FACULTY OF ENGINEERING
DEGREE OF BACHELOR OF ENGINEERING IN BIOMEDICAL ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING

(REGULAR PROGRAMME)

CURRICULUM & SYLLABI

(2021-2022)

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Established Under Section 3 of UGC Act 1956)
COIMBATORE 641 021
INDIA.

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act 1956)

Eachanari Post, Coimbatore – 641 021. INDIA

FACULTY OF ENGINEERING

DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY (B. E. /B. Tech.)

REGULATIONS
(2021)

CHIOCE BASED CREDIT SYSTEM

Phone: 0422- 6471113 – 5; Fax No : 0422 – 2980022, 2980023
Email: info@karpagam.com
Web: www.kahedu.edu.in

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FACULTY OF ENGINEERING

DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY

REGULAR PROGRAMME

REGULATIONS 2021

CHOICE BASED CREDIT SYSTEM

These regulations are effective from the academic year 2021 – 2022 and applicable to the candidates admitted to B. E. / B. Tech. during 2021 - 2022 and onwards.

1. ADMISSION

Candidates seeking admission to the first semester of the eight semesters B. E./B.Tech DegreeProgramme:

Should have passed the Higher Secondary Examination (10+2) prescribed by the State Government / Central Government with Mathematics/ Physics/ Chemistry/ Computer Science/ Electronics/ Information Technology/ Biology/ Informatics Practices/ Biotechnology/ Technical Vocational subject/ Agriculture/ Engineering Graphics/ Business Studies/ Entrepreneurship. (Any of the above three subjects) or any similar Examination of any other institution/ University or authority accepted by the Karpagam Academy of Higher Education as equivalent thereto).

Should obtained at least 45% marks (40% marks in case of candidates belonging to reserved category) in the above subjects taken together.

(OR)

Passed min. 3 years Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) subject to vacancies in the First Year, in case the vacancies at lateral entry are exhausted. (The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)

Lateral Entry Admission

Candidates who possess Diploma in Engineering / Technology (10+3 or 10+2+2) awarded by the Directorate of Technical Education with passed minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology are eligible to apply for admission to the third semester of B. E./B. Tech.. Such candidates shall undergo two additional engineering subjects in the 3rd and 4th semester as prescribed by the University.

OR

Passed B.Sc. Degree from a recognized University as defined by UGC, with at least 45% marks (40% marks in case of candidates belonging to reserved category) and passed 10+2 examination with Mathematics as a subject.

OR

Passed D.Voc. Stream in the same or allied sector.
(The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)

Eligibility criteria for admission in the third semester is given in the table below.

S. No.	Programme	Eligibility criteria
1.	B.E Bio Medical Engineering	Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks incase of candidates belonging to reserved category) in ANY branch of Engineering and Technology. **OR** Passed B.Sc. Degree from a recognized University as defined by UGC, with at least 45% marks (40% marks in case of candidates belonging to reserved category) and passed 10+2 examination with Mathematics as a subject. **OR** Passed D.Voc. Stream in the same or allied sector. (The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)
2	B. E. Civil Engineering	
3.	B. E. Computer Science and Design	
4.	B. E. Computer Science and Engineering	
5.	B. E. Electrical and Electronics Engineering	
6.	B. E. Electronics and Communications Engineering	
7.	B. E.Mechanical Engineering	
8.	B. Tech. Artificial Intelligence and Data Science	
9.	B. Tech Bio - Technology	
10.	B. Tech Food Technology	

Migration from other University

Candidates who have completed their first to sixth semesters of B. E./B. Tech. study in any University are eligible to apply for admission to their next semester of B. E./B. Tech. in the branch corresponding to their branch of study. The student will be exempted from appearing for Examination of the equivalent courses passed in the earlier programme and will have to appear for courses which he/she has not done during the period of his/her earlier programme. Along with the request letter and mark sheets, he/she has to submit a copy of syllabus of the programme duly attested by the Registrar,Competent authority,he/she has undergone. Equivalence Certificate shall be provided by the "Students' Affairs Committee" of Karpagam Academy of Higher Education

.Students' Affairs Committee comprises all the Heads of the Departments and Dean of the Faculty of Engineering and a nominee of the Registrar.

2 . PROGRAMMES OFFERED

A candidate may undergo a programme in any one of the branches of study approved by the University as given below.

List of B. E. and B. Tech. Degree Programmes

1. B.E Bio Medical Engineering
2. B. E. Civil Engineering
3. B. E. Computer Science and Design
4. B. E. Computer Science and Engineering
5. B. E. Electrical and Electronics Engineering
6. B. E. Electronics and Communications Engineering
7. B. E. Mechanical Engineering
8. B.Tech. Artificial Intelligence and Data Science
9. B. Tech. Bio-Technology
10. B. Tech Food Technology

3. MODE OF STUDY

Full-Time:

In this mode of study, the candidates are required to attend classes regularly on the specified working days of the University.

Conversion from full time mode of study to part time is not permitted.

Change from one programme to another is not permitted.

4. STRUCTURE OF PROGRAMMES

Every programme will have a curriculum with syllabus consisting of theory and practical courses such as:

(i) General core courses comprising Mathematics, Basic Sciences, Engineering Sciences and Humanities.

(ii) Core courses of Engineering/Technology.

(iii) Elective courses for specialization in related fields.

(iv) Workshop practice, computer practice, engineering graphics,laboratory work, in-plant training, seminar presentation, projectwork, industrial visits, camps, etc.

Every student is encouraged to participate in at least any one of the following programmes

- NSS / Sports/Physical exercise/NCC/YRC/Red Ribbon club/Environment club and Energy club
- Other Co-Curricular and Extra Curricular activities

(V) **Choice Based Credit System**

CBCS is introduced for students admitted in the academic year 2017-18. As per AICTE guidelines, CBCS is an approach in which students opt for courses of their choice. CBCS provides greater flexibility with multiple courses and enable students to undergo additional courses. CBCS is applicable to Full Time Undergraduate & Post Graduate Programmes of study. It provides a choice for students to select from the prescribed courses(Professional soft core, Professional Hard core, Professional Electives, Open Electives, Value added courses, Humanity Sciences, Basic sciences & Engineering sciences). A course designated as hard core for a particular programme of study must invariably be completed by the student to receive the degree in the programme. The Hardcore courses cannot be substituted by another courses. Students can exercise their choice among a set of Soft core courses from the list of Soft core courses specified for each Programme of study.The student should meet the criteria for prerequisites to become eligible to register for that course.The student should request for the course for every semester within the first week of semester. Maximum no of students to be registered in each course shall depend on availablility of physical facilities, classroom availability and lab capacity. Registration of already requested courses by students in previous semester is not allowed.

Each course is normally assigned certain number of credits.

No. of credits per lecture period per week 1

No. of credits per tutorial period per week 1

No. of credits for 3 periods of laboratory course per week 2

No. of credits for 3 periods of project work per week 2

No. of credits for 2 periods of Value added course per week: 1

No. of credits for 3 weeks of in-plant training during

semester vacations 1

Inevery semester, the curriculum shall normally have a blend of theory courses not exceeding6and practical courses not exceeding 3. However, the total number of courses per semester shall not exceed 8.

The prescribed credits required for the award of the degree shallbe within the limits specified below.

PROGRAMME	PRESCRIBED CREDIT RANGE
B. E./B. Tech.	160– 165

The medium of instruction for all Courses, Examinations, Seminar presentations and Project/Thesis reports is English.

Value Added Course

Besides core courses and elective courses, value added course is introduced. The blend of different courses is so designed that the student would be trained not only in his / her relevant professional field but also as a socially conscious human being.

Evaluation in the courses comprises two parts, one is the Continuous Internal Assessment (CIA) and the other one is the End Semester Examination (ESE). Evaluation in few courses may be by Internal Assessment only.

5. DURATION OF THE PROGRAMME

The prescribed duration of the programme shall be

Programme	Min. No. of semesters	Max. No. of semesters
B. E./B. Tech. (H. Sc. Candidates)	8	14
B. E./B. Tech. (Lateral Entry Candidates)	6	12

Each semester shall normally consist of 90 working days or 540 hours.

Additional classes for improvement, conduct of model test, etc., over and above the specified periods shall be arranged, if required. But for the purpose of calculation of attendance requirement for eligibility to appear for the end semester Examinations (as per Clause 11) by the students, 540 hours conducted within the specified academic schedule alone shall be taken into account and the overall percentage of attendance shall be calculated accordingly.

6. REQUIREMENTS FOR COMPLETION OF THE SEMESTER

Ideally every student is expected to attend all classes and secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classesand the conduct of the candidate has been satisfactory during the course.

A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in University / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmeswith prior permission from the Registrar shall be given exemption from prescribed attendance requirements and shall be permitted to appear for the Examination on the recommendation of the Head of the Department concerned and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean. However, the candidate has to pay prescribed condonation fees.

Candidates who are not recommended for condonation and those who have less than 65% attendance will not be permitted to proceed to the next semester and have to redo the course. However, they are permitted to write the arrear Examinations, if any.

7. CLASS ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Class Advisor for those students throughout their

period of study. Such Class Advisors shall advise the students and monitor the courses undergone by the students, check the attendance and progress of the students and counsel them periodically. If necessary, the Class Advisor may display the cumulative attendance particulars in the Department notice board and also discuss with or inform the Parents/Guardian about the progress of the students. Each student shall be provided with course plan for each course at the beginning of each semester.

8. CLASS COMMITTEE

Every class shall have a class committee consisting of teachers of the class concerned, Maximum of six student representatives [boys and girls] and the concerned Head of the Department. It is like the 'Quality Circle' with the overall goal of improving the teaching-learning process. The functions of the class committee include

- Clarifying the regulations of the degree programme and the details of rules therein particularly Clause 4 and 5 which should be displayed on Department Notice-Board.
- Informing the student representatives the details of Regulations regarding weight age used for each assessment. In the case of practical courses (laboratory / drawing / project work / seminar, etc.) the breakup of marks for each experiment / exercise /module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Solving problems experienced by students in the class room and in the laboratories.
- Informing the student representatives the academic schedule, including the dates of assessments and the syllabus coverage for each assessment.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any and requesting the teachers concerned to provide some additional academic support.

The class committee for a class under a particular branch is normally constituted by the Head of the Department. However, if the students of different branches are mixed in a class (like the first semester which is generally common to all branches), the class committee is to be constituted by the Dean.

The class committee shall be constituted within the first week of each semester.

The Chairperson of the Class Committee may convene the meeting of the class committee.

The Dean may participate in any Class Committee of the Faculty.

The Chairperson is required to prepare the minutes of every meeting, submit the same to Dean through the HOD within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the

Management, the same shall be brought to the notice of the Registrar by the HOD through Dean.

The first meeting of the Class Committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two subsequent meetings may be held in a semester at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

9. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course Committee' shall meet to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper for the Internal Assessment test(s).

10. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' (Log book) which consists of attendance marked in each theory or practical or project work class, the test marks and the record of class work (topic covered), separately for each course.

Continuous Internal Assessment (CIA): The performance of students in each subject will be continuously assessed by the respective teachers as per the guidelines given below:

THEORY COURSES:

S. No.	CATEGORY	MAXIMUM MARKS
1.	Assignment	5
2.	Seminar *	5
3.	Attendance	5
4.	Test – I	8
5.	Test – II	8
6.	Test – III	9
Continuous Internal Assessment : TOTAL		40

*Evaluation shall be made by a committee.

PATTERN OF TEST QUESTION PAPER (Test I & II)

INSTRUCTION	REMARKS
Maximum Marks	60
Duration	2 Hours
Part- A	1 to 9 Two Mark Questions, uniformly covering the two units of the syllabus. All the 9 Questions are to be answered. (**9 x 2 =18Marks)**.
Part- B	Question 10 to 12 will be of either or type, covering two units of the syllabus. Each Question may have subdivision. (**3 x 14 =42 Marks)**.

PATTERN OF TEST QUESTION PAPER(Test III)

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part - A	Part A will be online Examination. 20 Objective type Questions, Covering all the 5 units. **(20 x 1= 20 Marks) (Online Examination).**
Part- B	21 to 25 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. (**5 x 2= 10Marks)**.
Part- C	Question 26 to 30 will be of either or type, covering Five units of the syllabus. Each Question may have subdivision. **(5 x 14=70 Marks).**

PRACTICAL COURSES:

S. No	CATEGORY	MAXIMUM MARKS
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Model Examination	15
5.	Viva – Voce [Comprehensive]	10
Continuous Internal Assessment: TOTAL		40

Every practical exercise / experiment shall be evaluated based on the conduct of exercise/ experiment and records maintained.

INTEGRATED THEORY AND PRACTICAL COURSES:

The Continous Internal Assessment for Integrated Theory Course is awarded for 40 Marks with mark split up similar to regular theory course.

The external evaluation of integrated practical component from End semester Examinatiion by internal mode is awarded for 50 Marks and later scaled down to 15 Marks and similarly the external evaluation for integrated theory from End semester Examinatiion is awarded for 100 Marks and later scaled down to 45 Marks. Hence the external assessment for Integrated theory and practical components contribute to 60 Marks.

ATTENDANCE

Attendance carries a maximum of 5 marks and the distribution is as under:

S. No.	Attendance %	Marks
1	91 and above	5.0
2	81-90	4.0
3	76-80	3.0

PROJECT WORK/ INTERNSHIPS:

Final year project work will be always in-house. However, as a special case, if a student is able to get a project from a government organization or private or public sector company,, the student may be permitted to do his/her project work in reputed institution/research organization/industry. Hence final year students may have commencement of eighth semester classes for 30 days in fast track mode and complete their final semester and are made eligible for undergoing Internships in Industry and also interested students are permitted for doing projects in Industries.

CERTIFICATION COURSES :

Students have to undergo a minimum of one value added course beyond curriculum as a certified course per semester for duration not less than 30 hours**.**

11. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION (ESE)

A candidate shall normally be permitted to appear for the ESE of any semester commencing from I semester if he/she has satisfied the semester completion requirements (Subject to Clause 5) and has registered for Examination in all courses of the semester. Registration is mandatory for Semester Examinations as well as arrearExaminations failing which the candidate will not be permitted to attend the next semester. A candidate already appeared for a subject in a semester and passed the Examination is not entitled to reappear in the same subject of the semester for improvement of grade.

12. END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each subject, for 100 marks, later scaled down to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part - A	Part A will be online Examination. 20 Objective type Questions. Covering all the 5 units. **20*1= 20 Marks (Online Examination)**
Part- B	21 to 25 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. (**5 *2= 10Marks)**.
Part- C	Question 26 to 30 will be of either or type, covering Five units of the syllabus. Each Question may have subdivision. **(5*14=70 Marks)**

13. PASSING REQUIREMENTS

Passing minimum: The passing minimum for CIA is 20 (i.e. out of 40 marks). The passing minimum for ESE is 30 (i.e. out of 60 marks). The overall passing minimum for theory/laboratory course is 50 (Sum of his/her score in CIA and ESE) out of 100 marks.

The passing minimum for value added course is 50 marks out of 100marks. There will be two tests, the first covering 50% of syllabus for 50 marks and the other for 50 marks.

If the candidate fails to secure a pass in a particular course ESE, itis mandatory that candidate shall register and reappear for the Examination in that course during the subsequent semester when Examination is conducted in that course. Further the candidate should continue to register and reappear for the Examination till a pass is secured in such supplementary Examination within the stipulated maximum duration of the programme (Clause 5.1).

The CIA marks obtained by the candidate in his/her first or subsequent appearance where he/she secures a pass shall be retained by the office of the Controller of Examinations and considered valid for all remaining attempts till the candidate secures a pass in his/her ESE.

If the candidate fails to secure a pass in a particular course in CIA, it is mandatory that candidate shall register and reappear for the CIA in that course during the subsequent semesterwhen CIA is conducted in that course by the faculty member assigned for that particular course during that semester by the concerned HOD. Further, the candidate should continue to register and reappear for the CIA till a pass is secured in such subsequent Examination within the stipulated maximum duration of the programme (Clause 5.1).

If a candidate fails to secure a pass in value added course, he/she has to appear for the tests when course is conducted subsequently.

ONLINE COURSE(MOOC) COORDINATOR

To help students in planning their online courses and for general advice on online courses, the HOD shall nominate a MOOC coordinator for the online courses. The Online course MOOC coordinator

shall identify the courses which students can select for their programme from the available online courses offered by the different agencies periodically and inform the same to the students. Further, the coordinator shall advice the students regarding the online courses and monitor their course.

Student Shall study atleast one online course from Sawayam/NPTEL in anyone of the first seven semesters for which examination shall be conducted at the end of the course by the respective organization.body. The student can register to the course which are approved by the department. The student shall produce a pass certificate from the respective body befiorethe end of the seventh semester.

14. AWARD OF LETTER GRADES

All assessments of a course will be done on absolute mark basis. However, for the purpose of reporting the performance of a candidate letter grades, each carrying certain number of points will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
D	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AB		0	ABSENT

GRADE SHEET

After results are declared, Grade sheet will be issued to each student which will contain the following details:

i. The list of courses enrolled during the semester and the grade scored,

ii. The Grade Point Average (**GPA**) for the semester and

iii. The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of Credits (**C**) of courses enrolled and the Grade Points (**GP**) corresponding to the grades scored in those courses, taken for all the courses to the sum of the number of credits of all the courses in the semester.

$$GPA = \frac{\text{Sum of [C*GP]}}{\text{Sum of C}}$$

CGPA will be calculated in a similar manner, considering all the courses enrolled from First semester. **RA** grade and value added course will be excluded for calculating **GPA** and **CGPA**.

REVALUATION

Revaluation and Re-totaling is allowed on representation. A candidate can apply for revaluation of his/her semester Examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the Head of the Department and Dean. Revaluation is not permitted for Supplementary Examinations, Practical Examinations, Technical Seminars, In-plant Training and Project Work.

TRANSPARENCY AND GRIEVANCE COMMITTEE

A student may get the Photostat copy of the answer script on payment of prescribed fee, if he/she wishes. The students can represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HOD, the Dean of another Faculty nominated by the University), HOD of the Department concerned, the faculty of the course and Dean from other discipline nominated by the University and the COE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External Examiner will be final. The student has to pay prescribed fee for the same.

15. ELIGIBILITY FOR AWARD OF DEGREE

A student shall be declared to be eligible for award of Degree if he/she has

- Successfully gained the required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
- No disciplinary action is pending against him/her.

The award of the degree must be approved by the Board of Management of Karpagam

University.

16. CLASSIFICATION OF THE DEGREE AWARDED

A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses in his/her first appearance within the specified minimum number of semesters (vide Clause 5.1) securing a CGPA of not less than **8** shall be declared to have passed the Examination in First Class with Distinction.

A regular candidate or a lateral entrant is eligible to register for BE(Honors),B.Tech(Honors). If, he / she has passed all the courses in the first appearance and

holds / maintains a CGPA of 7.5 at VI Semester. He / she has to take an additional 20 credits by studying online courses through Swayam/NPTEL . Such a candidate is eligible for the award of BE (Honor),B.Tech(Honor). However, is he / she fails in securing 20 additional credits but maintains CGPA of 7.5 and above is not eligible for Honors degree but eligible for First class with Distinction.

A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses within the specified minimum number of semesters (vide Clause 5.1) plus one year (two semesters), securing CGPA of not less than **6.5**shall be declared to have passed the Examination in First Class.

16.3 All other candidates (not covered in Clauses 17.1 and 17.2) who qualify for the award of the degree (vide Clause 15) shall be declared to have passed the Examination in Second Class.

17. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

A candidate may for valid reasons and on prior application, be granted permission to Withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination. Such withdrawal shall be permitted only once during the entire duration of the degree programme. Withdrawal application shall be valid only if the candidate is otherwise eligible towrite the Examination

.**17.3** Withdrawal application is valid only if it is made within 10 days prior to the commencement of the Examination in that course or courses and recommended by the Head of the Department, Dean and approved by the Registrar.

17.3.1 Notwithstanding the requirement of mandatory TEN days notice, applications for withdrawal for special cases under extraordinary conditions may be considered on the merit of the case.

Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during IIIsemester.

Withdrawal from the ESE is NOT applicable to arrear Examinations.

The candidate shall reappear for the withdrawn courses during the Examination conducted in the subsequent semester.

18. PROVISION FOR AUTHORISED BREAK OF STUDY

Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he/she applies to the Registrar, through the Head of the Department and Dean stating reasons thereof and the probable date of rejoining the programme.

The total number of semesters for completion of the programme from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum no. of semesters specified in Clause 5.1 irrespective of the period of break of study (vide Clause 18) in order that he/she may be eligible for the award of the degree (vide Clause 15). The candidate thus permitted to rejoin the programme at the commencement of the semester after the break shall be governed by the curriculum and regulations in force at the time of rejoining. Such candidates may have to do additional courses as per the curriculum and regulations in force at that period of time.

The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification (vide Clause17). However, additional break of study granted will be counted for the purpose of classification.

The total period for completion of the programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in Clause 5.1 irrespective of the period of break of study (vide Clause 18.3) in order that he/she maybe eligible for the award of the degree.

If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Withdrawal' or 'Break of Study' (Clause18 and 18 respectively).

19. SUPPLEMENTARY ESE: After the publication of VIII semester results,if a student has **ONE** arrear in any theory course of the entire programme, he/she will be permitted to apply within 15 days of the publication of results, and appear for supplementary Examination.

20. INDUSTRIAL VISIT

Every student is required to undergo one industrial visit for every semester, starting from the third semester of the programme.

21. DISCIPLINE

Every student is required to observe discipline and decorous behavior both inside and outside the University and not to indulge in any activity which will tend to bring down the prestige of the University. The erring student will be referred to the Disciplinary Committee constituted by the University, to enquire into acts of indiscipline and recommend to the University about the disciplinary action to be taken.

If a student indulges in malpractice in any of the ESE/CIA he/she shall be liable for punitive action as prescribed by the University from time to time.

22. REVISION OF REGULATION AND CURRICULUM

The University may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi, if found necessary on the recommendations of Board of Studies, Academic Council and Board of Management of Karpagam University.

B.E - BIOMEDICAL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

i. To design, implement and analyze the emerging discipline of biomedical engineering to address the healthcare challenges and opportunities.
ii. To develop a biomedical engineer with an adequate technical and soft skills to solve the complex problems in the field of biomedical industry, Health care industry, Biomedical Research, medicine, academia, and consulting.
iii. To build and lead cross-functional biomedical equipments upholding the professional responsibilities & ethical values.
iv. Engage in continuing education and life-long learning to be competitive and enterprising.

PROGRAMME OUTCOME (PO)

a. Apply knowledge of mathematics, basic sciences, engineering fundamentals and specialization to solve Health care problems

b. Identify , design, formulate analyze & interpret data

c. Design an integrated system with due considerations to public health, safely , societal and environment

d. Investigate , formulate and solve Health care industry problems

e. Acquire skills to use modern engineering tools and software to solve complex engineering problems

f. Apply societal and cultural issues in professional engineering practice.

g. Understand the impact of engineering solutions in global and societal context

h. Function as a member of multidisciplinary team

i. Communicate effectively both orally and in writing

j. Recognize the need for ability to engage in lifelong learning

k. Understand the project management and finance

l. Acquire knowledge to design, develop, predict and model a biomedical system with professional responsibility

PROGRAMME SPECIFIC OUTCOMES (PSOs)

m) To continuous update knowledge in the field of Diagnostic and Therapeutic Equipments and Bio-imaging techniques

n) To develop biomedical entrepreneurs with innovative products useful to our country

PEO – PO MAPPING

PEO/PO	a	b	c	d	e	f	g	h	i	j	k	l
i	✓	✓	✓	✓	✓					✓		
ii		✓	✓	✓		✓	✓	✓				
iii				✓					✓		✓	
iv		✓		✓					✓		✓	✓

PEO – PSO MAPPING

PEO/PSO	a	b
i	✓	✓
ii		✓
iii	✓	
iv		✓

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University Established Under Section 3 of UGC Act 1956)
FACULTY OF ENGINEERING
B.E (BIOMEDICAL ENGINEERING)
COURSE OF STUDY AND SCHEME OF EXAMINATION
(2021 BATCH ONWARDS)

Course code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credit(s)	Maximum Marks			Page No.
			PO	PEO	L	T	P		CIA	ESE	Total	
SEMESTER I												
21BECC101	English	HS	a,f,h,j,k	i,ii,iv	2	0	2	3	40	60	100	1
21BECC102	Mathematics –I	BS	a,b,h,j,k	Iv	3	1	0	4	40	60	100	3
21BECC141	Engineering physics	BS	a,c,h,j,k	i,iv	3	1	2	5	40	60	100	5
21BECC142	Engineering chemistry	BS	a,b,d,e,j	i,iv	3	0	4	5	40	60	100	8
21BECC143	Python programming	ES	a,b,c,d ,f,g,j	i,ii, iv	2	0	2	3	40	60	100	12
21BEBME144	Basic Electrical& Electronics Engineering	ES	a,c,f,h,j,l	ii,iv	3	1	2	5	40	60	100	15
SEMESTER TOTAL					**16**	**3**	**12**	**25**	**240**	**360**	**600**	
SEMESTER II												
21BECC201	Communicative English	HS	a,f,h,j,k	i,iv	2	0	2	3	40	60	100	18
21BECC202	Mathematics - II	BS	a,b,h,j,k	Iv	3	1	0	4	40	60	100	20
21BEBME203	Medical Physics	HS	a,c,h,j,k	i,iv	3	0	0	3	40	60	100	23
21BECC204	Environmental studies	ES	a,b,d,e,h, j,k	i,ii,iv	3	1	0	3	40	60	100	26
21BEBME205	Human Anatomy and Physiology	PC	f,g,h,j,l	i,iv	3	0	0	3	40	60	100	29
21BEBME241	Electronic Devices and Circuits	ES	a,c,f,h,j,l	ii,iv	3	1	2	5	40	60	100	32
21BEBME211	Engineering Graphics	ES	a,b,e,h,j, k	i,ii,iii,i v	1	0	4	3	40	60	100	34
MANDATORY COURSE												
21BEBME251	Disaster Management	MC	j,h,g	i,iv	2	0	0	0	100	0	100	37
SEMESTER TOTAL					**20**	**3**	**8**	**24**	**380**	**420**	**800**	

SEMESTER III												
THEORY												
21BEBME301	Mathematics – III (Linear Algebra and Partial Differential Equations)	BS	a,b,c,d ,f,g,j	i,ii, iv	3	1	0	4	40	60	100	39
21BEBME302	Digital Electronics	PC	a,b,d ,f,,j	i,ii, iv	3	0	0	3	40	60	100	42
21BEBME303	C++ and Data Structures	ES	a,b,c,d ,f,g,j	i,ii, iv	3	0	0	3	40	60	100	45
21BEBME304	Biomaterials	PC	a,b,c,d ,f,g,	i,ii, iv	3	0	0	3	40	60	100	47
21BEBME305	Fundamentals of Biochemistry	PC	a,b,c,d ,f,g,j	i,ii, iv	3	0	0	3	40	60	100	49
21BEBME306	Signal and systems	PC	a,b,c,d ,f,g,j	i,ii,	3	0	0	3	40	60	100	51
PRACTICALS												
21BEBME311	Biochemistry & Human Physiology Laboratory	PC	h,i,j,l	i,ii	0	0	2	1	40	60	100	53
21BEBME312	Digital Electronics Laboratory	PC	h,i,j,l	i,ii	0	0	2	1	40	60	100	54
MANDATORY COURSE												
21BEBME351	Indian constitution	MC	j,h,g	i,iv	2	0	0	0	100	0	100	56
SEMESTER TOTAL					**20**	**1**	**4**	**21**	**420**	**480**	**900**	
SEMESTER IV												
THEORY												
21BEBME401	Mathematics - IV (Probability and Statistics)	BS	a,b,d,j	i,ii, iv	3	1	0	4	40	60	100	58
21BEBME402	Linear Integrated Circuits	PC	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	60
21BEBME403	Biosensors and Transducers	PC	a,b,c,d,g, j	i,ii, iii, iv	3	0	0	3	40	60	100	62
21BEBME404	Microprocessor and Microcontroller	PC	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	64
21BEBME405	Pathology and Microbiology	PC	a,b,c,d,g, j	i,ii, iii, iv	3	0	0	3	40	60	100	66
PRACTICALS												
21BEBME411	Pathology and Microbiology Laboratory	PC	h,i,j,l	i,ii	0	0	2	1	40	60	100	68

21BEBME412	Microprocessor and Microcontroller Laboratory	PC	h,i,j,l	i,ii	0	0	2	1	40	60	100	70
21BEBME413	Biosensors and Transducers Laboratory	PC	h,i,j,l	i,ii	0	0	2	1	40	60	100	71
MANDATORY COURSE												
21BEBME451	Soft skills –Verbal & Reasoning	MC	h,i,j,l	i,ii	1	0	0	0	100	0	100	72
				SEMESTER TOTAL	**16**	**1**	**6**	**19**	**420**	**480**	**900**	
SEMESTER V												
THEORY												
21BEBME501	Modeling of physiology system	PC	a,b,c,d,g, j	i,ii, iii	3	1	0	4	40	60	100	74
21BEBME502	Biomedical Instrumentation	PC	a,b,c,d,g, j	i,ii, iii, iv	3	0	0	3	40	60	100	76
21BEBME503	Biomedical Signal Processing	PC	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	78
21BEBME504	Professional Ethics and Entrepreneurship development	HS	j,h,g	i, iv	3	0	0	3	40	60	100	80
21BEBME505	Artificial intelligence	PC	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	82
21BEBME5E --	Professional Elective I	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	84
PRACTICALS												
21BEBME511	Biomedical Instrumentation Laboratory	PC	h,i,j,l	i,ii	0	0	2	1	40	60	100	85
21BEBME512	Biomedical Signal Processing Laboratory	PC	h,i,j,l	i,ii	0	0	2	1	40	60	100	86
MANDATORY COURSE												
21BEBME551	Mini Project	MC	h,i,j,l	i,ii	0	0	2	0	100	0	100	87
				SEMESTER TOTAL	**18**	**1**	**6**	**21**	**420**	**480**	**900**	
SEMESTER VI												
THEORY												
21BEBME601	Biomedical Image processing	PC	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	89
21BEBME602	Biomechanics	PC	a,b,c,d,g, j	i,ii, iii, iv	3	1	0	4	40	60	100	90
21BEBME603	Diagnostic and Therapeutic Equipment	PC	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	93

21BEBME604	Hospital Management	PC	a,b,c,d,g, j	i,ii, iii, iv	3	0	0	3	40	60	100	95
21BEBME605	Rehabilitation Engineering	PC	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	98
21BEBME6E--	Professional Elective-II	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	101
PRACTICALS												
21BEBME611	Biomedical Image processing Laboratory	PC	h,i,j,l	i,ii	0	0	2	1	40	60	100	102
21BEBME612	Diagnostic and Therapeutic Equipments Laboratory	PC	h,i,j,l	i,ii	0	0	2	1	40	60	100	103
MANDATORY COURSE												
21BEBME651	Hospital Training	MC	h,i,j,l	i,ii	0	0	2	0	100	0	100	104
				SEMESTER TOTAL	**18**	**1**	**6**	**21**	**420**	**480**	**900**	
SEMESTER VII												
THEORY												
21BEBME701	Artificial Organs and Implants	PC	a,b,c,d,g, j	i,ii, iii, iv	3	0	0	3	40	60	100	105
21BEBME741	Virtual Bioinstrumentation	PC	a,b,c,d,g, j	i,ii, iii	1	0	4	4	40	60	100	107
21BEBME7E_ _	Professional Elective-III	PE	a,b,c,d,g, j	i,ii, iii, iv	3	0	0	3	40	60	100	110
21BEBME7E_ _	Professional Elective-IV	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	110
21BE_ _OE_ _	Open Elective-I	OE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	110
PROJECT												
21BEBME791	Project Work Phase- I	PW	h,i,j,l	i,ii	0	0	8	4	100	0	100	110
MANDATORY COURSE												
21BEBME751	Technical Seminar	**MC**	h,i,j,l	i,ii	2	0	0	0	100	0	100	110
SEMESTER TOTAL					**15**	**0**	**12**	**20**	**400**	**300**	**700**	
SEMESTER VIII												
THEORY												
21BEBME8E--	Professional Elective-V	PE	a,b,c,d,g, j	i,ii, iii, iv	3	0	0	3	40	60	100	111
21BEBME8OE--	Open Elective-II	OE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	111
PROJECT												
21BEBME891	Project Work Phase-II and viva-voce	PW	a,b,c,d,g, j	i,ii, iii,iv	0	0	16	8	120	180	300	111

SEMESTER TOTAL	**6**	**0**	**16**	**14**	**200**	**300**	**500**	
PROGRAMME TOTAL	**129**	**10**	**70**	**165**	**2900**	**3300**	**6200**	

LIST OF ELECTIVES
PROFESSIONAL ELECTIVES

Professional Electives are offered, based on three different domains such as Signal processing, IoT & Wearable Sensors and Product Development & Additive Manufacturing

S.No	Name of the Courses	Domain
1.	Bioergonomics	**Domain -I** **Signal processing**
2.	Biomedical Transport Phenomena	
3.	Biometric Systems	
4.	Brain Computer Interface and its applications	
5.	Communication and its Application in Medicine	
6.	Telehealth Technology	
7.	Virtual Reality and Augmented Reality	
8.	Neural engineering	
9.	Biomedical Photonics	**Domain -II** **IoT & Wearable Sensors**
10.	Bio MEMS	
11.	Embedded System in Medical devices	
12.	Internet of things	
13.	Lasers and Fiber Optics in Medicine	
14.	Robotics in medicine	
15.	Bio tech Prosthetic Equipments	**Domain -III** **Product Development & Additive Manufacturing**
16.	Design of Medical Implants and devices	
17.	Hospital waste management	
18.	Intellectual Property Rights	
19.	Nano Bio Engineering	
20.	Nanotechnology in Medicine	

Elective I

Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credit(s)	Maximum Marks			Page No.
			PO	PEO	L	T	P		CIA	ESE	Total	
21BEBME5E01	Bioergonomics	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	112
21BEBME5E02	Biomedical Photonics	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	114
21BEBME5E03	Communication and its Application in Medicine	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	116
21BEBME5E04	Hospital waste management	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	119

Elective II

Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credit(s)	Maximum Marks			Page No.
			PO	PEO	L	T	P		CIA	ESE	Total	
21BEBME6E01	Biomedical transport Phenomena	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	122
21BEBME6E02	Telehealth Technology	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	124
21BEBME6E03	Bio MEMS	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	127
21BEBME6E04	Nano Bioengineering	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	129

Elective III

Course code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credit(s)	Maximum Marks			Page No.
			PO	PEO	L	T	P		CIA	ESE	Total	
21BEBME7E01	Biometric Systems	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	132
21BEBME7E02	Neural Engineering	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	135
21BEBME7E03	Lasers and Fiber Optics in Medicine	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	138
21BEBME7E04	Biotech Prosthetic Equipments	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	140

Elective IV

Course code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credit(s)	Maximum Marks			Page No.
			PO	PEO	L	T	P		CIA	ESE	Total	
21BEBME7E05	Brain Computer Interface and its applications	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	142
21BEBME7E06	Embedded System in Medical devices	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	144
21BEBME7E07	Robotics in Medicine	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	146
21BEBME7E08	Design of Medical Devices and Implants	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	148

Elective V

Course code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credit(s)	Maximum Marks			Page No.
			PO	PEO	L	T	P		CIA	ESE	Total	
21BEBME8E01	Virtual Reality and Augmented Reality	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	150
21BEBME8E02	Internet of things	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	153
21BEBME8E03	Intellectual Property Rights	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	156
21BEBME8E04	Nanotechnology in Medicine	PE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	158

OPEN ELECTIVES

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Course code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credit(s)	Maximum Marks			Page No.
			PO	PEO	L	T	P		CIA	ESE	Total	
ELECTRONICS AND COMMUNICATION ENGINEERING												
21BEECOE01	Neural Networks and its applications	OE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	160
21BEECOE02	Principles of Modern Communication Systems	OE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	162
COMPUTER SECIENCE ENGINEERING												
21BECSOE01	Internet Programming	OE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	164
21BECSOE02	Machine Learning	OE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	167
BIOTECHNOLOGY												
20BTBTOE01	Bioreactor Design	OE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	170
20BTBTOE04	Fundamentals of Nanobiotechnology	OE	a,b,c,d,g, j	i,ii, iii	3	0	0	3	40	60	100	172

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act 1956)

Pollachi Main Road, Eachanari Post, Coimbatore – 641 021. INDIA

FACULTY OF ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING

S.No.	Course work-subject area	Credits/ Semester								Credits Total	No. of courses	Percentage
		I	II	III	IV	V	VI	VII	VIII			
1	Humanities and Social Sciences **(HS)**	3	6	-	-	3	-	-	-	12	4	7.27
2	Basic Sciences **(BS)**	14	4	4	4	-	-	-	-	26	6	15.76
3	Engineering Sciences **(ES)**	8	11	3	-	-	-	-	-	22	6	13.33
4	Professional Core **(PC)**	-	3	14	15	15	18	7	-	72	29	43.64
5	Professional Electives **(PE)**	-	-	-	-	3	3	6	3	15	5	9.09
6	Open Electives **(OE)**	-	-	-	-	-	-	3	3	6	2	3.64
7	Project Work **(PW)**	-	-	-	-	-	-	4	8	12	2	7.27
8	Mandatory Courses **(MC)**	-	-	-	-	-	-	-	-	0	6	0
9	Total	25	24	21	19	21	21	20	14	**165**	60	100
TOTAL CREDITS 165												

Semester-I

21BECC101 **ENGLISH** **4H-3C**

Instruction Hours/week: L:2 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students :

- To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
- To help students acquire their ability to speak effectively in real life situations.
- To inculcate the habit of reading and to develop their effective reading skills.
- To ensure that students use dictionary to improve their active and passive vocabulary.
- To enable students to improve their lexical, grammatical and communicative competence.
- To enable students to improve their technical writing

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Use English language for communication: verbal & non –verbal.
- Enrich comprehension and acquisition of speaking & writing ability.
- Gain confidence in using English language in real life situations.
- Improve word power: lexical, grammatical and communication competence.
- To guide the students to write business letters and other forms of technical writing.
- To enable students to prepare for oral communication in formal contexts.

Unit: I - **Basic Writing Skills** **9**

Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents - Techniques for writing precisely

Unit: 1I - Vocabulary Building **9**

The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance, with prefixes and suffixes from foreign languages in English to form derivatives. - Synonyms, antonyms, and standard abbreviations.

Unit: III - Grammar and Usage **9**

Subject-verb agreement - Noun-pronoun agreement - Misplaced modifiers – Articles – Prepositions – Redundancies - Clichés

Unit: IV - Listening and Reading Skills **9**

Note taking- viewing model interviews – listening to informal conversations – improving listening / reading comprehension – reading model prose / poems – reading exercise

Unit: V.-**Writing Practices** **9**

Comprehension - Précis Writing - Essay Writing Listening Comprehension - Common Everyday Situations: Conversations and Dialogues - Communication at Workplace – Interviews - Formal Presentations

Total periods : 45

Note: Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Sangeeta Sharma , Meenakshi	Technical Communication: Principles And Practice,	2nd Edition, OUP	2015
2	Sanjay Kumar and PushpLata	Communication Skills	Oxford University Press	2015
3	Liz Hamp - Lyons and Ben Heasly	Analyze Writing	Cambridge University Press	2006

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	F.T. Wood	Remedial English Grammar	Macmillan.	2007
2	Michael Swan	Practical English Usage	OUP.	2017

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-I

21BECC102 **MATHEMATICS-I** **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for the students

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To understand geometrical aspects of curvature and elegant application of differential calculus which are needed in Engineering applications.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model Engineering problems.
- To familiarize the student with functions of several variables which is the foundation for many branches of Engineering.
- To introduce sequence and series which is central to many applications in Engineering.

Course Outcomes

Upon completion of this course the students will be able

- To solve the rank, Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices and the students will be able to use matrix algebra techniques for practical applications.
- To equip the students to have basic knowledge and understanding in one field of materials, differential calculus
- To solve simple standard examples using the ideas of differential equations.
- To apply various techniques to solve Partial Differential Equations
- To develop the tool of power series for learning advanced Engineering Mathematics.
- To apply the knowledge acquired to solve various Engineering problems.

UNIT I - Matrices **12**

Introduction - Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic forms – Reduction to canonical form through orthogonal reduction. Simple problems using Scilab.

UNIT II – Differential Calculus **12**

Overview of Derivatives - Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes- Evolutes as Envelope of normals

UNIT III - Differential Equations **12**

Linear Differential equations of second and higher order with constant coefficients – Homogeneous equation of Euler's and Legendre's type – Method of variation parameters.

UNIT IV – Functions of Several Variables **12**

Partial derivatives- Homogeneous functions and Euler's theorem - Total derivative - Differentiation of implicit functions - Jacobians -Partial differentiation of implicit functions- Taylor's series for functions of two variables- Errors and approximations - Maxima and minima of functions of two variables- Lagrange's method of undetermined multipliers.

UNIT V - Sequences and series **12**

Sequences: Definition and examples – **Series:** Types and Convergence – Series of positive terms – Tests of convergence: Comparision test, Integral test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

Total periods : 60

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Grewal B.S.,	Higher Engineering Mathematics	43rd Edition Khanna Publishers	2014
2	Erwin Kreyszig	Advanced Engineering Mathematics	10th Edition, John Wiley	2016
3	N.P. Bali and Manish Goyal	A text book of Engineering Mathematics, Laxmi Publications	Laxmi Publications	2014

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Veerarajan T	Engineering Mathematics	Tata McGraw-Hill	2017
2	Ramana B.V	Higher Engineering Mathematics	TataMcGraw Hill	2017
3	Hemamalini. P.T	Engineering Mathematics	11th Reprint, Tata McGraw Hill	2014

WEBSITES:

1. www.efunda.com
2. www.mathcentre.ac.uk
3. www.intmath.com/matrices-determinants
4. www. Intmath.com/calculus/calculus-intro.php

Semester-I

21BECC141 ENGINEERING PHYSICS (THEORY & LAB) 6H-5C

Instruction Hours/week: L:3 T:1 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives

The Goal of this course is for students to

- To inculcate the basics of properties of matter and its applications.
- To study the basics of sound and ultrasonics with appropriate applications.
- To disseminate the fundamentals of thermal and quantum physics and their applications.
- To introduce the concepts of light, laser and fiber optics for diverse applications.
- To impart the basic knowledge of crystal and its various crystal structures.
- To analyse the relevant problems in engineering stream.

Course Outcomes

Upon completion of this course, the students will be able to

- Understand the elastic nature of materials.
- Infer the characteristics of laser for various engineering applications.
- Extend the knowledge on optical fiber for communication purposes.
- Illustrate the thermal properties of materials through various methods.
- Develop the idea of quantum mechanics through applications.
- Identify the different atomic arrangements of crystals and its defects.

UNIT I – PROPERTIES OF MATTER AND SOUND 12

Elasticity – basic definitions, stress - strain diagram - factors affecting elastic modulus and tensile strength – Poisson's ratio – Twisting couple - Torsion pendulum- bending of beams – bending moment – young's modulus – cantilever method, uniform and non-uniform bending – I- shaped girders.

Loudness, decibel, echo, reverberation, Sabine's formula, Ultrasonic – Production, Industrial and medical applications.

UNIT II – LIGHT, LASER AND FIBER OPTICS 12

Light – interference – reflection, refraction – Air wedge - LASER- Principle – characteristics - emission and absorption process - Einstein's coefficients derivation. Types of LASER - Nd:YAG, CO_2, Semiconductor LASER- Applications of LASER in industry and medicine.

Fiber optics: Total internal reflection – modes of propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers (Material, refractive index and mode) – fiber optical communication system (block diagram) - Fiber optic sensors: pressure and displacement.

UNIT III – THERMAL PHYSICS 12

Introduction– thermal expansion of solids and liquids – expansion joints – bimetallic strips – Mode of heat transfer - heat conductions in solids – thermal conductivity – derivation, Phonons - Forbe's and Lee's disc method: theory and experiment – conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV – QUANTUM PHYSICS **12**

Merits of quantum theory, Demerits of classical theory – Black body radiation, Photo electric effect – Compton scattering: experimental description, dual nature of matter and radiation – de Broglie wavelength, uncertainty principle – Schrödinger's wave equation – time dependent and time independent equations – particle in one dimensional box- physical significance of wave function, Scanning Electron Microscope, Transmission Electron Microscope.

UNIT V – CRYSTAL PHYSICS **12**

Crystalline materials – types - unit cell, primitive cell, intercepts, interfacial angle - crystal systems, Bravais lattices, Miller indices – determination of inter-planar distances - Coordination number and packing factor for SC, BCC, FCC, HCP structures-crystal imperfections: point defect, line defect, surface and volume defect. Crystal growth techniques: Czochralski and Bridgman method.

Total periods : 60

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Bhattacharya D.K. & Poonam T.	Engineering Physics	Oxford University Press	2015
2	Gaur R.K. and Gupta S.L	Engineering Physics	Dhanpat Rai Publications	2012
3	Pandey.B.K. & Chaturvedi .S	Engineering Physics	Cengage Learning India	2012

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Halliday.D., Resnick R. & Walker. J	Principles of Physics	Wiley	2015
2	Amitkumar J Patel, and MaheshkumarK.Patel	Engineering Physics	White Falcon Publishing.	2018
3	Steven M. Girvin Yale University andKun Yang	Modern Condensed matter Physics	Cambridge University Press.	2019

WEBSITES:

1. https://nptel.ac.in/courses/122/103/122103011/
2. https://nptel.ac.in/courses/113/104/113104081/
3. http://hyperphysics.phy-astr.gsu.edu/hbase/optmod/lascon.html

(ii) Laboratory

Course Objective:

- To develop basic laboratory skills and demonstrating the application of physical principles.
- To prepare for the lab experiment and perform individually a wide spectrum of experiments.
- To present experimental data in various appropriate forms like tabulation, and plots.
- To analyze, Interpret and Summarize experimental results.
- To communicate clearly understanding of various experimental principles, instruments/setup, and procedure.
- To understand basic electric circuits.

Course Outcomes:

- The students will have the knowledge on Physics practical experiments and that knowledge will be used by them in different engineering and technology applications.
- Prepare for the lab experiment and perform individually a wide spectrum of experiments.
- Present experimental data in various appropriate forms like tabulation, and plots.
- Analyze, Interpret and Summarize experimental results.
- Communicate clearly understanding of various experimental principles, instruments/setup, and procedure.
- Prepare to develop the skills for understanding basic electric circuits.

LIST OF EXPERIMENTS – PHYSICS (Any 10 Experiments)

- Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of disc
- Uniform bending (or) Non-uniform Bending – Determination of young's modulus.
- Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille's flow .
- Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
- Laser- Determination of the wave length of the laser using grating, Acceptance angle of optical fiber.
- Spectrometer- Determination of wavelength using grating.
- Air wedge – Determination of thickness of a thin sheet/wire.
- Lee's disc – Determination of thermal conductivity.
- Determination of Band gap of a semiconductor.
- Potentiometer – Determination of thermo emf of a thermo couple.
- Characteristics of photo diode.
- Particle size determination using LASER.

Semester-I

21BECC142 ENGINEERING CHEMISTRY (THEORY & LAB) 7H-5C

Instruction Hours/week: L:3 T:0 P:4 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

COURSE OBJECTIVES:

The goal of this course is for students :

- To understand the terminologies of atomic and molecular structure
- To study the basics of Periodic properties, Intermolecular forces
- To study about spectroscopic technique
- To understand the thermodynamic functions
- To understand the concept of chemical reactions
- To comprehend the basic organic chemistry and to synthesis simple drug.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Rationalise periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity.
- Analyse the mechanism of different energy storage devices.
- Rationalise different types of corrosion and its prevention.
- List the various methods in the purification of water.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I - PERIODIC PROPERTIES, INTERMOLECULAR FORCES 9

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers. Ionic, dipolar and van Der Waals interactions.

UNIT II – ELECTROCHEMISTRY AND STORAGE DEVICES 9

Thermodynamic functions. Free energy and emf. Cell potentials, the Nernst equation and applications. Types of electrodes Standard Hydrogen Electrode (SHE) & Calomel. Energy storage devices Primary and secondary cells leclanche cell, Lead Acid Battery, Nickel Cadmium Battery, Lithium Battery Charging and discharging reactions.

UNIT III – CORROSION AND ITS CONTROL 9

Chemical and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion - Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings – Organic coatings-Paints - Constituents and functions – Inorganic coatings- Metallic coatings - Electroplating (Au) and Electro less plating (Ni) - Surface conversion coating - Hot dipping

UNIT IV – WATER TECHNOLOGY **9**

Sources-Characteristics – Specification for drinking water, BIS &WHO-Alkalinity – Types of alkalinity and determination – Hardness – Types and estimation by EDTA method - Domestic water treatment – Disinfection methods (Chlorination, Ozonation. UV treatment) – Boiler feed water – Requirements – Disadvantages of using hard water in boilers – Internal conditioning (Phosphate, Calgon and Carbonate conditioning methods) – External conditioning – Demineralization process – Desalination - Reverse osmosis.

UNIT V - SPECTROSCOPIC TECHNIQUES AND APPLICATIONS **9**

Spectroscopy (Principles and Instrumentation only).Electronic spectroscopy. Vibrational and rotational spectroscopy. Applications. Surface characterization techniques Scanning electron microscope (SEM) and Transmission electron microscopy (TEM). Fluorescence and its applications in medicine

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	B. H. Mahan	University chemistry	, Pearson Education	2010
2	M. J. Sienko and R. A.	Plane Chemistry: Principles and Applications.	Pearson Education	2010
3	C. N. Banwell	Fundamentals of Molecular Spectroscopy	McGraw-Hill,.	2017

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	B. L. Tembe	Engineering Chemistry	NPTEL Web-book	2010
2	P. W. Atkins,	Physical Chemistry	Oxford University Press	2018
3	K. P. C. Volhardt and N. E. Schore,	Organic Chemistry: Structure and Function,	5th Edition W.H. Freeman	2014
4	P C Jain & Monica Jain	Engineering Chemistry	DhanpatRai Publishing Company,	2015

WEBSITES:

1. www.mit.edu
2. www.nptel.com

(ii) Laboratory

Course Objectives

- To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.
- To estimate the amount of sodium carbonate and sodium hydrogen carbonate, hardness, chloride in water sample
- To make the student acquire practical skills in the determination of conductance of solutions, EMF etc
- To acquaint the students with the determination of rate constant of a reaction
- To determine acid value of oil
- To carried out different types of titrations for estimation of concerned in materials

Course Outcomes

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Determine the partition coefficient of a substance between two immiscible liquids.
- Acquaint the students with the determination of acid value of an oil
- Carrying out different types of titrations for estimation of concerned in materials using comparatively more qualities and quantities of materials involved for accurate results

Choice of 10 experiments from the following:

1. Determination of surface tension and viscosity
2. Determination of Sodium Carbonate and Sodium Hydrogen Carbonate in a mixure using volumetric titration
3. Determination of Ca / Mg using complexometric titration
4. Thin layer chromatography
5. Determination of chloride content of water
6. Determination of the rate constant of a reaction
7. Conductometry - Determination of cell constant and conductance of solutions
8. pH Metry – Determination of Acid / Base
9. Potentiometry - determination of redox potentials and emfs
10. Saponification/acid value of an oil
11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Adsorption of acetic acid by charcoal
13. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg

Semester-I

21BECC143 PYTHON PROGRAMMING (THEORY & LAB) 4H-3C

Instruction Hours/week: L:2 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

COURSE OBJECTIVES:

The goal of this course is for students :

- To perceive about core programming basics—including data types, control structures, algorithm development, and program design with functions
- To discuss the fundamental principles of Object-Oriented Programming, as well as in-depth data and information processing techniques
- To solve problems, explore real-world software development challenges, and create practical and contemporary applications
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To apply the string handling functions to solve the given problem

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Explain various operators used in python.
- Elaborate Object oriented concepts with python
- Demonstrate the functions of networking in python
- Develop algorithmic solutions to simple computational problems.
- Read and write data from/to files in Python programs.
- Utilize image processing techniques in python programming to solve a given problem

UNIT I INTRODUCTION 9

Installing Python; basic syntax, interactive shell, editing, saving, and running a script variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages.

UNIT II CONDITIONAL STATEMENT & STRING HANDLING 9

Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation – Manipulating files and directories, OS and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers.

UNIT III OBJECT ORIENTED PROGRAMMING WITH PYTHON 9

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modelling; persistent storage of objects – OOP, continued: inheritance, polymorphism, operator overloading; abstract classes; exception handling, try block

UNIT IV IMAGE PROCESSINGWITH PYTHON **9**

Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions Simple Graphics and Image Processing: "turtle" module; simple 2d drawing – colors, shapes; digital images, image file formats, image processing Simple image manipulations with 'image' module (convert to b/w, rayscale, blur, etc).

UNIT V NETWORKING WITH PYTHON **9**

Multithreading, Networks, and Client/Server Programming; introduction to HTML, interacting with remote HTML server, running html-based queries, downloading pages; CGI programming, programming a simple CGI form.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Shroff	Learning Python: Powerful Object-Oriented Programming	5th Edition	2013
2	Timothy A	Budd 'Exploring Python'	TATA McGRAW-HILL	2011
3	Vamsi Kurama	Python Programming: A Modern Approach	Pearson Education	2018

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	David M.Baezly	Python Essential Reference	Addison-Wesley Professional; 4 edition	2009
2	David M. Baezly.	Python Cookbook	O'Reilly Media; 3rd edition	2013
3	Guido Van Rossum, Fred . L. Drake	'Introduction to Python'	Network Theory Limited	2011
4	Alex Martelli	'Python in a Nutshell'	O'Reilly - 2nd Edition	2006

WEBSITES:

1. https://www.codecademy.com/learn/python
2. www.learnpython.org/

(ii) Laboratory

COURSE OBJECTIVES:

The goal of this course is for students:

- To compile, test, and debug simple Python programs.
- To evaluate Python programs with conditionals and loops.
- To utilize functions for structuring Python programs.
- To outline compound data using Python lists, tuples, and dictionaries.
- To apply data from/to files in Python.
- To do input/output with files in Python.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Compile, test, and debug simple Python programs.
- Illustrate Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Utilize Python lists, tuples, dictionaries for representing compound data.
- Recall and write data from/to files in Python.
- Apply Python features in developing software applications

LIST OF EXPERIMENTS:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball in Pygame

Semester-I

21BEBME144 BASIC ELECTRICAL & ELECTRONICS ENGINEERING 6H-5C

(Theory & Lab)

Instruction Hours/week: L:3 T:1 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives

- To impart the basic knowledge about the Electric circuits.
- To understand the concept of Electrical Machines and Transformers.
- To understand the basic concepts of star and delta connections
- To understand the operation of AC and DC circuits
- To understand the working of Semiconductor devices and Digital Circuits.
- To impart the basic knowledge of Measuring Instruments and Electrical Installation.

Course Outcomes

At the end of this course, students will be able to

- Attributing the electric circuits with DC and AC excitation by applying various circuit laws.
- Attributing the electrical machines and transformer.
- To understand the working principle of electronic devices and circuits
- Evaluate the various digital circuits in real time applications.
- Analysis various semiconductor devices in real time applications.
- Reproduce the Measuring Instruments and Electrical Installation.

UNIT I - DC Circuits (12)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

UNIT II - AC Circuits (12)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III - Electrical Machines And Transformer (12)

Construction and working of a three-phase and Single-phase induction motor. Construction, working and speed control of DC motor. Magnetic materials, BH characteristics, Construction and working principle of ideal and practical transformer.

UNIT IV- Semiconductor Devices And Digital Electronics (12)

Bipolar Junction Transistor – Characteristics. Introduction to operational Amplifier –Model– Applications. Number systems – binary codes - logic gates - Boolean algebra, laws & theorems

UNIT V- Measuring Instruments And Electrical Installation (12)

Principle, construction, and operation of moving coil and moving iron meters-Measurement of Power. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, RCCB, MCCB. Earthing. Types of Batteries and its application in Electric Vehicle, Important Characteristics for Batteries. Elementary calculations for energy consumption and battery back up

Total periods : 60

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	S.K.Bhattacharya	Basic Electrical Engineering	Pearson	2019
2	E. Hughes	Electrical and Electronics Technology	Pearson	2010
3	P. Kothari I. J. Nagrath	Basic Electrical Engineering	Tata McGraw Hill	2017

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	VN Mittle and Arvind Mittal	Basic Electrical Engineering	McGraw Hill	2017
2	A.Sudhakar Shyammohan S Palli	Circuits and Networks	McGraw Hill	2013
3	R.Muthusubramanian S.Salivahanan	Basic Electrical and Electronics Engineering	McGraw Hill	2014

WEBSITES:

1. www. nptel.ac.in.
2. encyclopedia-magnetica.com/doku.php/coenergy.
3. https://en.wikibooks.org/wiki/electronics/measuring instruments.

ii) Laboratory

Course Objective

- To impart the basic knowledge about the DC and AC Electric circuits.
- To measure the electrical quantities
- To understand the working of DC Machines
- To understand the working of Energy meter
- To verify the truth table of logic gates
- To impart the knowledge of digital logical circuits and their differences.

Course Outcomes (Cos)

At the end of this course, students will be able to

- Analyze basic electric circuits.
- Analyze the working principles of DC Machines
- Reproduce Electrical Installation
- Perform speed control for DC motor
- Measure energy by using single phase energy meter
- Verify the truth table of digital logic gates

List of Experiments

1. Experimental verification of electrical circuit problems using Ohms law
2. Experimental verification of electrical circuit problems using Kirchoff's Voltage law.
3. Experimental verification of electrical circuit problems using Kirchoff's Current law.
4. Measurement of electrical quantities – voltage, current, power & power factor in R load.
5. Measurement of energy using single phase energy meter.
6. Speed control of DC Shunt Motor.
7. Verification of truth table of Logic Gates.

SEMESTER-II

B.E Biomedical Engineering **2021-2022**

Semester-II

21BECC201 **COMMUNICATIVE ENGLISH** **4H-3C**

Instruction Hours/week: L:2 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students :

- To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
- To help students acquire their ability to speak effectively in real life situations.
- To inculcate the habit of reading and to develop their effective reading skills.
- To ensure that students use dictionary to improve their active and passive vocabulary.
- To enable students to improve their lexical, grammatical and communicative competence
- To enable students to improve their technical writing

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Use English language for communication: verbal & non –verbal.
- Enrich comprehension and acquisition of speaking & writing ability.
- Gain confidence in using English language in real life situations.
- Improve word power: lexical, grammatical and communication competence.
- To guide the students to write business letters and other forms of technical writing.
- To enable students to prepare for oral communication in formal contexts.

Unit: I - **Basic Writing Skills** **9**

Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents - Techniques for writing precisely

Unit: 1I - Vocabulary Building **9**

The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance, with prefixes and suffixes from foreign languages in English to form derivatives. - Synonyms, antonyms, and standard abbreviations.

Unit: III - Grammar and Usage **9**

Subject-verb agreement - Noun-pronoun agreement - Misplaced modifiers – Articles – Prepositions – Redundancies - Clichés

Unit: IV - Listening and Reading Skills **9**

Note taking- viewing model interviews – listening to informal conversations – improving listening / reading comprehension – reading model prose / poems – reading exercise

Unit: V.-**Writing Practices** **9**

Comprehension - Précis Writing - Essay Writing Listening Comprehension - Common Everyday Situations: Conversations and Dialogues - Communication at Workplace – Interviews - Formal Presentations

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Sangeeta Sharma , Meenakshi	Technical Communication: Principles And Practice,	2nd Edition, OUP	2015
2	Sanjay Kumar and PushpLata	Communication Skills	Oxford University Press	2011
3	Liz Hamp - Lyons and Ben Heasly	Analyze Writing	Cambridge University Press	2006

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	F.T. Wood	Remedial English Grammar	Macmillan.	2016
2	Michael Swan	Practical English Usage	OUP.	2017

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-II

21BECC202	**MATHEMATICS-II**	**4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students :

- To determine mathematical tools needed in evaluating multiple integrals and their usage.
- To utilize Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results
- To apply the knowledge of Mathematics in various Engineering fields by making them to identify the functions in engineering problems as analytic function and their analyze as a functions of a complex variables.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, to specify some difficult integration that appear in applications can be solved by complex integration in application areas such as fluid dynamics and flow of the electric current.
- To understand the concept of Matrices , Vector calculus, Analytic functions, Complex integration and Laplace transforms in their respective fields
- To utilize Laplace transforms efficiently for solving the problems that occur in various branches of engineering disciplines

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- To apply integration to compute multiple integrals, area, volume, integrals in polar and Cartesian coordinates, in addition to change of order and vector integration.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines
- To find the Analytic functions using the Cauchy Riemann equations and they will learn mapping properties of elementary functions and mapping properties of some special transcendental functions. They will understand relations between conformal mappings and quadratic differentials and how geometric structures are changing under conformal mappings.
- To evaluate complex integrals using the Cauchy integral formula and the residue Theorem and to appreciate how complex methods can be used to prove some important theoretical results.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients
- Apply the concept of Matrices, Vector calculus, Analytic functions, Complex integration and Laplace transforms in their respective fields.

UNIT-I MULTIPLE INTEGRALS 12

Double integral – Cartesian coordinates – Polar coordinates – Change of order of integration – Triple integration in Cartesian co-ordinates – Area as double integrals.

UNIT-II VECTOR CALCULUS 12

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem, Gauss divergence theorem and Stoke's theorems (Statement Only)- Surfaces : hemisphere and rectangular parallelopipeds.

UNIT-III ANALYTIC FUNCTIONS 12

Analytic functions - Cauchy-Riemann equations in Cartesian and polar forms – Sufficient condition for an analytic function (Statement Only) - Properties of analytic functions – Constructions of an analytic function - Conformal mapping: w = z+a, az, 1/z and bilinear transformation.

UNIT-IV COMPLEX INTEGRATION 12

Complex Integration - Cauchy's integral theorem and integral formula (Statement Only) – Taylor series and Laurent series - Residues – Cauchy's residue theorem (Statement Only) - Applications of Residue theorem to evaluate real integrals around unit circle and semi circle (excluding poles on the real axis).

UNIT-V LAPLACE TRANSFORM 12

Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Initial and final value theorems. Inverse Laplace transforms – Convolution theorem (statement only) – Solution of Ordinary Differential Equations with constant coefficients using Laplace transforms – Transform of periodic functions.

Total periods : 60

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Grewal, B.S.	Higher Engineering Mathematics	43rd Edition Khanna Publishers	2014
2	Kreyszig Erwin	Advanced Engineering Mathematics	John Wiley and Sons, 10th Edition	2016
3	Kandasamy. P, Thilagavathy. K,	Engineering Mathematics	S Chand & Co. Ltd	2008

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Bali.N., Goyal M. and Watkins C	Advanced Engineering Mathematics,	7th Edition Firewell Media	2009
2	Venkataraman, M. K	Engineering Mathematics	The National Publishing	2005
3	Narayanan. *S*, Manicavachagam pillay.T.K and Ramaniah	Advanced Mathematics for Engineering Students	Viswanathan S.(Printers and Publishers)	2002

WEBSITES:

1. www.intmath.com
2. www.efunda.com
3. www.mathcentre.ac.uk

Semester-II

21BEBME203 **MEDICAL PHYSICS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The Goal of this course is for students:

- To study the complete non-ionizing radiations including light and its effect in human body.
- To demonstrate the principles of ultrasound radiation and its applications in medicine.
- To appraise about radioactive nuclides and also the interactions of radiation with matters and how isotopes are produced.
- To perceive the role of Physics in cardiopulmonary system.
- To analyse the harmful effects of radiation and radiation protection regulations.
- To study the effects of sound and light in human body

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- Analyze the low and high frequency effects of non-ionizing radiation and physics of light.
- Define various clinical applications based on ultrasound wave.
- Explain the process of radioactive nuclide production using different techniques.
- Analyze radiation mechanics involved with various physiological systems.
- Apply the concept of physics in the function of cardiopulmonary system.
- Outline the detrimental effects of radiation and regulations for radiation safety.

UNIT I - ELECTROMAGNETIC SPECTRUM AND ULTRASOUND IN MEDICAL APPLICATION 9

Light: Physics of light, Intensity of light, limits of Vision and color vision- Reflection and Refraction – Absorption and Scattering Non-ionizing Electromagnetic Radiation Tissue as a leaky dielectric – Relaxation Processes – Overview of non – ionizing radiation effects - Low Frequency Effect – Higher frequency effect - Thermography- Applications, LASER – Applications in Medicine. Optical fiber – Medical endoscopy -Ultrasound: Ultrasonic Transducers – Interaction of Ultrasound with Materials – Doppler Effect and its Applications - sonogram.

UNIT II - RADIOACTIVE DECAY AND ITS APPLICATIONS IN MEDICINE 9

Spontaneous Emission – Isometric Transition - Gamma ray emission, alpha, beta, positron decay, electron capture Principles of Nuclear Physics – Natural radioactivity, Decay series, Half life period, type of radiation and their applications. Production of radionuclides – Cyclotron produced Radionuclide - Reactor produced Radionuclide – fission and electron Capture reaction, Radionuclide Generator – Milking Process - Linear accelerator, Radionuclide used in Medicine and technology.

UNIT III - INTERACTION OF RADIATION WITH MATTER AND IMAGING PRINCIPLES **9**

Interaction of charged particles with matter – Specific ionization , linear energy Transfer Range, Bremsstrahlung, Annihilation Interaction of Gamma radiations with matter – Photoelectric effect, Compton Scattering, pair Production, Attenuation of Gamma Radiation, Interaction of neuron with matter. Nuclear magnetic Resonance (NMR) principle – MRI. SQUID (Super Conducting Quantum Interference Device) principle – Magnetoencephalography.

UNIT IV - PHYSICS OF CARDIOPULMONARY SYSTEM **9**

The Airways, - blood and lung interaction – measurement of lung volume – pressure air flow volume relationships of lungs – physics of alveoli – the breathing mechanism – Major components of cardiovascular system – O_2 and CO_2 exchange in the capillary system – Physical activity of heart – transmural pressure – Bernolli's principles applied to cardiovascular system - Blood flow – laminar and turbulent.

UNIT V - RADIATION MEASURES AND METHODS **9**

Acute Radiation Effects – KERMA – Bragg's Curve - The concept of LD 50 – relationship between the dosimetric quantities - Radiation syndromes - Central nervous system syndrome - Gastro-intestinal syndrome –Bone Marrow syndrome Delayed Effects of Radiation - Stochastic and Deterministic effects – Late Deterministic effect in different organs and tissues.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	B.H Brown , PV Law ford, R H Small wood , D R Hose , D C Barber	Medical Physics and Biomedical Engineering	CRC Press	1999
2	Gopal B.Saha	Physics and Radiobiology of Nuclear Medicine	Springer, 3rd ed	2006

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	John R. Cameran and James G. Skofronick	Medical Physics	John–Wiley & Sons	1978
2	R.Hendee and Russell Ritenour	Medical Imaging Physics	Fourth Edition William, Wiley-Liss	2002

WEBSITES:

1. https://nptel.ac.in/courses/115102025/
2. https://nptel.ac.in/courses/113105025/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/lecture-notes/MIT6_012F09_lec01.pdf

Semester-II

21BECC204 **ENVIRONMENTAL STUDIES** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students :

- To create the awareness about environmental problems among people.
- To develop an attitude of concern for the environment.
- To motivate public to participate in environment protection and improvement.
- To relate critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Demonstrate core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- Identify concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
- Distinguish the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Analyse the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
- Recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- Identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.

UNIT I – INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS 9

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grass and Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT II - NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES 9

Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources -Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources- Use and over-exploitation of surface and ground water, floods,

droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT III - BIODIVERSITY AND ITS CONSERVATION 9

Levels of biological diversity - genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio-geographical classification of India. Biodiversity patterns (global, National and local levels). Hot-spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India.

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT IV - ENVIRONMENTAL POLLUTION 9

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban, industrial and e-wastes. Role of an individual in prevention of pollution. Case studies.

UNIT V - SOCIAL ISSUES AND THE ENVIRONMENT 9

Concept of sustainability and sustainable development. Water conservation -Rain water harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act). International agreements (Montreal and Kyoto protocols).Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides).Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).Human population growth: Impacts on environment, human health and welfare.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Anubha Kaushik., and Kaushik, C.P	Perspectives in Environmental Studies	New Age International Pvt.	2004
2	Arvind Kumar.	A Textbook of Environmental Science	APH Publishing Corporation,	2004
3	Mishra, D.D	Fundamental Concepts in Environmental Studies	S.Chand& CompanyPvt. Ltd	2010
4	Daniel, B. Botkin., and Edward, A. Keller	Environmental Science	John Wiley and Sons, Inc	1995

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Odum,E.P., Odum, H.T. and Andrews, J	Fundamentals of Ecology	Philadelphia: Saunders.	1971
2	Rajagopalan, R	Environmental Studies: From Crisis to Cure	Oxford University Press	2016
3	Sing, J.S., Sing. S.P. and Gupta, S.R.	Ecology, Environmental Science and Conservation	Chand & Publishing Company	2014
4	Singh, M.P., Singh, B.S., and Soma, S. Dey	Conservation of Biodiversity and Natural Resources	Daya Publishing House	2013
5	Tripathy.S.N., and Sunakar Panda	Fundamentals of Environmental Studies	Vrianda Publications Private Ltd	2010
6	Verma, P.S., and Agarwal V.K.	Environmental Biology (Principles of Ecology).	S.Chand and Company	2001
7	Uberoi, N.K.	Environmental Studies.	Excel Books Publications	2010

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-II

21BEBME205 HUMAN ANATOMY AND PHYSIOLOGY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for students

- To discuss all the organelles of an animal cell and their function.
- To perceive structure and functions of the various types of systems of human body.
- To outline about eye, ear and Endocrine glands of human
- To learn organs and structures involving in system formation and functions.
- To understand all systems in the human body.
- To infer basic understanding of the interconnection of various organ systems in human body

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Explain basic structure and functions of cells and its organelles
- Demonstrate about anatomy and physiology of various organ systems
- Illustrate eye, ear and Endocrine glands of human
- Explain the interconnect of various organ systems in human body
- Enlighten organs and structures involving in system formation and functions.
- Elucidate special senses in the human body.

UNIT I CELL 9

Structure of Cell– Organelles and description–Function of each component of the cell– Membrane potential– Action Potential–Generation and Conduction –Electrical Stimulation. Blood Cell– Composition –Origin of RBC–Blood Groups–Estimation of RBC, WBC and Platelet-Tissues and its functions.

UNIT II CARDIACANDNERVOUSSYSTEM 9

Heart, Major blood vessels– Cardiac Cycle– ECG–Blood Pressure–Feedback Control for Blood Pressure– Nervous Control of Heart- Cardiac output–Coronary and Peripheral Circulation – Structure and function of Nervous tissue–Neuron -Synapse - Reflexes -Receptors -Brain-Brainstem -Spinal cord– Reflex action– Velocity of Conduction of Nerve Impulses-Electroencephalograph –Autonomic Nervous System.

UNIT III RESPIRATORY SYSTEMANDMUSCULOSKELETALSYSTEM 9

Physiological aspects of respiration –Trachea and lungs -Exchange of gases –Regulation of Respiration -Disturbance of respiration function -Pulmonary function test-Muscles-tissue-types-structure of skeletal muscle-types of muscle and joints.

UNIT IV DIGESTIVE, EXCRETORY AND LYMPHATIC SYSTEM 9

Organisation of GI System, Digestion and absorption –Movements of GI tract–Intestine-Liver-Pancreas- Structure of Nephron–Mechanism of Urine formation–Urine Reflex–Skin and Sweat Gland–Temperature regulation, Lymphatic: Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels.

UNIT V EYE,EAR & ENDOCRINE GLANDS 9

Optics of Eye–Retina –Photochemistry of Vision –Accommodation -Neurophysiology of vision – EOG, Physiology of internal ear–Mechanism of Hearing–Auditory Pathway, Hearing Tests– Endocrine- Pituitary and thyroid glands.

Total periods : 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Prabhjot Kaur	Text Book of Anatomy and Physiology	Lotus Publsihers	2014
2	Elaine.N. Marieb	Essential of Human Anatomyand Physiology	Pearson Education, New Delhi	2016

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew	Fundamentals of Anatomy and Physiology	Pearson Publishers	2014
2	Gillian Pocock, Christopher D. Richards	The human Body – An introduction for Biomedical and Health	Oxford University Press, USA	2013
3	Eldra Pearl Solomon	Introduction to Human Anatomy and Physiology	W.B. Saunders Company	2015

WEBSITES:

1. https://openstax.org/details/books/anatomy-and-physiology
2. https://www.visiblebody.com/anatomy-and-physiology-apps/anatomy-and-physiology

Semester-I

21BEBME241 ELECTRONIC DEVICES AND CIRCUITS (THEORY & LAB) 6H-5C

Instruction Hours/week: L:3 T:1 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

COURSE OBJECTIVES:

The goal of this course is for students :

- To discuss the operational characteristics of a Semiconductor in Equilibrium and Non- Equilibrium conditions.
- To aware with the structure of basic electronic devices.
- To understand the operation and applications of electronic devices.
- To explain the working of PN junction diodes and special purpose diodes.
- To define the basic working of BJT and FET both in ideal and non- ideal conditions.
- To improve knowledge about the working of Rectifiers and Voltage regulators.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Demonstrate the fundamental concepts of electronic devices
- Build an electronic circuits using transistors.
- Analyze any electronic circuits logically
- Understand the specifications of regulators and power supply circuits.
- Apply positive feedback principle and design oscillators.
- Design multivibrator circuits.

UNIT I - SEMICONDUCTOR DIODES AND SPECIAL PURPOSE DIODES 12

Semiconductors: Intrinsic semiconductor – extrinsic semiconductor – Fermi level in an intrinsic semiconductor Semiconductor diodes : Formation of PN junction – working principle – VI characteristics – diode current equation – diode resistance – transition and diffusion capacitance. Special purpose diodes: Tunnel, Varactor, Pin contact, Zener diode, schottky diode- Clippers and clampers

UNIT II - BIPOLAR TRANSISTORS 12

Bipolar Transistors: NPN-PNP- Construction – working – transistor currents –transistor configurations (CB,CE,CC) and input- output characteristics – Early effect (base width modulation) – transistor as an amplifier Transistor as a switch.

UNIT III - FIELD EFFECT TRANSISTORS 12

Field-Effect Transistors: construction, working principle and VI characteristics of JFET – comparison of BJT and JFET – MOSFET : working principle and VI characteristics, enhancement MOSFET, depletion MOSFET - comparison of MOSFET with JFET.

UNIT IV - DC POWER SUPPLIES **12**

Rectifiers – Half wave, full wave and Bridge -Block schematic of a typical DC power supply, single phase HWR, FWR, filters - ripple factor and efficiency analysis , Voltage regulators: voltage regulation, Zener diode shunt regulator, transistor series regulator, transistor shunt regulator, switching regulators. Low dropout Regulators (LDO)

UNIT V - OSCILLATORS AND MULTIVIBRATORS **12**

Types of Oscillators: RC phase shift, Wein-bridge, Hartley, Colpitt, Crystal; types of multivibrators: Astable, mono and bi-stable.

Total periods : 60

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Millman and Halkias	Electronic devices and Circuits	Tata McGraw Hill International	2010
2	David A.Bell	Fundamental of electronic devices and circuits	Oxford press	2009

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Thomas L. Floyd	Electron Devices	Charles and Messil Publications	2012
2	G.K.Mithal	Electronic Devices andCircuits	KhannaPublishers	2013
3	Robert L. Boylestad and Louis Nashelsky	Electronic Devices and Circuit Theory	9th Edition Pearson Education	2009

WEBSITES:

3. www.mit.edu
4. www.nptel.com

(i) Laboratory

COURSE OBJECTIVE:

The goal of this course is for students :

- To analyze the Biasing network for BJT and FET, transient analysis and frequency response of BJT and FET in single stage and Oscillator
- To develop the ability to analyze and design analog electronic circuits using discrete components.
- To outline the amplitude and frequency responses of electronic circuits
- To simplify the operation of Oscillators and wave form generators.
- Understand the specifications of power supply circuits.
- To understand the concept of AC to DC conversion

COURSE OUTCOME:

Upon completion of this course, the student will be able to:

- Utilize the fundamental concepts of electronic devices
- Build basic electronic circuits with BJT and FET
- Deduct the circuit defects
- Design oscillator circuits
- Understand wave shaping concepts
- Demonstrate halfwave and full wave rectifier.

LIST OF EXPERIMENTS:

1. V-I Characteristics of PN diode
2. V-I Characteristics of Zener diode
3. V-I Characteristics of Clippers and Clampers
4. Input and Output Characteristics of BJT
5. Drain and transfer characteristics of JFET
6. Hartley Oscillator
7. Colpitt Oscillator
8. AstableMultivibrator
9. Half wave rectifier– with and without filter
10. Full wave rectifier – with and without filter

Semester-II

21BECC211 **ENGINEERING GRAPHICS** **5H-3C**

Instruction Hours/week: L:1 T:0 P: 4 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as manufacturability, and sustainability
- To Understand the application of industry standards and techniques applied in engineering graphics
- To Apply auxiliary or sectional views to most practically represent engineered parts
- To sketch freehand drawings and to efficiently communicate ideas graphically
- To understand Dimension and annotate two-dimensional engineering drawings
- To prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Understand the engineering drawing and its place in society.
- Gain the knowledge of usage of Drawing instruments
- Expose the visualization of engineering drawing and engineering graphics standards.
- Expose the engineering communication.
- Apply dimensions in drawings
- Use various graphic tools

UNIT I INTRODUCTION **9**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Bureau of Indian Standards (BIS), Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice geometric constructions, principles of dimensioning– linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Reducing Scale, Enlarging Scale, Plain Scale, Diagonal Scale and Vernier Scale. Conic sections including the Ellipse, Parabola and Hyperbola (eccentricity method only); Cycloid, Epicycloid, Hypocycloid and Involute.

UNIT II FREE HANDSKETCHING **9**

Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

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UNIT III INTRODUCTION TO COMPUTER GRAPHICS – 2D 9

Overview of Computer Graphics, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars, Drawing Area, Dialog boxes and windows, Shortcut menus ,The Command Line (where applicable), Select and eraseobjects.; Isometric Views of lines, Planes, Simple and compound Solids]; consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate

dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Annotations, layering & other functions.

UNIT IV PROJECTION OF POINTS, LINES AND PLANE SURFACES 9

Projection of points and straight lines located in the first quadrant inclined to both planes– Determination of true lengths and true inclinations. Projection of polygonal surface and circular lamina inclined to both reference planes

UNIT V ISOMETRIC PROJECTIONS 9

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple solids, truncated prisms, pyramids, cylinders and cones; Conversion of Isometric Views to Orthographic Views and Vice-versa

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Venugopal K and Prabhu Raja V	Engineering Graphics,	New Age International Publishers	2015
2	C M Agrawal and Basant Agrawal	Engineering Graphics	Tata McGraw Hill	2012
3	Shah, M.B. & Rana B.C	Engineering Drawing and Computer Graphics	Pearson Education	2010

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	James D. Bethune	Engineering Graphics with AutoCAD	Macromedia Press	2019
2	Narayana, K.L. & P Kannaiah	Text book on Engineering Drawing	ScitechPublishers	2010
3	Bhatt N.D., Panchal V.M. & Ingle P.R,	Engineering Drawing	Charotar PublishingHouse	2014

WEBSITES:

1. www.mit.edu
2. www.nptel.com

B.E Biomedical Engineering **2021-2022**

21BEBME251	**Disaster Management**	**Semester II** **2H-1C**

Instruction Hours/week: L:2 T:0 P:0 **Marks:** Internal**:100** External**:0** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course for students is :

- To provide students an exposure to disasters, their significance and types
- to gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To discuss about impact of Development projects
- To analyse Disaster Damage Assessment
- To understand Disaster Risk Management
- To discuss various case studies and field works

Course Outcomes

At the end of the course the students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society.
- Assess vulnerability and various methods of risk reduction measures as well as mitigation
- Discuss inter-relationship between disaster and development
- Analyse Disaster Damage Assessment
- Manage Disaster Risk
- Analyse various case studies

Unit I Introduction to Disasters **6**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc. – Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability – Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

Unit II Approaches to Disaster Risk Reduction (DRR) **6**

Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- non-structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional

Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

Unit III Inter-Relationship between Disasters and Development 6

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources.

Unit IV Disaster Risk Management in India 6

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment

Unit V: Disaster Management: Applications and Case Studies and Field Works 6

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

Total Periods : 30

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Singhal J.P	Disaster Management	Laxmi Publications	2019
2	Tushar Bhattacharya	Disaster Science and Management	McGraw Hill India	2012

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Gupta Anil K, Sreeja S. Nair	Environmental Knowledge for Disaster Risk	NIDM, New Delhi	2011
2	Kapur Anu	Vulnerable India: A Geographical Study of Disasters	IIAS and Sage Publishers	2010

21BEBME301 **MATHEMATICS-III** **4H-4C**

(LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS)

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations and diagonalization.
- To apply the concept of inner product spaces in orthogonalization.
- To understand the procedure to solve partial differential equations.
- To give an integrated approach to number theory and abstract algebra
- To provide a firm basis for further reading and study in the subject.

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

- Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of advanced algebraic techniques.
- Demonstrate their mastery by solving non - trivial problems related to the concepts and by proving simple theorems about the statements proven by the text.
- Explain the various types of partial differential equations.
- Solve the various types of partial differential equations.
- Solve engineering problems using Fourier series.

UNIT I VECTOR SPACES 12

Vector spaces- Definition, Axioms, Examples of vector spaces or not vector spaces – Basic Theorems-Subs paces – Linear combinations and linear system of equations – Linear independence and linear dependence of vector spaces -Spanning of a subspace– Bases and dimensions.

UNIT II LINEAR TRANSFORMATION AND DIAGONALIZATION 12

Linear transformation on vector space, properties of the function T- Null spaces and ranges, Definition and Examples - Dimension theorem - Matrix representation of a linear transformations - Eigen values and eigenvectors - Diagonalizability.

UNIT III INNER PRODUCT SPACES 12

Inner product space, Definitions and Examples, norms-Orthogonal and Orthonormal Basis - Gram Schmidt orthogonalization process -Orthonormal complement - Adjoint of linear operations - Least square approximation.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS 12

Formation – Solutions of first order equations – Standard types and equations reducible to standard types – Singular solutions – Lagrange‘s linear equation – Integral surface passing through a given curve – Classification of partial differential equations - Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

UNIT V FOURIER SERIES SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Dirichlet‘s conditions – General Fourier series – Half range sine and cosine series - Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

Total periods : 60

TEXT BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Friedberg, A.H., Insel, A.J. and Spence, L	Linear Algebra	Prentice – Hall of India Private Limited, New Delhi .	2002
2	Dr. Grewal B.S.	Higher Engineering Mathematics	Khanna Publishers, New Delhi.	2018
3	Burden, R.L. and Faires, J.D	"Numerical Analysis", 9th Edition	Cengage Learning	2011
4	James, G	Advanced Modern Engineering Mathematics	Pearson Education	2018
5	Kolman, B. Hill, D.R	Introductory Linear Algebra‖	Pearson Education, New Delhi	2009
6	Kumaresan, S	Linear Algebra – A Geometric Approach	Prentice – Hall of India, New Delhi, Reprint	2000
7	Lay, D.C	Linear Algebra and its Applications	5th Edition, Pearson Education	2018
8	O‘Neil, P.V	Advanced Engineering Mathematics‖	Cengage Learning	2017

9	Strang, G	Linear Algebra and its applications	Thomson (Brooks/Cole), New Delhi	2006
10	Sundarapandian, V.	Numerical Linear Algebra	Prentice Hall of India, New Delhi	2008

REFERENCE BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	T.S.Blyth.,E.F.Robertson	Basis Linear Algebra	Springer	2012

WEBSITES

1. www.efunda.com
2. www.mathcentre.ac.uk
3. www.intmath.com/matrices-determinants
4. www. Intmath.com/calculus/calculus-intro.php

Semester-III

21BEBME302 **DIGITAL ELECTRONICS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students

- To explain the methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
- To introduce the design of various combinational digital circuits using logic gates
- To illustrate the concept of synchronous sequential circuits
- To bring out the analysis and design procedures for asynchronous sequential circuits
- To summarize the concept of memories and programmable logic devices.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Demonstrate the methods for simplifying Boolean expressions
- Design various combinational digital circuits using logic gates.
- Use Boolean algebra and apply it to digital systems.
- Explain the formal procedures for the analysis and design of combinational circuits and sequential circuits
- Interpret the concept of synchronous and asynchronous sequential circuits
- Apply the concept of memories and programmable logic devices.

UNIT-I NUMBER SYSTEMS AND BOOLEAN ALGEBRA 9

Review of number systems-Binary, Octal, Decimal, Hexadecimal-Number base conversions – complements – signed Binary numbers. Binary Arithmetic- Binary codes: Weighted –BCD-Gray code-Excess 3 code-ASCII – Error detecting and correcting code – conversion from one code to another-Boolean postulates and laws –De-Morgan's Theorem- Principle of Duality-Boolean expression – Boolean function- Minimization of Boolean expressions – Sum of Products (SOP) –Product of Sums (POS)-Minterm- Maxterm- Canonical forms – Conversion between canonical forms –Karnaugh map Minimization – Don't care conditions-QuineMcCluskey method.

UNIT-II LOGIC GATES AND COMBINA TIONAL CIRCUITS 9

LOGIC GATES: AND, OR, NOT, NAND, NOR, Exclusive – OR and Exclusive – NOR-Implementations of Logic Functions using gates, NAND –NOR implementations –Multi level gate implementations.

COMBINATIONAL CIRCUITS: Design procedure – Arithmetic circuits- Adders-Subtractors – Binary adder / Subtractor- Serial adder/ Subtractor - Parallel adder/ Subtractor- Carry look ahead adder- BCD adder- Carry look ahead adder – Magnitude Comparator- Multiplexer/ Demultiplexer- encoder / decoder – parity checker. Implementation of combinational logic using MUX.

UNIT-III SEQUENTIAL CIRCUITS 9

Flip flops SR, JK, T, D and Master slave –Characteristic table and equation– Edge triggering – Level Triggering –Realization of one flip flop using other flip flops – Analysis of synchronous sequential circuits - Design of synchronous sequential circuits- Asynchronous– Synchronous counters –Classification of sequential circuits – Moore and Mealy -Design of Synchronous counters: state diagram- State table –State minimization –State assignment- Register – shift registers– SIPO – PISO – PIPO- Universal shift register

UNIT-IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Design of fundamental mode and pulse mode circuits – primitive state / flow table – Minimization of primitive state table –state assignment – Excitation table – Excitation map- cycles – Races – Hazards: Static –Dynamic –Essential –Hazards elimination.

UNIT-V MEMORY DEVICES 9

Classification of memories –RAM organization– Static RAM Cell-Bipolar RAM cell – MOSFET RAM cell –Dynamic RAM cell –ROM organization - PROM –EPROM –EEPROM – Programmable Logic Devices – Programmable Logic Array (PLA)- Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).

Total periods : 45

TEXT BOOKS:

S.No.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Morris Mano.M	Digital Design	Prentice Hall of India Pvt. Ltd., New Delhi	2017
2	John M .Yarbrough	Digital Logic Applications and Design	Thomson- Vikas publishing house, New Delhi	2006

REFERENCES:

S.No.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Salivahanan.S and Arivazhagan.S	Digital Circuits and Design	Vikas Publishing House Pvt. Ltd, New Delhi	2018
2	Charles H.Roth	Fundamentals of Logic Design	Thomson Publication Company, New Delhi.	2019
3	Donald P.Leach and Albert Paul Malvino	Digital Principles and Applications	Tata McGraw Hill Publishing Compan y Limited, New Delhi	2018
4	Jain.R.P	Modern Digital Electronics	Tata McGraw–Hill publishing company limited, New Delhi	2009
5	Thomas L. Flo yd	Digital Fundamentals	Pearson Education, New Delhi	2017

WEBSITES:

1. http://www.allaboutcircuits.com/vol_2/chpt_9/2.html
2. http://www.educypedia.be/electronics/digital.html

Semester-III

21BEBME303 **C++ & DATA STRUCTURES** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To analyse Object Oriented Programming concepts and basic characteristics of C++
- To design problem solutions using Object Oriented Techniques.
- To infer the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a C++ application with threads and generics classes
- To design and build simple Graphical User Interfaces

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

- Utilize a simple Java programming environment, compile programs and interpret compiler errors.
- Distinguish and use the fundamental data types.
- Design classes and organise them into packages.
- Utilize the basic data structures.
- Compare the basic search and sort algorithms.
- Apply appropriate data structure and algorithm to solve a problem.

UNIT I OBJECTS ORIENTED PROGRAMMING 9

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- Characteristics of OOP- Classes-Objects-Data types- Constructors and Destructors- methods -access specifiers - static members –Comments- Control Flow, Arrays- Array Lists –Strings.

UNIT II INHERITANCEAND INTERFACES 9

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- Interfaces – defining an interface, implementing interface, differences between classes and interfaces- Exceptions - exception hierarchy-nput / Output Basics – Streams – Byte streams and Character streams

UNIT III OPERATOR OVERLOADING 9

Overloading unary operator – overloading binary operator – data conversion- Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations.

UNIT IV LINEAR DATA STRUCTURES 9

Abstract data types- List ADT – array-based implementation – linked list implementation —singly linked lists- circularly linked lists- doubly-linked list Stack ADT – Operations- Evaluating arithmetic expressions- Queue ADT – Operations - Circular Queue – Priority Queue – dequeue

UNIT V NON LINEAR DATA STRUCTURES AND SEARCHING 9

Tree- Binary trees-AVL Trees-Heap- Graphs- Types of Graphs- Breadth-first traversal - Depth-first traversal – Topological Sort- Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort- Hashing.

Total periods : 45

TEXT BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Herbert Schildt	Java: The Complete Reference	Mcgraw-Hill	2017
2	Libert & Keogh	Java programming: Black Book	Dreamtech Press	2015
3	Mark Allen Weiss	Data Structures and Algorithm Analysis in C	Pearson Education	2014

REFERENCES:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Gay S. Horstmann and Gary Cornel	Core Java: Volume I – Fundamentals	Sun Microsystems Press	2011
2	Timothy Budd	Understanding Object-Oriented programming with Java	Pearson Education	2006
3	Herbert Schildt	Java The Complete Reference	Oracle Press	2020

WEBSITES

1. https://nptel.ac.in/courses/106105151/
2. https://nptel.ac.in/courses/106101208/
3. https://nptel.ac.in/courses/106102064/
4. https://nptel.ac.in/courses/106/106/106106127/

Semester-III

21BEBME304 **BIOMATERIALS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students

- To infer characteristics and classification of Biomaterials.
- To understand the response of biomaterials in living system
- To identify different metals, ceramics and its nanomaterial's characteristics as Biomaterials.
- To interpret polymeric materials and its combinations that could be used as a tissue replacement implants.
- To discuss the concepts of Nano Science and Technology.
- To perceive the concept of biocompatibility and the methods for biomaterials testing.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Analyze different types of Biomaterials and its classification and apply the concept of nano technology towards biomaterials use.
- Evaluate response of biomaterials in living system.
- Identify significant gap required to overcome challenges and further development in metallic and ceramic materials
- Determine significant gap required to overcome challenges and further development in polymeric materials
- Create combinations of materials that could be used as a tissue replacement implant.
- Perceive the testing standards applied for biomaterials.

UNIT I INTRODUCTION TO BIO-MATERIALS 9

Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena.

UNIT II METALLIC AND CERAMIC MATERIALS 9

Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics.

UNIT III POLYMERIC IMPLANT MATERIALS 9

Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach.

UNIT IV TISSUE REPLACEMENT IMPLANTS 9

Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extracellular Matrix. Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.

UNIT V TESTING OF BIOMATERIALS

Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilisation of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.

Total periods : 45

TEXT BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Sujata V. Bhatt	Biomaterials	Narosa Publishing House	2005
2	Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O. Soboyejo	Biomaterials: A Nano Approach	CRC Press	2010

REFERENCE BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Myer Kutz	Standard Handbook of Biomedical Engineering& Design	McGraw Hill	2003

WEBSITES

1. https://www.nature.com/subjects/biomaterials
2. https://www.sciencedirect.com/journal/biomaterials

Semester-III

21BEBME305 FUNDAMENTALS OF BIOCHEMISTRY 3H-3C

Instruction Hours / week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students

- To study about the biochemistry of living cells, metabolism of biomolecules and the methods of investigation and diagnostic tools.
- To summarize the role of these biomolecules by providing basic information on specific metabolic diseases and disorders of these biomolecules.
- To analyse the structural and functional properties of carbohydrates, proteins and lipids
- To discuss about functions of each organelles and Transport of substances across biological membranes
- To infer about the biochemistry of living cells
- Demonstrate the concepts of biochemistry of living cells

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Demonstrate the concepts of biochemistry of living cells
- Understand the concepts of protein biochemistry
- Explain about functions of each organelles and Transport of substances across biological membranes
- Illustrate the structural and functional properties of carbohydrates, proteins and lipids
- Perceive the concepts of investigation of metabolism.
- Understand the structural and functional properties of various organelles and biomolecules

UNIT I BIOCHEMISTRY OF LIVING CELLS 9

Biochemistry of living cells, sub cellular fractionation using the differential centrifugation method. Functions of each organelles, redox potential, oxidative phosphorylation, Transport of substances across biological membranes.

UNIT II CARBOHYDRATES 9

Carbohydrates: Definition, classification, biological functions; glycolysis, TCA cycle, glycogenesis, glycogenolysis, Diabetes Mellitus – Blood Sugar analysis and glucose tolerance test.

UNIT III PROTEINS & LIPIDS 9

Proteins: Definition, classification, architecture, biological functions; Classification of amino acids, Oxidative and nonoxidative deamination, transamination, decarboxylation, urea cycle, Purification of proteins. Lipids: Definition, classification, biological functions; biosynthesis of long chain fatty acids, degradation of fatty acids - oxidation of fatty acids.

UNIT IV METHODS OF INVESTIGATION OF METABOLISM 9

Liver function tests, Renal function tests, Gastric function tests. Diagnostic tools: Principles and applications of photometry, flurometry, flame photometry, automation in clinical laboratory.

UNIT V CLINICAL BIOCHEMISTRY 9

Principles and applications of chromatography, electrophoresis, spectroscopic techniques. Blood gas analysis. Regulation of acid-base balance. Measurement of electrolytes. Uses of radioisotopes in biology and medicine.

Total periods : 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Lehninger.A .L., Nelson D.L., Cox .M.M.,	Principles of Biochemistry	CBS Publications	1993
2	Kumar V., & Gill, K. D.	Basic concepts in clinical biochemistry:	Springer, Singapore	2018

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Ambiga Shanmugam	Fundamentals of Biochemistry for Medical Students	Karthick Printers, Madras	2016

WEBSITES:

1. https://openstax.org/details/books/anatomy-and-physiology
2. https://www.sciencedirect.com/journal/biomaterials

Semester-III

21BEBME306 SIGNALS AND SYSTEMS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for students :

- To discuss the basic properties of signal and systems
- To understand signal types, properties and analysis
- To analyze continuous time signals
- To analyze discrete time signals
- To learn the concepts of Fourier Transform in signal analysis.
- To demonstrate the DTFT and Z –trnasforms for discrete signals

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Apply Laplace and Fourier transform for continuous signals
- Analyze continuous time LTI systems using Fourier and Laplace Transforms
- Apply DTFT and Z transforms for discrete signals
- Apply Fourier series and Transforms on signals
- Represent continuous and discrete systems in time and frequency domain using different transforms
- Analyze discrete time LTI systems using Z transform and DTFT

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Continuous time signals (CT signals) - Discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals - Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - CT systems and DT systems- Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Noncausal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series analysis-spectrum of Continuous Time (CT) signals- Fourier and Laplace Transforms in CT Signal Analysis - Properties.

UNIT III LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS 9

Differential Equation-Block diagram representation-impulse response, convolution integrals-Fourier and Laplace transforms in Analysis of CT systems.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband Sampling - DTFT – Properties of DTFT - Z Transform – Properties of Z Transform

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

Difference Equations-Block diagram representation-Impulse response - Convolution sum-Discrete.Fourier and Z Transform Analysis of Recursive & Non-Recursive systems.

Total periods : 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Allan V. Oppenheim, S. Wilsky and S. H. Nawab	Signals and Systems	Pearson	2007
2	B. P. Lathi	Principles of Linear Systems and Signals	Second Edition Oxford	2009

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year ofpublication
1	R. E. Zeimer, W. H. Tranter and R. D. Fannin	Signals & Systems Continuous and Discrete,	Pearson	2007
2	John Alan Stuller	An Introduction to Signals and Systems	Thomson	2007
3	M. J. Roberts	Signals & Systems Analysis using Transform Methods & Mat Lab	Tata McGraw Hill	2003

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-III

21BEBME311 BIOCHEMISTRY AND HUMAN PHYSIOLOGY LABORATORY

2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

OBJECTIVE:

The goal of this course is for students

- To estimate and quantify biomolecules.
- To divide amino acid molecules
- To evaluate and interpret of biochemical parameter
- To understand differential count of WBCs
- To understand the Ishihara chart
- To understand the auditory conduction

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Solve the quantitative test of different biomolecules
- Label the separation technology of proteins and amino acids.
- Analyse blood group
- Estimate of blood glucose
- Estimation of Hemoglobin
- Perceive the Biochemistry laboratory functional parameters

LIST OF EXPERIMENTS:

1. General tests for carbohydrates, proteins and lipids.
2. Preparation of serum and plasma from blood.
3. Estimation of blood glucose.
4. Estimation of serum cholesterol.
5. Estimation of creatinine in urine.
6. Separation of amino acids using thin layer chromatography.
7. Estimation of Hemoglobin
8. Differential count of different WBCs and Blood group identification
9. Ishihara chart for color blindness and Snellen's chart for myopia and hyperopia – by letters reading and opthalmoscope to view retina.
10. Weber's and Rinnee's test for auditory conduction.

B.E Biomedical Engineering **2021-2022**

Semester-III

21BEBME312 DIGITAL ELECTRONICS LABORATORY 2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

OBJECTIVE:

The goal of this course is for students

- Learn the basics of gates.
- To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- Learn about counters
- Learn about Shift registers
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits

OUTCOMES:

Upon completion of this course, students will be able to:

- Analyse different methods used for simplification of Boolean expressions.
- Design and implement Combinational circuits.
- Design and implement synchronous and asynchronous sequential circuits.
- Interpret the concept of synchronous and asynchronous sequential circuits
- Implement shift registers using Flip-flops.
- Apply the knowledge on digital circuits design

LIST OF EXPERIMENTS:

1. Study of logic gates.
2. Design and implementation of adders and Subtractors using logic gates.
3. Design and implementation of code converters using logic gates BCD to excess-3 code
4. Design and implementation of 4 bit binary Adder/Subtractor and BCD adder using IC 7483.
5. Design and implementation of 2 bit Magnitude Comparator using logic gate 8 bit Magnitude Comparator using IC 7485.
6. Design and implementation of 16 bit odd/even parity checker generator using IC74180.
7. Design and implementation of Multiplexer and Demultiplexer using logic gates and study of IC74150 and IC74154.

8. Design and implementation of encoder and Decoder using logic gates and study of IC 7447 and IC 74147.
9. Construction and verification of 4 bit ripple counter and Mod-10/ Mod- 13 Ripple counters.
10. Design and implementation of 3 bit Synchronous up/down counter.
11. Implementation of SISO, SIPO,PISO and PIPO shift registers using Flip-flops.

B.E Biomedical Engineering **2021-2022**

21BEBME351 **Semester-IV**

INDIAN CONSTITUTION **2H-0C**

Instruction Hours/week: L:2 T:0 P:0 **Marks:** Internal**:100** External**:00** Total**:100**

End Semester Exam:3 Hours

Course Objectives

- To know about Indian constitution.
- To know about central and state government functionalities in India.
- To know about Indian society.
- To inculate the students
- To imparts a good knowledge in judicial system in states
- To familiarize the student with constitutional Amendments and Functionaries.

Course Outcomes

Upon completion of the course, students will be able to

- Clarify on functions of the Central government.
- Define functions of the State government
- Explain the functions of Constitution
- Understand and abide the rules of the Indian constitution.
- Identify and appreciate different culture among the people.
- Gain knowledge on Indian Society

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working), Philosophy of the Indian constitution Preamble Salient Features

UNIT II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES `

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT IV LOCAL ADMINISTRATION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Panchayat raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Panchayat: Position and role Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT V ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	D.D. Basu	Introduction to the Constitution of India	Lexis Nexis	2015
2	M. P. Jain	Indian Constitution Law	7th Edn., Lexis Nexis	2014

WEBSITES:

1. www.mit.edu
2. www.nptel.com

21BEBME401 **Semester-IV**

MATHEMATICS-IV **4H-4C**

(PROBABILITY AND STATISTICS)

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students

- To provide the required skill to apply the statistical tools in Engineering problems.
- To introduce the basic concepts of probability.
- To introduce the basic concepts of random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To understand the notion of sampling distributions and statistical techniques
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

- Explain the fundamental concepts of probability and standard distributions which can describe real life phenomenon.
- Explain the basic concepts of one and two dimensional random variables and their applications in engineering.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Discuss the notion of sampling distributions and statistical techniques used in engineering and management problems.
- Discuss about the techniques in quality control that model engineering problems.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – The axioms of probability – Conditional probability – Baye‘s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression using SPSS tool– Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chisquare and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 12

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design using SPSS tool.

UNIT V STATISTICAL QUALITY CONTROL 12

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

Total periods : 60

TEXT BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Johnson, R.A., Miller, I and Freund J	Miller and Freund‘s Probability and Statistics for Engineers	Pearson Education, Asia	8th Edition, 2015
2	Milton. J. S. and Arnold. J.C.	Introduction to Probability and Statistics	Tata McGraw Hill	4th Edition, 2007
3	Devore. J.L.	Probability and Statistics for Engineering and the Sciences	Cengage Learning, New Delhi	8th Edition, 2014

REFERENCE BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Papoulis, A. and Unnikrishnapillai, S.	Probability, Random Variables and Stochastic Processes	McGraw Hill Education India	4th Edition, 2010.
2	Ross, S.M.	Introduction to Probability and Statistics for Engineers and Scientists	Elsevier	3rd Edition, 2004.

WEBSITES:

1. www.cut-theknot.org/probability.shtml
2. www.mathworld. Wolfram.com
3. www.mathcentre.ac.uk

Semester-IV

21BEBME402 LINEAR INTEGRATED CIRCUITS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for students :

- To discuss the basic concepts of linear integrated circuits
- To study the circuit configuration and introduce practical applications of linear integrated circuits.
- To introduce the concept of Passive and Active filters
- To infer the theory and applications of PLL
- To make use of the theory of ADC and DAC using OP – AMPS
- To demonstrate the concepts of waveform generation and introduce some special function ICs

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Define linear and non linear applications of OP – AMPS
- Create waveforms using OP – AMP Circuits
- Ability to design new analog linear circuits and develop linear IC based Systems.
- Understand the concept of application of waveform generators
- Design ADC and DAC using OP – AMPS
- Analyze special function ICs

UNIT I OPERATIONAL AM PLIFIER CHARACTERISTICS 9

Review of Amplifiers- Feedback Amplifiers, Types of Feedback, Op-amp - Block diagram Representation of op-amp- Open loop & closed loop configurations – DC & AC performance characteristics of op-amp – Frequency compensation - Noise– Differential amplifiers -Electrical Characteristics and internal schematic of 741 op - amps.

UNIT II OPAMP APPLICATIONS 9

Inverting & Non-inverting voltage amplifiers -Voltage follower –Summing & averaging amplifiers - AC amplifiers, Instrumentation Amplifiers-V-to-I and I-to-V Converters-Differentiators and Integrators. Wave Shaping Circuits - Clipper and Clampers– Low-pass, high-pass and band-pass filters-Comparators and its applications.

UNIT III WAVEFORM GENERATORS AND PLL 9

Waveform Generators: Sine-wave Generators – Square / Triangle / Sawtooth Wave generators. IC 555 Timer: Monostable operation and its applications, Astable operation and its applications, PLL: Operation of the Basic PLL-Closed loop analysis of PLL-Voltage Controlled Oscillator-Monolithic PLL IC 565-PLL Applications

UNIT IV ACTIVE FILTERS & VOLTAGE REGULATOR 9

Filters: Passive and Active filters – Filter Approximations-Design of Low pass Filter , High pass Filter, Band pass Filter and Band Rejection Filter, Voltage Regulators: Basics of Voltage Regulator – Linear Voltage Regulators using Op-amp – IC Regulators (78xx, 79xx, LM 317, 723)-Switching Regulators.

UNIT V DATA CONVERTERS &SPECIALFUNCTION ICS 9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R2R Ladder type, sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion. SPECIAL FUNCTION ICS : ICL8038 function generator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Isolation Amplifier,

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Roy Choudhur y and Shail Jain	Linear Integrated Circuits	New Age International Publishers	2018
2	Ramakant A.Gayakwad	Op-Amps and Linear Integrated Circuits	Prentice Hall of India, New Delhi	2015

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Robert F. Coughlin, Frederick F. Driscoll	Operational-Amplifiers and Linear Integrated Circuits	Prentice Hall of India, New Delhi	2001
2	Sergio Franco	Design with operational amplifier and analog integrated circuits	McGraw Hill	2016

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-IV

21BEBME403 BIOSENSORS AND TRANSDUCERS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students

- To define the basic concepts such as generalized instrumentation system, general properties of input transducers, static and dynamic characteristics of transducers and sensors
- To perceive a thorough understanding of principle of sensors
- To know the principle of transduction, classifications and the characteristics of different transducers
- To create the biomedical applications of the transducers and sensors.
- To discuss working of some of the above transducers and sensors.
- To know the different display and recording devices.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Have a clear understanding of generalized medical instrumentation system, general properties of input transducers, static and dynamic characteristics of transducers and sensors.
- Demonstrate various transducers and sensors in the course.
- Describe the purpose and methods of measurements.
- Explain the principle of different sensors and its applications
- Apply the transducers and sensors learnt in the course in suitable medical contexts.
- Implement working knowledge of some of the transducers and sensors

UNIT I INTRODUCTION TO TRANSDUCERS ANDITS CHARACTERISTICS 9

Introduction: Generalized Instrumentation System, General Properties of Input Transducer Static Characteristics: Accuracy, Precision, Resolution, Reproducibility, Sensitivity, Drift, Hysteresis, Linearity, Input Impedance and Output Impedance. Dynamic Characteristics: First Order and Second Order Characteristics, Time Delay, Error Free Instrument, Transfer Functions. Design Criteria, Generalized Instrument Specifications.

UNIT II MEASUREMENTS 9

Displacement, motion and Pressure Measurement: (with applications) Resistive: Potentiometers, Strain Gauges and Bridge Circuits. Inductive: Variable Inductance and LVDT Capacitive type, Piezoelectric Transducers. Types of Diaphragms, Bellows, Bourdon Tubes.

UNIT III THERMAL MEASUREMENTS 9

Temperature Measurement: Thermistor, Thermocouple, Resistive Temperature Detector, IC based Temperature Measurement, Radiation Sensors and Applications .

UNIT IV SENSOR FABRICATION **9**

Sensor Fabrications – an overview, Fabrication Technique – Pressure sensor – Pizorestive pressure sensor – capacitive pressure sensor – Micro sensor – Biomedical Application.

UNIT V BIOSENSORS **9**

Chemical Sensors: Blood gas and Acid- Base Physiology Potentiometric Sensors, Ion Selective Electrodes, ISFETS. Ampero metric Sensors, Clark Electrode with examples - pH, pO2, pCO2 Electrodes, Transcutaneous Arterial Oxygen Tension, Carbon Dioxide measurements: capnostat. Fiber Optic Sensors: Design Principles in Fabrication of Fiber Optic Sensors - Temperature, Chemical, Pressure. Biosensor: Classifications: Biological phenomenon, Transduction Phenomenon i.e. Enzyme Sensor and Electrode based: Affinity Sensors (Catalytic Biosensors), Two examples of each Biosensors and Immunosensors.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Hermann K P. Neubert	Instrument Transducer– An Intro to their performance and design	Hermann K P. Neubert	2000
2	HarryN,Norton.	Biomedical sensors – fundamentals and application	Harry N,Norton.	2001
4	NandiniK	Electronics in Medicine and Biomedical Instrumentation	Jog PHI Second Edition	2013

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	LaGeddesandL.E.Baker	Principles of applied Biomedical Instrumentation	LaGeddesandL.E.Baker	1997
2	LeslieCromwell,Fred. J.Weibell and Pfeiffer	Biomedical instrumentation and measurement	Leslie Cromwell, Fred.J.Weibell and Pfeiffer	2002
4	Jacob Fraden	Handbook of Modern Sensors – Physics, Design and Application	AIP press	2000

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-IV

21BEBME404 MICROPROCESSOR AND MICROCONTROLLER 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students :

- To infer processor architecture and its programming
- To discuss interfacing concepts
- To appraise advanced processor architecture
- To utilize the concepts of Interfacing with Peripherals for building applications
- To demonstrate the concepts Reduced Instruction Set Computer (RISC) architecture and Advanced RISC Machine (ARM) architecture.
- To develop skill to explore system design technique .

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to

- Design assembly language programming (ALP) for different applications for 8085
- Compile assembly language programming (ALP) for different applications for 8086
- Perceive knowledge on advanced processors and controllers
- Create application by Interfacing memory and I/O device with controllers
- Demonstrate the architectures of Reduced Instruction Set Computer (RISC) and Advanced RISC Machine (ARM) processors
- Design and deploy the Interfacing peripherals in real time scenario.

UNIT I MICROPROCESSOR- 8085/8086 9

Introduction to 8085- Introduction to 8086 -Register Organization -Architecture- Signals- Memory Organization-Bus Operation-I/O Addressing-Minimum Mode-Maximum Mode- Timing Diagram- Interrupts - Service Routines – I/O and Memory Interfacing concepts 8085 Assembly language programming (ALP).

UNIT II PROGRAMMING OF 8086 9

Instruction Format - Instruction set - Addressing Modes- -Assembly language programs in 8086, Strings, Procedures, Macros, Assembler Directives- Interrupts and Interrupt Applications - 8086 Assembly language programming (ALP) .

UNIT III ADVANCED PROCESSOR AND MICROCONTROLLER 9

Advanced coprocessor Architectures- 286, 486, **Latest Pentium architecture**s- Architecture of 8051 microcontrollers, Register Set - I/O and memory addressing- Interrupts- Instruction set- Addressing modes.

UNIT IV INTERFACING WITH PERIPHERALS 9

Timer, serial I/O, parallel I/O, A/D and D/A converters; Arithmetic Coprocessors; System level interfacing design, Concepts of virtual memory, Cache memory

UNIT V INTRODUCTION TO RISC AND ARM 9

Introduction to RISC processors; RISC architecture – Review of ARMv7 core and its architecture, introduction to ARM Programming-register configuration and instruction set – sample program. ARM microcontrollers interface designs.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	R. S. Gaonkar	Microprocessor Architecture: Programming and Applications with the 8085	Penram International Publishing	2000
2	D A Patterson and J H Hennessy	Computer Organization and Design The hardware and software	Morgan Kaufman Publishers	2018
3	Douglas Hall	Microprocessors Interfacing	Tata McGraw Hill	2017

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Jonathan W Valvano	Introduction to Arm(r) Cortex-M Microcontrollers	Clifton Park, NY : Thomson Delmar Learning	2005.
2	Sergio Franco	Design with operational amplifier and analog integrated circuits	Createspace Independent Publisher	2016

WEBSITE:

1. http://www.engineersgarage.com
2. www.comtechdoc.org
3. www.emu8086.com
4. www.microcontroller.com

Semester-IV

21BEBME405 PATHOLOGY AND MICROBIOLOGY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To appraise the concept of cell biology.
- To analyse the about the structural and functional aspects of living organisms.
- To perceive the etiology and remedy in treating the pathological diseases.
- To define the importance of public health.
- To understand the structural and functional aspects of living organisms.
- To know the etiology and remedy in treating the pathological diseases.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Define about the structural and functional aspects of living organisms.
- Demonstrate about the function of microscope
- Elaborate about the importance of public health.
- Explain about the methods involved in treating the pathological diseases
- Perceive knowledge on Disease caused by bacteria, fungi and protozoal
- Distinguish Natural and artificial immunity

UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA 9

Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification- Dystrophic and Metastatic. cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT II FLUID AND HEMODYNAMIC DERANGEMENTS 9

Edema, Hyperemia /Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders Bleeding disorders, Leukaemias, Lymphomas Haemorrhage.

UNIT III MICROBIOLOGY 9

Structure of Bacteria and Virus. Routes of infection and spread; endogenous and exogenous infections, Morphological features and structural organization of bacteria and virus, growth curve, identification of bacteria , culture media and its types , culture techniques and observation of culture. Disease caused by bacteria, fungi, protozoal, virus and helminthes.

UNIT IV MICROSCOPES **9**

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope & SEM). Preparation of samples for electron microscope. Staining methods – simple, gramstaining and AFB staining.

UNIT V IMMUNOPATHOLOGY **9**

Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury: opsonization, phagocytosis, inflammation, Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification, SLE.Antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Ramzi S Cotran Vinay Kumar & Stanley L Robbins	Pathologic Basis of Diseases	7th edition,WB Saunders Co.	2005
2	Ananthanarayanan&Panicker	Microbiology	10th edition Orient black swan	2017

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Underwood	JCE: General and Systematic Pathology	Churchill Livingstone, 3rd edition,	2000
2	Dubey RC and Maheswari DK	A Text Book of Microbiology	Chand & Com	2007

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-IV

21BEBME411 PATHOLOGY AND MICROBIOLOGY LABORATORY 2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for students :

- To utilize the Compound microscope
- To examine on chemical examinations,
- To examine Cryoprocessing,
- To discuss about histopathological examinations
- To understand anemia and leukemia
- To understand bone marrow charts

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Plan practical experiments on tissue processing using Compound microscope.
- Analyse the concept of cryoprocessing.
- Analyse the staining Processes
- understand anemia and leukemia
- Use bone marrow charts
- Explain about Antigen-Antibody reaction

LIST OF EXPERIMENTS:

1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
2. Study of parts of compound microscope
3. Histopathological slides of benign and malignant tumours.
4. Manual paraffin tissue processing and section cutting (demonstration)
5. Cryo processing of tissue and cryosectioning (demonstration)
6. Basic staining – Hematoxylin and eosin staining.
7. Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS
8. Capsule stain
9. Simple stain.
10. Gram stain.
11. AFB stain.
12. Antigen-Antibody reaction Immuno electrophoresis

13. Slides of malarial parasites, micro filaria and leishmania donovani.
14. Haematology slides of anemia and leukemia.
15. Study of bone marrow charts.

Semester-IV

21BEBME412 MICROPROCESSOR AND MICROCONTROLLER LABORATORY

2H-1C

Instruction Hours/week: L: 0 T: 0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students,

- To introduce ALP concepts and features
- To design and implement programs on 8085 microprocessor
- To write ALP for arithmetic and logical operations in 8086 and 8051
- To differentiate Serial and Parallel Interface
- To interface different I/Os with Microprocessors
- To be familiar with MASM

Upon completion of this course, students will be able to:

- Write ALP Program for fixed and Floating Point and Arithmetic operations
- Interface different I/Os with processor
- Generate waveforms using Microprocessors
- Execute Programs in 8051
- Use Serial and Parallel Interface
- Perform A/D and D/A conversion

LIST OF EXPERIMENTS

1. Programs for 8/16 bit Arithmetic operations (Using 8085 and 8086).
2. Programs for Sorting and Searching (Using 8086).
3. Programs for String manipulation operations (Using 8086).
4. Programs on Subroutines (Using 8051).
5. Interfacing ADC and DAC (Using MSP 430 Controllers/8051).
6. Interfacing with 8255.
7. Transfer data serially between two kits (8253/8251).
8. Interfacing with 8279.
9. Traffic Control Using MSP 430 controller/8051.
10. Interfacing with 8259 Programmable Interrupt Controller.
11. Interfacing and Programming of Stepper Motor and (8051).
12. Programming using Arithmetic, Logical & Bit Manipulation instructions of 8051 microcontroller.

Semester-IV

21BEBME413 BIOSENSORS AND TRANSDUCERS LABORATORY 2H-1C

Instruction Hours/week: L: 0 T: 0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students,

- To learn about data acquisition of physiological signal
- To learn about various biosensors
- To distinguish contact and non-contact method of skin temperature measurement
- To discuss working principle of Transducers
- To experiment with basic functions of Biosensors.
- To make use of different physiological signals.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Interpret the characteristics of various biosensors
- Illustrate the importance of the sensors and transducers for medical applications.
- Analyse the characteristics of physiological signals
- Measure skin temperature
- Perform data acquisition of physiological signals
- Choose the biosensors for relevant application

LIST OF EXPERIMENTS

1. Study of Biological Sensors
2. Displacement measurement using LVDT
3. Characteristics of temperature sensors – thermistor and RTD.
4. Characteristics of thermocouple
5. Characteristics of Flow Transducer
6. Characteristics of photo diodes, phototransistor
7. Characteristics of Piezoelectric Transducer.
8. Data acquisition of physiological signals
9. Measurement of skin temperature by both contact and non-contact method.
10. Study of the characteristics of capacitor level sensor for saline level measurement in a I-V set.

Semester-IV

21BEBME451 SOFT SKILLS –VERBAL & REASONING

Instruction Hours/week: L:1 T:0 P:0 **Marks:** Internal**:100** External**:0** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVE:

- To elevate the students into productivity powerhouses who can employ life skills to bet6ter their performances.
- To help the students understand interpersonal skills.
- To support them in building interpersonal skills.
- To better the ability to work with others.
- To expose students to right attitudinal and behavioral aspects
- To build the right attitudinal through activities

INTENTED OUTCOMES

- ability to communicate smartly and effectively with co-workers, relationship enhancement
- Improvement of time management and organizational skill.
- development of leadership teamwork, creativity, efficiency & productivity
- development of presentation skills
- ability to recognize stress symptom & develop stress deflecting strategies
- brain storming & problem solving strategies to increase creativity and collaborative outcomes

UNIT I **(4)**

Overview to communication, self-Introduction, Presentation on their own topic, Extempore, Group Activity (Verbal Reasoning – Proposition)

UNIT II (3)

Group Discussion, Do's and Don'ts of Group Discussion, Body language, Grooming and Resume, Resume correction, Activity (Verbal Reasoning - Premise)

UNIT III **(4)**

Introduction to HRM – Questions - Do's and Don'ts - Interview - Mock GD – Stress Management, Activity (Verbal Reasoning – Syllogism)

UNIT IV **(4)**

Personality Development - Presentation skills, Interpersonal skills, Critical thinking, Confidence building and Stress management, Activity (Verbal Reasoning – Verbal Analogies)

Total Hours: 15

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Barun K Mitra	Personality Development and SoftSkills	Oxford University Press-New Delhi	2012
2	Rajiv K Mishra	Personality Development	Rupa & Co	2012

Semester-V

21BEBME501 MODELING OF PHYSIOLOGY SYSTEM 4H-4C

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To provide insights of modeling techniques of physiological systems
- To discuss the concept of different systems of body in mathematical model.
- To demonstrate the working of physiological system in terms of equations.
- To define the parameters involved in thermal regulatory system
- To apply mathematical modeling principles in understanding the various fundamental biological systems
- To study system concept of biological control

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Recall the application of basic physiological system
- Reproduce the concept of circulatory system
- Analyze the process regulation
- Describe the parameters involved in thermal regulatory system
- Discuss the process of ultra-filtration system
- Explain the mechanism of respiration

UNIT I BASICS OF PHYSIOLOGICAL SYSTEMS 12

Systems Analysis, examples of physiological control systems, differences between engineering and physiological control systems. Generalized system properties, mathematical approximate electrical analogy, linear models, lung mechanics, muscle mechanics, distributed parameter versus lumped parameter models, static analysis, regulation of cardiac output, blood glucose regulation, chemical regulation of ventilation, electrical model of neural control mechanism

UNIT II CIRCULATORY SYSTEM 12

Physical, chemical and rheological properties of blood, problems associated with extracorporeal blood flow, dynamics of circulatory system.

UNIT III THERMAL REGULATORY SYSTEM **12**

Parameters involved, Control system model etc. Biochemistry of digestion, types of heat from body, models of heat transfer between subsystem of human body like skin core, etc systems like within body, body- environment, etc.

UNIT IV ULTRA FILTRATION SYSTEM **12**

Transport through cells and tubules, diffusion, facilitated diffusion and active transport, method waste removal, counter current model of urine formation in nephron, Modeling Henle's loop

UNIT V RESPIRATORY SYSTEM **12**

Modelling oxygen uptake by RBC and pulmonary capillaries, Mass balancing by lungs, Gas transport mechanisms of lungs, oxygen and carbon di oxide transport in blood and tissues

Total periods : 60

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	David O. Cooney	Biomedical Engineering Principles	Marcel Decker Pub.Co	2000
2	Michael C.K.Kho	Physiological Control Systems	Prentice Hall of India	2018

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	John Enderly Susan Blanchard, Joseph Bronzino	Introduction to Biomedical Engineering	Second Edition, Academic Press Series in	2012

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-V

21BEBME502 BIOMEDICAL INSTRUMENTATION 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To illustrate origin of bio potentials and its propagations
- To understand the basic theory of Bio potential Electrodes and Bio potential measurement.
- To appraise the different types of electrodes and its placement for various recordings
- To design bio amplifier for various physiological recordings
- To study the various bio chemical measurements.
- To perceive the different measurement techniques for non-physiological parameters.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Differentiate different bio potentials and its propagations.
- Describe the electrode behaviour and circuit models
- Illustrate different electrode placement for various physiological recordings
- Design bio amplifier for various physiological recordings
- Explain various technique for non-electrical physiological measurements
- Measure various biochemical parameters.

UNIT I BIOPOTENTIAL ELECTRODES 9

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, Contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - motion artifacts, measurement with two electrodes.

UNIT II BIOPOTENTIAL MEASUREMENTS 9

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven‘s triangle, standard 12 lead system, Principles of vector cardiograph. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG

UNIT III SIGNAL CONDITIONING CIRCUITS 9

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering 85

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement:

Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT V BIOCHEMICAL MEASUREMENT AND BIOSENSORS 9

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor(ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers - colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyser (simplified schematic description) – Bio Sensors – Principles – amperometric and voltometric techniques.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Joseph J. Carr and John M. Brown	Introduction to Biomedical Equipment Technology	Pearson Education	2004
2	John G. Webster	Medical Instrumentation Application and Design	John Wiley and sons	2020

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Leslie Cromwell	Biomedical Instrumentation and	Prentice hall of India, New Delhi	2007
2	KhandpurR.S	Handbook of Biomedical Instrumentation	Tata McGraw-Hill, New Delhi	2014
3	Myer Kutz	Standard Handbook of Biomedical Engineering & Design	McGraw-Hill	2003

WEBSITES:

1. www.mit.edu
2. www.nptel.com

21BEBME503 BIOMEDICAL SIGNAL PROCESSING 3H-3C

Instruction Hours/week: L:3 T: P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for students:

- To study the characteristics of different bio signals.
- To learn linear and non-linear filtering techniques to extract desired information
- To analyse the characteristics of some of the most commonly used biomedical signals, including ECG, EEG, EOG, and EMG.
- To perceive choice of filters to remove noise and artefacts from biomedical signals.
- To apply established engineering methods to analyse ECG signal problems.
- To discuss established engineering methods to analyse neurological signals.

COURSE OUTCOMES

Upon completion of this course, the student will be able to:

- Design different types of biomedical signals and identify their spectral components.
- Utilize different filters on biomedical signals and judge filter performance.
- Identify physiological interferences and artifacts affecting ECG signal.
- Assess power and correlation spectra of EEG signal.
- Analyze biosignals in time and frequency domains.
- Perform classification and recognition Biosignals

UNIT I INTRODUCTION TO BIOMEDICAL SIGNALS 9

Biosignal Characteristics of Electro Cardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Electrogastrogram (EGG), Electroneurogram (ENG), Event related potentials (ERPs), Phonocardiogram (PCG), Speech signal, Objectives of Biomedical signal analysis, Difficulties in Biomedical signal analysis, Computer-aided diagnosis.

UNIT II FILTERING FOR REMOVAL OF ARTIFACTS 9

Time-domain Filters - synchronized averaging, Moving Average Filters, Derivative-based operators to remove low-frequency artifacts. Frequency-domain filters - Removal of High Frequency noise, Removal of low frequency noise, Removal of periodic artifacts, optimal filter-Wiener filter, Adaptive filters for removal of interference.

UNIT III CARDIOVASCULAR APPLICATIONS 9

Noise &Artifacts, ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection, Adaptive noise cancelling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets. Computation of diagnostic signal parameters of ECG like Heart rate and QRS detection using Multivariate analysis (PCA and ICA). Segmentation of PCG, intensity patterns, Spectral modelling and analysis of PCG signals.

UNIT IV NEUROLOGICAL APPLICATIONS 9

EEG rhythms & waveforms, EEG applications- Epilepsy, sleep disorders, brain computer interface. Modelling EEG- linear, stochastic models - Nonlinear modelling of EEG - artifacts in EEG & their characteristics and processing – Nonparametric spectral analysis, Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis - correlation analysis of EEG channels - coherence analysis of EEG channels. Evoked potentials- noise characteristics, Noise reduction by linear filtering.

UNIT V ANALYSIS ON WAVESHAPE, SIGNAL CLASSIFICATION AND RECOGNITION 9

Modelling intramuscular EMG-Intramuscular signal decomposition-Fractal analysis of EMG signals. Statistical analysis of VAG signals. Analysis on amplitude and latency of MEG signals. Analysis of ERP effect. Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Analysis of EEG using Empirical mode decomposition (EMD)

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	John G. Proakis and Dimitris G.Manolakis	Digital Signal Processing, Algorithms and Applications	PHI of India Ltd., New Delhi, 3rd Edition	2021
2	Rangaraj.M.Rangayyan	Biomedical signal Analysis	Wiley-IEEE Press	2015

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	SanjitK.Mitra	Digital Signal Processing', A Computer Based Approach	Tata McGraw-Hill, New Delhi	2001

WEBSITES:

1. www.mit.edu
2. www.nptel.com

21BEBME504 Professional Ethics and Entrepreneurship Development 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVE

- To develop managerial and entrepreneurial skills our culture and ethics
- To Distinguish Direct and Preventive Control
- To perceive Knowledge on the principles of management is essential for all kinds of people in all kinds of organisations
- To have a clear understanding of the managerial functions like planning, organizing, staffing, leading and controlling
- To create an awareness and practice through engineering ethics and human values
- To outline how business ethics works

INTENDED OUTCOMES

- Advanced philosophical knowledge of the profession of recreation and leisure
- Synthesis of trends and issues as related to current professional practice
- Evaluate organizational theories and human resource management principles
- Analyse the information competency
- Follow Ethical practice and ethical management
- Understand Models of Professional Roles

UNIT I HISTORICAL DEVELOPMENT, PLANNING, ORGANISING 9

Definition of Management – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies and Planning Premises– Forecasting – Decision–making – Formal and informal organization – Organization Chart –.

UNIT II DIRECTING AND CONTROLLING 9

Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment –Process of Communication – System and process of Controlling – Requirements for effective control – Control of Overall Performance – Direct and Preventive Control – Reporting

UNIT III ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – variety of moral issued – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – consensus and controversy – Models of Professional Roles – theories about right action – Self–interest – customs and religion – uses of ethical theories, case studies.

UNIT IV FACTORS OF CHANGES 9

Forces that shape culture, social control – Meaning, Agencies, Institution, Customs, Values, Folkways, Norms and Laws. Social changes – Meaning and nature – theories, Gender Sensitivity.

UNIT V ENTREPRENEURSHIP AND MOTIVATION **9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth– Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self-rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives, Startup – History of the startup terminology, 5 Steps from Concept to Startup, Special Considerations – Business Incubators: Meaning, Definition, Services, Development and Types.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Harold Kooritz and Heinz Weihrich	Essentials of Management	Tata McGraw Hill, New Delhi	2010
2	Khanka S.S	Entrepreneurial Development	S.Chand and Co. Ltd., New Delhi	2006
3	Mike Martin and Roland Schinzinger	Ethics in Engineering	McGraw–Hill, New York	2005

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tripathy P.C and Reddy P.N	Principles of Management	Tata McGraw Hill, New Delhi	2008
2	Rabindra N Kanungo	Entrepreneurship and innovation	Sage Publications, New Delhi	1998
3	Charles E Harris, and Michael J Rabins	Engineering Ethics – Concepts and Cases	Wadsworth Thompson Learning, New	2013

WEBSITES:

1. http://www.managementstudyguide.com/taylor_fayol.htm
2. http://tutor2u.net/business/gcse/people_motivation_theories.htm
3. http://lfkkb.tripod.com/eng24/gilliganstheory.html
4. http://www.developingeyes.com/five–types–of–entrepreneurs/

Semester-V

21BEBME505 **ARTIFICIAL INTELLIGENCE** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To discuss problems that are amenable to solution by AI methods.
- To analyze given problem in the language/framework of different AI methods.
- To summarize appropriate AI methods to solve a given problem.
- To solve problems that are amenable to solution by AI methods drugs
- To analyse empirical evaluation of different algorithms
- To define knowledge inference

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

- Identify problems that are amenable to solution by AI methods.
- Identify appropriate AI methods to solve a given problem.
- Interpret a given problem in the language/framework of different AI methods.
- Implement basic AI algorithms.
- Design and carry out an empirical evaluation of different algorithms on a problem formulation, and state the conclusions that the evaluation supports.
- Explain about expert systems

UNIT I INTRODUCTION TO AL AND PRODUCTION SYSTEMS **9**

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics - Specialized production system- Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms.

UNIT II REPRESENTATION OF KNOWLEDGE **9**

Game playing – Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

UNIT III KNOWLEDGE INFERENCE **9**

Knowledge representation -Production based system, Frame based system. Inference – Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning – Certainty factors, Bayesian Theory-Bayesian Network-Dempster – Shafer theory.

UNIT IV PLANNING AND MACHINE LEARNING **9**

Basic plan generation systems – Strips -Advanced plan generation systems – K strips -Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

UNIT V EXPERT SYSTEMS **9**

Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert system shells.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Peter Jackson	Introduction to Expert Systems	3rd Edition, Pearson Education,	2007
2	Stuart Russel and Peter Norvig	"AI – A Modern Approach"	2nd Edition Pearson Education 2007.	2020

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Deepak Khemani	Artificial Intelligence	Tata McGraw Hill Education	2013.

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-V

21BEBME5E--	**PROFESSIONAL ELECTIVE I**	**3H-3C**

Instruction Hours/week: L:3 T: 0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Semester-V

21BEBME511 BIOMEDICAL INSTRUMENTATION LABORATORY 2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To discuss the working principle of Biomedical Instrumentation systems.
- To infer the basic acquisition techniques of bioelectric signals.
- To apply different Detection, correlation and averaging of various biomedical signals.
- To understand PCB layout design
- To examine blood pressure measurement
- To examine pH measurement

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Develop preamplifiers and amplifiers for various bio signal recordings.
- Measure various non-electrical parameters using suitable sensors/transducers
- Understand about Isolation amplifier
- Demonstrate blood pressure measurement using sphygmomanometer
- Explain about Photo transducer
- Design PCB layout for any bio amplifier

LABORATORY EXPERIMENTS:

1. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
2. Design of EMG amplifier
3. Design of EOG amplifier to detect eye blink
4. Design of EEG amplifier.
5. Design and study the characteristics of optical Isolation amplifier
6. Measurement of pulse-rate using Photo transducer.
7. Measurement of pH and conductivity.
8. Measurement of blood pressure using sphygmomanometer.
9. Measurement and recording of peripheral blood flow
10. Design a PCB layout for any bio amplifier using suitable software tool.

Semester-V

21BEBME512 BIOMEDICAL SIGNAL PROCESSING LABORATORY 2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To experiment with basic signal processing operations
- To understand about Discrete time signals
- To Demonstrate the filtering operation
- To understand the architecture of DSP
- To analyse FIR and IIR filters and DSP Processor
- To discuss the architecture of DSP processor

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Create coding for different convolution and correlation techniques.
- Generate random noise
- Design FIR and IIR filters.
- Analyse the various filtering operation
- Implement sampling operation in DSP Processor
- Experiment with various biomedical signals using Digital Signal Processor.

LABORATORY EXPERIMENTS:

1. Linear and Circular convolutions.
2. Generation of elementary Discrete-Time sequences
3. Auto correlation and Cross Correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation .
6. Study of architecture of Digital Signal Processor
7. Generation of various signals and random noise.
8. Perform MAC operation using various addressing modes
9. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.
10. Implement an Up-sampling and Down-sampling operation in DSP Processor

B.E Biomedical Engineering		**2021-2022**
		Semester-V
21BEBME551	**MINI PROJECT**	**2H-0C**

Instruction Hours/week: L: 0 T: 0 P:2 **Marks:** Internal**:100** External**:0** Total**:100**

End Semester Exam:3 Hours

SEMESTER VI

B.E Biomedical Engineering **2021-2022**

Semester-VI

21BEBME601 BIOMEDICAL IMAGE PROCESSING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To study the formation of an image and its acquisition
- To introduce the use and application of transforms in image processing
- To explain the fundamentals of medical image acquisition, processing and storage.
- To discuss simple image enhancement techniques in Spatial and Frequency domain.
- To appraise the concepts of degradation function and restoration techniques.
- To apply image compression and recognition methods

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the image fundamentals and mathematical transforms necessary for image processing.
- Illustrate the image enhancement techniques.
- Preprocess the image using filtering techniques
- Utilize image restoration procedures.
- Segment the region of interest in images.
- Apply the image compression procedures

UNIT I DIGITALIMAGEFUNDAMENTAL 9

Elements of digital image processing systems, Elements of Visual perception, Image sampling and quantization, Some Basic relationships between pixels, Matrix and Singular Value representation of discrete images.

UNIT II IMAGE TRANSFORMS 9

2D DFT, Cosine, Sine Hadamard, Haar, Slant, KL transform , Fourier transform and their properties.

UNIT III IMAGE ENHANCEMENT **9**

Histogram – Modification and specification techniques, Enhancement by point processing Image smoothening, Image sharpening, generation of spatial masks from frequency domain specification, Homomorphic filtering, and color image processing, color model – RGB Colormodel and HIS color model.

UNIT IV IMAGE RESTORATIONAND RECONSTRUCTION OF MEDICAL IMAGE **9**

Image degradation models, Unconstrained and Constrained restoration, mean filters, inverse filtering, Band pass filter , Band reject filter, Least mean square filter, Image reconstruction from projections–Radon transforms, Filter back projection algorithm, Fourier slice theorem, Fourier reconstruction of MRI Images.

UNIT V MEDICAL IMAGE COMPRESSION TECHNIQUES 9

Run length, Huffman coding, arithmetic coding, Golomb coding, Symbol based coding, Pixel coding, transform coding, JPEG Standard, predictive techniques, Wavelet coding. Application of image processing techniques in thermography, SPECT, PET images.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Rafael C., Gonzalez and Richard E. Woods	Digital Image Processing	Pearson Education Asia	2001
2	Anil K. Jain	Fundamentals of Digital Image Processing	Prentice Hall of India	1997

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	William K. Pratt	Digital Image Processing	John Wiley	2001

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-VI

21BEBME602 **BIOMECHANICS** **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To perceive about the principles of biomechanics.
- To study about the mechanics involved with various physiological systems.
- To gain knowledge about musculoskeletal mechanics
- To infer the mechanics of physiological systems.
- To discuss the mechanics of joints.
- To create mathematical models used in the analysis of biomechanical systems

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the principles of biomechanics.
- Discuss the mechanics of physiological systems.
- Demonstrate the mechanics of joints.
- Analyze the biomechanical systems using mathematical models.
- Design and develop the models specific to orthopedic applications
- Illustrate the mathematical models used in the analysis of biomechanical systems.

UNIT I INTRODUCTION TO MECHANICS 12

Introduction – Scalars and vectors, Statics – Force types, Resolution and composition of forces, Moments of force and couple, Resultant force determination, parallel forces in space, equilibrium coplanar forces, Dynamics, Basic principles – Linear motion, Newton‘s laws of motion, Impulse and Momentum, Work and Energy Kinetics – Velocity and acceleration, Kinematics – Link segment models, Force transducers, Force plates, Introduction to Constitutive equations –Constitutive equations of Non viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid

UNIT II MUSCULOSKELETAL MECHANICS 12

Bone structure and composition, Mechanical properties of bone: Electrical properties of bone, fracture mechanism and crack propagation in bones, fracture fixators, repairing of bones. Muscle structure, Muscle Actions - Mechanical Methods of Muscle Action Analysis, Tissue loads, Response of tissue to forces, Biomechanics of passive Muscle - Tendon units, ligament, Mechanical characteristics of muscles - Stretch shortening cycles, Force -Time Principle, Gait Analysis.

UNIT III CARDIOVASCULAR AND RESPIRATORY MECHANICS 12

Hook's law, Newtonian Fluid, Non-Newtonian fluid-. Blood flow: Laminar and Turbulent - Haematology and Blood Rheology - Relationship between diameter, velocity and pressure of blood flow - Resistance against flow. Mechanical properties of blood vessels - Arteries, arterioles, capillaries, veins, vascular graft-Prosthetic heart valves- TAH - heart valve dynamics. Interaction of blood and lung-Alveoli mechanics, P-V curve of lung - Airway resistance - Physics of lung diseases

UNIT IV BIOMECHANICS OF JOINTS 12

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Freebody diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video.

UNIT V MODELING AND ERGONOMICS 12

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics –Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted vibrations.

Total periods : 60

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Y.C. Fung	Bio-Mechanics- Mechanical Properties of Tissues‖	Springer-Verlag	1998
2	Subrata Pal	Textbook of Biomechanics‖	Viva Books Private Limited	2009

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers	Biofluid Mechanics: The Human Circulation ‖	Taylor and Francis	2007
2	Sheraz S. Malik and Shahbaz S. Malik	Orthopaedic Biomechanics Made Easy‖	Cambridge University Press	2015
3	Jay D. Humphrey, Sherry De Lange	An Introduction to Biomechanics: Solids and Fluids, Analysis and Design‖	Springer Science Business Media	2004
4	Shrawan Kumar	Biomechanics in Ergonomics‖, Second Edition	CRC Press	2007
5	Neil J. Mansfeild	Human Response to Vibration‖,	CRC Press	2005
6	Carl J. Payton	Biomechanical Evaluation of movement in sports and Exercise‖	-	2008

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-VI

21BEBME603 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To perceive the medical devices applied in measurement of parameters related to cardiology, neurology and the methods of continuous monitoring and transmitting them.
- To analyze some of the cardiac assist devices.
- To understand the principle of diathermy
- To discuss about the measurement of the signals generated by muscles.
- To summarize the need and use of some of the extracorporeal devices.
- To learn the patient safety measures

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Utilize different medical devices applied in measurement of parameters related to cardiology, neurology
- Explain about cardiac assist devices, its continuous monitoring andtransmission
- Measure signals generated by muscles
- Analyze different types of diathermy units.
- Identify the electrical hazards and Implement methods of patient safety
- Interpret the need and use of the extracorporeal devices.

UNIT I CARDIAC EQUIPMENT 9

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, Plethysmography. Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External

UNIT II NEUROLOGICAL EQUIPMENT 9

Clinical significance of EEG, Multi channel EEG recording system, Epilepsy, Evoked Potential– Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation.

UNIT III SKELETAL MUSCULAR EQUIPMENT 9

Generation of EMG, recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation.

UNIT IV DIATHERMY **9**

Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures.

UNIT V SPECIAL DIAGNOSTIC TECHNIQUES & PATIENT SAFETY **9**

Lithotripsy, Principles of Cryogenic technique and application, Need for heart lung machine, Endoscopy, Laproscopy., ophthalmic instruments. Physiological effects of electricity – important suscep tibility parameters – Macro shock – Micro shock hazards – Patient's electrical environment –Electrical safety codes and standards.

Total periods : 45

TEXT BOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	KhandpurR.S	Handbook of Biomedical Instrumentation	Tata McGraw Hill	2003

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Myer Kutz	Standard Handbook of Biomedical Engineering & Design	Mc Graw Hill	2003
2	L.A Geddes and L.E.Baker	Principles of Applied Biomedical Instrumentation	Mc Graw Hill	2008
3	Leslie Cromwell	Biomedical Instrumentation and Measurement	Pearson Education,	2007
4	Antony Y.K.Chan	Biomedical Device Technology, Principlesand design	Charles ThomasPublisher Ltd	2008
5	Joseph J. Carr and John M. Brown	Introduction to Biomedical Equipment Technology	Pearson education	2004
6	John G.Webster	Medical Instrumentation Application and Design	John Wileyand Sons	2006

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-VI

21BEBME604 **HOSPITAL MANAGEMENT** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To discuss the fundamentals of hospital administration.
- To learn about Bio-Medical Waste Management.
- To analyze the market related research process.
- To summarize the quality and safety aspects in hospital.
- To perceive knowledge about human resource management in hospital
- To explain about hospital information systems

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Explain various information management systems and relative supportive services.
- Interpret market related research processes in healthcare and hospital sectors.
- Illustrate the quality and safety aspects in hospital.
- Demonstrate about human resource management in hospital
- Understand about NABH and NABL
- Explain the importance of supportive services

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management –Telemedicine - Bio-Medical Waste Management.

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT III MARKETING RESEARCH PROCESS 9

Marketing information systems - assessing information needs, developing &disseminating information - Market Research process - Other market research considerations – Consumer Markets& Consumer Buyer Behavior - Model of consumer behavior - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems –Medical Transcription, Medical Records Department – Central Sterilization and Supply Department– Pharmacy– Food Services - Laundry Services.

UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL 9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABH, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	R.C.Goyal,	Hospital Administration and Human Resource Management‖	PHI – Fourth Edition	2006
2	G.D.Kunders	Hospitals – Facilities Planning and Management – TMH, New Delhi	Fifth Reprint	2007

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Cesar A.Caceres and Albert Zara	The Practice of Clinical Engineering	Academic Press, NewYork	1977
2	Norman Metzger	Handbook of Health Care Human Resources Management‖	2nd edition Aspen Publication Inc. Rockville, Maryland, USA	1990
3	Peter Berman	Health Sector Reform in Developing Countries‖	Harvard University Press	1995
4	William A. Reinke	Health Planning For Effective Management‖	Oxford University Press	1988
5	Blane, David, Brunner	Health and SOCIAL Organization: Towards a Health Policy for the 21stCentury‖	Eric Calrendon Press	2002

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-VI

21BEBME605 REHABILITATION ENGINEERING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To perceive the rehabilitation concepts and Rehabilitation team for future development
- and applications.
- To understand the Primary & secondary Disabilities
- To discuss various Principles of Rehabilitation Engineering.
- To infer the various orthotic devices and prosthetic devices to overcome orthopedic
- problems.
- To explain the need for medical aids.
- To explain about different types of models of Hand and arm replacement

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Elaborate about the needs of rehabilitations and its future development.
- Understand the terminologies used by the rehabilitation team
- Demonstrate Engineering Concepts in Sensory & Motor rehabilitation. Apply the different types of Therapeutic Exercise Technique to benefit the society.
- Design and apply different types Hearing aids, visual aids and their application in biomedical field and hence the benefit of the society.
- Understand the need of virtual reality based rehabilitation
- Simplify about different types of models of Hand and arm replacement.

UNIT I INTRODUCTION TO REHABILITATION 9

What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team Classification of members, The Role of Psychiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist - Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist, Psychologist, Music therapist, Dance therapist & Biomedical engineer.

UNIT II PRINCIPLES OF REHABILITATION 9

Introduction, The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles - Practice of Rehabilitation and Assistive Technology.

UNIT III THERAPEUTIC EXERCISE TECHNIQUE 9

Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilization exercises, Endurance exercises.

UNIT IV MANAGEMENT OF COMMUNICATION & VIRTUAL REALITY 9

Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids. Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V ORTHOTIC, PROSTHETIC DEVICES & RESTORATION TECHNIQUES 9

General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO. Prosthetic devices: Hand and arm replacement, Body powered prosthetics, Myoelectric controlled prosthetics and Externally powered limb prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and Walking, Hybrid Assistive Systems (HAS).

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Sunder	Textbook of Rehabilitation	Jaypee Brothers Medical Publishers Pvt. Ltd,New Delhi 2nd Edition	2007
2	Joseph D.Bronzino	The Biomedical Engineering Handbook	Third edition-3 volume set, Taylor & Francis	2006

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Horia-NocholaiTeodorecu, L.C.Jain	Intelligent systems and technologies in rehabilitation Engineering	CRC Press / IEEE Press	2000
2	Keswick. J	What is Rehabilitation Engineering, Annual Reviews of Rehabilitation	SpringerVerlag	1982
3	Warren E. Finn,Peter G. LoPresti	Handbook of Neuroprosthetic Methods	Plenum press, New York	2002

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-VI

21BEBME6E-- PROFESSIONAL ELECTIVE II 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Semester-VI

21BEBME611 BIOMEDICAL IMAGE PROCESSING LABORATORY 2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students to:

- To implement fundamental image processing techniques in Biomedical Images.
- To infer enhancement and Transformation of Medical Images.
- To perceive knowledge about reconstruction of images.
- To learn about pre processing of image
- To understand the CT images
- To study the MATLAB implementation

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the image fundamentals and mathematical transforms necessary for image processing.
- Illustrate the image enhancement techniques.
- Pre process the image using filtering techniques
- Utilize image restoration procedures.
- Segment the region of interest in images.
- Apply the image compression procedures.

LIST OF EXPERIMENTS:

1. Digital image Fundamentals.
2. Image Enhancement and Transformation.
3. Edge detection and boundary tracing techniques.
4. Removal of noise in medical images.
5. Image compressions.
6. Restoration of CT images.
7. Reconstruction of images.
8. Image Analysis.
9. MATLAB implementation.

Semester-VI

21BEBME612 DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS LABORATORY 2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To learn about Electrical safety measurements
- To understand the concept the ultrasonic diathermy
- To understand the concept of biotelemetry
- To provide practice on recording and analysis of different Bio potentials
- To learn different non-electrical parameters using various methods.
- To study the function of different Therapeutic equipment.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Measure different bioelectrical signals using various methods
- Assess different non-electrical parameters using various methodologies
- Illustrate various diagnostic and therapeutic techniques.
- Handle therapeutic equipment
- Design ECG amplifier
- Design and simulate by using Lab View

LIST OF EXPERIMENTS:

1. Simulation of ECG – detection of QRS complex and heart rate
2. Study of shortwave and ultrasonic diathermy
3. Study of biotelemetry
4. Electrical safety measurements.
5. Measurement of Respiratory parameters using spirometery.
6. Study of medical stimulator.
7. Study of ESU – cutting and coagulation modes
8. Recording of Audiogram
9. Design of ECG amplifier, recording and analysis using Lab View

Semester-VI

21BEBME651	**HOSPITAL TRAINING**	**2H-0C**

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:100** External**:0** Total**:100**

End Semester Exam:3 Hours

SEMESTER VII

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEBME701 ARTIFICIAL ORGANS AND IMPLANTS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To discuss the overview of artificial organs & transplants
- To extend the principles of implant design with a case study
- To explain the implant design parameters and solution in use
- To simplify about various blood interfacing implants
- To know the biocompatibility of artificial organs
- To learn about the implantable medical devices

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the implant design parameters and solution in use
- Analyze about various blood interfacing implants
- Evaluate response of biomaterials in living system
- Perceive knowledge about artificial organs & transplants
- Demonstrate different types of soft tissue replacement and hard tissue replacement
- Assess biocompatibility of artificial organs

UNIT I ARTIFICIAL ORGANS 9

Artificial blood, Artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyzer membrane), Dental Implants

UNIT II IMPLANT DESIGN & MATERIALS 9

Principles of implant design, Clinical problems requiring implants for solution. Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, carbons, medical applications

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION 9

Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

UNIT IV BLOOD INTERFACING IMPLANTS 9

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS 9

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Kopff W.J	Artificial Organs	John Wiley and sons, New York, 1st edition	1976
2	Park J.B.,	Biomaterials Science and Engineering‖	Plenum Press	1984

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	J D Bronzino	Biomedical Engineering handbook Volume II	CRC Press / IEEE Press	2000
2	R S Khandpur	Handbook of Biomedical Instrumentation	Tata McGraw Hill	2003
3	Joon B Park	Biomaterials – An Introduction	Plenum press, New York	1992
4	Yannas, I. V	Tissue and Organ Regeneration in Adults‖	New York, NY: Springer	2001
5	Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino	Clinical Engineering‖	CRC Press, 1st edition	2010
6	Myer Kutz	Standard Handbook of Biomedical Engineering & Design	McGraw- Hill	2003

WEBSITE:

1. www.mit.edu
2. www.nptel.com

Semester-VII

21BEBME741 VIRTUAL BIOINSTRUMENTATION 5H-3C

(Theory & Lab)

Instruction Hours/week: L:1 T:0 P:4 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

COURSE OBJECTIVES:

The goal of this course is for students:

- To introduce virtual instrumentation concepts and applications.
- To discuss about programming structure in LabVIEW.
- To analyze data acquisition hardware.
- To infer knowledge on VI programs for specific applications.
- To perceive the basics of virtual instrumentation.
- To program virtual instrumentation software for biomedical applications.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Illustrate programming concepts of virtual instruments.
- Compile programming structure in LabVIEW.
- Understand the use of VI for data acquisition.
- analyze different types of interfaces.
- Choose data from hardware systems.
- Develop VI programs for specific applications.

UNIT I REVIEW OF VIRTUAL INSTRUMENTATION 9

Overview: Virtual Instruments, Need of VI, advantages, block diagram and architecture of a Virtual Instrument - Conventional Instruments versus virtual Instruments graphical user interfaces ‘G' programming, comparison with conventional programming.

UNIT II VI PROGRAMMING TECHNIQUES 9

LabVIEW: Key terms, front panel, block diagram, Graphical programming pallets - Sub VI's, icon and connector panels - Data types Data flow programming - Editing, debugging and running a virtual instrument, object properties and their configuration Typical examples.

UNIT III PROGRAMMING STRUCTURE 9

Loops, auto- indexing - Shift registers - CASE structure - State machine - Formula node - Sequence structures: flat and stacked - Arrays and clusters functions, polymorphism, error clusters

and error handling functions - Visual displays: Waveform charts, waveform graphs, XY graphs and intensity graphs - Strings and string functions - File I/O - Attribute modes: Local and global variables.

UNIT IV DATA ACQUISITION FUNDAMENTALS 9

Overview - Key terms, DAQ and other data acquisition acronyms - Connecting computer to real world - Signals - Selecting and configuring DAQ measurement hardware - Data acquisition in LabVIEW - Understanding analog and digital I/O - NIDAQmx Tasks-VISA.

UNIT V APPLICATIONS 9

VI based temperature monitor - VI based cardiac monitor (ECG) Bio bench - A virtual instrument application for data acquisition and analysis of physiological signals ECG signal processing - simulation of ON/OFF controller and PID controllers, image acquisition and processing.

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Richard Jennings	LabVIEW Graphical Programming	McGraw – Hill Education, 5th edition	2019
2	Gary Jonson	Labview Graphical Programming	McGraw Hill, NewYork, 4th edition	2018
3	Lisa K.wells& Jeffrey Travis	Labview for everyone	Prentice Hall Inc., New Jersey	1997

REFERENCE:

S.NO.	Author(s) Name	Title of the book	Publisher	year of publication
1	Sokol off	Basic concepts of Labview 4	Prentice Hall Inc.,New Jersey	1998

WEBSITE:

1. www.mit.edu
2. www.nptel.com

ii) Laboratory

COURSE OBJECTIVE:

The goal of this course is for students:

- To perceive the basics of virtual instrumentation
- To familiarize the students with Virtual Instrumentation and to do programming for applications
- To understand the D/A acquisition interface
- To analyse timing issues
- To learn about GPIB
- To do program with Lab view software for biomedical applications

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- understand about Programming Techniques
- learn about Data Acquisition and inter facing techniques
- do programming for process control and other applications
- use D/A acquisition interface
- use serial communication interface
- use Lab view software for biomedical signal analysis

List of Experiments:

1. Getting Started with LabVIEW –Basic operations, controls and indicators.
2. Simple programming structures and Timing Issues
3. LabVIEW–Debugging VI, Sub-VI's
4. LabVIEW–Traffic Light-Programming Structure, Sub-Vis, Clusters
5. GPIB-Serial poll Byte
6. Communication viaRS232/Serial Port.
7. Oscilloscope-Attribute Nodes, Menus
8. RC Circuit measurement-Timing issues
9. Lab VIEW – Incorporating user written C subroutines
10. Digital-to-Analog acquisition interfacing - Analog I/O
11. The RS232 Interface – Function Generator
12. Importing pictures, Global/ local variables. Arrays, Clusters

B.E Biomedical Engineering **2021-2022**

Semester-VII

20BEBME7E-- PROFESSIONAL ELECTIVE-III 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEBME7E-- PROFESSIONAL ELECTIVE-IV 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEECOE-- OPEN ELECTIVE-1 3H-3C
21BECSOE--
21BEEEOE--

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEBME791 PROJECT WORK PHASE I 8H-4C

Instruction Hours/week: L:0 T:0 P:8 **Marks:** Internal**:100** External**:0 T**otal**:100**

End Semester Exam:3 Hours

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEBME751 TECHNICAL SEMINAR 2H-0C

Instruction Hours/week: L:2 T:0 P:0 **Marks:** Internal**:100** External**:0 T**otal**:100**

End Semester Exam:3 Hours

SEMESTER VIII

B.E Biomedical Engineering		**2021-2022**
		Semester-VIII
21BEBME8E--	**PROFESSIONAL ELECTIVE-V**	**3H-3C**
Instruction Hours/week: L:3 T:0 P:0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Biomedical Engineering		**2021-2022**
21BEECOE--		**Semester-VIII**
21BECSOE—	**OPEN ELECTIVE-II**	**3H-3C**
21BEEEOE--		
Instruction Hours/week: L:3 T:0 P:0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Biomedical Engineering		**2021-2022**
		Semester-VIII
21BEBME891	**PROJECT WORK PHASE II & VIVA-VOCE**	**16H-8C**
Instruction Hours/week: L:0 T:0 P:16	**Marks:** Internal**:120** External**:180** Total**:100**	
	End Semester Exam:3 Hours	

PROFESSIONAL ELECTIVES FOR SEMESTER V

PROFESSIONAL ELECTIVE I

B.E Biomedical Engineering **2021-2022**

Semester-V

21BEBME5E01 **BIOERGONOMICS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To be exposed to principles of ergonomics.
- To develop the mechanics of muscle physiology concepts.
- To understand the anthropometric design principles
- To learn the process of hearing
- To infer the factors in design of work space surfaces
- To familiar with the mathematical models, analysis and design of biomedical devices using case studies.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Understand principles of ergonomics.
- Analyse the factors in design of work space surfaces
- Elaborate with the mathematical models, analysis and design of biomedical devices using case studies.
- Apply the principles of good ergonomic design in anthropometry
- Design biomedical devices by applying ergonomics.
- Optimize the design of Medical Equipments.

UNIT I VISUAL AND AUDITORY ERGONOMICS 9

Process of seeing – visual capabilities-factors affecting visual acuity and contrast sensitivity – human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual display-process of hearing-principles of auditory display.

UNIT II MUSCLE PHYSIOLOGY 9

Muscle physiology -muscle metabolism-respiratory response-joint motion study- measure of physiological in- efficiency and energy consumption-work rest cycles-aspects of manual and posture study, material handling (MMH) Bio-mechanical recommended limits of MMH.

UNIT III CONTROLS AND DISPLAYS 9

Spatial compatibility physical arrangement of displays and controls- movement capability- rotary controls and rotar displays movement of displays orientation of the operator and movement relationships control orders and control responses- human limitations in tracking task.

UNIT IV ANTHROPOMETRY 9

Anthropometry- anthropometric design principles –work space envelope- factors in design of work space surfaces- principles of seat design –principles of control panel. Organization classification of human errors theories of accident causation-reducing accidents by altering behaviour.

UNIT V CASE STUDIES

Case Study 1: computer design, control panel design of an electronic instrument, computer key board, hand drill etc. Case Study 2: Biomedical Application, Design optimization of Medical Equipments.

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Pascale Carayon	Handbook of Human Factors and Engineering, Second Edition	CRC Press	2016
2	Robert.N. Bailey	Human Performance Engineering, Third Edition	Prentice Hall	1996
3	Martin Helander	Guide to Human Factors and Ergonomics, Second Edition	CRC Press	2005

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Shrawan Kumar	Biomechanics in Ergonomics, Second Edition	CRC Press	2007
2	Stephen Pheasant, Christine M. Haslegrave	Body space: Anthropometry, Ergonomics and the Design of Work	CRC Press	2016

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-V

21BEBME5E02 BIOMEDICAL PHOTONICS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To illustrate the concept optical properties of the tissues
- To analyse the instrumentation in photonics
- To infer knowledge about the diagnostic applications
- To outline the concept of therapeutic applications.
- Explain about the therapeutic applications.
- Understand practical applications of optics in medicine.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Apply concept optical properties of the tissues
- Utilise the instrumentation in photonics
- Describe photonics and its therapeutic applications.
- Describe surgical applications of laser
- Utilise the knowledge about the diagnostic applications
- Apply the concepts of laser to understand the laser safety procedures.

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

Refraction, Scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues,opto-thermal interaction, fluorescence.

UNIT II INSTRUMENTATION IN PHOTONICS 9

Instrumentation for absorption, scattering and emission measurements, excitation light sources – high pressure arc lamp, solid state LEDs, Lasers, optical filters, solid state detectors - optical detectors - time resolved and phase resolved detectors.

UNIT III SURGICAL APPLICATIONS OF LASERS 9

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology.

UNIT IV DIAGNOSTIC APPLICATIONS 9

Optical coherence tomography, Elastography, Fluorescence Imaging, Raman Imaging, FLIM.

UNIT V THERAPEUTIC APLLICATIONS 9

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and nononcological applications of PDT - Biostimulation effect – applications

Total Periods : 45

TEXT BOOKS:

1. Tuan Vo Dirh, ―Biomedical Photonics – Handbook, CRC Press, Bocaraton, 2014.

2. Paras N. Prasad, ―Introduction to Biophotonic, A. John Wiley and Sons, Inc. Publications, 2003

REFERENCES:

1. MarkolfH.Niemz, ―Laser-Tissue Interaction Fundamentals and Applications, Springer, 2019
2. G.David Baxter ―Therapeutic Lasers – Theory and practice, Churchill Livingstone publications Edition- 2001.
3. Leon Goldman, M.D., &R.James Rockwell, Jr., ―Lasers in Medicine, Gordon and Breach, Science Publishers Inc., 1975.

WEBSITES:

1. www.mit.edu
2. www.nptel.com

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B.E Biomedical Engineering **2021-2022**

Semester-V

21BEBME5E03 **COMMUNICATION AND ITS APPLICATION IN MEDICINE** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

Course Objectives

The goal of this course is for students

- To study the various analog and digital modulation techniques
- To understand analog and digital communication techniques.
- To Learn data and pulse communication techniques.
- To explain data communication codes
- To be familiarized with multiple accessing techniques.
- To study the principles behind biotelemetry

Course Outcomes

Upon completion of this course, students will be able to:

- Distinguish analog and digital communication
- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Knowledge on various types of noises during transmission.
- Analyze various data communication
- Gain knowledge on Transmission of physiological signal

UNIT I ANALOG COMMUNICATION **9**

Introduction to Communication Systems - Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).

UNIT II PULSE AND DATA COMMUNICATION **9**

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM). Data Communication: History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes – Data communication Hardware - serial and parallel interfaces.

UNIT III DIGITAL COMMUNICATION **9**

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT IV MULTIPLE ACCESS (MA)TECHNIQUES 9

Multiplexing: definition, purpose ,Frequency division multiple access (FDMA) , Time division multiple access (TDMA) , Code-division multiple access (CDMA) , Comparison of multiple access techniques , Differences between multiple access and multiplexing , Wireless communication systems , Structure of mobile telephone and public switched telephone network, Propagation issues in mobile radio

UNIT V: BIOTELEMETRY. **9**

ECG telemetry system. Temperature telemetry system. Multi-channel wireless telemetry system. Transmission of physiological signals over telephone. Telemedicine: ECG, wireless telemetry

Total Periods : 45

TEXT BOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Wayne Tomasi	Advanced Electronic Communication Systems‖	6th Edition, Pearson Education	2015

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Simon Haykin	Communication Systems‖	5th Edition, John Wiley & Sons	2009
2	Rappaport T.S	Wireless Communications: Principles and Practice	2nd Edition, Pearson Education	2010
3	H.Taub, D L Schilling and G Saha	Principles of Communication	4th Edition, Pearso Education	2017
4	B. P.Lathi	Modern Analog and Digital Communication Systems‖	4th Edition, Oxford University Press	2011

5	Blake	Electronic Communication Systems‖	Thomson Delma Publications	2002
6	Martin S.Roden	Analog and Digital Communication System‖	3rd Edition, Prentice Ha of India	2003

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-V

21BEBME5E04 HOSPITAL WASTE MANAGEMENT 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60**
Total**:100** **End Semester Exam:**3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To introduce the relevance of this course to the existing technology
- The student should be made to understand the principles, practices and areas of application in Hospital management
- To know the hazardous materials used in hospital and its impact on health.
- To get knowledge on biomedical waste management.
- To infer the hazards in biomedical waste management.
- To develop knowledge on facility safety and infection control.

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COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Distinguish various waste disposal procedures and management.
- Understand the biomedical waste disposal concept.
- Explain the importance of supportive services.
- Demonstrate Biomedical Waste Management techniques.
- Elaborate the hazards in biomedical waste management.
- Apply knowledge on facility safety and infection control.

UNIT I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS 9

Healthcare Hazard Control : Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

UNIT II BIOMEDICAL WASTE MANAGEMENT 9

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labelling, waste handling, collection, storage and transportation, treatment and disposal.

UNIT III HAZARDOUS MATERIALS 9

Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection.

UNIT IV FACILITY SAFETY 9

Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention,Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

UNIT V INFECTION CONTROL, PREVENTION AND PATIENT SAFETY 9

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events,
Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tweedy, James T.,	Healthcare hazard control and safetymanagement	CRC Press_Taylor and Francis	2014
2	Anantpreet Singh, Sukhjit Kaur	Biomedical Waste Disposal	Jaypee Brothers Medical Publishers (P) Ltd	2012

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	R.C.Goyal	Hospital Administration and Human Resource Management	PHI – Fourth Edition	2017
2	V.J. Landrum	Medical Waste Management and disposal‖	Elsevier	1991

WEBSITES:

1. www.mit.edu
2. www.nptel.com

PROFESSIONAL ELECTIVES FOR SEMESTER VI

PROFESSIONAL ELECTIVE II

B.E Biomedical Engineering **2021-2022**

Semester-VI

21BEBME6E01 BIOMEDICAL TRANSPORT PHENOMENA 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To discuss the concepts and law of thermodynamics.
- To analyse the physical properties of the body fluids and cell membrane.
- To apply solute transport in biological systems.
- To infer knowledge about oxygen transport in biological systems and bioartificial organs.
- To explain the Modelling approaches for drug distribution
- To define the factors affecting drug distribution

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Demonstrate the concepts and law of thermodynamics.
- Analyse the physical properties of the body fluids and cell membrane.
- Create the solute transport in biological systems.
- Perceive the knowledge about oxygen transport in biological systems and bioartificial organs.
- Analyse the factors affecting drug distribution
- Design a model for drug distribution

.

UNIT- I THERMODYNAMIC CONCEPTS 9

First law and second law of thermodynamics, properties, fundamental property relations.

UNIT-II PHYSICAL PROPERTIES OF THE BODY FLUIDS AND CELL MEMBRANE 9

Body fluids and compositions, capillary plasma retention, osmotic pressure, formation of interstitial fluid, net capillary filtration rate, lymphatic system, solute transport across the capillary endothelium, cell membrane and ion pumps. Blood transport: Momentum transport fundamentals, marginal zone theory for blood flow and rheology. Mechanical energy balance (Bernoulli's equation.).

UNIT-III SOLUTE TRANSPORT IN BIOLOGICAL SYSTEMS: **9**

Capillary properties, capillary flow rates, solute diffusion-Fick's law, solute transport by capillary function, diffusion with in heterogeneous media, solute permeability, solute transport across the capillary wall, shell balances, krogh tissue cylinder. Active transport of biological solutes.

UNIT-IV OXYGEN TRANSPORT IN BIOLOGICAL SYSTEMS AND BIOARTIFICIAL ORGANS **9**

Diffusion of oxygen in multicellular systems, haemoglobin, hill equation, tissue oxygenation, oxygen transport in bioartificial organs, oxygen transport in krogh tissue cylinder.

UNIT-V PHARMACOKINETIC ANALYSIS **9**

Modelling approaches, factors affecting drug distribution, drug clearance, model for intravenous injection of drug, accumulation of drug in urine, constant infusion of drug, first order drug absorption and elimination, two compartment model. Extracorporeal devices: haemodialysis and blood oxygenators.

Total Periods : 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Fournier R	Basic Transport Phenomena in Biomedical Engineering	3rd Edition, CRC press, Taylor and Francis Group.	2017

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Truskey G.A, Yuan F, Katz D.F	Transport phenomena in biological systems	Pearson Prentice Hall	2009
2	Cooney D.O	Biomedical engineering principles: An Introduction To Fluid, Heat, and Mass Transport Processes	Marcel Dekker, Inc	2000

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-VI

21BEBME6E02 TELEHEALTH TECHNOLOGY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To infer the key principles for telemedicine and health.
- To define telemedical technology.
- To know telemedical standards, mobile telemedicine and it applications.
- To State the principles of clinical telehealth
- To understand the scope, benefits and limitations of Telemedicine and security in telemedicine applications

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Apply multimedia technologies in telemedicine.
- Explain Protocols behind encryption techniques for secure transmission of data.
- Utilize telehealth in healthcare.
- Outline the basic concepts involved in telemetry based transmission and reception
- Discuss the communication devices and Networks of telemedicine
- Describe telehealth systems for secure transmission of medical data and retrieval of telemedicine based information.

UNIT I TELEMEDICINE AND HEALTH 9

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Telehealth, Telecare, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine- Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II TELEMEDICAL TECHNOLOGY 9

Principles of Multimedia-Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT,ISDN, Internet, Air/wireless communications: GSM satellite, and Microwave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine–LAN and WAN technology. Satellite communication. Mobile hand held devices and mobile communication. Internet technology and telemedicine using world wide web(www).Video andaudio conferencing. Clinical data–local and centralized.

UNIT III TELEMEDICAL STANDARDS 9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption.Protocols:TCP/IP,ISO-OSI,StandardstofollowedDICOM,HL7,H.320series(Video phone based ISBN)T.120,H.324(Video phone based PSTN),Video Conferencing, Real-timeTelemedicine integrating doctors/Hospitals, Clinical laboratory data, Radiological data, and other clinically

significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT IV MOBILE TELEMEDICINE 9

Teleradiology: Definition, Basic parts of tele radiology system: Image Acquisition system Display stem, Telepathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine-patient information medical history ,test reports, medical images diagnosis and treatment. Hospital information system-Doctors, paramedics, facilities available. Pharmaceutical information system.

UNITV TELEMEDICAL APPLICATIONS 9

Telemedicine Access to healthcare services–health education and selfcare. Introduction to roboticssurgery,Telesurgery,Telecardiology,Teleoncology,Telemedicine in neurosciences, electronic Documentation, e-health services security and inter operability. Telemedicine access to healthcare services– health education and selfcare, Business aspects-Project planning and costing, Usage of telemedicine.

Total Periods : 45

TEXTBOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Norris,A.C	Essentials of Telemedicine and Telecare	Wiley	2002

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Wootton,R.,Craig,J.,Patterson,V	Introduction to Telemedicine .Royal Society of Medicine	Taylor&Francis	2006
2	O'Carroll,P.W.,Yasnoff, W.A.,Ward,E.,Ripp,L.H., Martin,E.L	Public Health Informatics and InformationS ystems	Springer	2013

3	Ferrer-Roca,O.,Sosa-Iudicissa,M.	Handbook of Telemedicine.Technology and Informatics	IOS Press (Studies in Health)Volume54	1999
4	Simpson,W.	Videoover IP,A practical guide to technology and applications	Focal PressElsevier	2005
5	MohanBansal	Medical Informatics	Tata McGraw-Hill	2002

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-VI

21BEBME6E03 **BIO MEMS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for students

- To gain knowledge on the principles and application of Bio MEMS
- To Learn various MEMS fabrication techniques.
- To Understand different types of sensors and actuators and their principles of operation at the micro scale level.
- To Know the application of MEMS in different field of medicine
- To Comprehend the characteristics of fluid flow and actuation through micro channels.
- To Explain the need and use of CAD for MEMS design

Course Outcomes

Upon completion of this course, students will be able to:

- Discuss various MEMS fabrication techniques.
- Explain different types of sensors and actuators and their principles of operation at themicro Scale level.
- Analyse the Properties of piezoelectric materials
- Apply MEMS in different field of medicine.
- Acquainted with micro fluidic systems
- Design MEMS devices for different medical applications.

UNIT I MEMS MATERIALS AND FABRICATION 9

Typical MEMs and Microsystems, materials for MEMS - active substrate materials- Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT IV MICROFLUIDIC SYSTEMS 9

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in sub micrometer and nano scale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, micro fluid dispenser, micro needle, micro pumps-continuous flow system, micro mixers

UNIT V APPLICATIONS OF BIOMEMS 9

CAD for MEMs, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, micro system approaches to polymerase chain reaction (PCR),DNA sensor, MEMS based drug delivery

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tai Ran Hsu	MEMS and Microsystems Design and Manufacture	Tata McGraw Hill Publishing Company, New Delhi	2017
2	Wanjun Wang, Stephen A.Soper	BioMEMs: Technologies and Applications	CRC Press, New York	2007

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Marc J. Madou	Fundamentals of Microfabrication: the Science of Miniaturization	CRC Press	2002
2	Nadim Maluf, Kirt Williams	An introduction to Microelectro Mechancial Systems Engineering	Second Edition Artech House Inc MA,	2004
3	Chang Liu,	Foundations of MEMS	Pearson Education International, New Jersey, USA	2011
4	Nitaigour Premchand Mahalik	MEMS	Tata McGraw Hill Publishing Company, New Delhi	2007

WEBSITE:

1. www.mit.edu
2. www.nptel.com

Semester-VI

21BEBME6E04 NANO BIOENGINEERING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for students

- To understand the basics of Materials in Medicine.
- To understand the basics of Biological Interactions with Materials.
- To explore various nano particles
- To learn Toxicity of nano particles
- To explore about tissue engineering
- To infer the knowledge of drug delivery systems

Course Outcomes

Upon completion of this course, students will be able to:

- Analyse various kinds Carbon Nanomaterials
- Analyse Safety Testing of Biomaterials
- Analyse the toxic levels of nano materials
- Apply the concept of Natural polymers in tissue engineering applications
- Discuss the strategies in tissue engineering
- Explain about drug delivery systems

UNIT –I SYNTHETIC MATERIALS IN MEDICINE 9

properties of Materials: Bulk Properties of Materials, Surface Properties of Materials. Classes of Materials Used inMedicine: Structure and Properties of Metals, Ceramics, Glasses, and Glass-Ceramics, Polymers, Hydrogels, Family of Carbon Nanomaterials, Bioresorbable and Bioerodible Materials, Composites, Thin Films, Grafts and Coatings, Biologically Functional Materials.

UNIT –II BIOLOGICAL INTERACTIONS WITH MATERIALS INTRODUCTION 9

Biocompatibility, Toxicity, Cytotoxicity, Hypersensitivity, Carcinogenicity, Interaction of Materials with Soft Tissues, Inflammation, Granulation Tissue Formation, Foreign Body Reaction, Fibrosis, Modification of Blood- Biomaterial Interactions, Interaction with Blood by Heparin, Interactions with Proteins, Cell Adhesion, Interactions with Hard Tissues, The Vroman Effect, Adhesion of Osteoblasts, Osseointegration, Fibrous Capsule Formation, Safety Testing of Biomaterials.

UNIT –III NANOTOXICOLOGY 9

Introduction, Toxicity of nanoparticles, Types of Nanoparticles causing Toxicity, Target organ toxicity, Exposure, Uptake, and Barriers, Experimental Models in Nanotoxicology - In vitro Models, In Vivo Models, Predicting Penetration and Fate of Nanoparticles in the Body, Toxicity Mechanisms - Mechanisms for Radical Species Production, General Genotoxicity Mechanisms, Detection and Characterization of Genotoxicity.

UNIT –IV TISSUE ENGINEERING **9**

Introduction, Stem cells, Morphogenesis, Generation of tissue in the embryo, Tissue homeostasis, Cellular signalling, Extracellular matrix as a biologic scaffold for tissue engineering, Natural polymers in tissue engineering applications, Degradable 15 polymers for tissue engineering, Degradation of bioceramics. Cell source, Cell culture: harvest, selection, expansion, and differentiation, Cell nutrition, Cryobiology, Scaffold design and fabrication, Controlled release strategies in tissue engineering

UNIT –V DRUG DELIVERY SYSTEMS **9**

Fundamentals of Drug Nanoparticles: Production, Size, Surface area, Suspension and Settling, Magnetic and Optical Properties, Biological Transport. Manufacturing of Nanoparticles: Ball-Milling, High-Pressure Homogenization, Spray-Drying Production in Nonaqueous Liquids, Hot-Melted Matrices, Pelletization Techniques, Direct Compress. Delivery of Nanoparticles: Brain Delivery, Ocular Drug Delivery, Gene Delivery Systems, Carriers in Cancer Therapy, Cardiovascular System, Vascular Delivery to the Lungs, Targeting Lymphatics.

Total Periods : 45

TEXT BOOKS

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemon	BlOMATERIALS SCIENCE: An Introduction to Materials in Medicine 2nd Edition	Academic Press	2012
2	Ralph S. Greco, Fritz B. Prinz, R. Lane Smith	Nanoscale Technology in Biological Systems	CRC PRESS	2004

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	John W. Nicholson	The Chemistry of Medical and Dental Materials	The Royal Society of Chemistry	2020
2	C. S. S. R. Kumar, J. Hormes, C. Leuschner	Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications, and Impact	WILEY	2005
3	Clemens van Blitterswijk, Peter Thomsen	Tissue Engineering,	Academic Press	2008
4	VLADIMIR P TORCHILIN	Nanoparticulates Drug Carriers	Imperial College Press	2006

WEBSITES:

1. www.mit.edu
2. www.nptel.com

PROFESSIONAL ELECTIVES FOR SEMESTER VII

PROFESSIONAL ELECTIVE III

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEBME7E01 BIOMETRIC SYSTEMS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To introduce the relevance of this course to the existing technology
- To infer the technologies of finger print,iris,face and speech recognition.
- To develop the general principles of design of biometric systems and the underlying trade-offs.
- To recognize personal privacy and security implications of biometrics-based identification technology.
- To identify issues in the realistic evaluation of biometrics-based systems.
- To explain biometric authentication

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Demonstrate the technologies of finger print, iris, face and speech recognition
- Analyse the general principles of design of biometric systems and the underlying trade-offs.
- Identify personal privacy and security implications of biometrics-based identification technology.
- Develop fingerprint recognition technique.
- Analyse Feature Extraction and Pattern Classification
- Perceive the issues in the realistic evaluation of biometrics-based systems.

UNIT I INTRODUCTIONTOBIOMETRICS 9

Introduction and background–biometric technologies–passive biometrics–active biometrics-Biometric systems–Enrolment–templates–algorithm–verification–Biometric applications– biometric characteristics-Authentication technologies–Need for strong authentication-Protecting privacy and biometrics and policy–Biometric applications–biometric characteristics

UNIT II FINGERPRINT TECHNOLOGY 9

History of fingerprint pattern recognition- General description of finger prints-Fingerprint feature processing techniques-fingerprint sensors using RF imaging techniques–fingerprint quality assessment–computer enhancement and modelling of fingerprint images–fingerprint enhancement –Feature extraction–fingerprint classification–fingerprint matching

UNIT III FACE RECOGNITION AND HAND GEOMETRY 9

Introduction to face recognition, Neural networks for face recognition–face recognition from correspondence maps–Hand geometry–scanning–Feature Extraction-Adaptive Classifiers- Visual-Based Feature Extraction and Pattern Classification-feature extraction–types of algorithm–Biometric fusion.

UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION 9

Voice Scan–physiological biometrics–Behavioral Biometrics-Introduction to multimodal biometric system–Integration strategies–Architecture–level of fusion–combination strategy–training and adaptability– examples of multimodal biometric systems–Performance evaluation-Statistical Measures of Biometrics–FAR–FRR–FTE– EER–Memory requirement and allocation.

UNIT V BIOMETRIC AUTHENTICATION 9

Introduction-Biometric Authentication Methods-Biometric Authentication Systems–Biometric authentication by fingerprint-Biometric Authentication by Face Recognition.-Expectation-Maximization theory-Support Vector Machines. Biometric authentication by fingerprint–biometric authentication by hand geometry-Securing and trusting a biometric transaction–matching location–local host-authentication server–match on card (MOC)–Multibiometrics and Two-Factor Authentication

Total Periods : 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	JamesWayman, AnilJain, DavideMaltoni	Biometric Systems,Technology Design and Performance Evaluation	Springer	2005
2	S.Y.Kung,S.H.Lin,M. W.Mak	Biometric Authentication:AMachine Learning Approach	Prentice Hall	2004

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Paul Reid	Biometrics for Network Security	Pearson Education	2003
2	Nalini K Ratha, Ruud Bolle	Automatic fingerprint Recognition System	Springer	2003
4	John Chirillo, Scott Blaul	Implementing Biometric Security	John Wiley	2003
5	Arun A. Ross, Karthik Nanda Kumar, Anil K. Jain	Handbook of Multi biometrics	Springer	2006

WEBSITES:

1. www.mit.edu
2. www.nptel.com

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEBME7E02 **NEURAL ENGINEERING** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students :

- To discuss the physiological concepts of nerve impulse generation and Electromyography
- To be acquainted with the nervous system development
- To be exposed to neuronal diseases and disorders
- To discuss about EEG and its various applications
- To Explore Evoked potentials and its importance in medicine
- To introduce various techniques to study central and peripheral nerve function

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Explain the basic structure and functions of human nervous system
- Understand the physiology behind generation of nerve impulses.
- Describe various techniques that are used to evaluate the functioning of central and peripheral nervous system.
- Analyse visualization and radiological assessment of nervous system
- Differentiate between a normal and abnormal signal coming from a healthy and a diseased nervous system respectively.
- Gain knowledge about the evaluation of electrophysiology.

UNIT I NERVE EXCITABILITY AND ELECTROMYOGRAPHY 9

Nerve Excitability: Functional insights derived from axonal structures, Nerve excitability findings in Neurologic diseases: Chemotherapy induced neurotoxicity, Porphyric Neuropathy, Inflammatory Neuropathy and its Treatment, Spinal Cord Injury; Nerve conduction studies, Microneurography and its potential clinical applications.Clinical Electromyography (EMG), Quantitative EMG,Neuromuscular Ultrasound as a compliment to the electrodiagnostic valuation, Electrophysiologic study of Disorders of Neuromuscular Junction:, H-Reflex and F-Reflex, Blink reflex and other cranial nerve reflexes, Electrophysiological evaluation of movement disorders, Evaluation of autonomic nervous system.

UNIT II ELECTROENCEPHALOGRAPHY 9

Electroencephalography (EEG): General Principles and Clinical Applications, Neonatal and Paediatric EEG, EEG Artefacts and Benign Variants, Video EEG monitoring for epilepsy, Invasive Clinical Neurophysiology in Epilepsy and movement disorders, Topographic mapping, Frequency analysis and other quantitative techniques in EEG, Intraoperative EEG monitoring during carotid endarterectomy and cardiac surgery, Magnetoencephalography.

UNIT III EVOKED POTENTIALS 9

Evoked Potentials and Related Techniques: Visual Evoked potentials (VEPs), Electroretinography and other diagnostic approaches to the Visual System, VEPs in infants and children, Brainstem Auditory Evoked Potentials (AEPs), Brainstem AEPs in infants and children, Somatosensory evoked potentials, Diagnostic and therapeutic role of Magnetic stimulation in neurology.

UNIT IV FUNCTIONAL NEUROIMAGING AND COGNITION 9

Historical and physiological perspective, Functional neuroimaging methods: PET and MRI, Network analyses, Functional neuroimaging of: Attention, Visual recognition, Semantic memory, Language, Episodic memory, Working memory, Cognitive aging, Neuro-psychologically impaired patients

UNIT V ELECTROPHYSIOLOGICAL EVALUATION IN SPECIAL SITUATIONS 9

Electrophysiological evaluation of sacral function: Bladder, bowel and sexual function, Vestibular laboratory testing, Polysomnographic evaluation of sleep disorders, Electrophysiologic evaluation of: brain death, patients in the intensive care unit, patients with suspected neurotoxic disorders.

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Michael J. Aminoff	diagnosis in Clinical Neurology	Sixth Edition, Elsevier Saunders	2012
2	Kim E. Baretteet. al	Ganong‘s review of Medical Physiology	23rd Edition, McGraw Hill	2019

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Eric R. Kandelet	Principles of Neural Science	McGraw-Hill	2012
2	Cooper, et. al	Techniques in Clinical Neurophysiology: A Practical Manual	Elsevier	2005

WEBSITES:

1. www.mit.edu
2. www.nptel.com

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEBME7E03 LASERS AND FIBER OPTICS IN MEDICINE 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

Course Objectives

The goal of this course is for students

- To Understand Biomedical Laser principles and applications.
- To be familiar with optical properties of tissues
- To infer the knowledge of photonics
- To be exposed to Optical Holography
- To explain the various applications of Laser
- To understand photodynamic therapy.

Course Outcomes

Upon completion of this course, students will be able to:

- Analyse the optical properties of tissues
- Use the Photonics instrumentation
- Apply lasers in different areas of medicine.
- Perceive the lasers in ophthalmology
- Discuss about optical hologram
- Explain the special techniques of Lasers.

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

Refraction, scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

UNIT II INSTRUMENTATION IN PHOTONICS 9

Instrumentation for absorption, scattering and emission measurements, excitation light sources –high pressure arclamp, solid state LEDs, optical filters, polarisers, time resolved and phase resolved detectors.

UNIT III APPLICATIONS OF LASERS 9

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology.

UNIT IV OPTICAL HOLOGRAPHY 9

Wave fronts, interference patterns, principle of hologram, optical hologram, applications.

UNIT V SPECIAL TECHNIQUES 9

Near field imaging of biological structures, in-vitro clinical diagnostic, fluorescent spectroscopy, photodynamictherapy.

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Leon Goldman, M.D, & R.James Rockwell, Jr.,	Lasers in Medicine	Gordon and Breach, Science Publishers Inc.,	1971
2	Abraham Katzir	Lasers and Optical Fibers in Medicine	Academic Press Edition	2012

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tuan Vo Dirh	Biomedical Photonics – Handbook	CRC Press, Bocaraton	2015
2	Glasser, O.,	Medical Physics -- Vol 1, 2, 3	Adam Hilgar Brustol Inc	2013
3	G.David Baxter	Therapeutic Lasers – Theory and practice	Churchill Livingstone Publications	1994

WEBSITES: latest edition

1. www.mit.edu
2. www.nptel.com

Semester-VII

21BEBME7E04 BIO TECH PROSTHETIC EQUIPMENTS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVE

The goal of this course is for students:

- To discuss heart lung machine and artificial heart
- To analyze some of the cardiac assist devices.
- To explain the need of artificial kidney
- To discuss about the prosthetic and orthodic devices.
- To summarize the need and use of some respiratory and hearing aids
- To explain Materials for Prosthetic and Orthodic devices.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Demonstrate about heart lung machine and artificial heart
- Explain about cardiac assist devices, its continuous monitoring and transmission
- Explain about prosthetic and orthodic devices
- Interpret the need and use of the extracorporeal devices.
- Discuss the types of deafness
- Analyse various materials for Prosthetic and Orthodic devices

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L system. Different types of oxygenators, pumps, pulse and continuous types, monitoring process, shunting, the indication for cardiac transplant, driving mechanism, blood handling system, functioning and different types of Artificial heart, mock test setup for assessing its functions.

UNIT II CARDIAC ASSIST DEVICES 9

Synchronous counter pulsation, assisted through respiration right ventricular by-pass pump, left ventricular bypasspump, open chest and closed chest type, Principle and problems --Intra Aortic balloon pumping, Veno Arterial Pumping, Prosthetic Cardio Valves, Biomaterials for purposes, its characteristics and testing.

UNIT III ARTIFICIAL KIDNEY 9

Indication and principle of Heamodyalisis, Membrane, Dialasate, different types of Heamodialisers, monitoring systems, wearable artificial kidney, implanting type.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES 9

Hand and Arm replacement – Different Types of Models Externally Powered Limb Prosthesis Feedback in Orthodic System, functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and Orthodic devices.

UNIT V RESPIRATORY AND HEARING AIDS 9

Intermittent positive pressure, breathing apparatus operating sequence, electronic IPPB unit with monitoring for all respiratory parameters, audiograms , types of deafness, conductive and nervous, hearing aids, constructional and functional characteristics.

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Levine S.N.(Ed.)	Advances in Biomedical Engineering and Medical Physics	Inter University Publications, New York	1968
2	Kolff W.J.	Artificial Organs	John Wiley and Sons, New York	1976

REFERENCES:

1	Andreas.F. Von racum	"Hand book of Bio material Evaluation,"	Mc.Millan Publishers	1987
2	Albert M.Cook and WebsterJ.G.,	Therapeutic Medical Devices	Prentice Hall Inc., New Jersey	1982
3	R.S.Khandpur	Handbook of Biomedical Instrumentation	Tata McGraw Hill, 2nd Edition	2014

WEBSITES:

1. https://nptel.ac.in/
2. https://ocw.mit.edu/

PROFESSIONAL ELECTIVES FOR SEMESTER VII
PROFESSIONAL ELECTIVE IV

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEBME7E05 BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

Course Objectives

The goal of this course is for students

- To Understand the basic concepts of brain computer interface
- To Study the various signal acquisition methods
- To Learn about the signal processing methods used in BCI
- To Learn the various applications of BCI
- To analyse feature extraction methods
- To explain machine learning methods for BCI

Course Outcomes

Upon completion of this course, students will be able to:

- Evaluate concept of BCI.
- Assign functions appropriately to the human and to the machine.
- Select appropriate feature extraction methods
- Use machine learning algorithms for translation.
- Design classifier for a BCI system.
- Implement BCI for various applications

UNIT I INTRODUCTION TO BCI 9

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous - Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.

UNIT II BRAIN ACTIVATION 9

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.

UNIT III FEATURE EXTRACTION METHODS 9

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction - Phase synchronization and coherence

UNIT IV MACHINE LEARNING METHODS FOR BCI 9

Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF‘s, Perceptron‘s, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis

UNIT V APPLICATIONS OF BCI 9

Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs:P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing.

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Rajesh.P.N.Rao,	Brain-Computer Interfacing: An Introduction	Cambridge University Press, First edition	2013
2	Jonathan Wolpaw, Elizabeth Winter Wolpaw	Brain Computer Interfaces: Principles and practice	Oxford University Press, USA, Edition 1,	2012

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Ella Hassianien, A &Azar.A.T	Brain-Computer Interfaces Current Trends and Applications	Springer	2015
2	Andrew Webb	Statistical Pattern Recognition	Wiley International	2002.

WEBSITE:

1. www.mit.edu
2. www.nptel.com

Semester-VII

21BEBME7E06 EMBEDDED SYSTEM IN MEDICAL DEVICES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for the students

- To understand the basics of Embedded System.
- To learn about optimization techniques in Embedded System
- To learn various state machine models
- To understand the Application Specific Instruction-Set Processors.
- To explore various Communication Interfaces
- To explore about Real Time Operating System

Course Outcomes

Upon completion of this course, students will be able to:

- Analyse various kinds Application Specific Instruction-Set Processors
- Analyse communication interfaces
- Apply the concept of Real Time Operating System in engineering appli cations
- Analyse various Digital Signal Processors
- Understand the Need for communication interfaces
- Design Real time application

Unit I **9**

Introduction to Embedded System: Introduction, design challenge, processor technology, IC technology, Design technology, Trade-offs, Single purpose processors, custom single purpose processor design and optimization techniques.

Unit II **9**

General Purpose Processors, State Machine and Concurrent Process Models: Basic architecture, operation, Pipelining, Programmer's view, development environment, Application Specific Instruction-Set Processors (ASIPs)

Unit III **9**

Micro Controllers and Digital Signal Processors, models Vs. languages, finite state machines with data path model (FSMD), using state machines, program state machine model (PSM), concurrent process model, concurrent processes, communication among processes, synchronization among processes, implementation, data flow model, real-time systems

Unit IV **9**

Communication Interfaces: Need for communication interfaces, RS232 / UART, RS422 / RS485, USB, Infrared, IEEE 1394 Firmwire, Ethernet, IEEE 802.11, Blue tooth.

Unit V **9**

Basic Concepts of Real Time Operating System: Architecture of the Kernel, Tasks and Task scheduler, Interrupt service routines, Semaphores, Mailboxes , Message Queues, Event Registers, Pipes, Signals, Timers, Memory Management, Priority inversion problem.

Total periods : 45

TEXT BOOKS

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Frank Vahid, Tony D. Givargis	Embedded System Design – A Unified Hardware/Software Introduction	John Wiley	2006
2	K.V.K.K. Prasad	Embedded / Real Time Systems	Dreamtech Press	2003

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Sri Ram V Iyer, Pankaj Gupta	Embedded / Real Time Systems	Tata McGraw Hill	2017
2	Steve Heath	Embedded System Design	Elsevier, Second Ed.,	2002

WEBSITES:

1. www.mit.edu
2. www.nptel.com

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEBME7E07 ROBOTICS IN MEDICINE 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for students

- To understand the basics of Robotics, Kinematics.
- To understand the basics of Inverse Kinematics.
- To learn various Robotic configurations.
- To learn about Biologically Inspired Robots
- To explore various kinematic motion planning solutions
- To explore various applications of Robots in Medicinε

Course Outcomes

Upon completion of this course, students will be able to:

- Explain various kinds robotics techniques, vision, planning and applications.
- Outline the basic concept of robotics
- Identify and discuss the Robot Vision
- Describe about manipulators and kinematics.
- Demonstrate Task level programming
- Discuss the applications of robotic systems in medical field.

UNIT I INTRODUCTION 9

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot

UNIT II KINEMATICS 9

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three-Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNIT III ROBOT VISION 9

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

UNIT IV PLANNING 9

Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

UNIT V APPLICATIONS 9

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynecology, Orthopedics, Neurosurgery.

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Robert Schilling	Fundamentals of Robotics-Analysis and control‖	Prentice Hall	2011
2	J.J.Craig	Introductionto Robotics‖,	Pearson Education	2004

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Staugaard, Andrew C	Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning‖	Prentice Hall Of India	1987
2	Grover, Wiess, Nagel, Oderey	Industrial Robotics: Technology, Programming and Applications‖	McGraw Hill	2017
3	Wolfram Stadler	Analytical Robotics and Mechatronics‖	McGraw Hill,	1995
4	Saeed B. Niku,	Introduction to Robotics: Analysis, Systems, Applications‖	Prentice Hall	2001
5	K. S. Fu, R. C. Gonzales and C. S. G. Lee	Robotics‖	McGraw Hill	2008

WEBSITES:

1. www.mit.edu
2. www.nptel.com

B.E Biomedical Engineering **2021-2022**

Semester-VII

21BEBME7E08 **DESIGN OF MEDICAL DEVICES AND IMPLANTS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for students

- To understand Principles of Implant Design.
- To define design parameters
- To Learn the concept of Biocompatibility.
- To be familiarized with Dental and Otologic Implants.
- To state the properties of implant materials
- To explain surgical Tools and Implants.

Course Outcomes

Upon completion of this course, students will be able to:

- Analyse design parameters
- Elaborate the design of Clinical Trials.
- Use various Implants.
- Choose materials for design of implants in tissue replacement.
- Discuss the Soft Tissue and Hard Tissue Replacement Implants
- Gain knowledge on Surgical Tools and Implants

UNIT-I **9**

Clinical Problems Requiring Implants for Solution; Principles of Implant Design / Design Parameters: Permanent versus Absorbable Devices; The Missing Organ and its Replacement

UNIT-II **9**

Biocompatibility: Local and Systemic Effects; Design Specifications: Tissue Bonding and Modulus Matching; Degradation of Devices: Natural and Synthetic Polymers; Biocompatibility: Scar Formation and Contraction; Degradation of Devices: Corrosion and Wear; Federal Regulation of Devices I; Oral Presentations of Proposals for Design II; Federal Regulation of Devices II

UNIT-III **9**

Scaffolds for Cartilage Repair; Implants for Bone; Implants for Plastic Surgery; Cardiovascular Prostheses: Heart Valves and Blood Vessels; Devices for Nerve Regeneration; Musculoskeletal Soft Tissues: Meniscus,

Intervertebral Disk; Dental and Otologic Implants; Other Devices: Spinal Cord, Heart Lung; Final Oral Presentation of Designs (Mock FDA Panel)

UNIT-IV **9**

Criteria for Materials Selection; Tissue Engineering I: Scaffolds; Tissue Engineering II: Cells and Regulators Medical Device Classification, Bioethics and Privacy, Biocompatibility and Sterilization Techniques, Design of Clinical Trials, Design Control & Regulatory Requirements.

UNIT-V **9**

Introduction to specific medical technologies: Biopotentials measurement (EMG, EOG, ECG, EEG), Medical Diagnostics (In-vitro diagnostics), Medical Diagnostics (Imaging), Minimally Invasive Devices, Surgical Tools and Implants.

Total Periods : 45

TEXT BOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Kopff W.J	Artificial Organs	John Wiley	1977
2	Park J.B.	Biomaterials Science and Engineering	Plenum Press	1984

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	J D Bronzino,	Biomedical Engineering handbook	CRC Press	2015
2	Yadin David, Wolf W. von Maltzahn, Michael R. Neuman,	Clinical Engineering	CRC Press	2003
3	C. Ross Ethier, Craig A Simmons	Introduction to Biomechanics From Cells to Organisms	Cambridge Texts in Biomedical Engineering	2007

WEBSITES:

1. www.mit.edu
2. www.nptel.com

PROFESSIONAL ELECTIVES FOR SEMESTER VIII

PROFESSIONAL ELECTIVE V

B.E Biomedical Engineering 2021-2022

21BEBME8E01 VIRTUAL REALITY AND AUGMENTED REALITY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam: 3 Hours

Course Objectives

The goal of this course is for students

- To impart the fundamental aspects, principles of virtual reality technology.
- To gain knowledge about applications of virtual reality.
- To introduce the relevance of this course to the existing technology through demonstrations and applications.
- To understand virtual reality to build Biomedicalengineering applications
- To learn about augmented reality
- To knowthe intricacies of these platform to develop PDA applications with better optimality

Course Outcomes

Upon completion of this course, students will be able to:

- Understand the basic concepts of Virtual reality
- Infer the importance of virtual reality
- Comprehend the significance Virtual reality in present scenario
- Analyse VR on the mobile and VR on the web.
- Design of various modeling concepts.
- Develop the Virtual Reality applications in different areas

UNIT I INTRODUCTION 9

The three I‘s of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback..

UNIT II VR DEVELOPMENT PROCESS 9

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNIT III CONTENT CREATION CONSIDERATIONS FOR VR 9

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

UNIT IV VR ON THE WEB & VR ON THE MOBILE 9

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters- device development and drivers-Design Haptics

UNIT V APPLICATIONS 9

Medical applications-military applications-robotics applications- Advanced Real time Tracking other applications-games, movies, simulations, therapy.

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	C. Burdea & Philippe Coiffet	Virtual Reality Technology‖	Second Edition, Gregory, John Wiley & Sons,	2003
2	Jason Jerald	. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machineryand Morgan & Claypool	New York, NY, US	2015

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Dieter Schmalstieg & Tobias Hollerer	Augmented Reality: Principles and Practice (Usability)	Pearson Education (US), Addison Wesley Educationa Publishers Inc, New Jersey, United States	2016

2	Steve Aukstakalnis,	Practical Augmented Reality A Guide to the Technologies Applications, and Human Factors for AR and VR (Usability)	Addison-Wesley Professional1 edition,	2016
3	Robert Scoble & Shel Israel	The Fourth Transformation How Augmented Reality & Artificial Intelligence Wi Change Everything	Patrick Brewster,Press	2016
4	Tony Parisi,	Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile	O'Reilly Media; 1 edition	2015
5	Tony Parisi	Programming 3D Applications with HTML5 and WebGL: 3D Animation	O'Reilly Media; 1 edition	2014
6	Jos Dirksen	Learning Three.js: The JavaScript 3D Library for WebGL	Packt Publishing - ebooks Account 2nd Revised ed Edition	2015

WEBSITE:

1. www.mit.edu
2. www.nptel.com

Semester-VIII

21BEBME8E02 INTERNET OF THINGS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols.
- To discuss about design and development of IoT systems.
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Explain the concept of IoT.
- Analyse various protocols for IoT.
- Build simple IoT Systems using Arduino and Raspberry Pi.
- Apply data analytics and use cloud offerings related to IoT.
- Analyse applications of IoT in real time scenario.
- Utilize concepts of design and development of IoT systems.

UNIT I FUNDAMENTALS OF IoT **9**

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoT WF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II IoT PROTOCOLS **9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4,802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRa WAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT III DESIGN AND DEVELOPMENT 9

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework –Django – AWS for IoT – System Management with NETCONF-YANG

UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plant wide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

Total Periods : 45

TEXTBOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry	IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things	Cisco Press	2017

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Arshdeep Bahga, Vijay Madisetti	Internet of Things – A hands-on approach	Universities Press	2015
2	Olivier Hersent, David Boswarthick, Omar Elloumi	The Internet The Internet of Things – Key applications and Protocols‖	Wiley	2012
3	lasios Tsiatsis ,lligan, Karnouskos, Stefan Avesande	From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence		2014
4	Dieter Uckelmann, Mark Harrison, Michahelles, Florian(Eds),	Architecting the Internet of Things‖	Springer	2011

5	Michael Margolis	Cookbook, Recipes to Begin, Expand, and Enhance Your Projects-2nd Edition	O'Reilly Media	2012

WEBSITES:

1. www.mit.edu
2. www.nptel.com

B.E Biomedical Engineering **2021-2022**

Semester-VIII

21BEBME8E03 INTELLECTUAL PROPERTY RIGHTS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60**
Total**:100** **End Semester Exam:**3 Hours

COURSE OBJECTIVES:

The goal of this course is for students :

- To discuss the concepts of Intellectual property and its rights
- To discuss about the patents, copyrights and trademarks.
- Learn how to value intangible assets, taking into account their commercial potential and legal status.
- To Explore the legal & business issues surrounding marketing of new products related to Technology
- To Facilitate the students to explore career options in IPR.
- .To learn about Patent filing

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Review an intellectual property portfolio and comprehend the extent of their protection.
- Describe the registration of copy rights, trademarks, patents and industry
- Develop a business plan that advances the value of their intellectual property portfolio
- Analyse International convention relating to Intellectual Property
- Distinguish Indian Position Vs WTO and Strategies relating to Intellectual Property
- Explain some of the limits of their intellectual property rights and comprehend some basic legal pitfalls

UNIT I INTRODUCTION 9

Introduction – Invention and Creativity – Intellectual Property (IP) – Importance – Protection of IPR – Basic types of property(i) Movable Property(ii) Immovable Property and (iii) Intellectual Property.

UNIT II PATENTS, COPYRIGHTS AND TRADEMARKS 9

IP – Patents – Copyrights and related rights – Trade Marks and rights arising from Trademark registration – Definitions – Industrial Designs and Integrated circuits – Protection of Geographical Indications at national and International levels – Application Procedures.

UNIT III INTERNATIONAL STANDARDISATION 9

International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities – History– General Agreement on Trade and Tariff (GATT).

UNIT IV INDIAN STRATEGIES 9

Indian Position Vs WTO and Strategies – Indian IPR legislations – commitments to WTO-Patent Ordinance andthe Bill – Draft of a national Intellectual Property Policy – Present against unfair competition.

UNIT V CASE STUDIES 9

Case Studies on – Patents (Basumati rice, turmeric, Neem, etc.) – Copyright and related rights – Trade Marks – Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition.

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Subbaram N.R	Handbook of Indian Patent Law and Practice	S. Viswanathan, Printers and Publishers Pvt. Ltd	2007

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Eli Whitney	United States Patent Number: 72X	Cotton Gin	March 14, 1794
2	Derwent IP Matters	Using the Internet for non-patent prior art searches	-	July 2000.

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-VIII

21BEBME8E04 NANOTECHNOLOGY IN MEDICINE 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To perceive knowledge of Nanotechnology in the field of medicine.
- To discuss the Importance of Nanomaterials in drug delivery.
- To explain Nanomaterials and Nano systems in Medical Diagnostics and Therapeutic
- To learn about Bio Inspired Nanomaterials
- To understand the applications for Nano therapeutic Devices
- To infer nanotechnology in health monitoring systems.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Describe the basic science behind the properties of materials at nanoscale
- Utilize of nanotechnology health care and medicine.
- Interpret nanomaterials in drug delivery.
- Describe Biosensors based nano system
- Apply nanomaterials and Nano systems in Medical Diagnostics and Therapeutics.
- Applyof nanotechnology in health monitoring systems.

UNIT I INTRODUCTION 9

Cellular Nano machines and the Building Blocks of Life, A New Generation of Nano tools, Importance of various nano materials in health and medicine.

UNIT II NANOPARTICLES FOR DIAGNOSTICS 9

Nanoparticles in Medical Diagnostics and Therapeutics, Targeted drug delivery, Magnetic Nanoparticles as Contrast Agents for Medical Diagnosis, Liposome based delivery, Bio Inspired Nanomaterials for a New Generation of Medicine.

UNIT III THERAPEUTIC NANO DEVICES 9

Definition and scope, Synthetic Approaches: top-down versus bottom-up Approaches for Nanotherapeutic Device Components, Applications for Nano therapeutic Devices.

UNIT IV NANOSYSTEMS FOR HEALTHCARE MONITORING – I 9

Single-Molecule Detection Techniques for Monitoring Cellular Activity at the Nano scale Level, Nano probes,Integrated Cantilever-Based Biosensors for the Detection of Chemical and Biological Entities.

UNIT V NANOSYSTEMS FOR HEALTHCARE MONITORING – II 9

Nano pore Methods for DNA Detection and Sequencing, Nano tube Based Membrane Systems, micro/nano fluidicsystems for bio-object sorting, single chip electrophoresis system.

Total Periods : 45

TEXT BOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tuan Vo-Dinh	Nanotechnology in Biology and Medicine: Methods, Devices and Applications	CRC press	2019

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Chala Kumar	Bio functionalization of nanomaterials	Wiley	2005
2	Charles Pooles, Frank J. Ownes	Introduction to Nanotechnology	Wiley	2003
3	Bharat Bhushan	Handbook of Nanotechnology	Springer	2003

WEBSITES:

1. www.mit.edu
2. www.nptel.com

LIST OF OPEN ELECTIVES OFFERED BY
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.E Biomedical Engineering **2021-2022**

21BEECOE01 NEURAL NETWORKS AND ITS APPLICATIONS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

Course Objectives

- To introduce the basic concepts of neural networks and its applications in various domain
- To educate how to use Soft Computing to solve real-world problems
- To have a solid understanding of Basic Neural Network.
- To provide students with a sound and comprehensive understanding of artificial neural networks and machine learning.
- To gain exposure in the field of neural networks and relate the human neural system into the digital world
- To provide knowledge of computation and dynamical systems using neural networks

Course Outcomes

At the end of the course the students will be able to

- Understand the basic concepts of neural networks and its applications in various domains
- Gain knowledge about learning process in Neural Networks
- Apply perception concept in design
- Design using ART phenomena
- Gain knowledge on SOM concepts
- Ability to develop the use of Soft Computing to solve real-world problems

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules-types of neural networks-single layer, multiple layer-feed forward, feedback networks

UNIT II LEARNING PROCESS 9

Error– correction learning– memory based learning- hebbian learning-competitive learning- Boltzmann learning-supervised and unsupervised learning-adaptation-statistical learning theory.

UNIT III PERCEPTION 9

Single layer Perception-Adaptive filtering-unconstrained Optimization-Least-mean square algorithm-

Leaning Curve-Annealing Technique-perception convergence Theorem-Relationship between perception and Baye's Classifier-Back propagation algorithm

UNIT IV ATTRACTOR NEURAL NETWORK AND ART 9

Hopfield model-BAM model -BAM Stability-Adaptive BAM -Lyapunov function-effect of gain- Hopfield Design-Application to TSP problem-ART-layer 1-layer 2-orienting subsystem- ART algorithm-ARTMAP.

UNIT-V SELF ORGANIZATION 9

Self-organizing map-SOM Algorithm-properties of the feature map-LVQ-Hierarchical Vector Quantization. Applications of self-organizing maps: The Neural Phonetic Type Writer Learning Ballistic Arm Movements.

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Simon Haykin	Neural Networks and Learning Machines	Pearson/Prentice Hall	2009
2	Satish Kumar	Neural Networks: A Classroom Approach	TMH	2008

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Freeman J.A, S kapura D.M	Neural networks, algorithms, applications,and programming techniques	Wesley	2005
2	Rajasekaran.S, Vijayalakshmi Pai.G.A	Neural Networks, Fuzzy Logic and Genetic Algorithms, Synthesis and Applications	PHI, New Delhi	2003

WEBSITES:

1. https://nptel.ac.in/courses/117105084/
2. https://www.geeksforgeeks.org/adaptive-resonance-theory-art/

21BEECOE02 PRINCIPLES OF MODERN COMMUNICATION SYSTEMS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

- To provide students with an overview of communication systems
- To provide an overview on mobile communication
- To make students to have a better understanding on satellite and radar communication
- To understand the basic communication techniques which in turn are used as the building blocks of the larger and more complex communication systems.
- To acquire the basic engineering understanding to the modern communication systems and; the relevant theory and technique.
- Design simple systems for landing and navigation.

Course Outcomes

At the end of the course the students will be able to

- Understand past, present and future trends in mobile communication.
- Gain knowledge about mobile cellular communication
- Understand various standards in use for wireless communication and its application.
- Demonstrate some basic application of GPS.
- Gain knowledge about RADAR working and its applications
- Demonstrate how a simple radar system works and its applications.

UNIT I THE EVOLUTION OF ELECTRONIC COMMUNICATION 9

From smoke signals to smart phones - History of communications: Theoretical Foundations, Development & Applications - Frequencies for communication - Frequency regulations - Overview of communication transmitter and receiver.

UNIT II MOBILE CELLULAR COMMUNICATIONS 9

Evolution to cellular networks – Cellular systems generations and standards: 1G, 2G, 3G, 4G - Cellular network components - Components of a mobile phone - setting up a call process - Making a call process - Receiving a call process - Spectrum allocation: Policies and strategies, Role of TRAI.

UNIT III WIRELESS COMMUNICATION 9

Introduction - Bluetooth - Infrared communication - IEEE Wireless LANs (Wi-Fi) - IEEE 802.16 (WiMaX) - Future mobile and wireless networks: Introduction to 5G- device to device communication- IoT.

UNIT IV SATELLITE COMMUNICATION 9

History of Satellite communication, Basics of Satellites, Types of Satellites, Capacity Allocation –

Launch Vehicles and Orbits: Introduction to launching vehicles, Important Orbits, working of rocket, Three Pioneersof Rocketry - Basics of Global Positioning System (GPS) - Applications of GPS.

UNIT V RADAR & NAVIGATION 9

Introduction, Radar Block diagram and Operation, Radar Frequencies, Applications of Radar. Navigation Systems: Introduction & methods of navigation, Instrument Landing System, Microwave landing system- Modern Navigation systems.

Total Periods : 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	S.Haykin	Communication Systems	John Wiley	2007
2	B.P.Lathi	Modern Digital and Analog Communication Systems	Oxford University Press	2007
3	Rappaport Theodore S	Wireless Communications: Principles and Practice	Pearson Education India	2010

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Vijay. K. Garg	Wireless Communication and Networking	Morgan Kaufmann Publishers	2007
2	T.Pratt, C. Bostian and J.Allnutt	Satellite Communications,	John Wiley and Sons,	2003
3	M. I. Skolnik	Introduction to Radar Systems	Tata McGraw Hill	2006

WEBSITES:

1. https://nptel.ac.in/
2. https://ocw.mit.edu/

LIST OF OPEN ELECTIVES OFFERED BY
DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

B.E Biomedical Engineering **2021-2022**

21BECSOE01 INTERNET PROGRAMMING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students

- To studyconcepts of Internet, IP addresses and protocols
- To introduce the Java programming language and explore its current strengths and Weaknesses
- To write working Java code to demonstrate the use of applets for client side programming
- To understand the applications Perl
- To studyInternet telephony and various multimedia applications
- To learn java-specific web services architecture

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- analyse the requirements for and create and implement the principles of web page development
- Understand the concepts of object-oriented and scripting
- Implement client side programming using java applets
- Generate applications based upon advanced java concepts
- Use AJAX and web services to develop interactive web applications
- Explain Internet telephony and various multimedia applications

UNIT I Introduction (9)

Introduction - Network of Networks, Intranet, Extranet and Internet. World Wide Web- Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. TCP/IP- Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing- Classful and Classless Addressing, Subnetting

UNIT II HTML (9)

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps- map, area, attributes of image area- Extensible Markup Language (XML)- Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts- Introduction- Environment Variable, GET and POST Methods.

UNIT III PERL (9)

Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling- JavaScript- Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies- Definition of cookies, Create and Store a cookie with example. Java Applets-Container Class, Components, Applet Life Cycle, Update method, Applications.

UNIT IV CLIENT SERVER PROGRAMMING (9)

Client-Server programming In Java - Java Socket, Java RMI. Threats - Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks- Network security techniques- Password and Authentication- VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall- Introduction, Packet filtering, Stateful, Application layer, Proxy.

UNIT V INTERNET TELEPHONY (9)

Introduction, VoIP- Multimedia Applications- Multimedia over IP: RSVP, RTP, RTCP and RTSP-Streaming media, Codec and Plugins, IPTV- Search Engine and Web Crawler- Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

Total Periods : 45

TEXTBOOKS:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	Paul Deitel, Harvey Deitel and Abby Deitel	Internet and World Wide Web-How to Program 5th Edition	Dorling Kindersley pvt Ltd	2011
2.	N.P. Gopalan and J. Akilandeswari	Web Technology: A Developer's Perspective	PHI Learning	2013

REFERENCES:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	Rahul Banerjee	Internetworking Technologies, An Engineering Perspective	PHI Learning, Delhi	2013
2.	Robert W. Sebesta	Programming the World Wide Web	Pearson Education	2016

WEBSITES:

1.https://nptel.ac.in/courses/106/105/106105084/
2.https://supportline.microfocus.com/Documentation/books/sx22sp1/piover.htm
3.https://www.geeksforgeeks.org/internet-and-web-programming/

B.E Biomedical Engineering **2021-22**

21BECSOE02	**MACHINE LEARNING**	**3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60**

Total**:100** **End Semester Exam:**3 Hours

COURSE OBJECTIVES

The goal of this course is for the students

- To introduce the basic concepts and techniques of Machine Learning.
- To have a complete understanding of the Supervised and Unsupervised learning techniques
- To studythe various probability based learning techniques
- To learn Dimensionality Reduction Techniques.
- To understand Evolutionary Models and Graphical models of machine learning algorithms
- To design appropriate machine learning algorithms for problem solving

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the appropriate machine learning strategy for anygiven problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modifyexisting machine learning algorithms to improve classification accuracy/ efficiency
- Analyse and suggest appropriate machine learning approaches for various types of problems

UNIT I INTRODUCTION 9

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations
– Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS 9

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

UNIT III BAYESIAN AND COMPUTATIONAL LEARNING 9

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV INSTANT BASED LEARNING 9

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.

UNIT V ADVANCED LEARNING 9

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

Total Periods : 45

TEXTBOOKS:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	Michael Bowles	Machine Learning in Python-Essential Techniques for Predictive Analysis	Wiley	2015.
2.	Stephen Marsl	MachineLearning – An Algorithmic Perspective	CRC	2014
3	Jason Bell	Machine learning – Hands on for Developers and Technical Professionals	Wiley	2014

REFERENCES:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	Ethem Alpaydin	Introduction to Machine Learning	Third Edition, MIT Press	2014
2.	Tom M Mitchell	Machine Learning	McGrawHill	2013
3	Peter Flach	Machine Learning: The Art and Science of Algorithms that Make Sense of Data	First Edition, Cambridge University	2012

WEBSITES:

1. https://nptel.ac.in/courses/106106139/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-867-machine-learning-fall-2006/
3. https://www.dataquest.io/blog/machine-learning-python/

LIST OF OPEN ELECTIVES OFFERED BY

DEPARTMENT OF BIOTECHNOLOGY

B.E BIOMEDICAL ENGINEERING **2021-2022**

20BTBTOE01 **BIOREACTOR DESIGN** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

- Impart basic knowledge in bioprocess Engineering
- Design the bioreactors for various operations.
- Discuss the principle and working of heat transfer equipments.
- Extend the knowledge in principle of heat transfer inside a bioreactor
- Construct the equipments used in mass transfer operations.
- Illustrate the equipments used in separation process.

Course Outcomes

After completing the course, the students will be able to

- Summarize the basic concepts in bioprocess Engineering.
- Design the bioreactors for various operations.
- Develop the heat transfer equipments for Bioprocess Engineering.
- Construct the equipments used in mass transfer operations.
- Categorize the equipments used in separation process.
- Describe the applications of bioreactors.

UNIT I: **INRODUCTION TO BIOPROCESS ENGINEERING**

Introduction – Biotechnology and Bioprocess Engineering- Biologists and Engineers Differ in their approach to research-How Biologists and Engineers work Together- Bioprocesses: Regulatory constraints.

UNIT II: REACTOR DESIGN

Design of Airlift fermentor, Bubble column reactor and Continuous stirred tank reactor.

UNIT III: HEAT TRANSFER EQUIPMENTS

Design of Shell and tube Heat exchanger, Double pipe heat exchanger, long tube vertical evaporator and forced circulation evaporator.

UNIT IV : MASS TRANSFER EQUIPMENTS

Design of Bollmann extractor, fractionating column, packed tower and spray tray absorber

UNIT V: SEPARATION EQUIPMENTS

Design of plate and frame filter press, leaf filter, rotary drum filter, disc bowl centrifuge, rotary drum drier and Swenson –walker crystallizer.

TEXTBOOKS:

S.NO.	Author(s)Name	Titleofthebook	Publisher	Year of Publications
1	James Edwin Bailey, DavidF.Ollis	Biochemical Engineering Fundamentals	McGraw-Hill	2007
2	DonW.Green,RobertH.Perry	Chemical Engineer Handbook	The McGraw-HillCompanies, Inc.	2008

REFERENCE:

S.NO	Author(s)Name	Title of the book	Publisher	Year of Publications
1	Pauline.M.Doran	Bioprocess Engineering Principles	Academic Press	2013

20BTBTOE04 FUNDAMENTALS OF NANOBIOTECHNOLOGY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

- Impart the skills in the field of nano biotechnology and its applications.
- Acquire knowledge in the nano particles and its significance in various fields.
- Extend the knowledge in types and application of nano particles in sensors.
- Define the concepts of biomaterials through molecular self assembly.
- Equip students with clinical applications of nano devices.
- Describe deeper understanding of the socio-economic issues in Nanobiotechnology.

Course Outcomes

After completing the course, the students will be able to

- Develop skills in the field of nano biotechnology and its applications.
- Summarize the nanoparticles and its significance in various fields.
- Extend the knowledge in types and application of nano particles in sensors.
- Define the concepts of biomaterials through molecular self assembly.
- Outline the clinical applications of nano devices.
- Describe the socio-economic issues in nano biotechnology.

UNIT I: INTRODUCTION

Introduction, Scope and Overview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Nanotechnology in Different, Fields: Nanobiotechnology, Materials, Medicine, Dental care.

UNIT II: NANO PARTICLES

Introduction, Types of Nanoparticles, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles Nanofabrications-MEMS/NEMS, Atomic Force Microscopy, Self assembled monolayers/ Dip- pen Nanolithography, Soft Lithography, PDMS Molding, Nano Particles, Nano wires and Nanotubes.

UNIT III: MEDICAL NANOTECHNOLOGY

Nanomedicine, Nanobiosensor and Nanofludics. Nanocrystals in biological detection, Electrochemical DNA sensors and Integrated Nanoliter systems. Nano-Biodevices and Systems. Fabrication of Novel Biomaterials through molecular self assembly- Small scale systems for in vivo drug delivery- Future nanomachine.

UNIT IV: NANOBIOTECHNOLOGY

Clinical applications of nanodevices. Artificial neurons. Real-time nanosensors- Applications in cancer biology. Nanomedicine. Synthetic retinyl chips based on bacteriorhodopsins. High throughput DNA sequencing with nano carbontubules. Nanosurgical devices.

UNIT V: ETHICAL ISSUES IN NANOTECHNOLOGY

Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology: With Especial Reference to Nanomedicine, Nanomedicine Applied in Nonmedical Contexts, Social Issues Relating to Nanomedicine. Social and Ethical Issues, Economic Impacts, Other Issues, Nanotechnology and Future Socio-economic challenges.

TEXTBOOKS:

S.NO.	Author (s) Name	Titleofthebook	Publisher	Year of Publication
1	Niemeyer,C.M. andMirkin,C.A	Nanobiotechnology:Concepts, Applicationsand	Wiley-VCH	2005
2	Goodsell,D.S.	Bionanotechnology	JohnWiley andSons, Inc	2004

REFERENCES:

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Shoseyov,O. and Levy,I	Nanobiotechnology: BioinspiredDevicesand MaterialsoftheFuture	Humana Press	2008
2	Bhushan,B.	SpringerHandbookof Nanotechnology	Springer-VerlagBerlin Heidelberg	2017
3	FreitasJrR.A	Nanomedicine	Landes Biosciences	2006
4	Kohler,M.and Fritzsche,W.	Nanotechnology–An IntroductiontoNanostructuring Techniques	Wiley-VCH	2008

LIST OF VALUE ADDED COURSE

1. Circuit Simulation and PCB designing
2. Biosignal Processing using MATLAB
3. Data science and Bigdata Analytics
4. 3D Printing
5. Hands on training on Artificial Organs and Implants.