 31 Lecture 32	Lubrication theory, Application for synovial fluid flow	
11 Lecture 31	Synovial Fluid in Joints           Synovial fluid properties and rheology	
Lecture 30	Disease related synovial fluid	
Lecture 29	Function and importance of fluid flow in synovial fluid	
Lecture 28	Synovial joints physiology	
10	Synovial Fluid in Joints	
	aneurysm)	
Lecture 27	Obstructive blood flow related to stroke (Carotid artery	
	stenosis)	
Lecture 26	,	

Com	ononta	Grading	СО	Blooms Taxonomy
Com	oonents	Glaung		
	Class Test/			
Continuous	Assignment	20%	CO1, CO2, CO4	C2, C6, C4
Assessment	1-3			
(40%)	Class	5%	CO3	C5
(40%)	Participation	370	003	63
	Midterm	15%	CO3	C5
			CO 1	C2
Einal	Exam	60%	CO 2	C6
Final	Exam	00%	CO 3	C5
		Ē	CO 4	C4
Total	Marks	100%		
(CO = Course	e Outcome, C = 0	Cognitive Domai	in)	
TEXT BOOK	KS			
1. Applied Bio	ofluid Mechanics,	Lee Waite and J	erry Fine. ISBN -10: 0-07-1472	217-7
REFERENC	E BOOKS			
1. A Brief Intr	oduction to Fluid	Mechanics, You	ng, Munson, and Okiishi; Fifth	Edition
REFERENC	E SITE			

# 6.2.4.2 BME 435 Biomedical Implants and Braces

					: 3.00	)		
Cours	se Code	: BME 435	Lecture Contact H	Iours	: 3.00	)		
	se Title	: Biomedical Implants	Credit Hours		. 5.00	5		
		1						
PRE-	REQUISIT	Е						
		STRUCTURE						
		ducation (OBE)						
	OPSIS/RAT							
	-	s the solution of clinical proble	•				-	•
		cell-matrix control volumes; th						
		selection of biomaterials; instr						
	-	cacy, including risk/benefit ration			-			esign of clinic
rials,	surface mod	lification, corrosion and triboc	orrosion aspects of i	mplants a	nd clin	nical con	ncern etc.	
OBJI	ECTIVE							
. T	o familiarize	students with various types of	implants and their p	oroperties				
		with different biomaterials invo		-				
		fferent design consideration an	-	-	nt desi	gning a	nd fabrica	tion.
		COMES & GENERIC SKILL	-	1		<u> </u>		
No.		Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessme Methods
CO1	Be able	to explain principles of imp	plant C2	1	1		1	ть
COI	modelling		C2	1		-	1	T, F
	D1.1.	4	C					
	Be able	to apply the knowledge	OI					
CO2	biomateria			1,3	1	-	1	T, F
CO2	biomateria	al selection and de		1,3	1	-	1	T, F
CO2	biomateria considerat	al selection and de tion for implant designing	esign C3	1,3	1	-	1	T, F
	biomateria considera Be able	al selection and de- tion for implant designing to <b>analyze</b> possible fa	esign C3 ilure		1	-		
	biomateria considera Be able mechanist	al selection and de- tion for implant designing to <b>analyze</b> possible fa n that can affect the perform	esign C3 ilure	1,3 2,8			1	T, F MID, F
CO2 CO3	biomateria considera Be able mechanisu and longe	al selection and de tion for implant designing to <b>analyze</b> possible fa in that can affect the perform vity of the implant	esign C3 ilure ance C4					
CO3	biomateria considera Be able mechanisu and longe Be able to	al selection and de- tion for implant designing to <b>analyze</b> possible fa n that can affect the perform vity of the implant o <b>evaluate</b> implant monitoring	esign C3 ilure ance C4	2,8	1		1,3	MID, F
CO3	biomateria considerat Be able mechanist and longe Be able to different	al selection and de tion for implant designing to <b>analyze</b> possible fa in that can affect the perform vity of the implant o <b>evaluate</b> implant monitoring diagnostic techniques involve	esign C3 ilure ance C4					
	biomateria considerat Be able mechanist and longe Be able to different implant m	al selection and de tion for implant designing to <b>analyze</b> possible fa in that can affect the perform vity of the implant <b>evaluate</b> implant monitoring diagnostic techniques involve onitoring	csign C3 ilure ance C4 g and d in C5	2,8	1		1,3	MID, F
CO3 CO4	biomateria considera Be able mechanisa and longe Be able to different implant m Be able t	al selection and de tion for implant designing to <b>analyze</b> possible fa in that can affect the perform vity of the implant <b>evaluate</b> implant monitoring diagnostic techniques involve onitoring o critically <b>review</b> recent art	esign C3 ilure ance C4 g and d in C5 icles	2,8	1	-	1,3	MID, F T, F
CO3 CO4	biomateria considera Be able mechanisu and longe Be able to different implant m Be able t from the	al selection and de- tion for implant designing to <b>analyze</b> possible fa in that can affect the perform vity of the implant <b>o evaluate</b> implant monitoring diagnostic techniques involve onitoring o critically <b>review</b> recent art scientific literature and ide	esign C3 ilure ance C4 g and d in C5 icles	2,8	1		1,3	MID, F
CO3 CO4 CO5	biomateria considerat Be able mechanist and longe Be able to different implant m Be able t from the relevant a	al selection and de tion for implant designing to <b>analyze</b> possible fa in that can affect the perform vity of the implant <b>evaluate</b> implant monitoring diagnostic techniques involve onitoring o critically <b>review</b> recent art scientific literature and ide reas of research opportunities.	esign C3 ilure ance C4 g and d in C5 icles ntify C6	2,8 2 3,9,12	1 1 5	5	1,3 1,3 5	MID, F T, F PR, Pr, F
CO3 CO4 CO5	biomateria considera Be able mechanisu and longe Be able to different implant m Be able t from the relevant a	al selection and de tion for implant designing to <b>analyze</b> possible fa n that can affect the perform vity of the implant <b>evaluate</b> implant monitoring diagnostic techniques involve onitoring o critically <b>review</b> recent art scientific literature and ide reas of research opportunities. oblems, CA-Complex Activitie	esign C3 ilure ance C4 g and d in C5 icles ntify C6 es, KP-Knowledge P	2,8 2 3,9,12	1 1 5	5	1,3 1,3 5	MID, F T, F PR, Pr, F
CO3 CO4 CO5 (CP- 0 Assig	biomateria considera Be able mechanisu and longe Be able to different implant m Be able t from the relevant a	al selection and de tion for implant designing to <b>analyze</b> possible fa in that can affect the perform vity of the implant <b>evaluate</b> implant monitoring diagnostic techniques involve onitoring o critically <b>review</b> recent art scientific literature and ide reas of research opportunities.	esign C3 ilure ance C4 g and d in C5 icles ntify C6 es, KP-Knowledge P inal Exam)	2,8 2 3,9,12 Profile, T	1 1 5 – Test;	5	1,3 1,3 5 Project; Q	MID, F T, F PR, Pr, F

Clinical Problems Requiring Implants for Solution: introduction to irreversibility of injury, overview of regeneration, problems and recommended implants for solution. Principles of Implant design; Missing Organ and Its Replacement: transplantation, autografting, permanent prosthesis, stem cells, in vitro synthesis, induced organ regeneration. Biomaterial for Implants: types and requirements for ideal implant materials, functional properties, surface characterization and preparation, sterilization. Instruments for Surgical Implantation Procedures; Implants for Bone: clinical problem, materials for bone implants, application and procedure involved in bone implantation. Spinal Implants; Dental and Otologic Implant; Implants for Plastic Surgery: materials and their properties, chin implants, jaw implants and chick implants. Implants for Cardiovascular System: cardiac resynchronization therapy and cardiac assisted devices, pacemaker and implantable cardiac defibrillator. Biocompatibility: Local and Systemic Effects; Degradation of Device: corrosion of Metals, degradation of nonabsorbable and absorbable polymers. Nerve Regeneration: synthesis of nerve fibers, device for nerve stimulation (TENS and EMS). Diagnostic Techniques Available for Implant Monitoring.

SKILL	MAPPING												
	1				PR	OGI	2 4 1	101	TCC	MES	(PO)		
No.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to <b>explain</b> principles of implant modelling	3											
CO2	Be able to <b>apply</b> the knowledge of biomaterial selection and design consideration for implant designing	3		2									
CO3	Be able to <b>analyze</b> possible failure mechanism that can affect the performance and longevity of the implant		3						1				
CO4	Be able to <b>evaluate</b> implant monitoring and different diagnostic techniques involved in implant monitoring		3										
CO5	Be able to critically <b>review</b> recent articles from the scientific literature and identify relevant areas of research opportunities.			3						3			3
(Numer	ical method used for mapping which indicate	s 3 as	s high	i, 2 as	s me	dium	n, an	d 1 a	ıs low	v leve	l of m	atching	g)
	HING LEARNING STRATEGY g and Learning Activities									E		4 (1	)
	-Face Learning								_	Eng	gagen	nent (ho	juis)
1'acc-10	Lecture											42	
	Practical / Tutorial / Studio											-	
	Student-Centred Learning											-	
Self-Di	rected Learning												
	Non-face-to-face learning											42	
	Revision of the previous and (or) subsequen	t lect	ure a	t hon	ne							21	
	Preparation for final examination											21	
Formal	Assessment												
	Continuous Assessment									2			
	Final Examination									3			
Total											1	131	

#### TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

#### **COURSE SCHEDULE**

Week	Торіс	Assessment
1	Clinical Problems Requiring Implants for Solution	
Lecture 1	Introduction to irreversibility of injury	
Lecture 2	Overview of regeneration: spontaneous and induced	
Lecture 3	Problems and recommended implants for solution	
2	Principles of Implant design	CT – 1, Final
Lecture 4	Functional performance of the device (mechanical, chemical	
	and attachment vehicle)	
Lecture 5	Effects of the implant on the body	
Lecture 6	Effects of the body on the implant	
3	Missing Organ and Its Replacement	
Lecture 7	Overview of the methods to use for organ replacement	
Lecture 8	Transplantation, Autografting, Permanent prosthesis	
Lecture 9	Stem cells, In vitro synthesis, Induced organ regeneration	
4	Biomaterial for Implants	
Lecture 10	Types and requirements for ideal implant materials	
Lecture 11	Functional properties of the biomaterials (Bulk properties,	
	Surface properties and Chemical Properties)	
Lecture 12	Surface characterization and preparation, Sterilization	
5	Instruments for Surgical Implantation Procedures	
Lecture 13	Classes of instruments by function for surgical implantation	
	procedures	
Lecture 14	Functions of the instruments	Midterm, Final
Lecture 15	Characteristics and uses of the instruments	
6	Implants for Bone	
Lecture 16	Clinical problems that required bone implant	
Lecture 17	Biomaterial used for bone implants (functional, chemical and	
	mechanical properties)	
Lecture 18	Application and procedure involved in bone implantation	
7	Spinal Implants	
Lecture 19	Types of spinal implants (cages, hooks, plates, pedicle screws,	
	rods, spinal cord stimulator)	
Lecture 20	Material used and their characteristics	
Lecture 21	Usage and benefits of spinal implants	
	Midterm Break	
8	Dental Implant	
Lecture 22	Types of dental implants and their usage	
Lecture 23	Characteristics and functions of dental implants	
Lecture 24	Implantation procedure involved in dental surgery	
9	Implants for Plastic Surgery	

Lecture 25	Overview if implants used for plastic surgery	CT – 2, Final
Lecture 26	Materials used in plastic surgery and their properties	
Lecture 27	Chin implants, jaw implants and chick implants	
10	Implants for Cardiovascular System	
Lecture 28	Introduction to implantable cardiac devices	
Lecture 29	Overview of pacemaker and implantable cardiac defibrillator,	
Lecture 30	stent (material and functions), Heart Valves	
	Overview cardiac resynchronization therapy and cardiac assisted devices	
11	Biocompatibility: Local and Systemic Effects	
Lecture 31	Overview of biocompatibility	
Lecture 32	Chemical effect related to biocompatibility	
Lecture 33	Mechanical effect: alteration on strains in surrounding tissue,	
	Electrical and Thermal effects	
12	Degradation of Device	
Lecture 34	Corrosion of Metals	
Lecture 35	Degradation of nonabsorbable polymers	CT – 3, FINAL
Lecture 36	Degradation of absorbable polymers	
13	Nerve Regeneration	
Lecture 37	Parameters for study of nerve regeneration	
Lecture 38	Synthesis of nerve fibers	
Lecture 39	Device for nerve stimulation (TENS and EMS)	
14	Diagnostic Techniques Available for Implant Monitoring	
Lecture 40	Overview of diagnostic techniques for implant monitoring	FINAL
Lecture 41	Evaluation of bone implant interface and Radiographic	
	Evaluation	
Lecture 42	Review	

#### ASSESSMENT STRATEGY

~			СО	Blooms Taxonomy				
Comp	oonents	Grading						
	Class Test/							
Continuous	Assignment	20%	CO2, CO3	C2, C3, C5				
Assessment	1-3							
(40%)	Class	5%	_					
(4070)	Participation	570	-	-				
	Midterm	15%	CO3	C4				
			CO 1	C2				
Einal	Exam	60%	CO 2	C3				
Final	Exam	00%	CO 3	C4				
			CO 4	C5				
Total	Marks	100%						
(CO = Course	e Outcome, C = O	Cognitive Domain	)					
TEXT BOOK	KS							
1. LIMSwiki,	1. LIMSwiki, Introduction to Implants: Devices, Procedures, and Conditions Requiring Them (Volume 1)							

**REFERENCE BOOKS** 

1. Yannas, I. V. Tissue and Organ Regeneration in Adults. New York, NY: Springer, 2001. ISBN: 9780387952147. **REFERENCE SITE** 

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## 6.2.4.3 BME 437 Neuroscience and Neural Engineering

Cours	e Code	: BME 437	Lectu	are Contact	t Hours	: 3.00	)			
Cours	e Title	: Neuroscience and Neural		it Hours	: 3.00					
		Engineering					. 5.00			
PRE-	REQUISIT	TF.								
	-	an Anatomy								
		an Physiology								
		I STRUCTURE								
Outco	me Based I	Education (OBE)								
SYNC	DPSIS/RAT	FIONALE								
This o	course aim	s to provide fundamental know	vledge a	about neur	oscience	and t	he bas	ic meel	hanism of 1	neura
engine	eering and a	associated devices.								
OBJE	CTIVE									
l. To	o provide k	nowledge about the fundamental	knowled	lge about t	he neuro	science	;			
		lents to learn about the basic mec		-				ted dev	ices.	
		COMES & GENERIC SKILLS			0	U				
COU	KSE OU IV	Bloom's							Assess	mer
No.		Course Outcome	Ta	axonomy	PO	СР	CA	KP	Meth	
CO1	connectiv	to <b>remember</b> the function rity of brain with other organs		C1	1	1	-	1,2	T, MI	D, F
		to understand the mechanism	of							
CO2	neuroscie associate		and	C2	1	1,2	-	1,2	Τ,	F
	Be abl	8 11 1	iate						Τ,	F
CO3		abilitation for various neu	ıral	C4	1	1	-	1		
	disorders									
CO4		apply neurostimulation techniq nerve activity.	ues	C3	6	1	-	1	Τ,	F
	Be able	to critically review recent artic	les							
CO5		scientific literature and ident treas of research opportunities.	tify	C6	3,9,12	5	5	5	PR, F	r, R
(CP- 0		oblems, CA-Complex Activities	KP-Kn	owledge P	rofile. T	– Test:	PR - 1	Proiect:	O - Ouiz: A	SG
	-	Presentation; R - Report; F – Fir		-	, -	,		j,	<b>( (</b> , )	
	Remember	C2 - Understand C3 - A		C4 - Ana	lyze	C5 -	Evalua	te	C6 - Creat	e
				1	5	-			1	
COIII	RSE CON	FFNT								
			<i>.</i>			-4:- 1	NT			
	•	Biology of brain, Structural		•					•	
		Molecular Neuroscience, Neura unction and motor actions, Sen		-		-				
-cur0	Jinuseulai J	anonon and motor actions, Sen	loory ne		, rourai	mon	auton	P100033	ing and real	

Nueroplasticity and neurorehabilitation. **Functional Neuroimaging:** Functional neuroimaging basis and applications of EEG, EMG, fMRI, DTI, fNIRS, etc.

**Motor System:** Pattern of neuro-signal, neurosignal processing, Brain-computer interfaces, Firing rate estimation, Population vectors; **Visual System:** visual evoked potential (VEP), VEP Stimuli, VEP Electrode Placement, VEP Waves and Types, Retinal Implants; **Auditory System:** Auditory evoked potentials, Brainstem auditory evoked potentials, Cochlear Implants; **Neurostimulations:** Introduction to Functional Electrical Stimulation (FES), Muscular FES, Peripheral FES, Electrocortical Stimulation, transcranial magnetic stimulation, deep brain stimulation; **Neuromodulation and Applications:** Noninvasive Neuromodulation Methods and Functional Applications (TMS, rTMS, TDC), Recent Trends of Neural Engineering.

SKILL MAPPING

No.	Course Learning Outcome		PROGRAM OUTCOMES (PO)										
INO.	Course Learning Outcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to <b>remember</b> the functional connectivity of brain with other organs	3											
CO2	Be able to <b>understand</b> the mechanism of neuroscience, neural engineering, and associated devices	2											
CO3	Be able to <b>categorize</b> appropriate neurorehabilitation for various neural disorders.	2											
CO4	Be able to <b>apply</b> neurostimulation techniques to restore nerve activity.						3		1				
CO5	Be able to critically <b>review</b> recent articles from the scientific literature and identify relevant areas of research opportunities.			3						9			3
(Numer	ical method used for mapping which indicates	s 3 as	high	, 2 as	s me	lium	n, an	d 1 a	s low	leve	l of m	atching	)
TEACE	IING LEARNING STRATEGY												
Teachin	g and Learning Activities									Eng	gagen	nent (ho	urs)
Face-to-	Face Learning												
	Lecture											42	
	Practical / Tutorial / Studio									-			
	Student-Centred Learning											-	
Self-Dir	ected Learning												
	Non-face-to-face learning											42	
	Revision of the previous and (or) subsequent	t lect	ure a	t hon	ne							21	
	Preparation for final examination											21	
Formal	Assessment											_	
	Continuous Assessment											2	
	Final Examination											3	
Total												131	
TEACH	HING METHODOLOGY												
Lecture	and discussion, Co-operative and collaborativ	/e me	ethod	, Pro	blem	bas	ed m	netho	d				

Week	Торіс	Assessment
1	Brain Anatomy	
Lecture 1	Biology of brain, Structural anatomy of Brain	
Lecture 2	Functional Neuroanatomy	
Lecture 3	Functional Neuroanatomy	
2	Neuroscience Fundamentals	CT – 1, Final
Lecture 4	Molecular Neuroscience	
Lecture 5	Neuromuscular junction and motor actions	
Lecture 6	Neuromuscular junction and motor actions	
3	Neuroscience Fundamentals	
Lecture 7	Cognitive and Behavioral neuroscience	
Lecture 8	Neural circuits and systems	
Lecture 9	Neural circuits and systems	
4	Neuroscience Fundamentals	
Lecture 10	Sensory neuroscience	
Lecture 11	Neural information processing and learning	
Lecture 12	Translational neuroscience and medicine, Clinical neuroscience	
5	Neural Disorders	
Lecture 13	Mechanisms underlying neurological disorders of stroke, , ,	
Lecture 14	Parkinson's disease	
Lecture 15	Alzheimer's disease or epilepsy	
6	Neural Disorders	Midterm, Final
Lecture 16	Dementia	
Lecture 17	Autism	
Lecture 18	Nueroplasticity and neurorehabilitation	
7	Functional Neuroimaging	
Lecture 19		
Lecture 20	Functional neuroimaging basis and applications of EEG,	
Lecture 21	EMG, fMRI, DTI, fNIRS, etc	
	Midterm Break	
8	Motor System	
Lecture 22	Pattern of neuro-signal,	
Lecture 23	Neurosignal processing, Brain-computer interfaces,	
Lecture 24	Firing rate estimation, Population vectors	
9	Visual System	
Lecture 25	Visual evoked potential (VEP), VEP Stimuli,	
Lecture 26	VEP Electrode Placement, VEP Waves and Types	CT – 2, Final
Lecture 27	Retinal Implants	
10	Auditory System	
Lecture 28	Auditory evoked potentials	
Lecture 29	Brainstem auditory evoked potentials	
Lecture 30	Cochlear Implants	
11	Neurostimulations	
Lecture 31	Introduction to Functional Electrical Stimulation (FES)	
Lecture 32	Muscular FES	

Lecture 33	Peripheral FES			
12	Neurostimulation			
Lecture 34	Electrocortical Stimulation			
Lecture 35	Transcranial magnetic stimulation			
Lecture 36	Deep brain stimulation	CT – 3, FINAL		
13	Neuromodulation and Applications			
Lecture 37				
Lecture 38	Lecture 38 Mail 1 1 Franciscular Line (TMG, TMG, TMG, TDG)			
Lecture 39	Methods and Functional Applications (TMS, rTMS, TDC),			
14	Neuromodulation and Applications	FINAL		
Lecture 40	Recent Trends in Neural Engineering			
Lecture 41	Case study on Recent Applications			
Lecture 42				
ASSESSMENT S	STRATEGY	•		

			СО	Blooms Taxonomy
Com	ponents	Grading	20	
Continuous Assessment	Class Test/ Assignment 1-3	20%	CO1, CO3, CO4	C2, C4
(40%)	Class Participation	5%	CO3	C2
	Midterm	15%	CO2	C3
	•		CO 1	C2
Einal	Exam	60%	CO 2	C3
Final	Exam	00%	CO 3	C2
			CO 4	C4
Total	Total Marks 100%			*
(CO = Cours	e Outcome, C = 0	Cognitive Doma	in)	
TEXT BOOK	KS			
1 Dolo Dury	as Gaorga I Aug	austing and at al	"Neuroscience" Third Edition	Singuar Associates 2004

1. Dale Purves, George J. Augustine, and et.al, "Neuroscience" Third Edition, Sinauer Associates, 2004.

 Charles Watson, Matthew Kirkcaldie, and George Paxinos, "The Brain: An Introduction to Functional Neuroanatomy," Academic Press, 2010..

#### **REFERENCE BOOKS**

1. Metin Akay (Edited), "Handbook of Neural Engineering," IEEE Press, 2007.

**REFERENCE SITE** 

## 6.2.4.4 BME 439 Biofabrication

### COURSE INFORMATION

Course Code	: BME 439	Lecture Contact Hours	: 3.00
Course Title	: Biofabrication	Credit Hours	: 3.00
PRE-REQUISIT	ΓE		

Course Code: BME 303 Course Title: Biomaterials

Course Code: ME 291

Course Title: Principles of Mechanical Engineering

#### CURRICULUM STRUCTURE

Outcome Based Education (OBE)

#### SYNOPSIS/RATIONALE

This course covers the module that include fabrication technology, protype fundamentals, CNC and CAM manufacturing, liquid, solid and powder based prototyping, biosensor fabrication, tissue regeneration, 3d organ printing and rapid prototyping for bone and prosthetics.

#### OBJECTIVE

- 1. To develop knowledge and understanding of the commercial use of additive manufacture and 3D printing for biomedical applications.
- 2. To learn how to use biomedical CAD/CAM software to design person specific medicaldevices.
- 3. To develop knowledge and understanding of biomaterials, and specifically how to select and evaluate biomaterials for a specific application.
- 4. To develop knowledge and understanding of bioprinting and biofabrication, and specifically the techniques by which cells and other biological materials may be processed.
- 5. To develop knowledge and understanding of the additive manufacture processes and process chains which can be used in biomedical applications, including those for biofabrication.

No.	Course Outcome	Bloom's Taxonomy	РО	СР	CA	KP	Assessment Methods
CO1	Be able to <b>explain</b> different additive manufacturing technologies available in the context of biofabrication.	C2	1	1	-	1,3	T, F
CO2	Be able to <b>understand</b> the benefits of additive manufacture in biomedical applications, bioprinting and biofabrication.	C2	1	1,3	-	1,3	T, F
CO3	Be able to work from a defined need to <b>develop</b> a product based on biomedical additive manufacture, including definition of the product workflow, the manufacturing process chain, and the route to market.	C6	3,4	1	-	1	MID, F
CO4	Be able to <b>evaluate</b> and <b>develop</b> opinions on the 3D printing industry and the resulting biomedical applications.	C5 & C6	2	1	-	1	T, F

#### **COURSE OUTCOMES & GENERIC SKILLS**

C1 - Remember	C2 - Understand	C3 - Apply	C4 - Analyze	C5 - Evaluate	C6 - Create
COURSE CONTI	ENT				

Introduction to Fabrication Technology, Overview of fabrication technique, Traditional vs Nontraditional machining, Traditional machining: Turning, Milling, Drilling, Boring, Reaming, Nontraditional Machining, Joining technology and Molding, Introduction to various non-traditional machining (Mechanical, Electrical, Electro-thermal and Chemical) process, Introduction to welding (Laser welding, electron beam welding) and soldering, Overview of molding processes (casting, compression molding, injection molding, extrusion molding), Introduction to Rapid Prototyping (RP), Fabrication Technologies, Prototype fundamental, Primary consideration and advantages of rapid prototyping, Classification and functions of different rapid prototyping techniques, Overview of CNC and CAM (Manufacturing), Introduction to computer numerical control (CNC) and computer assisted manufacturing (CAM) techniques, Manual and CAM control of CNC machine (Purpose of G-code, M-code and alphabetical command), Different types of tooling required for CNC mills, lathes and machine centers, Rapid Prototyping Process, Automated process, process chain, Overview of 3D modeling, data conversion and transmission, Preparation of model, building and postprocessing, Liquid-Based Rapid Prototyping Systems, Overview of few techniques involved liquid-based RP system (stereolithography apparatus (SLA), cubital's solid ground curing (SGC)), Overview of solid creation system (SCS) and solid object ultraviolet-laser printer (SOUP), Other liquid-based RP systems and microfabrication, Solid-Based RP systems

Introduction to laminated object manufacturing (LOM), fused deposition modeling (FDM), Techniques of paper lamination technology (PLT), Mult-jet modeling system (MJM), Few more solid-based RP techniques (SSM, MEM, M-RPM etc.), Powder-Based Rapid Prototyping Systems, 3D Systems' Selective Laser Sintering (SLS), Z Corporation's Three-Dimensional Printing (3DP), Optomec's Laser Engineered Net Shaping (LENS),, Fraunhofer's Multiphase Jet Solidification (MJS), RP Data Formation, STL file format and problems regarding, STL file formats, Consequences of building a valid and invalid tessellated model, STL file repair, newly proposed formats and standards for representing layered manufacturing, Process Parameters and General Engineering Applications, Application-Material Relationship, Finishing Processes, Applications in Design, Analysis and Planning, Applications in Manufacturing and Tooling; Aerospace Industry; Automotive Industry; Jewelry Industry, RP techniques for biosensor fabrication, Introduction to uses of RP in biosensor fabrication, RP of microfluidic system, Functionalization of biosensor and biomaterials compatibility, RP for Tissue Regeneration, RP technologies in tissue regeneration, 3D Organ Printing – Microvascular, Biomimetic model for microvasculature printing, Microvasculature printing strategies, Microvasculature post-printing stage, RP for bone and prosthetic limb, Bone: properties, structure, and modelling, The aim in designing a prosthetic limb, A biomimetic approach to design and fabricate Limb

#### SKILL MAPPING

No.	Course Learning O	utcome				PR	OG	RAM	101	JTCC	OMES	5 (PO)		
INO.	Course Learning O	utcome	1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to <b>explain</b> dif manufacturing technologic the context of biofabrication	es available in	3											
CO2	applications, bioprinting and biofabrication.													
CO3	Be able to work from a c develop a product based additive manufacture, inclu of the product w manufacturing process c route to market.	on biomedical iding definition orkflow, the			3	3								
CO4	Be able to <b>evaluate</b> and <b>de</b> on the 3D printing ind resulting biomedical applie	ustry and the		3										
Teachin Face-to	HING LEARNING STRAT g and Learning Activities Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning rected Learning	EGY									En		42 - -	ours)
	Non-face-to-face learning Revision of the previous an Preparation for final exami		lect	ure at	t horr	ne							42 21 21	
	Assessment Continuous Assessment Final Examination										2 3			
Total TEAC	HING METHODOLOGY												131	
	and discussion, Co-operative	e and collaborativ	e me	ethod	, Prol	olem	ı bas	ed n	netho	od				
	Week											As	sessme	nt
1		to Fabrication T	ech	nolog	y									-
Lecture		abrication technic		6	-									
	Lecture 2 Traditional vs Nontraditional machining													

Lecture 3	Traditional machining: Turning, Milling, Drilling, Boring,	ered by BME Department
Lecture 5	Reaming	
2	Nontraditional Machining, Joining technology and Molding	
Lecture 4	Introduction to various non-traditional machining (Mechanical,	-
	Electrical, Electro-thermal and Chemical) process	
Lecture 5	Introduction to welding (Laser welding, electron beam welding)	
-	and soldering	CT – 1 and Midterm,
Lecture 6	Overview of molding processes (casting, compression molding,	Final
	injection molding, extrusion molding)	
3	Introduction to Rapid Prototyping (RP)	-
Lecture 7	Fabrication Technologies, Prototype fundamental	-
Lecture 8	Primary consideration and advantages of rapid prototyping	_
Lecture 9	Classification and functions of different rapid prototyping	_
	techniques	
4	Overview of CNC and CAM (Manufacturing)	Midterm, Final
Lecture 10	Introduction to computer numerical control (CNC) and computer	
	assisted manufacturing (CAM) techniques	
Lecture 11	Manual and CAM control of CNC machine (Purpose of G-code,	-
	M-code and alphabetical command)	
Lecture 12	Different types of tooling required for CNC mills, lathes and	-
	machine centers	
5	Rapid Prototyping Process	-
Lecture 13	Automated process, process chain	-
Lecture 14	Overview of 3D modeling, data conversion and transmission	-
Lecture 15	Preparation of model, building and postprocessing	-
6	Liquid-Based Rapid Prototyping Systems	-
Lecture 16	Overview of few techniques involved liquid-based RP system	-
	(stereolithography apparatus (SLA), cubital's solid ground curing	
	(SGC))	
Lecture 17	Overview of solid creation system (SCS) and solid object	
	ultraviolet-laser printer (SOUP)	
Lecture 18	Other liquid-based RP systems and microfabrication	
7	Solid-Based RP systems	
Lecture 19	Introduction to laminated object manufacturing (LOM), fused	
	deposition modeling (FDM)	
Lecture 20	Techniques of paper lamination technology (PLT), Mult-jet	
	modeling system (MJM)	
Lecture 21	Few more solid-based RP techniques (SSM, MEM, M-RPM etc.)	
	MID TERM	
8	Powder-Based Rapid Prototyping Systems	
Lecture 22	3D Systems' Selective Laser Sintering (SLS)	
Lecture 23	Z Corporation's Three-Dimensional Printing (3DP)	
Lecture 24	Optomec's Laser Engineered Net Shaping (LENS), Fraunhofer's	1
	Multiphase Jet Solidification (MJS)	

9	RP Data	Formation						
Lecture 2	5 STL file	format and proble	ems regarding STL file formats					
Lecture 26	Consequ	ences of building	a valid and invalid tessellated mode	:1				
Lecture 27	STL file	repair, newly prop						
	represen	ting layered manu						
10	Process	Parameters and	General Engineering Applications	5				
Lecture 28	Applicat	ion-Material Relat	tionship, Finishing Processes					
Lecture 29	Applicat	ions in Design, Aı	nalysis and Planning		CT – 2, FINAL			
Lecture 30	Applicat	ions in Manufactu	ring and Tooling; Aerospace Indust	ry;				
	Automot	ive Industry; Jewe						
11		niques for biosen						
Lecture 31			in biosensor fabrication					
Lecture 32		icrofluidic system						
Lecture 33	Function	alization of bioser	nsor and biomaterials compatibility					
12		lissue Regenerati						
Lecture 34	RP techr	ologies in tissue r	regeneration					
Lecture 35		e for using laser as						
		ers for cell printing		_				
Lecture 36		caffold Fabricatio						
13		an Printing Micro						
Lecture 37			rovasculature printing,		CT – 3, FINAL			
Lecture 38		licrovasculature printing strategies						
Lecture 39		sculature post-prir						
14	RP for I	<b>Bone and Prosthe</b>						
Lecture 40	-	operties, structure						
Lecture 41		in designing a pro						
Lecture 42	A biomi	metic approach to	design and fabricate Limb					
FINAL EXA	MINATION							
ASSESSMEN	NT STRATEGY							
Com	oonents	Grading	СО	Blo	oms Taxonomy			
	Class Test/	Granng						
	Assignment	20%	CO1, CO3, CO4		C2, C4			
Continuous	1-3				,			
Assessment	Class	50/	602		62			
(40%)	Participation	5%	CO3		C2			
	Midterm 15% CO2				C3			
	•		CO 1		C2			
E21	Even	60%	CO 2		C3			
Final	Exam	60%	CO 3		C2			
			CO 4		C4			
Total	Marks	100%	1					

### (CO = Course Outcome, C = Cognitive Domain)

#### **TEXT BOOKS**

1.Rapid prototyping: principles and applications, 2nd edition, Chua C. K., Leong K. F., Lim C. S., World Scientific **REFERENCE BOOKS** 

1.Rapid prototyping of biomaterials: principles and applications, Woodhead Publishing

**REFERENCE SITE** 

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# CHAPTER 7 ANNEX-A

# 7.1 **Program Outcomes**

PO-1	<b>Engineering knowledge:</b> Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.	
PO-2	<b>Problem analysis:</b> Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)	
РО-3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)	
PO-4	<b>Investigation:</b> Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.	
PO-5	<b>Modern tool usage:</b> Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. (K6)	
PO-6	<b>The engineer and society:</b> Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)	
PO-7	<b>Environment and sustainability:</b> Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)	
PO-8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)	
PO-9	Individual work and teamwork: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	
PO-10	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	

Annex-A

P	20-11	<b>Project management and finance:</b> Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
P	PO-12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

# 7.2 Knowledge Profile

Attributes			
K1	A systematic, theory-based understanding of the natural sciences applicable to the discipline		
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline		
K3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline		
K4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline		
K5	Knowledge that supports engineering design in a practice area		
K6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline		
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability		
K8	Engagement with selected knowledge in the research literature of the discipline		

# 7.3 <u>Range of Complex Engineering Problem Solving</u>

Attributes	Complex Engineering Problems
Depth of knowledge required	<b>P1:</b> Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach
Range of conflicting requirements	<b>P2:</b> Involve wide-ranging or conflicting technical, engineering and other issues

	Annex-A
Depth of analysis required	<b>P3:</b> Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
Familiarity of issues	P4: Involve infrequently encountered issues
Extent of applicable codes	<b>P5:</b> Are outside problems encompassed by standards and codes of practice for professional engineering
Extent of stakeholder involvement and conflicting requirements	<b>P6:</b> Involve diverse groups of stakeholders with widely varying needs
Interdependence	<b>P7:</b> Are high level problems including many component parts or sub- problems

# 7.4 **<u>Range of Complex Engineering Activities</u>**

Attributes	Complex activities
Range of resources	A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	A2: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	A3: Involve creative use of engineering principles and research- based knowledge in novel ways
Consequences for society and the environment	A4: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	A5: Can extend beyond previous experiences by applying principles-based approaches

### 7.5 **Bloom Taxonomy at a Glance**



*Ref: tips.uark.edu

# CHAPTER 8 ANNEX-B

# 8.1 <u>CO-PO Mapping for Entire Program</u>



### 8.2 <u>CO-PO Mapping by Different Levels</u>



### 8.3 <u>CO-PO Mapping for Sessional and Theory</u>



Annex-B





### 8.5 <u>CO-PO Mapping for Non-Departmental Courses</u>

