FACULTY OF ENGINEERING

DEGREE OF BACHELOR OF ENGINEERING IN BIOMEDCAL ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING (REGULAR PROGRAMME)

CURRICULUM & SYLLABI (2023-2024)



KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University) (Established UnderSection3of UGCAct1956) (Accredited with A⁺ Grade by NAAC in the Second Cycle) Pollachi Main Road, Eachanari Post, Coimbatore– 641021, Tamil Nadu, India. Phone:0422- 2980011-14 |Email:info@karpagam.com



KARPAGAM ACADEMY OF HIGHER EDUCATION

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

Eachanari, Coimbatore-641 021. INDIA

FACULTY OF ENGINEERING DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY REGULAR PROGRAMME REGULATIONS 2023 CHOICE BASED CREDIT SYSTEM

These regulations are effective from the academic year 2023 – 2024 and applicable to the candidates admitted to B. E. / B. Tech. during 2023 - 2024 and onwards.

1. ADMISSION

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

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)

1.2 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)

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

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

1.3 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 Engineering
- 4. B. E. Computer Science and Engineering (Cyber Security)
- 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

3.1 Full-Time:

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

- **3.2** Conversion from full time mode of study to part time is not permitted.
- **3.3** Change from one programme to another is not permitted.

4. STRUCTURE OF PROGRAMMES

- **4.1** 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, project work, 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 availability of physical facilities, classroom availability and lab capacity. Registration of already requested courses by students in previous semester is not allowed.

4.2 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 weeks of field project/internship training during	
semester vacations	1

4.3 In every semester, the curriculum shall normally have a blend of theory courses not exceeding 6 and practical courses not exceeding 4. However, the total number of coursesper semester shall not exceed 9.

4.4 The prescribed credits required for the award of the degree shall be within the limits specified below.

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

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

4.6 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.

4.7 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

5.1The prescribed duration of the programme shall be

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

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

5.3 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

6.1 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 classes and the conduct of the candidate has been satisfactory during the course.

6.2 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 programmes with 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.

6.3 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

8.1. 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.

8.2 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.

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

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

- **8.5** The Dean may participate in any Class Committee of the Faculty.
- **8.6** 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.

8.7 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 the 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

10.1 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.

10.2 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:

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

THEORY COURSES:

*Evaluation shall be made by a committee.

INSTRUCTION REMARKS			
Maximum Marks	60		
Duration	2 Hours		
Port_ 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).		
	Question 10 to 12 will be of either or type, covering two		
Part- B	units of the syllabus. Each Question may have		
	subdivision.		
	(3 x 14 =42 Marks).		

PATTERN OF TEST QUESTION PAPER (Test I & II)

PATTERN OF TEST QUESTION PAPER (Test III)

INSTRUCTION	REMARKS		
Maximum Marks	Marks 100		
Duration	3 Hours		
Port _ A	Part A will be online Examination. 20 Objective type		
I alt - A	Questions, Covering all the 5 units. (20 x 1= 20 Marks)		
	(Online Examination).		
Dort R	21 to 25 Two Mark Questions, uniformly covering the		
I al t- D	Five units of the syllabus. All the 5 Questions are to be		
	answered.		
	(5 x 2= 10Marks).		
	Question 26 to 30 will be of either or type, covering Five		
Part- C	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	s 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 Continuous Internal Assessment for Integrated Theory and Practical Course is awarded for 40 Marks with mark split up similar to regular theory course. But Assignment and Seminar components are replaced by Observation and Record marks.

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

The external evaluation of integrated practical component from End semester Examination 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 Examination 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.

10.3 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

10.4 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.

10.5 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 arrear Examinations 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.

INSTRUCTION REMARKS			
Maximum Marks	100		
Duration	3 Hours		
Port - A	Part A will be online Examination. 20 Objective		
I alt - A	type Questions. Covering all the 5 units. 20*1 =		
	20 Marks (Online Examination)		
Port- 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).		
	Question 26 to 30 will be of either or type,		
Part- C	covering Five units of the syllabus. Each		
	Question may have subdivision.		
	(5*14=70 Marks)		

PATTERN OF ESE QUESTION PAPER:

13. PASSING REQUIREMENTS

13.1 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.

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

13.2 If the candidate fails to secure a pass in a particular course ESE, it is 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.

13.3 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 semester when 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).

13.3.1 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.

13.4 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.

13.4.1 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 before the end of the seventh semester.

14. AWARD OF LETTER GRADES

14.1 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
0	91 - 100	10	OUTSTANDING
A+	81-90	9	EXCELLENT
Α	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
В	61 – 65	6	ABOVE AVERAGE
С	55 - 60	5	AVERAGE
D	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE

AB	0	ABSENT

14.2 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.

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

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**.

14.3 REVALUATION

Revaluation and Re-totaling are 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.

14.4 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 Karpagam Academy of Higher Education (Deemed to be University), Coimbatore-641021 XII 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

Academy of Higher Education.

16. CLASSIFICATION OF THE DEGREE AWARDED

- **16.1** 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.
- 16.2 A regular is eligible candidate or a lateral entrant 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.
- 16.3 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

- **17.1** 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.
- **17.2** 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 to write 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.
- **17.4** 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 III semester.

- **17.5** Withdrawal from the ESE is NOT applicable to arrear Examinations.
- **17.6** The candidate shall reappear for the withdrawn courses during the Examination conducted in the subsequent semester.

18. PROVISION FOR AUTHORISED BREAK OF STUDY

18.1 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.

18.2 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.

18.3 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.

18.4 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 may be eligible for the award of the degree.

18.5 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 Academy of Higher Education.

23.KARPAGAM INNOVATION AND INCUBATION COUNCIL (KIIC) (A Section 8 Company)

Based on the 2019 National Innovation and Startup Policy and the 2019–2023 Tamil Nadu Startup Policy, KIIC has recommended to the KAHE students who are affiliated with the KIIC that it be incorporated in the university Program Regulations 2023-24 and implement from this academic year.

23.1 Norms to Student Start-Ups

- a) Any (UG/PG /(Ph.D.) Research scholars, student, right from the first year of their programme is allowed to set a startup (or) work part time/ full time in a startup or work as intern in a startup
- b) Any (UG/PG / (Ph.D.) Research scholars) student right from the first year of their programme is allowed to earn credit for working on Innovative prototypes/business Models/ Pre incubation (case to case basis). Start Up activities will be evaluated based on the guidelines being given by the expert committee of the KIIC
- c) Student Entrepreneurs may use the address of incubation center (KIIC) to register their venture while studying in KAHE.
- d) Students engaged in startups affiliated with the KIIC or those who work for them may be exempted from KAHE's attendance requirements for academic courses under current regulations, up to a maximum of 30% attendance per semester, including claims for ODs and medical emergencies Potential Students who have been incubated at KIIC may be permitted to take their University semester exams even if their attendance is below the minimum acceptable percentage, with the proper authorization from the head of the institution.

(On case-to-case basis depends upon the applicability strength, societal benefits and quality of the Innovation and Subsequent engagement of the students with the/ her business)

- e) Any Students Innovators/entrepreneurs are allowed to opt their startup in place mini project /major project, /seminar and summer training etc. (In plant training, Internship, value added Course.). The area in which the student wishes to launch a Startup may be interdisciplinary or multidisciplinary.
- f) Student's startups are to be evaluated by Expert committee, formed by KIIC and KAHE.

23.2 Guide lines to award Credits/ Marks to a Student startup

Student's startup stages are divided into five phases and these startup phases can be considered equally in place of the course title as mentioned below with the same credits allotted to the course title in a university curriculum.

Sl. No.	Description/Startup phases	In place of the Subject / Course title	Grades/Credits /Marks
1	Idea stage/Problem Identification	Seminar	
2	Proof of Concept (POC) /Solution development	In-plant training /Internship	Same Marks/Credits can
3	Product Development (Lab scale) /Prototype Model/ Company Registered	Mini Project/ Value added Course	be awarded that are listed in the course title's curriculum for the
4	Validation/Testing	Main Project phase I	respective startup phases.
5	Business Model/Ready for Commercialization/Implementation	Main Project phase II	

B.E BIOMEDICAL ENGINEERING

POs	PROGRAM OUTCOMES (POs)
PO1	Engineering knowledge : Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis : Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions : Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society: Apply reasoning informed by the contextual knowledge toassesssocietal,health,safety,legalandculturalissuesandtheconsequent responsibilities relevant to the professional engineering practice.
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work : Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication : Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance : Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning : Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSOs	PROGRAM SPECIFIC OUTCOMES (PSOs)
PSO1	Design and development of bio-electronic systems for biosignal & medical image acquisition, diagnostics and therapeutics
PSO2	To Apply information and communication technologies and software tools for analyzing and interpreting data to generate report.



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 (2023 BATCH ONWARDS)

			Semester – I									
Course code	Course Title	gory	Outcomes		Inst hou	ruct irs/w k	ion ⁄ee	lit(s)	Max	Marks	Page No.	
		Cate	РО	PSO	L	Т	Р	Cred	CIA	ESE	TOTAL	
23BECC101	Professional Communicative English	HS	8, 9, 10, 12	1	3	0	0	3	40	60	100	1
23BECC102	Matrices and Calculus	BS	1,2,3,12	1	3	1	0	4	40	60	100	3
23BECC103	Environmental Studies	BS	1,2,6,7,8, 10,12	1	3	0	0	3	40	60	100	5
23BEBME141	Engineering Physics	BS	1,2,3,6, 9,10,12	1	4	0	2	5	40	60	100	8
23BECC142	Programming in C	ES	1,2,3,4,9,10,1 2	1	4	0	2	5	40	60	100	11
23BECC111	Engineering Graphics	ES	1,2,3,4,8,10,1 2	1	2	0	2	3	40	60	100	14
23BEMC151	Design Thinking	MC	1,2,3,4,6,7,8,9 , 10,12	2	1	0	2	2	100	-	100	315
23BEMC152	Sports and Yoga	MC	-	-	1	0	0	0	100	-	100	317
23BEMC153	தமிழர் மரபும் பண்பாடும்	МС	-	-	1	0	0	0	100	-	100	319
	Tota	al			22	1	8	25	540	360	900	
			Semester -II									
Course code	Course Title	ıtegory	Outcomes		Inst hou	ruct irs/w k	ion ⁄ee	edit(s)	Max	timum	Marks	Page No.
		ü	РО	PSO	L	Т	Р	C	CIA	ESE	TOTAL	
23BECC201C	Transforms and its Applications	BS	1,2,3,12	1	3	1	0	4	40	60	100	17
23BEBME202	Medical Physics	PC	1, 2, 3,6,8,10,12	1	3	0	0	3	40	60	100	19
23BEBME203	Biochemistry	BS	1,2,6,7,8, 10,12	1	3	0	0	3	40	60	100	22
23BEBME204	Introduction to Bio Medical Engineering	PC	1,2,6,8,9,10,1 2	1	3	0	0	3	40	60	100	25
23BEBME241	Basic Electrical and Electronics Engineering	ES	1,2,6,8,9,10,1 2	1	3	0	2	4	40	60	100	27
23BEBME242A /23BEBME242 B	Data Structures and Algorithms/ Object Oriented Programming with Python	ES	1,2,6,8,9,10,1 2	1	4	0	2	5	40	60	100	30/3 3
23BEMC251	Soft Skills	MC	-	_	1	0	0	0	100	-	100	321
23BEMC252	Women Safety and Security	MC	-	1	0	0	0	100	-	100	322	
	Total				21	1	4	22	440	360	800	

			S	EMESTE	R-III							
Course	Course Title	egory	Outco	omes	Ir He	struct ours/w	ion eek	dit(s)	Max	ximum M	larks	Рада
Code	Course Thie	Cat	РО	PSO	L	Т	Р	Cre	CIA	ESE	Total	No
THEORY												
23BEBME301A / 23BEBME301B	Numerical methods / Discrete Mathematics	BS	1,2,3,12	1	3	1	0	4	40	60	100	37/39
23BEBME302	Human Anatomy and Physiology	PC	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	42
23BEBME303	Biosensors and Measurements	PC	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	44
23BEBME304	Signals and Systems	PC	1,2,3,4,9 ,10,12	1	3	0	0	3	40	60	100	46
23BEBME305	Pathology and Immunology	PC	1,2,6,8,9 ,10,12	1	3	0	0	3	40	60	100	48
23BEBME341	Data Structures and Algorithm	ES	1,2,3,4,9 ,10,11,1 2	1	3	0	2	4	40	60	100	50
PRACTICAL	S											
23BEBME311	Biosensors and Measurements Laboratory	PC	1,2,3,4,5 ,6,8,9,10 ,12	2	0	0	2	1	40	60	100	53
23BEBME312	Pathology and Immunology Laboratory	ES	1,2,3,4,5 6,8,9,10, 12	1	0	0	2	1	40	60	100	55
MANDATOR	Y COURSE											
23BEMC351	Aptitude and Reasoning	MC		-	1	0	0	0	100		100	323
23BEMC352	Foreign Language (German/French)	MC		-	1	0	0	0	100		100	327
INTERNSHIP												
23BEBME391	Internship/Field Project	MC		-	0	0	0	1	100	0	100	57
		S	EMESTER	R TOTAL	20	1	6	23	620	480	1100	

SEMESTER-IV

Course	Course Title	ory	Outcor	nes	ļ	Instruction Hours/week		t(s)	Max	kimum M	larks	
Code		Categ	РО	PSO	L	Т	Р	Credi	CIA	ESE	Total	Page No
THEORY		•										
23BEBME401	Biomaterials and Artificial Organs	PC	1,2,3,9,10,12	i	3	0	0	3	40	60	100	58
23BEBME402	Biomedical Signal Processing	PC	1,2,3,9,10,1 1	i	3	1	0	4	40	60	100	60
23BEBME403	Biomedical Instrumentation	PC	1,2,3,9,10,1 2	i	3	0	0	3	40	60	100	62
23BEBME404	Analog and Digital Electronics	PC	1,2,3,9,10, 12	i	3	0	0	3	40	60	100	64
23BEBME441	Java Programming	PC	1,2,3,4,9,1 0,12	1	3	0	2	4	40	60	100	66
23BEBME4E	Professional Elective -I	PC	-	-	3	0	0	3	40	60	100	69
PRACTICAL	S	I					L					
23BEBME411	Biomedical Signal Processing Laboratory	PC	1,2,3,4,5,6, 8,9,10,12	1	0	0	2	1	40	60	100	70
23BEBME412	Biomedical Instrumentation Laboratory	PC	1,2,3,4,6,8, 9,10,12	1,2	0	0	2	1	40	60	100	71
MANDATOR	Y COURSE											
23BEMC451	Foundation of Entrepreneurship	MC	-		2	0	0	0	100	0	100	329
23BEMC452	Essence of Indian Traditional knowledge and Heritage	MC	-		2	0	0	0	100	0	100	331
	SEMESTER T	OTAL	-		22	1	6	22	520	480	1000	

SEMESTER-V

		tegory	Outcom	ies	Ir He	nstruct ours/w	ion /eek	edit(s)	Max	kimum M	larks	Page No
Course Code	Course Title	Ca	РО	PSO	L T P		Cr	CIA	ESE	Total	No	
THEORY												
23BEBME501	Medical Diagnostic Equipment	PC	1,2,3,4,6,7, 8,9,10,12	1,2	3	0	0	3	40	60	100	72
23BEBME502	Internet of Medical Things(IoMT)	PC	1,2,3,5,6,8, 9,10,12	1,2	3	0	0	3	40	60	100	74
23BEBME503	Biomedical Image processing	PC	1,2,5,9,10,1 2	1,2	3	0	0	3	40	60	100	76
23BEBME504	Bio Control System	PC	1,2,3,4,6,9, 10,12	1,2	3	1	0	4	40	60	100	78
23BEBME541	Business Data Processing	PC	1,2,3,4,9,10 ,12	1,2	3	0	2	4	40	60	100	80
23BEBME5E	Professional Elective-II	PE	-	-	3	0	0	3	40	60	100	82
PRACTICAL	S	I	1					1			1	1
23BEBME511	Biomedical Image Processing Laboratory	PC	1,2,3,4,5,8, 9,10,12	1,2	0	0	2	1	40	60	100	83
23BEBME512	Internet of Medical Things Laboratory	PC	1,2,3,5,6,8, 9,10,12	1,2	0	0	2	1	40	60	100	84
MANDATORY	COURSE											
23BEMC551	Cyber Security	MC	-		1	0	0	0	100	0	100	332
INTERNSHI						I						1
23BEBME591	Internship/Field Project	MC	-		0	0	0	1	100	0	100	85
	SEMESTERTOT	AL	<u> </u>		19	1	6	23	520	480	1000	

			SEN	AESTE	R-VI							
		ory	Outcomes		Ir He	nstruct ours/w	ion veek	t(s)	Ma	ximum M	arks	Daga
Course Code	Course Title	Categ	PO PSO		L	Т	Р	Credit	CIA	ESE	Total	No
THEORY												
23BEBME601	Biomechanics	PC	1,2,3,4,6,8, 9,10,12	1,2	3	1	0	4	40	60	100	86
23BEBME602	Medical Therapeutic Equipment	PC	1,2,3,6,7,8, 9,10,12	1,2	3	0	0	3	40	60	100	88
23BEBME603	Assistive Technology & Rehabilitation	PC	1,2,3,6,8,9, 10,12	1,2	3	0	0	3	40	60	100	90
23BEBME6E_	Professional Elective-III	PE	-	-	3	0	0	3	40	60	100	92
23BEBME6E-	Professional Elective-IV	PE	-	-	3	0	0	3	40	60	100	92
23BEBMEOE- -	Open Elective-I	OE	-	-	3	0	0	3	40	60	100	92
PRACTICAL	S					•						<u>.</u>
23BEBME611	Diagnostic and Therapeutic Equipment Laboratory	PC	1,2,3,4,5,6, 8,9,10,12	1,2	0	0	2	1	40	60	100	93
23BEBME612	Medical Equipment Trouble shooting Laboratory (Industry Curriculum)	PC	1,2,3,4,5,6, 8,9,10,12	1,2	0	0	2	1	40	60	100	94
MINI PROJECT												
23BEBME651	Universal Human Values	MC	-		1	0	0	1	100	0	100	334
MANDATORY	COURSE											
23BEBME691	Mini Project	MC	-		0	0	2	1	100	0	100	95
		S	EMESTER T	OTAL	19	1	6	23	520	480	900	

SEMESTER-VII

Course		tegory	Outcom	ies	Ir He	nstruct ours/w	ion eek	edit(s)	Max	Maximum Marks		Page
Code	Course Title	Cat	РО	PSO	L	Т	Ρ	Cr	CIA	ESE	Total	No
THEORY												
23BEBME701	Artificial Intelligence in Healthcare	PC	1,2,3,5,6, 8,9,10,12	2	3	0	0	3	40	60	100	96
23BEBME702	Medical Ethics Regulatory Standards	PC	1,2,3,6,7, 8,9,10,12	2	3	0	0	3	40	60	100	98
23BEBME703	Biomedical waste and Hospital Management	PC	1,2,6,7,8, 9,10,12	2	3	0	0	3	40	60	100	100
23BEBME7E_ _	Professional Elective-V	PE	-	-	3	0	0	3	40	60	100	102
23BEBME7E_ _	Professional Elective -VI	PE	-	-	3	0	0	3	40	60	100	102
23BEBMEOE	Open Elective-II	OE	-	-	3	0	0	3	40	60	100	102
PRACTICAL	S			<u> </u>			L	L			1	-
23BEBME711	Artificial Intelligence Laboratory	PC	1,2,3,4,5, 9,10,12	2	0	0	2	1	40	60	100	103
PROJECT W	ORK											
23BEBME791	Project Work Phase-I	PW	-		0	0	8	4	100	0	100	104
		S	EMESTER	TOTAL	18	0	10	23	380	460	800	

SEMESTER-VIII

Course	Course Title	Category	In He	struct ours/w	ion eek	Credit(s)	Max	Page No		
Code			L	Т	Р		CIA	ESE	Total	
PROJECT										
23BEBME891	Project Work Phase-II and Viva-Voce	PW	0	0	9	8	120	180	300	105
	SEMESTER T	OTAL	0	0	16	8	120	180	300	
PROGRAMME TOTAL				6	62	169	3560	3280	6800	

Professional Electives:

Bio Engineering	Healthcare Communication Systems	Medical Device Design and Development
Modelling of Physiological Systems	Analog and Digital Communication	Medical Device Design
Introduction to Cell Biology	Wearable Devices	Applied Design thinking for Biomedical Engineers
Bio MEMS	Body Area Networks	Integrated Medical Product Development
Biomedical Informatics	Virtual Reality and Augmented Reality in Healthcare	Software Design tools for Biosensing and Control
Microfluids	Telemedicine	Intellectual Property Rights
Neuro Engineering	Internet of Things in Healthcare	Biomimetics
Bio Fluid Mechanics	Laser in Medicine	Rapid Prototyping
Tissue Engineering	Biometric Systems	Robotics and Automation in Medicine
Fundamentals of Nano Biotechnology	Speech Processing	Graphical System Design for Biomedical Engineers
Bioergonomics	Brain Computer Interface	Medical Sensors MEMS and NEMS
Genetic Engineering	Cognitive Engineering	Quality Control for Biomedical Devices
Clinical Engineering	Cognitive Psychology	Healthcare System Design

Elective	Ι

Course	Course Title	tegory	Out	Ins Ho	truct urs/w	ion /eek	edit(s)	Max	Page No			
Code		Ca	РО	PSO	L	Т	Р	C	CIA	ESE	Total	
23BEBME4E01	Modeling of Physiological Systems	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	106
23BEBME4E02	Introduction to Cell Biology	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	108
23BEBME4E03	Analog and Digital Communication	PE	1,2,3,4,6, 8,9, 10,12	1	3	0	0	3	40	60	100	130
23BEBME4E04	Wearable Devices	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	132
23BEBME4E05	Medical Device Design	PE	1,2,3,6,8 ,9,10,12	2	3	0	0	3	40	60	100	154
23BEBME4E06	Applied Design thinking for Biomedical Engineers	PE	1,2,3,6,8 ,9,10,12	2	3	0	0	3	40	60	100	156
				Elective	II							
23BEBME5E01	Bio MEMS	PE	1,2,3,6,8 ,9,10,12	1,2	3	0	0	3	40	60	100	110
23BEBME5E02	Biomedical Informatics	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	112
23BEBME5E03	Body Area Networks	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	134
23BEBME5E04	Virtual Reality and Augmented Reality in Healthcare	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	136
23BEBME5E05	Integrated Medical Product Development	PE	1,2,3,6,8 ,9,10,12	2	3	0	0	3	40	60	100	158
23BEBME5E06	Software Design tools for Biosensing and Control	PE	1,2,3,4,5 ,6,8,9,10 ,12	2	3	0	0	3	40	60	100	160
]	Elective	ш							
23BEBME6E01	Microfluids	PE	1,2,3,6,8 ,9,10,12	2	3	0	0	3	40	60	100	114
23BEBME6E02	Neuro Engineering	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	116
23BEBME6E03	Telemedicine	PE	1,2,6,8, 9,10,12	1	3	0	0	3	40	60	100	138
23BEBME6E04	Internet of Things in Healthcare	PE	1,2,3,4,6, 8,9,10,12	2	3	0	0	3	40	60	100	140
23BEBME6E05	Intellectual Property Rights	PE	1,2,6,8, 9,10,12	2	3	0	0	3	40	60	100	162

23BEBME6E06	Biomimetics	PE	1,2,6,8, 9,10,12	2	3	0	0	3	40	60	100	164
]	Elective	IV	<u> </u>						
23BEBME6E07	Bio Fluid Mechanics	PE	1,2,3,4,6, 8,9,10,12	1	3	0	0	3	40	60	100	118
23BEBME6E08	Tissue Engineering	PE	1,2,3,4,6, 8,9,10,12	2	3	0	0	3	40	60	100	120
23BEBME6E09	Laser in Medicine	PE	1,2,3,4,6, 8,9,10,12	2	3	0	0	3	40	60	100	142
23BEBME6E10	Biometric Systems	PE	1,2,3,6, 8,9,10,12	1	3	0	0	3	40	60	100	144
23BEBME6E11	Rapid Prototyping	PE	1,2,3,4,5, 6,8,9,10, 12	2	3	0	0	3	40	60	100	166
23BEBME6E12	Robotics and Automation in Medicine	PE	1,2,3,5,6, 8,9,10,12	2	3	0	0	3	40	60	100	168
				Elective	V	<u>.</u>						
23BEBME7E01	40	60	100	122								
23BEBME7E02	Bioergonomics	PE	1,2,3,4,6, 8,9,10,12	2	3	0	0	3	40	60	100	124
23BEBME7E03	Speech Processing	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	146
23BEBME7E04	Brain Computer Interface	PE	1,2,3,4,6, 8,9,10,12	1	3	0	0	3	40	60	100	150
23BEBME7E05	Graphical System Design for Biomedical Engineers	PE	1,2,3,5,6, 8,9,10,12	2	3	0	0	3	40	60	100	170
23BEBME7E06	Medical Sensors MEMS and NEMS	PE	1,2,3,4, 5,6,8,9, 10,12	2	3	0	0	3	40	60	100	172
]	Elective	VI							
23BEBME7E07	Genetic Engineering	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	126
23BEBME7E08	Clinical Engineering	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	128
23BEBME7E09	Cognitive Engineering	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	148
23BEBME7E10	Cognitive Psychology	PE	1,2,3,6,8 ,9,10,12	1	3	0	0	3	40	60	100	152
23BEBME7E11	Quality Control for Biomedical Devices	PE	1,2,3,6,8, 9,10,12	2	3	0	0	3	40	60	100	174
23BEBME7E12	Healthcare System Design	PE	1,2,3,6,8 ,9,10,12	2	3	0	0	3	40	60	100	176

LIST OF OPEN ELECTIVE COURSES OFFERED FROM OTHER DEPARTMENTS

SCIENCE AND HUMANITIES													
Course	Course Title	gory	Outcor	nes	Iı he	nstructi ours/we	ion eek	it(s)	Max	Page			
Code	Course Thie	Categ	РО	PSO	L	Т	Р	Credi	CIA	ESE	Total	No.	
23BESHOE01 / 23BTSHOE01	Mass communication	OE	1,2,3,4,6,12	1	3	0	0	3	40	60	100	180	
23BESHOE02/ 23BTSHOE02	Fuzzy mathematics	OE	1,2,3,4,6,12	1	3	0	0	3	40	60	100	182	
23BESHOE03/ 23BTSHOE03	Material sciences	OE	1,2,3,4,6,12	1	3	0	0	3	40	60	100	184	
23BESHOE04/ 23BTSHOE04	Green Chemistry	OE	1,2,3,4,6,12	1	3	0	0	3	40	60	100	187	
ELECTRICAL AND ELECTRONICS ENGINEERING													
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$													
23BEEEOE02	Hybrid Electric Vehicles	OE	1,2,3,4,5,6,7	1	3	0	0	3	40	60	100	192	
	ELEC	TRO	NICS AND C	OMMUNI	CATI	ON EN	IGINE	ERIN	G				
23BEECOE01	Real Time Embedded Systems	OE	1,2,3,4,5	1	3	0	0	3	40	60	100	195	
23BEECOE02	Consumer Electronics	OE	1,2,3,4,5,6,12	1	3	0	0	3	40	60	100	197	
			FOOD	TECHNO	DLOG	Y							
23BTFTOE01	Processing Of Food Material	OE	1,2,3,4,5,6,8,9 ,10	1	3	0	0	3	40	60	100	200	
23BTFTOE02	Nutrition And Dietetics	OE	1,2,3,4,8,9,10, 11	1	3	0	0	3	40	60	100	202	
23BTFTOE03	Ready To Eat Food	OE	1,2,3,4,8,9,10, 11,12	1	3	0	0	3	40	60	100	204	
23BTFTOE04	Agricultural Waste and ByproductS Utilization	OE	1,2,3,4,6,7,8,9 ,10	1	3	0	0	3	40	60	100	206	

MECHANICAL ENGINEERING

1,2,3,4,6,8,9,

OE

23BTFTOE05 Design of Food Process Equipment

23BEMEOE01 Battery Management System	OE	1,2,3,4,10,12	1	3	0	0	3	40	60	100	211
---	----	---------------	---	---	---	---	---	----	----	-----	-----

23BEMEOE02	Industrial Safety and Environment	OE	1,2,3,4,10,12	1	3	0	0	3	40	60	100	213
23BEMEOE03	Non Destructive Testing	OE	1,2,3,4,10,12	1	3	0	0	3	40	60	100	215
23BEMEOE04	Operations Research	OE	1,2,3,4,10,12	1	3	0	0	3	40	60	100	217
			CIVI	L ENGINE	ERIN	G						
23BECEOE01	Housing Plan And Management	OE	1,2,3,4,5,6,9,1 0,12	1	3	0	0	3	40	60	100	220
23BECEOE02	Building Services	OE	1,2,3,4,5,9,12	1	3	0	0	3	40	60	100	222
23BECEOE03	Repair and rehabilitation of structures	OE	1,2,3,4,5,6,9,1 1,12	1	3	0	0	3	40	60	100	224
23BECEOE04	Computer Aided Civil Engineering Drawing	OE	1,2,4,6,7,8,9,1 1,12	1	3	0	0	3	40	60	100	226
23BECEOE05	Contracts Management	OE	1,2,4,6,12	1	3	0	0	3	40	60	100	228
23BECEOE06	Air And Noise Pollution And Control	OE	1,2,4,5,7,9,11 12	, 1	3	0	0	3	40	60	100	231
			BIO	TECHNOI	.OGY	7						
23BTBTOE01	Basic Bioinformatics	OE	1,2,3,4,5,6,12	1	3	0	0	3	40	60	100	234
23BTBTOE02	Fundamentals of Nanobiotechnology	OE	1,2,3,4,5,8,11	1	3	0	0	3	40	60	100	237
		CO	MPUTER SC	IENCE AN	D EN	GINE	ERING	ſ				
23BECSOE01	Internet Of Things	OE	1,2,3,9,10,12	1	3	0	0	3	40	60	100	241
23BECSOE02	Machine Learning	OE	1,2,3,9,10,12	1	3	0	0	3	40	60	100	243
23BECSOE03	Blockchain Technologies	OE	1,2,3,4,9,10,1	1	3	0	0	3	40	60	100	245
23BECSOE04	Cloud Computing	OE	1,2,3,4,9,10,1	1	3	0	0	3	40	60	100	247
			COMPU ENGINEERI	TER SCIE NG (CYBE	NCE R SE	AND CURIT	Г Y)		-	•	•	
23BECYOE01	Basics of Cybercrime and Cyber Security	OE	1,2,3,4,9,10, 12	1	3	0	0	3	40	60	100	250

23BECYOE02	Basics of Cyber Forensics	OE	1,2,3,4,9,10, 12	1	3	0	0	3	40	60	100	252
23BECYOE03	Cyber Laws and Intellectual Property Rights	OE	1,2,3,9,10,1 2	1	3	0	0	3	40	60	100	254
23BECYOE04	Blockchain and Cyber Security	OE	1,2,3,9,10,1 2	1	3	0	0	3	40	60	100	256
	AF	RTIFI	CIAL INTEL	LIGENCE	AND	DATA	SCIE	NCE				
23BTADOE01	Fundamentals of Data Science	OE	1,2,3,4,9,10, 12	1	3	0	0	3	40	60	100	260
23BTADOE02	Fundamentals of Artificial Intelligence	OE	1,2,3,4,9,10, 12	1	3	0	0	3	40	60	100	262
23BTADOE03	Internet Programming	OE	1,2,3,9,10,1 2	1	3	0	0	3	40	60	100	264
23BTADOE04	Robotics And Automation	OE	1,2,3,4,9,10, 12	1	3	0	0	3	40	60	100	267
			FACULT	Y OF PHAI	RMA	CY267						
23BP804ET	Pharmaceutical Regulatory Science	OE	6,7,8,12	1	3	0	0	3	40	60	100	270
23BP809ET	Cosmetic Science Theory	OE	5,12	1	3	0	0	3	40	60	100	273
	FACULTY	OF A	ARTS, SCIEN	CE, COMN	MERO	CE AN	D MAI	NAGE	MENT			
23MBAPOE301	Organisational Behaviour	OE	6,7,8	1	3	0	0	3	40	60	100	277
23PHPOE301	Material Characterization	OE	1,2,3,4,5,10	1	3	0	0	3	40	60	100	280
23PHPOE302	Numerical Methods and Programming	OE	1,2,5,12	1	3	0	0	3	40	60	100	283
23CAPOE301	Robotics Process Automation	OE	1,2,3,4,9	1	3	0	0	3	40	60	100	286
23BCPOE301	Nutrition and Dietetics	OE	1,2,11	1	3	0	0	3	40	60	100	289
23CSPOE301	Cyber Forensics	OE	1,2,3,4,12	1	3	0	0	3	40	60	100	292
23CMPOE301	Personal Finance and Planning	OE	7,8,9,10,12	1	3	0	0	3	40	60	100	294
23CHPOE301	Chemistry in Everyday Life	OE	1,4,12	1	3	0	0	3	40	60	100	296
23MBPOE301	Fermentation Technology	OE	1,2,3,11,12	1	3	0	0	3	40	60	100	299

23EGPOE301	English For Competitive Examinations	OE	9,10,12	1	3	0	0	3	40	60	100	302		
23BTPOE301	Sericulture	OE	1,2,3,4,7,12	1	3	0	0	3	40	60	100	304		
23MMPOE301	Coding Theory	OE	1,2,3,4,12	1	3	0	0	3	40	60	100	307		
	BME- OPEN ELECTIVES OFFERED TO OTHER DEPERATMENT													
23BEBMEOE01	Human Anatomy and Physiology	OE	1,2,6,8,9,10, 12	-	3	0	0	3	40	60	100	310		
23BEBMEOE02	Artificial Organs and Implants	OE	1,2,6,8,9,10, 12	-	3	0	0	3	40	60	100	312		



KARPAGAM ACADEMY OF HIGHEREDUCATION (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 Credits/Semester											No. of	Percentage	
5.110.	area	Ι	II	III	IV	V	VI	VII	VIII	Total	courses	Tercentage	
1	Humanities and Social Sciences(HS)	3	-	-	-	-	_	-	-	3	1	1.78	
2	Basic Sciences (BS)	12	7	4	-	-	-	-	-	23	6	13.6	
3	Engineering Sciences(ES)	8	9	5	-	-	-	-	-	22	6	13.0	
4	Professional Core(PC)	-	6	13	22	19	12	10	-	82	30	48.52	
5	Professional Electives(PE)	-	-	-	I	3	6	6	-	15	6	8.87	
6	Open Electives (OE)	-	-	-	-	-	3	3	-	6	2	3.55	
7	Project Work(PW)	-	-	-	-	-	-	4	8	12	2	7.10	
8	Mandatory Courses (MC)	2	-	1	-	1	2	-	-	6	13	3.55	
9	Total	25	22	23	22	23	23	23	8	169	66	100	
			TC	DTA	L CR	EDI	TS	16	9				

B.E. BIOMEDICAL ENGINEERING 2 23BECC101 SEMESTER-I

PROFESSIONAL COMMUNICATIVE ENGLISH

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

3H-3C

COURSE OBJECTIVES:

The goal of this course is for the students to

- Extend the communicative competence of learners.
- Develop usage of language effectively in academic /work contexts
- Make use of Language skills in Reading and Writing
- Utilize language efficiently in expressing their opinions via various forms.
- Extend inter-personal communication skills.

COURSE OUTCOMES:

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

- Identify new words by employing vocabulary building techniques.
- Build correct sentence structures and grammatical patterns in oral and written communication
- Construct business letters, proposals and E-Mail communication.
- Adopt the skills of planning, structuring, and delivery techniques in group discussions and presentations.
- Follow leadership, work ethics and management principles.

UNIT-1 VOCABULARY BUILDING

 $Word\ formation\ process\ -\ One-word\ Substitutes\ -\ Homophones\ -\ Homophones\ -\ British\ and\ American\ vocabulary\ -\ Punctuation\ marks\ and\ capitalization$

UNIT-2 FUNDAMENTALS OF ENGLISH GRAMMAR

Subject –verb agreement (Concord) – If-conditionals – Modal verbs - Question types (Wh, Yes or No & Question tag), Prepositions- Articles

UNIT- 3 LANGUAGE SKILLS (READING AND WRITING)

Reading (Skimming& Scanning) - Reading Methods (SQR3) – Writing -Business Letters (Job Application Letter & Resume Preparation, sales letter, Quotation letter) – E- Mail communication & etiquettes – Business Proposals (Structure & Types)

UNIT-4 PROFESSIONAL SKILLS

Interview skills – Dos and Don'ts of an Interview, Group Discussion – Dos and Don'ts of GD, Presentation skills – Planning, structuring and Delivering Techniques.

UNIT -5 INTERPERSONAL SKILLS

Personality development –Conflict management, Team work, Leadership Principles, Negotiation skills

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

TOTAL HOURS :45

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 1

2023-2024

9

9

9

9

9

TEXT BOOKS

- 1. Raman. Meenakshi, Sharma. Sangeeta (2015). Technical Communication (Principles and Concepts). Oxford university press. New Delhi.
- 2. Sanjay Kumar, Pushpalata, (2011), Communication skills, 1stEditionOxfordPress.
- 3. Ashraf Rizvi M, Effective Technical Communication, McGraw Hill Education, First Edition, 2013.

CO-PO MAPPING

COs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	A4	-	-	-	-	-	-	-	1	2	3	-	3	-	-
CO2	P3	-	-	-	-	-	-	-	1	2	3	-	2	-	-
CO3	P4	-	-	-	-	-	-	-	2	2	3	-	2	-	-
CO4	A3	-	-	-	-	-	-	-	3	2	3	-	2	-	-
CO5	A2	-	-	-	-	-	-	-	3	2	3	-	3	-	-
Average		-	-	-	-	-	-	-	2	2	3	-	2.4	-	-

B.E - BIOMEDICAL ENGINEERING

23BECC102

MATRICES AND CALCULUS

Instruction Hours/week: L:3 T:1 P:0

Marks: Internal:40 External:60 Total:100 End Semester Exam: 3 Hours

SEMESTER-I

4H-4C

12

12

COURSE OBJECTIVES:

The goal of this course is for students:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the student with the differential calculus of multivariable functions. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals.
- To make the students acquire sound knowledge in techniques of solving linear ordinary differential equations.
- To provide knowledge about the concepts of partial differential equation with constant coefficients.

COURSE OUTCOMES:

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

- Make use of orthogonal transformation to reduce the quadratic form to canonical form.
- Utilize differential calculus of multivariable to optimization problems.
- Apply multiple integrals for finding the area and volume.
- Solve the linear differential equations using Euler's Cauchy and method of variation of parameter.
- Solve the nth order partial differential equations.

UNIT – I MATRICES

Eigenvalues and Eigenvectors of a real matrix– Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT – II DIFFERENTIAL CALCULUS OF MULTIVARIABLE FUNCTIONS 12

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions –Applications: Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT – III MULTIPLE INTEGRALS

Proper and Improper integrals - Bernoulli's extension formula – Double integrals – Change of order of integration – Double integrals in polar coordinates – Area using double integrals – Evaluation of Triple Integrals

2023-2024
Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 4

UNIT – IV ORDINARY DIFFERENTIAL EQUATIONS

Linear differential equation of second and higher order with constant coefficients - Euler-Cauchy linear differential equation – Method of Variation of parameters.

UNIT - V PARTIAL DIFFERENTIAL EQUATIONS

Homogeneous linear partial differential equations of second and higher order with constant coefficients - Classification of partial differential equations.

TOTAL: 45+15

TEXT BOOKS:

- 1. Grewal, B. S., & Grewal, J. S. (1996). Higher engineering mathematics. 2018, Khanna Publishers, New Delhi.
- 2. Kreyszig, E. (2007). Advanced Engineering Mathematics 10th Edition with Wiley Plus Set (p. 334). John Wiley & Sons.

REFERENCE BOOKS:

- 1. Thomas, B. T., and Ross L Finney (2002). Calculus and Analytic Geometry, Pearson Publishers, Ninth edition
- 2. Ross, S. L. (1984). Differential Equation-Jhon Wiley & Sons. Inc. New York.
- 3. Henner, V., Belozerova, T., & Khenner, M. (2013). Ordinary and partial differential equations. CRC Press.

WEBSITES:

- 1. www.archive.nptel.ac.in/courses/111/108/111108157/
- 2. www.nptel.ac.in/courses/111107108
- 3. www.archive.nptel.ac.in/courses/111/104/111104125/
- 4. www.nptel.ac.in/courses/111108081
- 5. www.nptel.ac.in/courses/111108144

Cos	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
Average		3	2	1	-	-	-	-	-	-	-	-	1	1	-

CO PO MAPPING:

12

B.E - BIOMEDICAL ENGINEERING 2023-2024 23BECC103

SEMESTER-I

ENVIRONMENTAL STUDIES

3H-3C

9

9

9

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.
- Develop an attitude of concern for the environment.
- Motivate public to participate in environment protection and improvement. •
- To gain a variety of experiences and acquire a basic understanding of environment and it's associated problems.
- Relate critically about their roles and identities as citizens, consumers and environmental • actors in a complex, interconnected world.

COURSE OUTCOMES:

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

- Outline the ecological processes supporting the life system.
- Infer the importance of environment and impact of human activities on natural resources.
- Explain the levels and values of biodiversity and its conservation. •
- Summarize the problems of environmental pollution and its control measures. •
- Interpret the remediation methods for social issues and degraded environment.

UNIT I INTRODUCTION - ENVIRONMENTAL STUDIES& ECOSYSTEMS

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**

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

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

Definition, causes, effects and control measures of Air pollution, Water pollution – Water reuse and recycling, 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.

9

9

Total Hours: 45

UNIT V - SOCIAL ISSUES AND THE ENVIRONMENT

Concept of sustainability and sustainable development, Circular Economy. 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.

Text Books:

- 1. Anubha Kaushik., and Kaushik, C.P. 2004. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, New Delhi.
- 2. Erach Bharucha. 2004. A text book for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, New Delhi.
- 3. Rajagopalan, R. 2016. Environmental Studies: From Crisis to Cure, Oxford University Press.
- Sing, J.S., Sing. S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.
- 5. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S. Chand& Company Pvt. Ltd., New Delhi.
- 6. Arvind Kumar. 2004. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
- 7. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
- 8. Tripathy. S.N., and Sunakar Panda. (2004). Fundamentals of Environmental Studies (2nd ed.). Vrianda Publications Private Ltd, New Delhi.
- 9. Verma, P.S., and Agarwal V.K. 2001. Environmental Biology (Principles of Ecology). S. Chand and Company Ltd, New Delhi.
- 10. Uberoi, N.K. 2005. Environmental Studies. Excel Books Publications, New Delhi.

CO PO MAPPING:

COs /POS	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	2	3	3	-	1	-	2	1	-
CO2	K2	2	1	-	-	-	2	3	3	-	1	-	2	1	-
CO3	K2	2	1	-	-	-	2	3	3	-	1	-	2	1	-
CO4	K2	2	1	-	-	-	2	3	3	-	1	-	2	1	-
CO5	K2	2	1	-	-	-	2	3	3	-	1	-	2	1	-
Avei	rage	2	1	-	-	-	2	3	3	-	1	-	2	1	-

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 7

B.E. BIOMEDICAL ENGINEERING

23BEBME141

ENGINEERING PHYSICS (THEORY & LABORATORY) SEMESTER-I 6H-5C

Instruction Hours/week: L:4 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

- Inculcate the basics of properties of matter, sound and its applications.
- Understand the basics of laser and optical fiber with appropriate applications.
- Disseminate the fundamentals of thermal physics and their applications.
- Introduce the concepts of quantum mechanics for diverse applications.
- Impart the basic knowledge of crystal and its various crystal structures.

COURSE OUTCOMES

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

- Identify the elastic properties of the materials using Young's modulus and rigidity modulus
- Examine the performance of light, laser and optical fibres
- Apply the concept of thermal properties for calculating thermal conductivity of the materials
- Relate the quantum concepts in electron microscope
- Outline the basics of crystals, structures and its defects

UNIT I – PROPERTIES OF MATTER

Elasticity –stress – strain – Hookes law- classification of elastic modulus -Poisson's ratio - Stress-Strain diagram and its uses - factors affecting elastic modulus and tensile strength Moment, Couple and Torque– Twisting couple on a wire - Torsion pendulum- bending of beams – bending moment – cantilever- young's modulus – uniform bending and non-uniform bending(Experimental) – I- shaped girders and its applications.

UNIT II – LASER AND FIBER OPTICS

LASER: Introduction - characteristics - Einstein's co-efficients derivation Principle of laser actionpopulation inversion- pumping methods -Types of laser - Nd: YAG, CO₂- Applications of LASER in industry and medicine.

Fiber optics - principle- 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).

2023-2024

9

UNIT III – THERMAL PHYSICS

Mode of Heat Transfer -conduction, convection, radiation (qualitative) - thermal expansions of solid and liquid - bimetallic strips – thermal conductivity: Forbe's and Lee's disc method: theory and experiment – heat conduction through compound media (series and parallel) – Thermal insulators – Laws of thermodynamics – refrigerators-microwave oven and solar water heater.

UNIT IV – QUANTUM PHYSICS

Black body radiation -Energy Distribution laws: Stefan Boltzmann's law, Wein's Displacement law Rayleigh Jeans Law- Photo electric effect – Compton effect (Qualitative) – De Broglie hypothesis - uncertainty principle – physical significance of wave function - Schrödinger's Time dependent wave equation - Schrödinger's Time independent wave equation –Electron Microscope:Scanning Electron Microscope and Transmission Electron Microscope.

UNIT V – CRYSTAL PHYSICS

Classification of solids: Crystalline and amorphous solids – crystal structure - unit cell, primitive cell –seven crystal systems, Bravais lattices, Miller indices – inter-planar distances(Qualitative) -Coordination number and Atomic packing factor for Simple Cubic, Body Centered Cubic, Face Centered Cubic, Hexagonal Closed Packing structures – Defects in crystal: Point & Line defect.

Total Hours: 45

9

- TEXT BOOKS:
 - 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.
 - 4. Charles Kittel, Kittel's Introduction to Solid State Physics, Wiley India Edition, 2019.
 - 5. P.M. Mathews, K.Venkatesan, A text book of Quantum Mechanics, 2/e, Mc Graw Hill Education, 2017.
 - 6. Laser Fundamentals, William T Silfvast, Cambridge Univ Press. 2012.
 - 7. Fiber Optics and Optoelectronics, R P Khare, Oxford, 2012.
 - 8. D.S. Mathur, Elements of properties of matter, S.Chand, 2010.

REFERENCES:

- 1. Halliday.D. Resnick R. & Walker. J, Principles of Physics, Wiley, 2015.
- 2. Daniel V.Schroeder, An Introduction to Thermal Physics, Pearson, 2014.

WEBLINKS:

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

(ii) LABORATORY

LIST OF EXPERIMENTS – PHYSICS (Any 7 Experiments)

- 1. Torsional pendulum Determination of rigidity modulus of wire and moment of inertia of disc
- 2. Uniform bending– Determination of young's modulus.
- 3. Non-uniform Bending Determination of young's modulus.
- 4. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille's flow.
- 5. Laser- Determination of the wave length of the laser using grating,
- 6. Optical Fiber Determination of Numerical Aperture and Acceptance angle of the optical fiber.
- 7. Air wedge Determination of thickness of a thin sheet/wire.
- 8. Lee's disc Determination of thermal conductivity.
- 9. Determination of Band gap of a semiconductor.
- 10. Characteristics of photo diode.

CO PO MAPPING

COs /POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO2	K4	3	3	2	-	-	1	-	-	2	2	-	1	1	-
CO3	K3	3	2	-	-	-	-	-	-	2	2	-	1	1	-
CO4	K2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
CO5	K2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
Average		2.6	1.8	1.5	-	-	1	-	-	2	1.6	-	1	1	-

B.E. BIOMEDICAL ENGINEERING

23BECC142

PROGRAMMING IN C (THEORY & LABORATORY)

Instruction Hours/week: L:4 T:0 P:2

Marks: Internal:40 External:60 Total:100 **End Semester Exam:3 Hours**

(i) THEORY

COURSEOBJECTIVES:

The goal of this course is for the students:

- To interpret problem solving using C.
- To apply the concept of arrays and strings.
- To identify the functions of C Language.
- To apply the concept of pointers.
- To develop C Programs using user defined function and file handling.

COURSE OUTCOMES:

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

- Apply problem solving techniques for a given problem •
- Solve problems using arrays and strings. •
- Build modular applications in C using functions.
- Categorize dynamic memory management operators with pointers.
- Examine sequential and random access file processing...

UNITI INTRODUCTION

An overview of computers and programming - Understanding computer systems - Programming logic - Steps in program development - Algorithm - Using pseudocode and flowchart - types of programming languages - Compiler - Interpreter - Linker - Introduction to C - Structure of C program - Identifiers and Keywords - Data types - Constants and variables - Type conversion -Operators - Expressions. Formatted and Unformatted Input/Output functions - Control structures

UNIT II ARRAYS AND STRINGS

Arrays in C - Declaring and initializing arrays in C - Defining and processing 1D and 2D arrays -Inserting and deleting elements of an array - Strings - Defining and initializing strings - Processing of string - Character arithmetic - String manipulation functions and library functions of string.

UNITILI FUNCTIONS

Functions - Types of Functions - Function prototypes - Function definition - Function call including passing arguments by value and passing arguments by reference - Passing arrays to functions - Math library functions - Recursive functions - Scope rules (local and global scope) - Storage classes in C.

9

9

2023-2024

6H-5C

9

SEMESTER-I

UNIT IV POINTERS

Pointers - Pointer declaration and initialization - Types of pointers - Pointer expressions and arithmetic - Operations on pointers - Passing pointer to a function - Pointer and one-dimensional array - Pointers and strings – Command line arguments - Dynamic memory management functions.

UNIT V USER DEFINED TYPES AND FILE HANDLING

User defined types - Enumerator – Typedef - Structures - Declaration of a structure - Accessing structures - Array of Structures - Structures and pointers - Nested structures – Bit fields – Unions - Declaration of a union – Accessing unions – Union vs Structure - File Input/Output – Preprocessor directives.

TOTAL HOURS:45

TEXTBOOKS:

- 1. Programming In C By Ashok N. Kamthane, 3rdedition, Pearson, 2015.
- 2. Programming In C, Reema Thareja, Oxford University Press, Second Edition, 2016.

REFERENCESBOOKS:

- 1. "C How To Program" By Paul Deitel And Harvey Deitel, 8th edition, Prentice Hall, 2015.
- 2. "Programming In Ansi C" By E. Balagurusamy, 8th edition, Mcgraw Hill Education, 2019.
- 3. "Let Us C", by Yashwant Kanetkar, 17th Edition, Bpb Publications, 2020.
- 4. "C: The complete reference", Herbert Schildt, 4th edition, Mcgraw Hill Education, 2017.

WEBSITES:

- 1. www.hackerrank.com
- 2. www.codechef.com
- 3. www.learn-c.org
- 4. <u>www.udemy.com</u>
- 5. www.hackearth.com

(ii) LABORATORY

LIST OF EXPERIMENTS:

- 1. Develop a C Program to find the roots of quadratic equation for non-zero coefficient using if-else ladder construct.
- 2. Develop Programs using simple control statements such as if else, while, do while. Example Extracting the digits of an integer, reversing digits, finding sum of digits

- 3. Develop a C Program to implement a simple calculator to perform addition, subtraction, multiplication and division operations using switch construct. Display appropriate messages for invalid operator and divide by zero error.
- 4. Develop C Program to generate Fibonacci sequence, calculation of factorials, printing various patterns and generate the Prime numbers between the ranges m & n using for loop.
- 5. Develop a C program to read n elements into an integer array, Insert and Delete element from the array.Print the input array and the resultant array with suitable messages.
- 6. Develop a C program to read two matrices A (m x n) and B (p x q) and compute the product of the two matrices. Print both the input matrices and resultant matrix with suitable headings and output should be in matrix format only. Program must check the compatibility of orders of the matrices for multiplication. Report appropriate message in case of incompatibility.
- 7. Develop a C function Program to sort the given names in Ascending Order.
- 8. Develop a C program to count the vowels & consonants in a given string.
- 9. Develop a C Program to find the GCD of two integers using Euclid's algorithm
- 10. Develop a recursive C function to find the factorial of a number, n!, defined by fact(n)=1, if n=0. Otherwise fact(n)=n*fact(n-1). Using this function, develop a C program to compute the Binomial coefficient nCr. Perform input validation as well.
- 11. Develop a C program to find the smallest and largest elements in an array using pointers and then swap these elements and display the resultant array.
- 12. Develop a C program to find the sum of all the elements of an integer array using pointers.
- 13. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using structures and pointers

TOTAL PERIODS : 30

COs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO2	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO3	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO4	K4	3	3	2	1	-	-	-	-	2	2	-	1	1	-
CO5	K4	3	3	2	1	-	-	-	-	2	2	-	1	1	-
Average		3	2.4	1.4	1	-	-	-	-	2	2	-	1	1	-

CO-PO MAPPING

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 13

B.E. BIOMEDICAL ENGINEERING

23BECC111

ENGINEERING GRAPHICS

Instruction Hours/week: L:2T:0 P:2

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Expose them to existing national standards related to technical drawings and develop their ability to produce engineering drawings using drawing instruments.
- Emphasize freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically.
- Introduce CAD software for the creation of 2D engineering drawings.
- Develop a clear understanding of projection and the projection of points.
- Produce computer generated drawings using CAD software and develop a clear understanding of plane geometry.

COURSE OUTCOMES:

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

- Apply BIS and ISO standards in engineering drafting.
- Construct mathematical curves in engineering applications
- Illustrate geometrical solids in 3D space using orthographic projections.
- Develop the projection of simple solids.
- Interpret the information of the 2D and 3D drawing

UNIT I INTRODUCTION

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.

UNIT II FREE HAND SKETCHING

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.

UNIT III INTRODUCTION TO COMPUTER GRAPHICS – 2D

Overview of Computer Graphics and drafting tools, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software, Sketching of 2D simple geometries, editing and dimensioning of 2D geometries. Projection of points and straight lines

9

9

9

Marks: Internal:40 External:60 Total:100 EndSemesterExam:3Hours

SEMESTER-I 4H-3C

located in the first quadrant inclined to both planes– Determination of true lengths and true inclinations (By using CAD software).

UNIT IV PROJECTION OF PLANE SURFACES AND SOLIDS

Projection of polygonal surface and circular lamina inclined to both reference planes (By using CAD software). Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT V ISOMETRIC PROJECTIONS

Demonstrating knowledge of the theory of CAD software, Introduction to 3D modeling packages. 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: 45

9

9

TEXT BOOKS:

- 1. Venugopal K and Prabhu Raja V, (2021), Engineering Graphics, New Age International Publishers.
- 2. James D. Bethune, (2020), Engineering Graphics with AutoCAD, Macromedia Press.
- 3. C M Agrawal and Basant Agrawal, (2019), Engineering Graphics, Tata McGraw Hill, New Delhi.

REFERENCE BOOKS:

- 1. Annaiah M.H., Prem Kumar, Chandrappa C N, (2022), Computer Aided Engineering Drawing, New Age International Private Limited.
- 2. Narayana, K.L. and P Kannaiah, (2021), Text book on Engineering Drawing, Scitech Publications (India) Pvt. Ltd.
- 3. Shah, M.B. and Rana B.C., (2010), Engineering Drawing and Computer Graphics, Pearson Education.
- 4. Bhatt N.D., Panchal V.M. and Ingle P.R, (2019), Engineering Drawing, Charotar Publishing House.

WEBSITES:

- 1. https://onlinecourses.nptel.ac.in/noc21_me128
- 2. https://www.mygreatlearning.com/academy/learn-for-free/courses/engineering-graphics-drawing
- 3. https://www.autodesk.in/solutions/technical-drawing

CO-PO MAPPING

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	1	-	2	-	2	-	-	3
CO2	2	1	-	-	-	-	-	1	-	2	-	2	-	-	2
CO3	3	2	1	-	3	-	-	1	-	2	-	2	-	-	3
CO4	3	2	1	-	3	-	-	1	-	2	-	2	-	-	3
CO5	3	2	1	-	3	-	-	1	-	2	-	2	-	-	3
Average	2.6	1.6	1	-	3	-	-	1	-	2	-	2	-	-	2.6

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 16

23BECC201C

TRANSFORMS AND ITS APPLICATIONS **4H-4C**

Instruction Hours/week: L:3 T:1 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

2023-2024

SEMESTER-II

COURSE OBJECTIVES:

The goal of this course is for students:

- To make the students to understand the concept of periodic function and represent them in Fourier series.
- To make the students to understand the applications of partial differential equations.
- To acquaint the students with the concepts of Fourier transform techniques. •
- To impart knowledge in Laplace transform techniques and its applications.
- To provide knowledge about solving ordinary differential equations using the Inverse Laplace • transform.

COURSE OUTCOMES:

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

- Make use of orthogonal transformation to reduce the quadratic form to canonical form. •
- Utilize differential calculus of multivariable to optimization problems.
- Apply multiple integrals for finding the area and volume.
- Solve the linear differential equations using Euler's Cauchy and method of variation of parameter.
- Solve the nth order partial differential equations.

UNIT I FOURIER SERIES

Dirichlet's conditions – General Fourier series in the interval (0,2l) & (-l,l) – Half range sine series – Half range cosine series –Harmonic analysis.

UNIT II: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Fourier series solution for one dimensional wave equation - Fourier series solution for one dimensional heat equation with zero end conditions.

UNIT III FOURIER TRANSFORMS

Fourier transform pair - Complex form of Fourier transform- Fourier sine and cosine transforms -Convolution theorem – Parseval's identity of Fourier transform.

UNIT IV LAPLACE TRANSFORM

Transforms of standard functions - Properties of Laplace transform - Transforms of derivatives and integrals -Initial and final value theorem - Transforms of periodic functions.

12

12

UNIT V INVERSE LAPLACE TRANSFORM

Inverse Laplace transforms of standard functions – Inverse Laplace transform using second shifting theorem – Method of partial fractions– Solution of ordinary differential equations with constant coefficients using Laplace transforms

Total Hours: 60

TEXT BOOKS:

- 1. John W. Miles Integral Transforms in Applied Mathematics Cambridge University Press 2008
- 2. Erwin Kreyszig Advanced Engineering Mathematics John Wiley and Sons, Tenth Edition 2017

REFERENCE BOOKS:

- 1. Eric W Hansen Fourier Transforms: Principles and Applications John Wiley 2014
- 2. N.W. McLachlan Laplace Transforms and Their Applications to Differential Equations Dover Publications Inc. 2014
- 3. Richard Haberman Applied Partial Differential Equations with Fourier Series and Boundary Value Problems Pearson, Fifth edition 2021

Web URL:

- 1. www.nptel.ac.in/courses/111106111
- 2. www.nptel.ac.in/courses/111107111
- 3. <u>www.nptel.ac.in/courses/111102129</u>
- 4. www.nptel.ac.in/courses/111106139
- 5. www.archive.nptel.ac.in/courses/111/105/111105123/

COs / POS	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO2	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	K2	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO4	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	K3	3	2	1	-	-	-	I	-	-	-	-	1	1	-
Averag	ge	2.6	1.6	1.0	-	-	-	-	-	-	-	-	1	1	-

CO PO MAPPING:

B.E. BIOMEDICAL ENGINEERING		2023-2024
23BEBME202		SEMESTER-II
MEDICAI	L PHYSICS	3H-3 C
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 Physics principles, units, concepts for the construction of Biomedical • Instruments and diagnosis applications.
- Study the complete non-ionizing radiations including light and its effect in human body. •
- Demonstrate the principles of ultrasound radiation and its applications in medicine. •
- Appraise about radioactive nuclides and also the interactions of radiation with Matters and how isotopes are produced.
- Perceive the role of Physics in cardiopulmonary system.

COURSE OUTCOMES

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

- Classify the low and high frequency effects of non-ionizing electromagnetic radiation •
- Illustrate the process of radioactive nuclei production using cyclotron and Technetium 99m • generator
- Identify the radiation mechanism involved in imaging system •
- Outline the radiation effects and its limits for radiation safety
- Utilize the properties of ultrasound in clinical applications

UNIT I - ELECTROMAGNETIC SPECTRUM AND ITS EFFECT

Physics of light, Reflection, Refraction, absorption and scattering - limits of vision and color visionelectromagnetic radiation tissue as a leaky dielectric – Relaxation Processes Non-ionizing Overview - ionizing radiationeffects-LowFrequencyEffect-Higherfrequencyeffectof non Thermography -Applications,

UNIT II - RADIOACTIVE DECAY AND ITS APPLICATIONS

Radioactive decay and its types - Spontaneous Emission - Isometric Transition - Gamma ray emission, alpha, beta, positron decay, electron capture, Sources of Radioisotopes: Natural and Artificial radioactivity - Decay series, half life period. Production of radionuclides - Technetium 99m generator- Cyclotron produced Radionuclide - Reactor produced Radionuclide - Applications of radionuclides.

UNIT III - INTERACTION OF RADIATION WITH MATTER AND IMAGING

PRINCIPLES

Interaction of charged particles with matter - Specific ionization, linear energy Transfer, Bremsstrahlung, Annihilation Interaction of Gamma radiations with matter - Photoelectric effect,

9

9

Compton Scattering, pair Production, Attenuation of Gamma Radiation, Interaction of neuron with matter. Nuclear magnetic Resonance (NMR).

UNIT IV - RADIATION MEASURES AND METHODS

Introduction – exposure – Inverse square law - Roentgen - Acute Radiation Effects – KERMA - absorbed dose – stopping power - relationship between the dosimetric quantities – Braggs curve - The concept of LD 50 – Stochastic and Non-stochastic effects:Cancer – Leukemia – Hemopoietic Syndrome – Gastrointestinal Syndrome – Central Nervous Syndrome.

UNIT V - PRINCIPLES & APPLICATIONS OF SOUND IN MEDICINE

Physics of sound - Classification of sound - Ultrasound fundamentals - Generation of ultrasound: Magnetostriction and Piezo electric oscillator - Ultrasound Transducer- Interaction of Ultrasound with matter - Cavitations- Reflection - Transmission - Scanning methods – Artifacts - Ultrasound in Doppler effect - Clinical Applications.

TEXT BOOKS

- 1. B.H Brown, PV Law ford, R H Small wood, D R Hose, D C Barber, "Medical Physicsand Biomedical Engineering", CRC Press, 1999.
- 2. Gopal B.Saha "Physics and Radiobiology of Nuclear Medicine" Springer, 3rd ed, 2006.
- 3. John R. Cameran and James G. Skofronick, "Medical Physics", John-Wiley & Sons, 1978.
- 4. RF. Farr and PJ.Allisy –Roberts, "Physics for Medical Imaging" Saunders, 1997.
- 5. P.Uma Devi, A. Nagarathnam, B S Satish Rao, "Introduction to Radiation Biology" B.I.Churchill Livingstone pvt ltd, 2000.
- 6. Hylton B. Meire and Pat Farrant Basic Ultrasound John Wiley and Sons, 1995.

Reference Books

- 1. R.Hendee and Russell Ritenour Medical Imaging Physics, Fourth Edition William, Wiley-Liss, 2002.
- 2. S.Webb, "The Physics of Medical Imaging", Taylor and Francis, 1988.

WEB LINKS

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

Total: 45

9

CO PO MAPPING:

COs	KL														
/		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
POS															
CO1	K2	2	1	-	-	-	-	I	1	-	1	I	1	1	-
CO2	K2	2	1	-	-	-	-	I	1	-	1	I	1	1	-
CO3	K3	3	2	1	-	-	1	I	1	-	1	I	1	1	-
CO4	K2	2	1	-	-	-	1	-	1	-	1	-	1	1	-
CO5	K3	3	2	1	_	_	1	-	1	-	1	_	1	1	_
Ave	rage	2.4	1.4	1	-	-	1	-	1	-	1	-	1	1	-

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 21

B.E.BIOMEDICALENGINEERING

23BEBME203

BIOCHEMISTRY

Instruction Hours/week: L:3 T:0 P:0

End Semester Exam: 3 Hours

Marks: Internal:40 External:60 Total:100

COURSE OBJECTIVES

The goal of this course for students is

- To make the students acquire knowledge about various biomolecules. •
- To impart the knowledge on chemistry of carbohydrates.
- To understand the importance of the amino acids, proteins, lipids, vitamins and nucleic acids. •
- To learn about the biologically important minerals. •
- To develop an understanding of the range and uses of analytical methods in chemistry

COURSE OUTCOMES

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

- Illustrate the basic structure and function of carbohydrates.
- Outline the importance of amino acids and proteins.
- Summarize the biological functions of lipids, vitamins and nucleic acids. •
- Infer the role of metals in biological processes. •
- Explain the principles and working of spectroscopic techniques.

Unit: I Biomolecules–Carbohydrates

Carbohydrates: Definition, classification, configuration of carbohydrates. Mono saccharides-Glucose: preparation, structural elucidation and functions. Fructose: preparation, structural elucidation and functions. Disaccharides- Structure, chemistry and function - Sucrose, Lactose, Maltose and Cellobiose. Trisaccharides-Structure of Raffinose. Polysaccharides- Introduction to starch and cellulose.

Unit: II Proteins and Amino acids

Definition, Structure and classification of amino acids based on chemical nature, peptide bond, Properties of amino acids: Isoelectric pH, Zwitter ions. Essential amino acids. Proteins: Classification of proteins, properties, structure of proteins: primary, secondary, tertiary and quaternary structure of proteins. Denaturation and Importance of proteins.

9

9

2023-2024 **SEMESTER-II**

3H-3C

Unit: III Lipids, Vitamins and Nucleic acids

Lipids: Definition, Classification of lipids, simple, compound and derived. Vitamins: Definition, Classification of vitamins, Fat soluble vitamins-sources, physiological functions and their deficiency disease. Water soluble vitamins-sources, physiological functions and their deficiency disease.

Nucleic acids; Nucleosides, Nucleotides, Types of nucleic acids- Watson and Crick model of DNA. RNA- definition, types, comparison of DNA and RNA. Biological functions of nucleic acids.

Unit: IV Biologically important Minerals

Importance of metals in biological systems – chemistry of hemoglobin and myoglobin – Role of: Na^+ and K^+ ions – Mg^{2+} and Ca^{2+} ions – Biological functions and toxicity of trace elements: Cr, Mn, Co, Ni and Cu – Ultra trace elements: As, Se, Mo, I, Fe and Zn – Biological fixation of nitrogen – Metallo-enzymes: Carbonic anhydrase, Carboxy peptidase. Biologically important Coordination compounds: Chelation examples - Chlorophyll -Vitamin B12. Applications of EDTA in qualitative and quantitative analysis.

Unit: V Spectroscopic Techniques and Applications

Spectroscopy (Principles and Instrumentation only). Colorimetry, UV-Visible spectroscopy, FT-IR and Raman spectroscopy. Applications. Surface characterization techniques Scanning electron microscope (SEM) and Transmission electron microscopy (TEM). Fluorescence and its applications in medicine.

Total Hours: 45

9

TEXT BOOKS:

- 1. O.P. Agarwal, Chemistry of Organic Natural Products, Geol publishing house, Meerut. 1999
- 2. Jayashree Ghose, Fundamental of concepts of applied Chemistry, 1st edition, S.Chand and Company (P) Ltd, New Delhi, 2006.
- P.L.Soni, H.M.Chawla, Text book of organic chemistry, 26th edition, S.Chand & Co, New Delhi, 2007.
- 4. B.S.Bahl and Arun Bahl, Advanced Organic chemistry, 18th edition, S.Chand & Co, New Delhi, 2012.
- 5. Ambika Shanmugam, Fundamentals of Biochemistry for Medical Students, 7th Edition, Lippincott Williams and Wilkins Publications, 2012
- 6. Satyanarayana.U., Fundamentals of Biochemistry, Allied & Books Pvt Ltd, Calcutta, 2019
- 7. Duls Fatima, L.M.Narayanan, R.P.Meyyan, K.Nallasingam, S.Prasanna Kumar, N.Arumugam, Biochemistry, 4th edition, Saras Publication, Nagercoil, 2013.
- 8. P.S.Kalsi & J.P.Kalsi, Bioorganic, Bioinorganic and supramolecular chemistry, 1st edition, New age International Limited, New Delhi, 2007.
- 9. Harper's Biochemistry. 25thed. Editors Murray R.K., Granner, D.K., Mayes, P.A., Rodwell, V.W., McGraw Hill, 2000.

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 23

- 10. Pabitra Krishna Bhattacharya & Prakash B.Samnani, Metal ions in biochemistry, 2nd edition, CRC Press, New Delhi, 2020.
- 11. B.K. Sharma, Analytical chemistry, 1st edition, krishnaprakashan media Pvt. Ltd., New Delhi, 2006.

COs /	KL														
POS		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	1	1	-	1	-	1	1	-
CO2	K2	2	1	-	-	-	1	1	1	-	1	-	1	1	-
CO3	K2	2	1	-	-	-	1	1	1	-	1	-	1	1	-
CO4	K2	2	1	-	-	-	1	1	1	-	1	-	1	1	-
CO5	K2	2	1	-	-	-	1	1	1	-	1	_	1	1	-
Avera	ge	2	1	-	-	-	1	1	1	-	1	-	1	1	-

CO-PO MAPPING

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 24

B.E. BIOMEDICALENGINEERING

23BEBME204

INTRODUCTION TO BIOMEDICAL ENGINEERING 3H-3C

Instruction Hours/week: L:3T:0P:0

Marks:Internal:40External:60Total:100

End SemesterExam:3Hours

COURSEOBJECTIVES

The goal of this course is for students,

- To provide basic ideas related to modeling techniques in biological systems
- To familiarize the parameters involved in the biological system
- To model the biological system.
- To know about the biomechanics involved in operation of the human system
- To acquaint the ethical issues in biomedical engineering

COURSEOUTCOMES

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

- Explain the building blocks of human physiological system(k2)
- Interpret the physiological signals (k2)
- Compare the performance of medical imaging system (k2)
- Summarize the properties of biomechanics systems (k2)
- Interpret the ethical codes of biomedical engineers (k2)

UNIT-I BASIC BIOLOGY

Engineering in modern medicine, Physiological Systems-Cell Structure, Structure of nerve cell and functions, Heart & Circulatory system, Respiratory Physiology, Kidney function, Brain & Central Nervous System.

UNIT-II PHYSIOLOGICAL SIGNALS

Signal representation, Signal in time and Frequency domain, Signal Estimation, Bioelectric Signals: ECG & EEG, Vital Signs, Biomagnetic Signals.

UNIT-III MEDICAL IMAGING SYSTEMS

Principles and Applications - X-ray & CT, Ultrasound Imaging, MRI, Nuclear Medicine, Microscopy, Biophotonics.

UNIT-IV BIOMECHANICS& BIOMATERIALS

Mechanical Properties of Tissue - Stress, Strain, Viscosity and Viscoelasticity, Applications of Sports Biomechanics, Biomaterials - Types, Properties, Applications - Artificial heart & Membrane Oxygenators.

9

9

2023-2024 SEMESTER-II

9

UNIT-V SOCIAL AND ETHICAL ISSUES RELATED TO BIOMEDICAL ENGINEERING

Principles of clinical research, randomized controlled trials, Technology and community, Environmental aspects of technology related to healthcare delivery, Healthcare economics and health rationing.

Total Hours:45

TEXTBOOKS:

- 1. R. S. Khandpur, Biomedical Instrumentation: Technology and Applications, TATA McGraw-Hill, 2011
- 2. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice Hall of India 2018

REFERENCES:

- 1. John D. Enderle and Susan M. BlanchardIntroduction to Biomedical Engineering, Elsevier International Projects Ltd , 2012
- 2. Laurence J. Street, Introduction to Biomedical Engineering Technology, CRC Press, 2008

WEBSITES:

- 1. www.nptel.ac.in/courses/102101068
- 2. www.nptel.ac.in/courses/102105090

CO PO MAPPING:

COs/ Pos	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO5	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
Averag	ge	2	1	-	-	-	1	-	1	1	1	-	1	2	-

B.E.BIOMEDICAL ENGINEERING

23BEBME241

BASIC ELECTRICAL & ELECTRONICS ENGINEERING 5H-4C

Instruction Hours/week: L:3 T:0 P:2

Marks: Internal: 40External:60Total: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 working of Semiconductor devices and Digital Circuits.
- To impart the basic knowledge of Measuring Instruments and Electrical Installation.
- Know the fundamentals of Electrical Engineering and Practical.

COURSE OUTCOMES

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

- Apply basics laws and theorems for a given DC circuits
- Solve a given single phase and three phase circuits
- Illustrate the basic principles, construction and working of AC, DC motor and transformer.
- Outline the basics of semiconductor devices and digital circuits.
- Illustrate the operation of measuring instruments, components of electrical installation and types of batteries.

UNIT I - DC CIRCUITS

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

UNIT II - AC CIRCUITS

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

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.

9

9

9

2023-2024

SEMESTER-II

UNIT IV- SEMICONDUCTOR DEVICES AND DIGITAL ELECTRONICS

9

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 9

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.

TEXT BOOKS

- 1. S.K.Bhattacharya, "Basic Electrical Engineering", Pearson, 2019.
- 2. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
- 3. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010
- 4. VN Mittle and Arvind Mittal, (2006), Basic Electrical Engineering, McGraw Hill.
- 5. A.Sudhaka and Shyammohan S Palli, (2013), Circuits and Networks, McGraw Hill.
- 6. R.Muthusubramanian and S.Salivahanan, (2014), Basic Electrical and Electronics Engineering, McGraw Hill.

WEB LINKS:

- 1. www.nptel.ac.in.
- 2. encyclopedia-magnetica.com/doku.php/co energy.
- 3. <u>www.en.wikibooks.org/wiki/electronics/measuring</u> instruments.

(i) LABORATORY

List of Experiments

- 1. Experimental verification of electrical circuit problems using Ohms law
- 2. Experimental verification of electrical circuit problems using Kirchhoff's Voltage law.
- 3. Experimental verification of electrical circuit problems using Kirchhoff'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.

CO-PO MAPPING

Cos/	Kl	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
POs															
CO1	K3	3	2	1	-	-	-	-	-	2	2	-	1	-	1
CO2	K3	3	2	1	-	-	-	-	-	2	2	-	1	-	1
CO3	K2	2	1	-	-	-	-	-	-	2	2	-	2	-	1
CO4	K2	2	1	-	-	-	-	-	-	2	2	-	2	-	1
CO5	K2	2	1	-	-	-	-	-	-	2	2	-	2	-	1
Aver	age	2.4	1.4	1	-	-	-	-		2	2	-	1.6	-	1

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 29

B.E.BIOMEDICALENGINEERING

23BEBME242A

DATA STRUCTURES AND ALGORITHMS (THEORY AND LABORATORY)

Instruction Hours/week: L:4 T:0 P:2

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

PRE-REQUISITES: Programming in C

(i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students:

- To understand the concepts of ADTs.
- To learn linear data structures lists, stacks, and queues.
- To interpret non-linear data structures trees and graphs.
- To implement sorting, searching and hashing algorithms.
- To apply Tree and Graph structures to real world scenario.

COURSE OUTCOMES:

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

- Build abstract data types for linked list data structure. •
- Apply the concepts of stack, queue and its applications. ٠
- Experiment with operations on binary trees.
- Identify the traversal techniques of graphs and its applications.
- Inspect sorting, searching and hashing techniques. •

UNIT I LISTS

Abstract Data Types (ADTs) – Elementary Data types–List ADT – Array-based implementation – Linked list implementation - Singly linked lists - Doubly-linked lists - Circularly linked lists -Applications of lists - Polynomial ADT - Multilists-Sparse Matrices.

UNIT II STACKS AND QUEUES

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions-Infix to Postfix conversion - Function Calls - Queue ADT - Operations - Circular Queue - Deque -Applications of Queues.

UNIT III TREES

Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees - Red-Black Trees - Priority Queue (Heaps) - Binary Heap.

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore - 641 021 Page | 30

9

9

SEMESTER II 6H-5C

2023-2024

UNIT IV MULTIWAY SEARCH TREES AND GRAPHS

B-Tree – B+ Tree – Tries – Graph Definition – Representation of Graphs – Types of Graphs – Breadth-first traversal – Depth-first traversal — Bi-connectivity – Euler circuits – Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES

Searching – Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Quick Sort – Merge Sort – Heap Sort – Radix Sort – Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45

TEXT BOOKS:

- 1. Mark Allen Weiss," Data Structures and Algorithm Analysis in C", Pearson Education, Second Edition, 2005
- 2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein," Introduction to Algorithms", Mcgraw Hill/ MIT Press, Fourth Edition,2022

REFERENCE BOOKS:

- 1. Narasimha Karumanchi," Data Structures and Algorithms Made Easy", CareerMonk Publications, First Edition,2016
- 2. Langsam, Augenstein and Tanenbaum, "Data Structures Using C", Pearson Education, Second Edition, 2015
- 3. Kamthane," Introduction to Data Structures in C", Pearson Education, First Edition, 2007
- 4. Kruse," Data Structures and Program Design in C", Pearson Education, Second Edition, 2003

WEBSITES:

- 1. www.nptel.ac.in/courses/106106145
- 2. www.nptel.ac.in/courses/106102064
- 3. www.coursera.org/learn/data-structures
- 4. www.edx.org/learn/data-structures
- 5. www.cs.usfca.edu/~galles/visualization/Algorithms.html

(ii) LABORATORY

LIST OF EXPERIMENTS:

- 1. Array implementation of Stack, Queue and Circular Queue ADTs
- 2. Implementation of Singly Linked List
- 3. Linked list implementation of Stack and Linear Queue ADTs
- 4. Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion
- 5. Implementation of Binary Search Trees and AVL Trees
- 6. Implementation of Heaps using Priority Queues
- 7. Implementation of Dijkstra's Algorithm

- 8. Implementation of Prim's Algorithm
- 9. Implementation of Linear Search and Binary Search
- 10. Implementation of Insertion Sort and Selection Sort
- 11. Implementation of Merge Sort and Quick Sort
- 12. Implementation of Open Addressing (Linear Probing and Quadratic Probing)

CO PO MAPPING

COs / POS	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO2	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO3	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO4	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO5	K4	3	3	2	1	-	-	-	-	2	2	-	1	1	-
Average		3	2.2	1.2	1	-	-	-	-	2	2	-	1	1	-

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 32

TOTAL: 30

B.E. BIOMEDICALENGINEERING

23BEBME242B

OBJECT ORIENTED PROGRAMMING WITH PYTHON (THEORY AND LABORATORY)

Instruction Hours/week: L:4 T:0 P:2

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

(i) THEORY

COURSEOBJECTIVES:

The goal of this course is for the students:

- To learn basic python language syntax, semantics and control structures. •
- To apply list, tuple, set and dictionary to handle data. •
- To solve the problems using functions and modules.
- To infer the object-oriented programming concepts in python. •
- To interpret inheritance and exception handling in python. •

COURSE OUTCOMES:

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

- Apply python control flow statements to solve problems.
- Model data structures for string, tuple, list, set, and dictionary. •
- Identify Python built-in functions to write user defined functions.
- Apply object-oriented programming concepts in python.
- Analyze the concepts of exception handling to a real world scenario. •

UNIT I - PYTHON FUNDAMENTALS

Introduction to Python – language classification - python language syntax - keywords - identifiers indentation - comments - input - output - escape characters - variables - operators - Control Statements.

UNIT II - DATA STRUCTURES IN PYTHON

String - Mutable vs immutable types - indexing and slicing - String functions - Tuple - Tuple operations- List - List operations - List as array - List comprehension - Set - Set operations -Dictionary – Dictionary operations.

UNIT III - FUNCTIONS AND MODULES

Python built in functions - User defined functions - Creating function – Invoking functions – Types of function arguments - Recursion and lambda or anonymous functions - Defining, Creating and Accessing a Package, importing packages and user defined modules.

2023-2024

SEMESTER-II

6H-5C

9

9

UNIT IV - CLASSES AND OBJECTS

Object Oriented terminologies (class, object, method, inheritance, abstraction, encapsulation, polymorphism) – UML Class diagram - access specifiers – Creating classes – Creating object – Accessing members - __init__() method - instance, static and class methods - Importance of self – Implementing encapsulation.

UNIT V - INHERITANCE, POLYMORPHISM AND EXCEPTION HANDLING

Implementing inheritance – Types of inheritance – Implementing Polymorphism - Method overloading – Method overriding – Operator overloading - Abstract Classes - Association and Aggregation - Errors vs exceptions – Handling exceptions – Raising exception – Creating user defined exception.

TOTAL: 45

9

TEXTBOOKS:

- 1. Think Python: How to Think Like a Computer Scientist AnanyLevitin, Allen B. Downey Second Edition, O'Reilly, 2016.
- 2. Python 3 Object-oriented Programming, Dusty Phillips, Third Edition, Packet Publishing, 2018.

REFERENCESBOOKS:

- 1. The Absolute Beginner's Guide to Python Programming, Kevin Wilson, Apress Media LLC, First Edition, 2022.
- 2. Python 3 The Comprehensive Guide, Johannes Ernesti, Peter Kaiser, Rheinwerk Publishing Inc., First Edition, 2022
- 3. Fundamentals of Python Programming, Richard L. Halterman, Southern Adventist University, First Edition, 2019

WEBSITES:

- 1. www.docs.python.org/3/
- 2. <u>www.programiz.com/python-programming</u>
- 3. www.scaler.com/topics/python/
- 4. <u>www.geeksforgeeks.org/python-oops-concepts/</u>
- 5. www.edureka.co/blog/object-oriented-programming-python/

(ii) LABORATORY

LIST OF EXPERIMENTS:

- 1. Programs using operators and control structures.
- 2. Programs using string functions.
- 3. Programs using tuple.
- 4. Programs using list.
- 5. Programs using set.
- 6. Programs using dictionary.
- 7. Programs using built-in functions.
- 8. Implementing user defined functions with various parameter options
- 9. Implementation of class & objects.
- 10. Implementation of inheritance and association.
- 11. Implementation of overloading and overriding.
- 12. Implementation of exception handling.

TOTAL: 30

COs/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO2	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO3	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO4	K3	3	2	1	-	-	-	-	-	2	2	-	1	1	-
CO5	K4	3	3	2	1	-	-	-	-	2	2	-	1	1	-
Average		3	2.2	1.2	1	-	-	-	-	2	2	-	1	1	-

CO-PO MAPPING

SEMESTER III

NUMERICAL METHODS

23BEBME301A

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

B.E Biomedical Engineering

Instruction Hours/week: L:3 T:1 P:0

- To inculcate the basic concepts of solving algebraic and transcendental equations.
- To understand the numerical techniques of interpolation in various intervals
- To provide the knowledge of numerical differentiation and integration
- To provide the knowledge of solving ordinary differential equations numerically
- To inculcate various techniques of solving partial differential equations numerically.

COURSE OUTCOMES:

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

- Solve the systems of linear and nonlinear equations by iterative methods.
- Make use of interpolation methods for finding the missing terms.
- Apply numerical methods for finding differentiation and integration of a given function.
- Solve ordinary differential equations using Euler's, Taylor's, Runge Kutta and Milne Thomson's method.
- Utilize implicit and explicit methods in heat and wave equations.

UNIT I SOLUTION OF EQUATIONS

Regula Falsi Method - Newton Raphson method for solving algebraic and transcendental equations -Solution of system of linear equations - Gauss elimination method - Gauss Jordan method -Gauss Seidel method

UNIT II INTERPOLATION

Interpolations with unequal intervals-Lagrange's interpolation -Newton's divided interpolation - Interpolation with equal intervals-Newton's forward and backward interpolation

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION

Approximation of derivatives using Newton's forward and backward interpolation - Numerical integration using Trapezoidal, Simpson's 1/3 and 3/8 rule

UNIT IV NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Single step method- Euler's method-Taylor's series method-Fourth order Runge – Kutta method –Multi step method-Milne's predictor corrector method

12

12

12

2023-2024 SEMESTER III 4H-4C

UNIT V NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Solutions of one dimensional heat equation by Bender-Schmidt and Crank Nicholson methods – Numerical solutions of one dimensional wave equation by explicit method

Total Periods : 45

TEXT BOOKS:

- 1. Steven C.Chapra and Raymond P.Canale, Numerical Methods for Engineers, McGraw Hill Education, Seventh Edition 2015
- 2. Curtis F. Gerald and Patrick O. Wheatley, Applied Numerical Analysis, Addison Wesley, Thirteenth Edition 2004

REFERENCE BOOKS:

- 1. Richard L. Burden and J. Douglas Faires, Numerical Methods Brooks/Cole, 4th edition ,2012
- 2. Erwin Kreyszig Advanced Engineering Mathematics ,John Wiley and Sons, Tenth Edition , 2011

WEB URLs:

- 1. https://archive.nptel.ac.in/courses/111/107/111107105/
- 2. https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/resources/lecture-2-eulers-numerical-method-for-y-f-x-y/
- 3. http://www.infocobuild.com/education/audio-video-courses/mathematics/numerical-analysis-iit-madras.html
- 4. http://www.infocobuild.com/education/audio-video-courses/mathematics/NumericalMethods-FiniteDifference-IIT-Roorkee/lecture-06.html

COs/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
Average		3	2	1	-	-	-	-	-	-	-	-	1	1	-

CO PO Mapping

SEMESTER III

4H-4C

23BEBME301B DISCRETE MATHEMATICS

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 inculcate the concepts of theories on Numbers.
- To extend student's logical and mathematical maturity and ability to deal with abstraction. •
- To synthesize methods of solving problems in summation of series and recurrence relations. •
- To introduce the concept of Theoretical Distributions.
- To make the students to interpret the importance of correlation function and spectral studies.

COURSE OUTCOMES:

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

- Interpret the concepts of divisibility, prime number, congruence and number theorems.
- Make use of propositional logic for solving problems.
- Solve word problems using combinatorial analysis.
- Explain major distributions of random variables and its applications. •
- Identify classes of states in Markov chains and characterize the classes

UNIT I NUMBER THEORY

Divisibility - Fundamental Properties - Euclidean algorithm - Euclid's lemma - Fundamental theorem of arithmetic - Congruence - Fermat's Little theorem (statement only) and the Chinese remainder theorem(statement only).

UNIT II PROPOSITIONAL CALCULUS

Propositional Calculus: Propositions - Logical connectives - compound propositions - conditional and biconditional propositions - Truth tables - Tautologies and contradictions - contrapositive - Logical equivalences and implications – Demorgan's Laws – Normal forms – Principal conjunctive and disjunctive normal forms.

UNIT III COMBINATORICS

Mathematical Induction - Permutations and combinations - Recurrence Relation - Formation of Recurrence relation – Solution of recurrence relation by Generating Functions – Concept of Probability – Conditional– Theorem of Total Probability - Baye's theorem.

UNIT IV THEORETICAL DISTRIBUTIONS

One dimensional Random Variables - Discrete and Continuous Random variables - Probability distribution function - Probability density function - Mathematical Expectations - Moments -. Mean and Variance - Moment generating function of Binomial, Poisson and Normal distributions

12

12

12

UNIT V STOCHASTIC PROCESS

Classification of Random Process – Discrete and Continuous cases — Auto Correlation Functions – Properties – Stationary Random processes – WSS and SSS processes – Power spectral density – properties of power spectral density – Cross-power spectral density and properties – Auto-correlation function and power spectral density of a WSS random sequence.

Total Periods : 60

TEXT BOOKS:

1.Ralph P GrimaldiDiscrete and Combinatorial Mathematics: An Applied Introduction5thEdition, Pearson New International Edition2016

 Kenneth H. Rosen Discrete Mathematics and Applications 7th Edition, Mcgraw Hill Education 2012

3. Peebles P Z Problems and solutions in probability, random variables and random signal principles

(SIE) 1st Edition, McGraw Hill Education 2017

4. Roy D Yates and David J Goodman Probability and Stochastic processes 2nd Edition, Wiley India Pvt Ltd 2005

5. Douglas C. Montgomery & George C. Runger, Applied Statistics and Probability for Engineers, John Wiley, Sixth Edition 2016

REFERENCE BOOKS:

1.Kenneth H RosenDiscrete Mathematics and its Applications with Combinatorics and Graph Theory
7thRevised Edition, Tata McGraw – Hill Pub Co Ltd2017

2.Kishor S TrivediProbability and Statistics with reliability, Queueing and Computer ScienceApplications2nd Edition, Revised Paperbook, Prentice Hall of India2016

3.Bernard Kolman, Robert C Busby and Sharon RossDiscrete Mathematical Structures6thEdition, Pearson publishers2008

4.Henry Stark and John W WoodsProbability and Random Processes with application to signalprocessing3rd Edition, Pearson Education2002.

WEBSITES:

- 1. https://www.geeksforgeeks.org/proposition-logic/
- 2. www.tutorialspoint.com/discrete_mathematics/
- 3. https://nptel.ac.in/courses/108103185
- 4. https://nptel.ac.in/courses/108106083
- 5. www.mathworld.wolfram.com
CO PO Mapping

COs/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	K2	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO5	K3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
Averag	ge	2.8	1.8	1	-	-	-	-	-	-	-	-	1	1	-

23BEBME302

HUMAN ANATOMY AND PHYSIOLOGY

Marks: Internal:40 External:60 Total:100

9

9

0

Instruction Hours/week: L:3 T:0 P:0

End Semester Exam:3 Hours

SEMESTER III

3H-3C

COURSE OBJECTIVES:

The goal of this course is for students:

- To understand basic building block of human body
- To learn about the functioning of cardiac and nervous system of human body
- To know the functions of respiratory and musculoskeletal systems
- To distinguish functional abilities of digestive, excretory and lymphatic system
- To discuss about the sensory and endocrine systems

COURSE OUTCOMES:

Upon completion of this course, students will be able to

- Explain the basic structure and functions of cells and organelles
- Outline the anatomy and physiology of cardiac and nervous system
- Illustrate the working mechanism of human respiratory and musculoskeletal system
- Infer the functions of digestive, excretory and lymphatic system
- Model the sensory and endocrine systems of human body

UNIT I FUNDAMENTAL ELEMENT OF HUMAN BODY

Structure of Cell - Description and function of cell components - Cell Membrane: Membrane and 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 CARDIAC AND NERVOUS SYSTEM

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: Structure - Brainstem - Spinal cord - Reflex action - Conduction of Nerve Impulses – Electroencephalograph.

UNIT III RESPIRATORY SYSTEM AND MUSCULOSKELETAL SYSTEM 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

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 SENSORY AND ENDOCRINE SYSTEMS

Optics of Eye - Retina - Photochemistry of Vision - Neurophysiology of eye - EOG, Structure of internal ear - Mechanism of hearing - Auditory Pathway, Hearing Tests - Endocrine - Pituitary and thyroid glands.

TEXTBOOKS:

- 1 Prabhjot Kaur, "Text Book of Anatomy and Physiology", Lotus Publishers, 2014
- 2 Elaine.N. Marieb, "Essential of Human Anatomy and Physiology". Pearson Education, New Delhi, 2016

REFERENCES:

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

	wiap	ping													
Cos/POs	Κ	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO
	L	1	2	3	4	5	6	7	8	9	0	1	2	1	2
CO1	К 2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO2	K 2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO3	K 2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO4	K 2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO5	К 3	3	2	1	-	-	1	-	1	1	1	-	1	1	-
Averag	ge	2.2	1.2	1	-	-	1	-	1	1	1	-	1	1	-

CO PO Mapping

B.E Biomedical Engineering

23BEBME303

BIOSENSORS AND MEASUREMENTS

Instruction Hours/week: L:3 T:0 P:0

End Semester Exam: 3 Hours

COURSE OBJECTIVES: The goal of this course is for students:

- To understand about the transducer, its characteristics and types •
- To know the working principle of different biosensors
- To distinguish different measuring systems including displacement, motion and thermal applications
- To learn about the fabrication process involved in sensor development
- To discuss on different display devices that are used in biomedical applications

COURSE OUTCOMES:

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

- Explain static and dynamic characteristics of transducers and biosensors
- Illustrate the working of biosensors •
- Identify the methods for measuring electrical and nonelectrical parameters •
- Identify the methods for measuring electrical and nonelectrical parameters •
- Demonstrate the applications of recording and visualization techniques

UNIT I INTRODUCTION TO TRANSDUCERS AND ITS 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 BIOSENSORS

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. Biosensor: Classifications: Biological phenomenon, Transduction Phenomenon i.e. Enzyme Sensor and Electrode based: Affinity Sensors (Catalytic Biosensors), Two examples of each Biosensors and Immunosensor

MEASUREMENT UNIT III

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

2023-2024

3H-3C

SEMESTER III

9

9

Marks: Internal:40 External:60 Total:100

UNIT IV SENSOR FABRICATION

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

UNIT V VISUALIZATION DEVICES

CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Biosensors: transduction mechanism in a biosensor and Classification – Electronic nose

Total Periods : 45

TEXTBOOKS:

1. Hermann K P. Neubert, "Instrument Transducer– An Intro to their performance and design", Oxford University Press, 2000

2. Harry N, Norton, "Biomedical sensors –fundamentals and application", Noyes Publications, 2001

3. Nandini K, "Electronics in Medicine and Biomedical Instrumentation", Jog PHI Second Edition, 2013

REFERENCES:

1. LaGeddesandL.E.Baker, "Principles of applied Biomedical Instrumentation", Wiley, 1997

2. LeslieCromwell,Fred., J.Weibell and Pfeiffer, "Biomedical instrumentation and measurement", Prentice Hall of India, 2002

3. Jacob Fraden, "Handbook of Modern Sensors – Physics, Design and Application", AIP press, 2000

WEBSITE

1. https://nptel.ac.in/courses/1081081471

CO PO Mapping

COs/	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
POs															
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO3	K2	3	2	1	-	-	1	-	1	1	1	-	1	1	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO5	K3	2	1	-	-	-	1	-	1	1	1	-	1	1	-
Ave	rage	2.2	1.2	1	-	-	1	-	1	1	1	-	1	1	

9

23BEBME304

SIGNALS AND SYSTEMS

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 learn about the elementary signals and systems and their properties
- To understand the procedure to analyse of continuous time signals
- To know the steps of analysing linear time invariant continuous time systems
- To elaborate the sequential steps to analyse discrete time signals
- To edify the processing sequence in analysing the linear time invariant discrete time systems

COURSE OUTCOMES:

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

- Classify the continuous and discrete signals and systems
- Analyse the continuous time signals and its transforms
- Interpret the linear time invariant continuous systems •
- Summarize the properties of discrete time signals •
- Solve difference equations for linear time invariant discrete system

UNIT I **CLASSIFICATION OF SIGNALS AND SYSTEMS**

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 & Timeinvariant, Causal & Noncausal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS

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

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

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS

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

LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS UNIT V

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

2023-2024

SEMESTER III

3H-3C

9

9

Total Periods : 45

TEXTBOOKS:

- 1. S Salivahanan, "Instrument Transducer– An Intro to their performance and Design", McGraw Hill Education 2018
- 2. B.P. Lathi, "Principles of Linear Systems and Signals", Second Edition Oxford, 2009

REFERENCES:

- 1. Allan V. Oppenheim, S.Wilsky and S. H. Nawab, "Signals and Systems", Pearson, 2007
- 2. R. E. Zeimer, W. H. Tranter and R. D. Fannin, "Signals & Systems Continuous and Discrete", Pearson, 2007
- 3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007
- M. J. Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGraw Hill, 2003

WEBSITE

- 1. https://nptel.ac.in/courses/117104074
- 2. https://nptel.ac.in/courses/117101055

Cos/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	-	-	-	1	1	-	1	1	-
CO2	K4	3	3	2	1	-	-	-	-	1	1	-	1	1	-
CO3	K3	2	1	-	-	-	-	-	-	1	1	-	1	1	-
CO4	K4	2	1	-	-	-	-	-	-	1	1	-	1	1	-
CO5	K3	3	2	1	-	-	-	-	-	1	1	-	1	1	-
Averag	e	2.4	1.6	1.5	1	-	-	-	-	1	1	-	1	1	-

CO PO Mapping

B.E Biomedical Engineering

23BEBME305 PATHOLOGY AND IMMUNOLOGY

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES:

The goal of this course is for students:

- To learn about cell degeneration and repair
- To understand the logic of fluid and hemodynamic derangements
- To know about different viruses and their properties
- To elaborate the different microscopes and staining methods
- To discuss about the chemicals involved in immunopathology

COURSE OUTCOMES:

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

- Explain the concepts of cell degeneration and repair
- Outline the working mechanism of hemodynamics derangements
- Classify the spread of endogenous and exogenous infections
- Show the electron microscope staining methods
- Identify the autoimmune and immunopathology disorders

UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA

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

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

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

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

9

SEMESTER III 3H-3C

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

2023-2024

9 ac

9

UNIT V IMMUNOPATHOLOGY

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, Sterilization: heat, filtration, chemicals and radiation, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.

Total Periods : 45

TEXTBOOKS:

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:

- 1. Underwood, "JCE: General and Systematic Pathology", Churchill Livingstone, 3rd edition, 2000.
- 2. Dube RC and Maheswari DK, "A Text Book of Microbiology", Chand & Com, 2007

WEBSITES:

- 1. https://nptel.ac.in/courses/102103015
- 2. https://ocw.mit.edu/courses/hst-035-principle-and-practice-of-human-pathology-spring-2003/
- 3. https://ocw.mit.edu/courses/20-106j-systems-microbiology-fall-2006/pages/lecture-notes/

Cos/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	1
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	1
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	1
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	1
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	1	1
Averag	e	2.2	1.2	1	-	-	1	-	1	1	1	-	1	1	1

CO PO Mapping

23BEBME341 DATA STRUCTURES AND ALGORITHMS

Instruction Hours/week: L:3 T:0 P:2

i) **THEORY:**

COURSE OBJECTIVES:

The goal of this course is for the students is to:

- Understand the concepts of ADTs.
- Learn linear data structures lists, stacks, and queues.
- Interpret non-linear data structures trees and graphs.
- Implement sorting, searching and hashing algorithms.
- Apply Tree and Graph structures to real world scenario.

COURSE OUTCOMES:

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

- Build abstract data types for linked list data structure.
- Apply the concepts of stack, queue and its applications.
- Experiment with operations on binary trees.
- Identify the traversal techniques of graphs and its applications.
- Inspect sorting, searching and hashing techniques.

UNIT I LISTS

Abstract Data Types (ADTs) – Elementary Data types–List ADT – Array-based implementation – Linked list implementation - Singly linked lists - Doubly-linked lists - Circularly linked lists - Applications of lists -Polynomial ADT -- Multilists-- Sparse Matrices.

UNIT II STACKS AND QUEUES

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – Deque – Applications of Queues.

9

9

SEMESTER-III

5H-4C

Marks: Internal:40 External:60 Total:100 **End Semester Exam:3 Hours**

UNIT III TREES

Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees – Red-Black Trees – Priority Queue (Heaps) – Binary Heap.

UNIT IV MULTIWAY SEARCH TREES AND GRAPHS

B-Tree – B+ Tree – Tries – Graph Definition – Representation of Graphs – Types of Graphs - Breadth-first traversal – Depth-first traversal — Bi-connectivity – Euler circuits – Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES

Searching – Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Quick Sort – Merge Sort – Heap Sort – Radix Sort – Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

ii) LABORATORY:

TEXT BOOKS

LIST OF EXPERIMENTS:

- 1. Array implementation of Stack, Queue and Circular Queue ADTs
- 2. Implementation of Singly Linked List
- 3. Linked list implementation of Stack and Linear Queue ADTs
- 4. Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion
- 5. Implementation of Binary Search Trees and AVL Trees
- 6. Implementation of Heaps using Priority Queues
- 7. Implementation of Dijkstra's Algorithm
- 8. Implementation of Prim's Algorithm
- 9. Implementation of Linear Search and Binary Search
- 10. Implementation of Insertion Sort and Selection Sort
- 11. Implementation of Merge Sort and Quick Sort
- 12. Implementation of Open Addressing (Linear Probing and Quadratic Probing)

Total Periods: 30

- 1. Mark Allen Weiss," Data Structures and Algorithm Analysis in C", Pearson Education, Second Edition, 2005
- Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein," Introduction to Algorithms", Mcgraw Hill/ MIT Press, Fourth Edition, 2022.

9

9

Total Periods: 45

REFERENCE BOOKS

- 1. Narasimha Karumanchi," Data Structures and Algorithms Made Easy", CareerMonk Publications, First Edition,2016
- 2. Langsam, Augenstein and Tanenbaum, "Data Structures Using C", Pearson Education, Second Edition, 2015
- 3. Kamthane," Introduction to Data Structures in C", Pearson Education, First Edition, 2007
- 4. Kruse," Data Structures and Program Design in C", Pearson Education, Second Edition, 2003

WEBSITES

- 1. www.nptel.ac.in/courses/106106145
- 2. www.nptel.ac.in/courses/106102064
- 3. www.coursera.org/learn/data-structures
- 4. www.edx.org/learn/data-structures
- 5. www.cs.usfca.edu/~galles/visualization/Algorithms.html

Cos/ POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	K3	3	2	1	-	-	-	-	-	2	2	-	2	1	
CO 2	K3	3	2	1	-	-	-	-	-	2	2	-	2	1	
CO 3	K3	3	2	1	-	-	-	-	-	2	2	-	2	1	
CO 4	K3	3	2	1	-	-	-	-	-	2	2	-	2	1	
CO 5	K4	3	3	2	1	-	-	-	I	2	2	-	2	1	
Average		3	2.2	1.2	1	-	-	-	-	2	2	-	2	1	

2023-2024 SEMESTER III

23BEBME311 BIOSENSORS AND MEASUREMENTS 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 distinguish contact and non-contact method of skin temperature measurement
- To outline the working principle of Transducers
- To experiment with basic functions of Biosensors.
- To identify different physiological signals.

COURSE OUTCOMES:

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

- Model the characteristics of biosensors (k3)
- Choose the biosensors and transducers for medical applications(k3)
- Analyse the characteristics of physiological signals (k4)
- Examine the skin temperature and photo transducer(k4)
- Compare the characteristics of physiological signals(k4)

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

COs/POS	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	1	2	-	2	2	2	-	1	1	2
CO2	K3	3	2	1	-	1	2	-	2	2	2	-	1	1	2
CO3	K4	3	3	2	1	1	2	-	2	2	2	-	1	1	2
CO4	K4	3	3	2	1	1	2	-	2	2	2	-	1	1	2
CO5	K4	3	3	2	1	1	2	-	2	2	2	-	1	1	2
Avera	ge	3	2.6	1.6	1	1	2	-	2	2	2	-	1	1	2

SEMESTER III

23BEBME312 PATHOLOGY AND IMMUNOLOGY 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 Cryo processing,
- To demonstrate the histopathological examinations
- To compare anemia and leukemia
- To classify bone marrow charts

COURSE OUTCOMES:

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

- Identify the chemicals in excretory sample
- Analyse the components of electron microscope
- Categorize staining methods using electron microscope
- Classify anemia and leukemia using haematology slides
- Test for 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. Gramstain.
- 11. AFB stain.
- 12. Antigen-Antibodyreaction 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.

COs /POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	1	2	-	2	2	2	-	1	2	-
CO2	K4	3	3	2	1	1	2	-	2	2	2	-	1	2	-
CO3	K4	3	3	2	1	1	2	-	2	2	2	-	1	2	-
CO4	K4	3	3	2	1	1	2	-	2	2	2	-	1	2	-
CO5	K4	3	3	2	1	1	2	-	2	2	2	-	1	2	-
Average		3	2.8	1.8	1	1	2	-	2	2	2	-	1	2	-

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 57

Instruction Hours/week: L:0 T:0 P:0

23BEBME311

INTERNSHIP/FIELD PROJECT

Marks: Internal:100 External:0 Total:100 End Semester Exam:3 Hours

2022-2023

Semester-III

1C

B.E Biomedical Engineering

23BEBME401 BIOMATERIALS AND ARTIFICIAL ORGANS 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 iomaterials.
- To discuss the overview of artificial organs & transplants
- To extend the principles of implant design with a case study

COURSE OUTCOMES:

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

- Explain the properties of Biomaterials
- Compare the metallic and ceramic materials used in implants
- Interpret the functions of polymeric implants used in biomedical applications
- Illustrate the operations of Artificial Organs
- Summarize material selection for implant design

UNIT I- INTRODUCTION TO BIO-MATERIALS

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

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

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.

9

9

9

2023-2024

SEMESTER-IV

>

UNIT IV- ARTIFICIAL ORGANS

Use of patient"s lung for gas exchange, the ideal heart lung device. Comparisons of natural and artificial lungs, Basic types of oxygenators, temperature maintenance, and gas flow rate requirements for artificial lungs. Basic methods of artificial waste removal, Hemodialysis, modeling of the patient, artificial kidney system, Drug delivery carriers.

UNIT V- IMPLANT DESIGN & MATERIALS

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

Total periods : 45

TEXT BOOKS:

1.Sujata V. Bhatt Biomaterials Narosa Publishing House , 2005

2. Sreeram Ramakrishna, Murugan Ramalingam, T. S. Sampath Kumar, and Winston O.

Soboyejo Biomaterials: A Nano Approach CRC Press, 2010

3.Kopff W.J Artificial Organs John Wiley and sons, New York, 1st edition, 1976

REFERENCES:

 Myer Kutz Standard Handbook of Biomedical Engineering& Design McGraw Hill 2003
BD Ratner, AS Hoffmann, FJ Schoen, JE Lemmon An Introduction to Materials in Medicine Academic Press 2012
J D Bronzino Biomedical Engineering handbook Volume II CRC Press / IEEE Press 2000 4. R S Khandpur Handbook of Biomedical Instrumentation Tata McGraw Hill 2003

WEBSITE:

- 1. <u>https://www.nature.com/subjects/biomaterials</u>
- 2. https://www.sciencedirect.com/journal/biomaterials
- 3. https://nptel.ac.in/courses/113108071
- 4. https://ocw.mit.edu/courses/2-782j-design-of-medical-devices-and-implants-spring

COs/ POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	2	1	2
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	2	1	2
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	2	1	2
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	2	1	2
CO5	K2	2	1	-	-	-	1	-	1	1	1	-	2	1	2
Ave	rage	2	1				1		1	1	1		2	1	2

CO -PO Mapping :

9

23BEBME402

ESSING SEMESTER-IV 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 find the characteristics of different bio signals.
- To find the linear and non-linear filtering techniques to extract desired information
- To analyze the characteristics of some of the most commonly used biomedical signals, including ECG, EEG, EOG, and EMG.
- To match the choice of filters to remove noise and artefacts from biomedical signals.
- To apply engineering methods to analyze ECG signal problems.

COURSE OUTCOMES

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

- Analyze the charactertics biomedical signals.
- Apply filtering techniques to remove artifacts
- Model cardio vascular monitoring system ECG and PCG signals
- Develop the neurological diagnostics systems
- Compare the signal classification and recognition methods

UNIT I- INTRODUCTION TO BIOMEDICAL SIGNALS

Sampling and aliasing, Signal reconstruction, Signal conversion systems, convolution - Correlation - FFT - decimation in time algorithm, Decimation in Frequency algorithm. Artificial intelligence in signal processing. 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

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

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. Wavelet transforms - mother wavelet, 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.

12

12

12

BIOMEDICAL SIGNAL PROCESSING ek: L:3 T:1 P:0 Marks:

UNIT IV- NEUROLOGICAL APPLICATIONS

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

12

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 : 60

TEXT BOOKS:

- 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:

- 1. Sanjit K.Mitra, Digital Signal Processing', A Computer Based Approach Tata McGraw-Hill, New Delhi, 2001
- 2. D.C.Reddy, Biomedical Signal Processing, Principles and Technique, TMH, New Delhi, 2005

WEBSITES:

- 1. tel.ac.in/courses/108105101
- 2. w.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/

COs/ POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K4	3	3	2	1	1	-	-	1	1	1	-	1	2	-
CO2	K3	3	2	1	-	1	-	-	1	1	1	-	1	2	-
CO3	K3	3	2	1	-	1	-	-	1	1	1	-	1	2	-
CO4	K3	3	2	1	-	1	-	-	1	1	1	-	1	2	-
CO5	K4	3	3	2	1	1	-	-	1	1	1	-	1	2	-
Aver	age	3	2.4	1.4	1	1			1	1	1		1	2	

CO-PO Mapping

B.E Biomedical Engineering

23BEBME403 **BIOMEDICAL INSTRUMENTATION**

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES:

The goal of this course is for students:

- To illustrate the origin of bio potentials and its propagations
- To apply the basic idea of Bio potential Electrodes and Bio potential measurement.
- To analyze the different types of electrodes and its placement for various recordings
- To build bio amplifier for various physiological recordings .
- To explain the various bio chemical measurements.

COURSE OUTCOMES:

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

- Explain the working of bio potential electrode
- Illustrate the operations of bio potential measuring systems •
- Infer the functions of signal conditioning circuits in noise filtering
- Interpret Non- electrical parameter measurements
- Organize the mechanism of biosensors and bio chemical measurement

UNIT I- BIOPOTENTIAL ELECTRODES

Cell and its structure - resting potentials - action potentials - bioelectric potentials - measurement of potentials and their recording - Electrode theory - bipolar and Unipolar electrode-surface electrode - electrode impedance - equivalent circuit for extra cellular electrodes- micro electrodes. basic principles of ECG, EEG, EMG.

UNIT II- BIOPOTENTIAL MEASUREMENTS

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

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

UNIT IV- MEASUREMENT OF NON-ELECTRICAL PARAMETERS

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. Measurement of heart sounds - phonocardiography. Cardiac pacemakers - internal and external pacemakers, defibrillators. Plethysmography -photo electric and impedance plethysmographs

2023-2024

SEMESTER-IV

3H-3C

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

9

9

UNIT V- BIOCHEMICAL MEASUREMENT AND BIOSENSORS

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:

- 1. Khandpur R.S, Handbook of Biomedical Instrumentation Tata McGraw-Hill, New Delhi 2014
- 2. John G. Webster Medical Instrumentation Application and Design John Wileyand sons 2020

REFERENCES:

- 1. Leslie Cromwell, Biomedical Instrumentation and Prentice hall of India, New Delhi 2007
- 2. Myer Kutz, Standard Handbook of Biomedical Engineering & Design, McGraw-Hill, 2003

WEBSITES:

1. https://ocw.mit.edu/courses/20-309-biological-engineering-ii-instrumentation-and-measurement-fall-2006/pages/syllabus/

COs/ POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	-	-	1	1	1	-	1	3	2
CO2	K2	2	1	-	-	-	-	-	1	1	1	-	1	3	2
CO3	K2	2	1	-	-	-	-	-	1	1	1	-	1	3	2
CO4	K2	2	1	-	-	-	-	-	1	1	1	-	1	3	2
CO5	K3	3	2	1	-	-	-	-	1	1	1	-	1	3	2
Avera	age	2.2	1.2	1					1	1	1		1	3	2

CO-PO Mapping

23BEBME404 ANALOG AND DIGITAL ELECTRONICS

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

COURSE OBJECTIVE

- To Design biomedical signal conditioning circuits
- To Work in various health related companies
- To Become familiar with various clinical devices •
- To Promote research in the field of biomedical engineering
- To Work with and service various clinical devices •
- To Excel in hardware and software applications in medical field

COURSE OUTCOME:

- Explain the characteristics and applications of Op-Amp
- Infer the operations of A/D and D/A converters
- Illustrate the working of Filters in analog and digital systems
- Interpret the function of A/D and D/A converters for digital applications
- Compare amplifier circuits in digital systems

UNIT I INTRODUCTION TO OPAMP

Introduction, Signal conditioning, 741 General purpose OPAMP: ideal characteristics, offset voltages and currents. Open & Closed Loop Configuration. Inverting, Non-Inverting, Summing, Voltage Follower, Integrator, differentiators, Log & Anti-Log Amplifiers, Differential Amplifiers, CMRR.

UNIT II DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS AND PLL 9

Analog switches, High speed sample and hold circuit and IC's, Types of D/A converter -Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, Voltage to Frequency converters. PLL-Closed loop analysis of PLL, Frequency multiplication/ division, FSK demodulator

UNIT III FILTERS

Introduction- Analog Filters, Active Filters and Passive Filters, First order and Second order Low Pass Filters, High Pass Filters, Band Pass Filters- Narrow Band Pass, Wide band Pass Filters, Band Reject Filters- Notch Filter, All Pass filters and higher Order filters- Design and applications.

UNIT IV A/D AND D/A CONVERTERS

Sample and Hold circuit - D/A converters: Resistive divider and R-2R ladder networks, A/D converters: Counting type, Successive approximation, parallel comparator, Voltage to Current Converter, 555 Timer and its applications- Astable multivibrators and Monostable Multivibrator.

UNIT V AMPLIFIERS

Instrumentation amplifiers, Bridge Amplifiers, Bioelectric Amplifiers: - Properties desired, Isolation Amplifiers:- Battery Powered, Carrier, Optically Coupled, Current Loading, Chopper Stabilized amplifier, Input Guarding.

Total Periods : 45

9

9

9

TEXT BOOKS:

- 1. Ramakant A Gayakwad Operational Amplifiers & Linear Integrated Circuits, Prentice Hall, 2000
- 2. Joseph J. Carr& John M. Brown, Introduction to Biomedical Equipment Technology Pearson Education Pvt. Ltd, 4th edition 2001

REFERENCE BOOKS:

- 1. Roy Choudhary, Linear Integrated Circuits, New Age International (P) Ltd, 2004
- 2. John P.Bentley Principles of Measurement System, Longman Science & Technology, 1995
- 3. Jacob Mill man, Micro Electronics, McGraw-Hill 1987
- 4. Robert Coughlin and Fredrer, Operational Amplifiers & Linear Integrated Circuits, Prentice Hall 2001

WEBSITES:

1. www.mit.edu

2. www.nptel.ac.in

CO-PO Mapping :

COs/ POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	-	-	-	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	-	-	-	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	-	-	-	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	-	-	-	1	1	-	1	2	-
CO5	K3	3	3	2	1	-	-	-	-	1	1	-	1	2	-
Aver	age	2.2	1.4	2	1	_	-	-	-	1	1		1	2	-

23BEBME441

JAVA PROGRAMMING

SEMESTER-IV 5H-4C

2023-2024

Instruction Hours/week: L:3 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 the students :

- To learn the fundamental concepts of Java programming.
- To gain knowledge of inheritance in Java.
- To understand the concepts of abstraction, exception and packages in Java.
- To infer Java Collection API and Multithreading plugins.
- To implement JDBC and Lambda expression in Java.

COURSE OUTCOMES:

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

- Solve problems using basic object-oriented programming concepts.
- Develop Java programs using inheritance.
- Build Java programs using interface and package to solve a complex problem.
- Discover the collection API for given problem statement and Multithreading.
- Construct an application using JDBC Connections for Java Programming.

UNIT I- INTRODUCTION TO JAVA

History of Java - Features of Java - Java Architecture - Comments - Data Types - Variables – Operators Type Conversion and Casting - Flow Control Statements - Reading Input from keyboard, Command Line Arguments, Using Scanner Class, Arrays - Classes and Objects - UML Class diagram - Methods - Constructors - static variables and Methods - this Keyword - Encapsulation -Concept of Access Control.

UNIT II-- INHERITANCE

Inheritance, Types of Inheritance - Super and Sub Classes - super keyword - final class and methods - Object class -Understanding Polymorphism, Types of polymorphism, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching - garbage collection - String class – String Buffer class – String Builder class

UNIT III- DATA ABSTRACTION

Packages, Introduction to Packages, User-Defined Packages, Accessing Packages - Abstract classes and Methods -Interfaces - Defining an interface - implementing interfaces - extending interfaces - Multiple Inheritance Using Interfaces - Exception Handling -Errors vs Exceptions - Exception hierarchy - usage of try, catch, throw, throws and finally - built in exceptions - user defined exceptions.

9

9

9

5H-4C

UNIT IV- COLLECTION API AND MULTITHREADING

Introduction to wrapper classes, Predefined wrapper classes, Conversion of types, Concept of Auto boxing and unboxing - Java Collections API - Introduction to Collection - Generics - List implementations - Set implementations - Map implementations - Multithreading: Introduction to Multithreading - Process Vs Thread, Thread life cycle -Thread class, Runnable Interface - Thread creation, Thread control and priorities - Thread synchronization

UNIT V- JDBC AND LAMBDA

JDBC - Introduction to JDBC - Establishing connection - Executing query -Processing results - Prepared Statement -Callable Statement - Transactions - Meta-Data objects. Functional Interfaces -Predicates - Functions - Suppliers -Consumers - Lambda Expressions - Accessing local variables- Accessing class variables - Function argument in lambda expression - Sorting - Predicates and Lambda Expressions

TOTAL PERIODS : 45

TEXT BOOKS:

1. Herbert Schildt, "Java2: The Complete Reference", Tata McGraw-Hill, Twelth Edition, 2022.

- 2. Cay S Horstmann and Gary Cornell, "Core Java: Volume I Fundamentals", Prentice Hall, Eleventh Edition, 2020.
- 3. Raoul Gabriel Urma, Mario Fusco and Alan Mycroft," Java 8 in Action: Lambdas, Streams and Functional style Programming", Manning Publications, First Edition, 2015.

REFERENCES BOOKS:

- 1. David Flanagan and Benjamin Evans," Java in Nutshell", O'Reilly Media, Seventh Edition, 2018.
- 2. Deitel and Deitel," Java How to Program, Early Objects", Prentice Hall, Eleventh Edition, 2018.

WEB SITES:

- 1. http://docs.oracle.com/javase/tutorial/java/nutsandbolts
- 2. http://www.javabeginner.com/learn-java
- 3. http://www.javapoint.com/creating-thread
- 4. http://www.ntu.edu.sg/home/ehchua/programming/java/JDBC_Basic.html
- 5. http://www.javapoint.com/java-8-method-reference

ii) LABORATORY

LIST OF EXPERIMENTS:

- 1. Programs using flow control statements and arrays.
- 2. Programs using classes and objects.
- 3. Programs using inheritance and polymorphism.
- 4. Programs using String, StringBuffer and StringBuilder class.
- 5. Programs using package, abstract class and interface.

9

- 6. Programs using exception handling mechanism.
- 7. Programs using user defined exception.
- 8. Programs using Collection API.
- 9. Programs using Multithreading.
- 10. Programs using Thread synchronization.
- 11. Programs using JDBC.
- 12. Programs using Lambda Expression.

TOTAL PERIODS : 30

COs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	K3	3	2	1	-	-	-	-	-	2	2	-	2	1	-
CO2	K3	3	2	1	-	-	-	-	-	2	2	-	2	1	-
CO3	K3	3	2	1	-	-	-	-	-	2	2	-	2	1	-
CO4	K4	3	3	2	1	-	-	-	-	2	2	-	2	1	-
CO5	K4	3	3	2	1	-	-	-	-	2	2	-	2	1	-
Average	e	3	2.4	1.4	1	-	-	-	-	2	2	-	2	1	-

			SEMESTER-IV
23BEBME4E	PROFESSIONAL ELECTIVE I		3H-3C
		 1 40 5	1 60 50 1 600

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

SEMESTER-IV

23BEBME411 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 infer about Discrete time signals.
- To demonstrate the filtering operation.
- To interpret the architecture of DSP.
- To analyse FIR and IIR filters and DSP Processor.

COURSE OUTCOMES:

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

- Construct elementary discrete time signals
- Build convolution and correlation of signals
- Analyze Fourier response of DT signal
- Examine IIR and FIR filters
- Inspect the MAC and sampling operation in DSP Processor.

LABORATORY EXPERIMENTS:

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

CO PO	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	1	-	-	-	2	2	-	1	2	-
CO2	K3	3	2	1	-	1	1	-	1	2	2	-	1	2	-
CO3	K3	3	3	2	1	1	1	-	1	2	2	-	1	2	-
CO4	K3	3	3	2	1	1	1	-	1	2	2	-	1	2	-
CO5	K4	3	3	2	1	1	1	-	1	2	2	-	1	2	-
Averag	e	3	2.6	1.6	1	1	1	-	1	2	2	-	1	2	-

2H-1C

Semester-IV

23BEBME412 BIOMEDICAL INSTRUMENTATION LABORATORY

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 construct PCB layout design
- To examine pH measurement

COURSE OUTCOMES:

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

- Examine the amplifier circuits for bio signal recordings
- Model the characteristics of optical Isolation amplifier
- Experiment with pulse rate and pH measuring systems
- Identify the blood pressure and peripheral blood flow
- Construct PCB layout for 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.

Cos/ POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K4	3	3	2	1	-	1	-	1	2	2	-	1	3	2
CO2	K3	3	2	1	-	-	1	-	1	2	2	-	1	3	2
CO3	K3	3	2	1	-	-	1	-	1	2	2	-	1	3	2
CO4	K3	3	2	1	-	-	1	-	1	2	2	-	1	3	2
CO5	K3	3	2	1	-	-	1	-	1	2	2	-	1	3	2
Average	9	3	2.2	1.2	1	-	1	-	1	2	2	-	1	3	2

B.E Biomedical En	gineering		2023-2024
			SEMESTER – V
23BEBME501	MEDICAL DIA	GNOSTIC EQUIPMENT	3H-3C
Instruction Hours/we	ek: L:3 T:0 P:0	Marks: Internal:40 Exter	rnal:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To infer cardiac equipment.
- To know about various Electro-physiological & Sensory diagnostic equipment.
- To study about various electrolyte analysis equipment.
- To know about the equipment used in blood bank.
- To study the various optical equipment.

COURSE OUTCOMES:

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

- Explain the concept of ECG •
- Compare the diagnostic methods to record electro physiological signals
- Interpret the equipment used in body fluid analysis.
- Illustrate the methods of blood analysis. •
- Analyze the applications of optical signal in diagnosis.

UNIT I – CARDIAC EQUIPMENT

ECG; continuous monitoring systems for pulse rate, temperature, B.P.Respiration, Arrhythmia monitor; B.P.monitor, Blood flow and cardiac output Measurement, Plethysmography, Oximetry, Treadmill (StressECG).

UNIT II - Electro-physiological & Sensory diagnostic equipment

EMG, EEG, EOG, ERG. Psychophysiological Measurements-polygraph, basal skin resistance (BSR), galvanic Skin resistance (GSR), Sensory responses - Audiometer-Puretone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

UNIT III - Clinical Equipment-I

UV, Visible and IR Spectro photometers, Flame Photometers, Electrolyte analysis using sensitive electrodes, pH meter, principle and applications. Densitometer and Electrophoresis apparatus.

UNIT IV - Clinical Equipment-II

Principles and applications of oil, gas and liquid chromatographs, Mass Spectrometry, Flow Cytometry, Radio immunoassay and ELISA techniques, Blood gas analyzers, Blood cell counters.

UNIT V - Optical Equipment

Various types of Endoscopes, Fiber optic, Fluid optic, Integral Camera. Electron Microscope, Transmission and Reflection.

Total periods: 45

9

9

9

9

TEXT BOOKS:

- 1. Khandpur, R.S "Handbook of Biomedical Instrumentation" Third Edition, Mc Graw-Hill, 2014.
- Geddas, L.A.&Baker, L.E "Principles of Applied Biomedical Instrumentation" Third Edition. John Wiley & Sons, 2016.
- 3. John G. Webster "Medical Instrumentation Application and Design" Wiley India Pvt Ltd,
- 4. 2015.
- 5. Joseph J. Carr and John M. Brown "Introduction to Biomedical Equipment Technology"

Pears on education, 2012.

WEBSITES:

- 1. https://ocw.mit.edu/courses/hst-s14-health-information-systems-to-improve-quality-of- care-in-
- resource-poor-settings-spring-2012/pages/lectures-and-videos/
- 2. https://www.coursera.org/lecture/healthcare-it/module-4-telehealth-IKo2k

COs/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	K2	2	1	-	-	-	1	1	1	1	1	-	1	2	3
CO 2	K2	2	1	-	-	-	1	1	1	1	1	-	1	2	3
CO 3	K2	2	1	-	-	-	1	1	1	1	1	-	1	2	3
CO 4	K2	2	1	-	-	-	1	1	1	1	1	-	1	2	3
CO 5	K4	3	3	2	1	-	1	1	1	1	1	-	1	2	3
Avera	ge	2.2	1.4	2	1	-	1	1	1	1	1	-	1	2	3

SEMESTER – V

23BEBME502	INTERNET	COF MEDICAL THINGS (IoMT)	3H-3 C
Instruction Hours/week: L	:3 T:0 P:0	Marks: Internal:40 Externa	al:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To infer Smart Objects and IoT Architectures.
- To demonstrate about various IOT-related protocols.
- To summarize about design and development of IoT systems.
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To develop IoT for popular healthcare applications.

COURSE OUTCOMES:

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

- Infer the fundamentals of IoT
- Interpret the IoT protocols
- Build simple IoT Systems using Arduino and Raspberry Pi.
- Apply data analytics for IoMT
- Model IoMT for healthcare applications.

UNIT I – FUNDAMENTALS OF IOT

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: one M2M,IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT – Functional blocks of an IoT eco system–Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT II – IOT PROTOCOLS

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE802.15.4,802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN–Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: WPAN, 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

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

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.

9

9

9

UNIT V- INTERNET OF MEDICAL THINGS

Case studies – Novel Symmetrical Uncertainty Measure (NSUM) Technique for Diabetes Patients, Healthcare Monitoring system through Cyber-physical system, An IoT Model for Neuro sensors, Ada Boost with feature selection using IoT for somatic mutations evaluation in Cancer, A Fuzzy-Based expert System to diagnose Alzheimer's Disease, Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Application Development in Mobile and Cloud Environments.

Total periods : 45

REFERENCE BOOKS:

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.

2. Arsh deep Bahga, Vijay Madisetti "Internet of Things – A hands-on approach" Universities Press, 2015.

3. Jan Ho⁻⁻ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesan David Boyle. "From Machine-to-Machine to the Internetof Things –Introduction to a New Age of Intelligence,Elsevier, 2014.

4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internetof Things -

Key applications and Protocols", Wiley, 2012.

5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

WEBSITES:

1. https://ocw.mit.edu/courses/20-309-biological-engineering-ii-instrumentation-and-measurement-fall- 2006/pages/syllabus/

COs/ POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	1	1	-	1	1	1	-	1	1	3
CO2	K2	2	1	-	-	1	1	-	1	1	1	-	1	1	3
CO3	K3	3	2	1	-	1	1	-	1	1	1	-	1	1	3
CO4	K3	3	2	1	-	1	1	-	1	1	1	-	1	1	3
CO5	K3	3	2	1	-	1	1	-	1	1	1	-	1	1	3
Avera	age	2.6	1.6	1	-	1	1	-	1	1	1	-	1	1	3

SEMESTER – V

23BEBME503 BIOMEDICAL IMAGE PROCESSING 3H-3C

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 study the image fundamentals and transforms necessary for image processing.
- To represent image in frequency domain Fourier transform
- To learn various image enhancement techniques used in biomedical image Processing
- To study techniques for improving quality of information in corrupted images
- To introduce schemes for compressing images to save storage space

COURSE OUTCOMES

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

- Summarize image fundamentals
- Compare image transform methods
- Make use of mathematical models to enhance image quality.
- Apply filtering techniques for noise removal
- Utilize image compression techniques for medical applications

UNIT I- DIGITAL IMAGE FUNDAMENTAL

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

UNIT II - IMAGE TRANSFORMS

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

UNIT III- IMAGE ENHANCEMENT

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

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.

9

9

9
TEXT BOOKS:

1. Rafael C., Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education, Asia, 2017.

2. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 2015.

REFERENCES:

- 1. William K. Pratt, "Digital Image Processing", John Wiley, 2010.
- 2. S.Sridhar, "Digital Image processing" Oxford University press, 2016.

WEBSITES:

- 1. https://nptel.ac.in/courses/102105090
- 2. https://nptel.ac.in/courses/108105091
- 3. https://ocw.mit.edu/courses/hst-582j-biomedical-signal-and-image-processing-spring-20

COs/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	K2	2	1	-	-	1	-	-	-	1	1	-	1	3	-
CO 2	K2	2	1	-	-	1	-	-	-	1	1	-	1	3	-
CO 3	K3	3	2	1	-	1	-	-	-	1	1	-	1	3	-
CO 4	K3	3	2	1	-	1	-	-	-	1	1	-	1	3	-
CO 5	K3	3	2	1	-	1	-	-	-	1	1	-	1	3	-
Avera	ge	2.6	1.6	1	-	1	-	-	-	1	1	-	1	3	-

B.E Biomedical Engineering

23BEBME504 BIO CONTROL SYSTEM

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 the systems in time and frequency domain
- To understand the concept of stability
- To acquire knowledge about the Bio Control system, Process regulation.
- To understand the concept behind feedback and continuum in various systems and subsystems.
- To study system concept of biological control

COURSE OUTCOME:

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

- Build mathematical model of bio control systems
- Compare engineering and physiological control system
- Analyze the thermal regulation process of human body
- Model a bio control system for autonomous function
- Develop a bio control system for musculoskeletal system

UNIT I-INTRODUCTION TO BIO CONTROL SYSTEM

Introduction: Technological control system, transfer function, mathematical approaches, system stability, introduction to biological control system, Modeling and block diagram, closed loop dynamics of first order and second order control system, similarities between biological and engineering control system, biological receptors and receptor characteristics.

UNIT II - PROCESS REGULATION

Difference between engineering and physiological control systems, generalized system properties, models with combination of system elements. Physiological system modeling, Linear model of respiratory mechanics, model of chemical regulation of ventilation, linear model of muscle mechanics, model of regulation of cardiac output, model of Neuromuscular reflex motion

UNIT III-MODELING OF HUMAN THERMAL REGULATORY SYSTEM

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

SEMESTER - V

4H-4C

9

9

Q

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 79

UNIT IV -BIOLOGICAL CONTROL I

UNIT V -BIOLOGICAL CONTROL II

Urine formation and control, Pupil control systems, skeletal muscle servomechanism and semicircular canal. Free swinging limbs, Endocrine control system.

Cardiac rate, blood pressure, respiratory rate, mass balancing of lungs, oxygen uptake by RBC and

Total periods : 45

TEXT BOOKS

1. Concise Medical Physiology by Sujit K.Chaudhuri, New Central Book agency, 2006

2. Modern control engineering by Ogata Katsuhika, 2nd edition, Prentice Hall, 2001

pulmonary capillaries, oxygen and carbon dioxide transport in blood and tissues.

REFERENCEBOOKS:

- 1. Learning and Physiological Regulation by Barry R.Dworkin, University Of Chicago Press, 1994
- 2. Modelling and Control in Biomedical Systems 2000 by E.Carson, E. Salzsieder, Pergamon Publishing, 2001

WEBSITES:

- 1. www.mit.edu
- 2. www.nptel.ac.in

CO-PO MAPPING

Cos/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	K3	3	2	1	-	-	1	-	3	1	1	-	2	-	2
CO 2	K2	2	1	-	-	-	1	-	3	1	1	-	2	-	2
CO 3	K4	3	3	2	1	-	1	-	3	1	1	-	2	-	2
CO 4	K3	3	2	1	-	-	1	-	3	1	1	-	2	-	2
CO 5	K3	3	2	1	-	-	1	-	3	1	1	-	2	-	2
Averag	e	2.8	2	1	1	-	1	-	3	1	1	-	2	-	-

9

SEMESTER - V

5H-4C

23BEBME541 BUSINESS DATA PROCESSING

Instruction Hours/week: L:3 T:0 P:2

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for students is:

- To understand the fundamentals of business data processing and its significance in modern organizations.
- To gain knowledge of database management systems, including database design principles, relational database concepts, and SQL fundamentals.
- To develop skills in data analysis and visualization techniques for business decision-making and reporting.
- To learn data analysis and visualization techniques.
- To summarize the applications of robotic process automation.

COURSE OUTCOMES:

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

- Apply business data processing in modern organizations to recognize the different types of data.
- Build a relational database table using SQL query for normalization technique
- Utilize data analysis and data visualization techniques to support business decision-making.
- Identify Robotic Process Automation (RPA) in business data processing.
- Analyze secure data transmission and storage practices to protect user data.

UNIT I INTRODUCTION TO BUSINESS DATA PROCESSING

Introduction - Overview of business data processing - significance in modern organizations - structured unstructured - and semi-structured data - Data processing lifecycle - data collection - data entry - data storage - data processing - data output - information systems - Ethical and legal considerations.

UNIT II DATABASE MANAGEMENT SYSTEMS

Introduction to database management systems - Database design principles - Relational database concepts - tables relationships - keys - normalization - SQL fundamentals - DDL - DML - Data integrity - Data Security - Privacy

UNIT III DATA ANALYSIS AND VISUALIZATION

Introduction - importance in business decision-making - techniques - descriptive - diagnostic - predictive prescriptive analysis - data visualization tools - techniques - Exploratory data analysis - visualization for business reporting and performance tracking

UNIT IV BUSINESS PROCESS AUTOMATION

Introduction to business process automation - Workflow management systems - process modeling -Business process reengineering - process optimization -

Robotic Process Automation (RPA) - its applications in business data processing

UNIT V DATA SECURITY AND PRIVACY IN BUSINESS

Overview of data security and privacy concerns - Data protection regulations - compliance - Secure data transmission and storage practices - Access control - user authentication - Data backup - disaster recovery.

TOTAL PERIODS:45

9

9

9

9

TEXT BOOKS:

1. Ramesh Sharda, DursunDelen, Efraim Turban, "Business Intelligence and Analytics: Systems for Decision Support", 11th Edition, Pearson, 2021

2. Carlos Coronel, Steven Morris, Peter Rob, "Database Systems: Design, Implementation, and Management", 13th Edition, Cengage Learning, 2019

REFERENCE BOOKS

1. Thomas H. Davenport, "Big Data at Work: Dispelling the Myths, Uncovering the Opportunities", Harvard Business Review Press, 2014

- 2. Alberto Cairo, "The Truthful Art: Data, Charts, and Maps for Communication", New Riders, 2016
- 3. Randy Krum, "Cool Infographics: Effective Communication with Data Visualization and Design", Wiley, 2013

WEBSITES:

- 1. https://www.coursera.org/specializations/business-data-management-communication
- 2. https://indiafreenotes.com/business-data-processing/

ii) LABORATORY

LIST OF EXPERIMENTS:

- 1. Exploring Data Types and Significance in Business
- 2. Designing a Relational Database Schema
- 3. SQL Querying and Data Manipulation
- 4. Visualizing Data for Business Insights
- 5. Process Modeling for Business Automation
- 6. Normalizing Tables for Data Integrity
- 7. Analyzing Descriptive Statistics in Business Data
- 8. Predictive Analytics for Forecasting Trends
- 9. Implementing Robotic Process Automation (RPA)
- 10. Securing Data and Ensuring Compile

COs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO2	K3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO3	K3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO4	K3	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO5	K4	3	3	2	1	-	-	-	-	2	2	-	2	-	2
Average	9	3	2.2	1.2	1	-	-	-	-	2	2	-	2	-	2

			SEMESTER – V
23BEBME5E	PROFESSIONAL ELECT	IVE II	3H-3C
		M I Internet	1 40 E-4

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

SEMESTER - V

23BEBME511 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 OBJECTIVE:

The goal of this course is for students :

- To implement fundamental image processing techniques in Biomedical Images.
- To realize enhancement and Transformation of Medical Images.
- To construct and reconstruct images
- To understand the CT images
- To implementation using scilab

COURSE OUTCOMES:

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

- Apply filtering techniques to remove noise in medical images
- Compare edge and boundary detection algorithms
- Assess the performance of image compression techniques
- Utilize transform for image reconstruction and restoration.
- Construct a medical image processing system

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. Python Implementation.

COs POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	2	-	-	1	2	2	-	2	3	2
CO2	K4	3	3	2	1	2	-	-	1	2	2	-	2	3	2
CO3	K5	3	3	3	2	2	-	-	1	2	2	-	2	3	2
CO4	K3	3	2	1	-	2	-	-	1	2	2	-	2	3	2
CO5	K3	3	2	1	-	2	-	-	1	2	2	-	2	3	2
Averag	e	3	2.4	1.6	1.5	2	-	-	1	2	2	-	2	3	2

SEMESTER - V

23BEBME512 INTERNET ON MEDICAL THINGS (IOMT) 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 acquire knowledge on embedded system design
- To understand the hardware architecture and programming aspects of embedded system
- To Understand IoT architecture and IOT-related protocols
- To Build simple IoT Systems using embedded target boards.
- To Understand IoMT infrastructure for healthcare applications.

COURSE OUTCOMES:

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

- Explain the basic arithmetic programs using embedded C
- Build timer based applications
- Develop basic application using Arduino
- Apply simple control systems
- Construct interfacing system for medical application

LABORATORY EXPERIMENTS:

- 1. Explore AVR/ARM based controllers using Embedded C.
- 2. Write Basic and arithmetic Programs Using Embedded C.
- 3. Write Embedded C program to test interrupt and timers.
- 4. Develop Real time applications–clock generation, waveform generation, counter using embedded C.
- 5. Explore different communication methods with IoT devices.
- 6. To interface LED/Buzzer with platform/Arduino/Raspberry Pi. And write an embedded C program
- 7. to turn on/off LED/Buzzer with specified delay.
- 8. To interface DC/stepper motor using relay with open platform /Arduino/Raspberry Pi and write an
- 9. embedded C program to turn on motor if push button is pressed.
- 10. Develop simple application-testing infrared sensor-IoT Applications-using open platform/Raspberry Pi.
- 11. Develop simple application to interface DHT11 sensor with and write a program to display temperature humidity readings in LCD.
- 12. Develop IoMT Application using open platform /Arduino/Raspberry Pi and sensors such as temperature, ECG, Pulse etc

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	1	-	1	2	2	-	2	1	2
CO2	3	2	1	-	2	1	-	1	2	2	-	2	1	2
CO3	3	2	1	-	2	1	-	1	2	2	-	2	1	2
CO4	3	2	1	-	2	1	-	1	2	2	-	2	1	2
CO5	3	2	1	-	2	1	-	1	2	2	-	2	1	2
Average	3	2	1	-	2	1	-	1	2	2	-	2	1	2

B.E Biomedical Engine	eering		2022-2023
23BEBME591	INTERNSH	HP/ FIELD PROJECT	Semester-V 2H-1C
Instruction Hours/week	:: L:0 T:0 P:0	Marks: Internal:100 E End	External:0 Total:100 Semester Exam:3 Hours

23BEBME601	BIOMECHANICS	Semester-VI 4H-4C
Instruction Hours/week: L:3 T:1 P:0	Marks	: Internal: 40 External: 60 Total: 100
	End Se	emester Exam:3 Hours
COURSE OBJECTIVES:		

The goal of this course is for students:

- To acquire knowledge on fundamental concepts of biomechanics
- To understand about musculoskeletal mechanics
- To understand the mechanics of cardiovascular and respiratory systems
- To learn about the mechanics of joints.
- To analyze mechanics of physiological systems and related applications

COURSE OUTCOMES:

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

- Summarize the principles and operations of biomechanics
- Identify the mechanical and electrical properties of musculoskeletal system
- Model the cardiovascular and respiratory system
- Categorize the biomechanics of multiple joints
- Distinguish the reason for cardiac and respiratory abnormal patterns

UNIT I- INTRODUCTION TO MECHANICS

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

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

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

12

12

UNIT IV- BIOMECHANICS OF JOINTS

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

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics –Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Process of seeing – visual capabilities-factors affecting visual acuity and contrast sensitivity – human factor aspects of hard copy text and computer screen text Whole body vibrations, Hand transmitted vibrations.

TEXT BOOKS:

- 1. Y.C. Fung, "Bio-Mechanics- Mechanical Properties of Tissues" Springer-Verlag, 1998.
- 2. Duane Knudson, "Fundamentals of Biomechanics, Second Edition, Springer, 2007.

REFERENCES:

1. Sheraz S. Malik and Shahbaz S. Malik, "Orthopaedic Biomechanics Made Easy" Cambridge University Press, 2015.

2. Jay D. Humphrey, Sherry De Lange," An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, Springer Science Business Media, 2004.

- 3. Shrawan Kumar,"Biomechanics in Ergonomics, Second Edition", CRC Press, 2007.
- 4. Neil J. Mansfeild, "Human Response to Vibration", CRC Press, 2005.

WEBSITES:

- 1. https://nptel.ac.in/courses/112105305
- 2. <u>https://nptel.ac.in/courses/112106248</u>

3. <u>https://ocw.mit.edu/courses/hst-021-musculoskeletal-pathophysiology-january-iap-2006/pages/lecture-notes/</u>

CO-PO MAPPING

Cos/	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
POs															
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	3	1
CO2	K3	3	2	1	-	-	1	-	1	1	1	-	1	3	1
CO3	K3	3	2	1	-	-	1	-	1	1	1	-	1	3	1
CO4	K4	3	3	2	1	-	1	-	1	1	1	-	1	3	1
CO5	K4	3	3	2	1	-	1	-	1	1	1	-	1	3	1
Avera	age	2.8	2.2	1.5	1	-	1	-	1	1	1	-	1	3	1

12

12

Total periods : 60

2022-2023

23BEBME602	MEDICAL T	HERAPEUTIC EQUIPMENT	Semester-VI					
		2	3H-3 C					
Instruction Hours/week	: L:3 T:0 P:0	Marks: Internal: 40 External	l: 60 Total: 100					
	End Sem							
COURSE OBJECTIVES:								
The goal of this course is	for students:							
To understandTo perceive the	the medical device of e basic principle and ac	cardiac equipment and its uses. Ivanced techniques of ventilators.						

- To examine the electrical stimulator techniques for nerve and muscles.
- To learn the various heat therapy equipment.
- To study the basic principles of biomedical LASERS.

COURSES OUTCOMES:

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

- Explain the working mechanism cardiac equipment
- Illustrate the principles of respiratory devices
- choose the stimulation methods for pain relief system
- Make use of electro therapeutic equipment for special case
- Compare the principles of laser and radiation therapeutic equipment

UNIT I - CARDIAC EQUIPMENT

External and Implantable pacemakers, Programmable pacemakers, Power sources, Design of encapsulation and leads, Pacing system analyzers. Cardiac Defibrillators, Basic principles and comparison of different Defibrillators, Energy requirements, Synchronous operation, Implantable Defibrillators, Defibrillator analyzers.

UNIT II - RESPIRATORY EQUIPMENT

Principles of constant pressure and constant volume ventilators, Basic principles of electromechanical, Pneumatic and electronic ventilators, Nebulizer, Ventilator testing.

UNIT III - ELECTRO THERAPY EQUIPMENT-I

Electro diagnosis, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Stimulator for pain relief, Interferential current therapy, Spinal cord stimulator, Functional Electrical Stimulation.

UNIT IV - ELECTROTHERAPY EQUIPMENT-II

High frequency heat therapy, Principle, Shortwave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy, Therapeutic IR radiation, Therapeutic UV lamps.

9

9

9

9

.....

UNIT V - THERAPEUTIC LASE RS

Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO₂ laser, He- Ne laser, Nd-YAG and Ruby laser.

Total periods : 45

TEXT BOOKS:

1. Khandpur R.S, "Hand book of Biomedical Instrumentation", Third Edition, McGraw Hill Education (India) Private Limited, 2014.

2. John G. Webster, Amit J. Nimunkar, "Medical Instrumentation, Application and Design", Fifth Edition. Wile y &sons, Inc., New York, 2020.

3. Joseph J. Carr, John M. Brown, "Introduction to Biomedical Equipment Technology",

Sixth edition. Pearson Education Inc., New Delhi, 2011.

REFERENCE BOOKS:

1. Leslie Cromwell, Fred J.Weibell & Erich, A.Pfeiffer, "Biomedical Instrumentation and Measurements", Second Edition. Pearson India, 2015.

2. Val Robertson, Alex Ward, John Low & Ann Reed, "Electrotherapy Explained, Principles and Practice", Fourth Edition. Butterworth Heinemann Ltd, Elsevier, 2008.

COs/	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
POs															
CO1	K2	2	1	-	-	-	1	1	1	1	1	-	1	2	1
CO2	K3	2	1	-	-	-	1	1	1	1	1	-	1	2	1
CO3	K3	3	2	1	-	-	1	1	1	1	1	-	1	2	1
CO4	K3	3	2	1	-	-	1	1	1	1	1	-	1	2	1
CO5	K2	2	1	-	-	-	1	1	1	1	1	-	1	2	1
Avera	ge	2.4	1.4	1	-	-	1	1	1	1	1	-	1	2	1

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 90

23BEBME603

ASSISTIVE TECHNOLOGY & REHABILITATION

Semester-VI **3H-3C**

2022-2023

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 tests to assess the hearing loss, development of electronic devices to compensate for the loss and various assist devices for visually and auditory impaired.
- To study the alternative and augmentative communication •
- To understand the rehabilitation concepts and Rehabilitation team members for future development and • applications.
- To study the various orthotic devices and prosthetic devices to overcome orthopedic problems. •
- To understand different types of Therapeutic Exercise Technique.

COURSE OUTCOMES:

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

- Compare the working of assistive devices
- Interpret the functions of alternative and augmented communications •
- Explain the concepts of rehabilitation engineering •
- Model orthopedic prosthetics •
- Select the therapeutic exercise for gait analysis

UNIT I - ENGINEERING CONCEPTS IN ASSISTIVE TECHNOLOGY

Sensory augmentation and substitution. Assistive Technology for visually Impaired – General Purpose, Task Specific (Mobility, Reading, Writing, Computer Access, Communication). Assistive Technology for Hearing Impaired - Hearing Assistance Solutions - Medical and Surgical Approach to restore function - Hearing aids, Cochlear Implantation, Assistive Listening Solutions and Visual and Tactual Substitution.

UNIT II - ALTERNATIVE AND AUGMENTATIVE COMMUNICATION (AAC)

User interface, Language Representation, Technology and Devices Feature. Human Factors, Performance Measurement, Wheelchairs- Manual, Electric Power, Power Assisted, Multi-Functional, Standards, Wheelchairs Transportation System, Securement Systems.

UNIT III - INTRODUCTION TO REHABILITATION ENGINEERING

Principles involved in rehabilitation engineering. Steps in patient management, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability and Functional Diagnosis, Medical Rehabilitation.

UNIT IV - ORTHOPEDIC PROSTHETICS AND ORTHOTICS IN REHABILITATION

Engineering Principles, Prosthesis Amputation Types Prescribed Prostheses, Components of Upper Limb Prosthesis - Sockets and Liners, Suspension, Control Systems (Myoelectric), Shoulder, Elbow and Wrist components, Terminal Devices. Components of lower limb prosthesis - Sockets and Liners, Suspension, Hip, Pelvic, Knee and Ankle Components. Orthotics- Biomechanical Principles, Spinal, Upper Extremity and Lower Extremity. FES systems-Restoration of hand function, restoration of standing and walking.

9

9

9

UNIT V - THERAPEUTIC EXERCISE TECHNIQUE

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

Total periods : 45

TEXT BOOKS:

1. Dr. Rory A. Cooper, Hisaichi Ohnabe, Douglas A. Hosbon,"An Introduction to Rehabilitation Engineering", CRC Press Book, Taylor and Francis Group, 2007.

2. Horia- Nocholai Teodorecu, L. C. Jain, "Intelligent systems and technologies in rehabilitation engineering", CRC, December 2000.

3. Sunder Textbook of Rehabilitation, Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint, 2007

4. Joseph D.Bronzino, "The Biomedical Engineering Handbook", Third edition-3 volume set, Taylor and Francis, 2006

REFERENCES:

1. Charles J. Robinson, "Rehabilitation Engineering", CRC Press, 1995.

- 2. Joseph D. Bronzino, "The Biomedical Engineering Handbook", Volume-II, CRC Press 2006
- 3. G. Salvendy, "Handbook of Human Factors and Ergonomics", Wiley, 2006.

4. Horia- Nocholai Teodorecu, L.C.Jain ,Intelligent systems and technologies in rehabilitation Engineering; CRC; December 2000.

5. Keswick. J, "What is Rehabilitation Engineering, Annual Reviews of Rehabilitation" SpringerVerlag, New York, 1982.

6. Warren E. Finn, Peter G. LoPresti, "Handbook of Neuroprosthetic Methods CRC", edition 2002.

7. Rory A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), "An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering", CRC Press, 2006.

0010		i m to													
Cos/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	2	1	-	-	-	1	-	2	1	1	-	1	3	1
CO2	K2	2	1	-	-	-	1	-	2	1	1	-	1	3	1
CO3	K2	2	1	-	-	-	1	-	2	1	1	-	1	3	1
CO4	K3	3	2	1	-	-	1	-	2	1	1	-	1	3	1
CO5	K3	3	2	1	-	-	1	-	2	1	1	-	1	3	1
Average	9	2.4	1.4	1	-	-	1	-	2	1	1	-	1	3	1

CO-PO MAPPING

23BEBME6E	PROFESSIONAL ELECTIVE III	SEMESTER-VI 3H-3C
Instruction Hours/we	eek: L:3 T:0 P:0	Marks: Internal:40 External:60 Total:100
		End Semester Exam:3 Hours

B.E Biomedical Engineering

23BEBME6E	PROFESSIONAL ELECTIV	EIV	3H-3C
Instruction Hours/week:	L:3 T:0 P:0	Marks: Internal:40 External	nal :60 Total :100
		End Semester Example	m:3 Hours

B.E Biomedical Engine	ering		2023-2024
			SEMESTER-VI
23OE	OPEN ELECTIVE – I		3H-3 C
Instruction Hours/week	: L:3 T:0 P:0	Marks: Inte	ernal:40 External:60 Total:100
			End Semester Exam:3 Hours

SEMESTER-VI

2023-2024

2023-2024

SEMESTER-VI

23BEBME611 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT 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 understand the concept the ultrasonic diathermy
- To study the control function in diagnostic and therapeutic equipment
- To provide practice on recording and analysis of different Bio potentials
- To understand patient safety procedures
- To provide practice on circuit debugging

COURSE OUTCOMES:

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

- Identify QRS waveform
- Summarize the working principles of ultrasonic diathermy telemetry medical stimulator
- Inspect the electrical safety parameters
- utilize the spirometer to obtain respiratory parameter
- Develop Audiogram and ECG amplifier system

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

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	1	1	-	1	2	2	-	2	3	2
CO2	K2	2	1	-	-	1	1	-	1	2	2	-	2	3	2
CO3	K4	3	3	2	1	1	1	-	1	2	2	-	2	3	2
CO4	K4	3	3	2	1	1	1	-	1	2	2	-	2	3	2
CO5	K3	3	2	1	-	1	1	-	1	2	2	-	2	3	2
Average		2.8	2.2	1.2	1	1	1	-	1	2	2	-	2	3	2

SEMESTER-VI

23BEBME612 MEDICAL EQUIPMENT TROUBLE SHOOTING LABORATORY 2H-1C (Industry Curriculum)

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 understand the function of medical devices through basic knowledge of physiology and engineering
- To read and understand medical device user guides and maintenance manuals
- To maintain and calibrate medical equipment so that it will remain working
- To analyze and troubleshoot a medical device and know how to repair it
- To work safely on a device and know when a device is safe to use.

COURSE OUTCOMES:

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

- Summarize the steps involved in troubleshooting process and techniques
- Inspect grounding for available equipment's
- Categorize the faults in Op Amp circuits
- List the parameters for digital troubleshooting
- Test the electrical parameters of diagnostics devices

List of Experiments:

- 1. Study of Troubleshooting Process and Fault finding Aids
- 2. Study of Troubleshooting Techniques
- 3. Study of Grounding Systems in Electronic Equipment
- 4. Fault Diagnosis in Op-Amp Circuits,
- 5. Digital Troubleshooting Methods
- 6. Digital IC Troubleshooters
- 7. Circuit board Troubleshooting
- 8. Trouble shooting of ECG Machine, and EEG Machine
- 9. Trouble shooting of Defibrillator and Electrosurgical unit
- 10. Trouble shooting of Anaesthesia machine

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	1	1	-	1	2	2	-	2	3	2
CO2	K3	3	2	1	-	1	1	-	1	2	2	-	2	3	2
CO3	K4	3	3	2	1	1	1	-	1	2	2	-	2	3	2
CO4	K3	3	2	1	-	1	1	-	1	2	2	-	2	3	2
C05	K4	3	3	2	1	1	1	-	1	2	2	-	2	3	2
Averag	e	2.8	2.2	1.2	1	1	1	-	1	2	2	-	2	3	2

2023-2024

23BEBME691

MINI PROJECT

SEMESTER-VI 2H-1C

Instruction Hours/week: L:0 T:0 P:2

Marks: Internal:100 External:0 Total:100

End Semester Exam:3 Hours

B.E Biomedical Engineering

23BEBME701	ARTIFICIAL IN	TELLIGENCE IN HEALTHCARE	3H-3 C
			Semester-VII
Instruction Hours/we	ek: L:3 T:1 P:0	Marks: Internal:40 External:60	Total:100

COURSE OBJECTIVES:

The goal of this course is for students:

- To understand the basic production system
- To know about game controlling
- To understand advanced generation system
- To explain the frame based systems
- To learn about different applications

COURSE OUTCOMES:

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

- Illustrate the characteristics of AI systems in healthcare
- Interpret the methods for knowledge representation
- Infer the principle of knowledge inference algorithm
- Explain the machine learning approaches in healthcare
- Identify the role of expert sysytems in biomedical application

UNIT I INTRODUCTION TO AL AND PRODUCTION SYSTEMS

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

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. Control Systems - Artificial Intelligence based optimal control - Reinforcement learning

UNIT III- KNOWLEDGE INFERENCE

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

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

2023-2024

End Semester Exam: 3 Hours

9

9 :ha:

9

UNIT V- APPLICATIONS AND EXPERT SYSTEMS

Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert system shells. Blood pressure control, Speech Recognition – Robot control for surgical applications - Hardware - Perception - Planning – Moving image guidance

Total Periods : 45

TEXT BOOK

1. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education2013.

REFERENCE BOOKS

- 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 Education2007.

CO-PO MAPPING

COs/	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
POs															
CO1	K3	3	2	1	-	1	1	-	1	1	1	-	1	1	3
CO2	K2	2	1	-	-	1	1	-	1	1	1	-	1	1	3
CO3	K2	2	1	-	-	1	1	-	1	1	1	-	1	1	3
CO4	K2	2	1	-	-	1	1	-	1	1	1	-	1	1	3
CO5	K3	3	2	1	-	1	1	-	1	1	1	-	1	1	3
Avera	ige	2.4	1.4	1	-	1	1	-	1	1	1	-	1	1	3

23BEBME702 MEDICAL ETHICS REGULATORY STANDARDS 3H-3C Semester-VII

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 medical device classes and regulatory effort
- To familiarize the international medical device regulations and standards.
- To understand Indian medical device regulations
- To explain the global policies on medical device regulations.
- To Inspect and investigate national and international device regulation standards

COURSE OUTCOMES:

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

- Infer the medical device testing factors
- Explain the regulatory standards for Food and Drug administration
- Summarize the Indian medical device rules and regulation
- Show the importance of ethics in handling miscellaneous issues.
- Make use of ethics principles for designing abnormalities detection device.

UNIT I DEFINITION OF TESTING

Parsing test requirements, test protocol, test methodology, purpose of the test, failure definition, determining sample size and test length, types of testing. Analysis of test data- failure rate, mean time between failure, reliability, confidence level, confidence limits, minimum life, graphical analysis. Reliability and liability-negligence, strict liability, breach of warranty, defects, plaintiff's conduct, defendant's conduct, defendant related issues, manufacturers and physicians responsibilities, accident reconstruction and forensics.

UNIT II FOOD AND DRUG ADMINISTRATION

History of device regulation, device classification, registration and listing, 510(k) process, declaration of conformance to a recognized standard, PMA application, investigational device exemptions, good laboratory practices, good manufacturing practices, human factors, design control, FDA and software classification, FDA inspection, advice on dealing with the FDA regulations and standards- definition of medical device, MDD, United States Domestic Standards, rest of the world standards.

UNIT III INDIAN MEDICAL DEVICE RULES AND REGULATIONS

Indian medical device rules and regulations-2017, licensing patents, copyrights and trade secrets, trademarks. Manufacturing and quality control- GMP regulations, design for manufacturability, design for assembly, manufacturing process

UNIT IV - MISCELLANEOUS ISSUES

Learning from failure, design for failure, design for convenience, universal design, design for assembly, prevention through design, design for the environment, pokayoke, product life issues, product testing issues. Product safety and legal issues, accident reconstruction and forensics, biomechanics and traffic-accident investigations. professional issues, BME – related professional societies, standards setting groups, professional engineering licensure, rules of professional conduct, codes of ethics, forensics and consulting, continuing education.

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 98

9

9

UNIT V- DESIGN OF CASE STUDIES

Multi-detector brain scanning system development, testing of anesthetists, apnea detection system, cancer clinic charting, EKG analysis techniques & module.

Total Periods: 45

TEXT BOOKS:

9

1. Seeram Ramakrishna, Medical Devices Regulations, Standards and Practices, Wood Head Publishing series in Biomaterials, UK, 2015

REFERENCE:

1. Val Theisz Medical Device Regulatory Practices, An International Perspective, CRC Press 2016

WEBSITE:

- 1. https://nptel.ac.in/courses/127106136
- 2. https://nptel.ac.in/courses/127106010

COs /POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	1	2	1	1	-	1	1	1
CO2	K3	2	1	-	-	-	1	1	2	1	1	-	1	1	1
CO3	K3	2	1	-	-	-	1	1	2	1	1	-	1	1	1
CO4	K3	2	1	-	-	-	1	1	2	1	1	-	1	1	1
CO5	K3	3	2	1	-	-	1	1	2	1	1	-	1	1	1
Average	e	2.2	1.2	1	-	-	1	1	2	1	1	-	1	1	1

B.E Biomedical Engineering

23BEBME703 BIOMEDICAL WASTE AND 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 OBJECTIVE

- To introduce the practices followed in Biomedical waste management.
- To gain knowledge about Hazardous material.
- To Introduce the practices followed in hospital.
- To understand human resource management hospital.
- To learn the working of hospital information systems, quality and safety aspects in hospital schemes.

COURSE OUTCOMES

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

- Explain the biomedical waste Management practices.
- Infer the impact of Hazardous material and safety precautions in hospital
- Outline the process of planning and challenges involved in hospital Administration
- Interpret the principles and functions of human resource management.
- Compare the quality standards involved in hospital management.

UNIT I - BIOMEDICAL WASTE MANAGEMENT

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 labeling, waste handling, collection, storage and transportation, treatment and disposal.

UNIT II - HAZARDOUS MATERIALS

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.Hazardand Safety in a hospital Setup.

UNIT III – OVER VIEW OF HOSPITAL ADMINISTRATION

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

UNIT IV- HUMAN RESOURCE MANAGEMENT IN HOSPITAL

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 V – HOSPITAL INFORMATION SYSTEMS & QUALITY AND ASPECTS IN HOSPITAL

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems - Medical Transcription, Medical Records Department-Central Sterilization. International Standards ISO 9000 - 9004 - Features of ISO 9001 -

9

9

Q

9

2023-2024 Semester-VII

ISO 14000 – ISO 13485-Environment Management Systems.NABH,JCI,NABL,NABA.Security–Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care –Medical Audit.

Total Periods: 45

TEXTBOOKS:

- 1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI, 2006.
- 2. G.D.Kunders, "Hospitals Facilities Planning and Management", TMH, 2007.
- 3. Anant preet Singh, Sukhjit Kaur, "Biomedical Waste Disposal" Jaypee Brothers, 2012.
- **4.** Tweedy, James T, "Healthcare hazard control and safety management", CRC Press Taylor and Francis, 2014.

WEBSITES:

- 1. https://www.csm.tech/in/healthcare/offering/hospital-administration-management-system/
- 2. https://byjus.com/current-affairs/biomedical-waste/

3. <u>https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7152398/#:~:text=Health%20Risks,health%20f acilities</u>

COs/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	1	2	1	1	-	1	1	2
CO2	K2	2	1	-	-	-	1	1	2	1	1	-	1	1	2
CO3	K2	2	1	-	-	-	1	1	2	1	1	-	1	1	2
CO4	K2	2	1	-	-	-	1	1	2	1	1	-	1	1	2
CO5	K2	2	1	-	-	-	1	1	2	1	1	-	1	1	2
Averag	e	2	1	-	-	-	1	1	2	1	1	-	1	1	2

B.E Biomedical Engineering			2023-2024
			Semester-VII
23BEBME7E	Professional	Elective-V	3H-3C
Instruction Hours/week: L:3 T:0 P:0		Marks: Inter	nal:40 External:60 Total:100
			End Semester Exam:3 Hours
B.E Biomedical Engineering			2023-2024
	D 6 · 1	T I (* T /T	Semester-VII
	Professional	Elective-VI	3H-30
histi dellon 110013/ week. E.S 1.01.0			End Semester Exam:3 Hours
B.E Biomedical Engineering			2023-2024 Someston VII
23BE—OE	Open Elective -	п	Semester-VII 3H-3C
Instruction Hours/week: L:3 T:0 P:0		Marks: Inter	nal:40 External:60 Total:100

End Semester Exam:3 Hours

2023-2024

Semester-VII

23BEBME711

ARTIFICIAL INTELLIGENCE 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 understand the concepts AI
- To provide skills for designing and analysing AI based algorithms.
- To enable students to work on various AI tools.
- To provide skills to work towards solution of real life problems
- To familiarize the AI algorithms based on tools

COURSE OUTCOMES:

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

- Interpret the functions of PROLOG programming language
- Develop programming solutions for given problem.
- Examine the turbo PROLOG program for medical diagnosis
- Solve the 4-queen and salesman problems using PROLOG
- Analyze LISP and Hill climbing algorithms

LIST OF EXPERIMENTS

- 1. Study of PROLOG programming language and its functions
- 2. Write simple fact for the statements using PROLOG
- 3. Write predicates one converts centigrade temperature to Fahrenheit, the other checks if a temperature is below freezing
- 4. Write a program to solve the monkey banana problem using PROLOG
- 5. WAP in turbo prolog for medical diagnosis and show the advantages and disadvantages of green and red cuts.
- 6. WAP to implement factorial, Fibonacci of given number using prolog
- 7. Write a program to solve 4-queen problem using prolog
- 8. Write a program to implement travelling salesman problem using prolog
- 9. Write a program to solve water jug problem using LISP
- 10. Write a program to implement Hill climbing algorithm

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	2	-	-	-	2	2	-	1	-	3
CO2	K3	3	2	1	-	2	-	-	-	2	2	-	1	-	3
CO3	K4	3	3	2	1	2	-	-	-	2	2	-	1	-	3
CO4	K3	3	2	1	-	2	-	-	-	2	2	-	1	-	3
CO5	K4	3	3	2	1	2	-	-	-	2	2	-	1	-	3
Average	e	2.8	2.2	1.5	1	2	-	-	-	2	2	-	1	-	3

B.E Biomedical Engineering		2023-2024
23BEBME791	Project Work Phase-I	Semester-VII 8H-4C
Instruction Hours/week: L:0 T:0 P:8	Marks: Internal:100	External:0 Total:100
	End Ser	nester Exam: 3 Hours

SEMESTER VIII

B.E Biomedical Engineering SEMESTER VIII

23BEBME891 PROJECT WORK PHASE II & VIVA-VOCE

Instruction Hours/week: L:0 T:0 P:16

Marks: Internal:120 External:180 Total: 300 End Semester Exam:3 Hours

2023-2024

16H-8C

PROFESSIONAL ELECTIVES: BIO ENGINEERING

2023-2024

End Semester Exam: 3 Hours

			Elective
23BEBME4E01	MODELING OF	PHYSIOLOGICAL SYSTEMS	3H-3C
Instruction Hours/wee	ek: L:3 T:0 P:0	Marks: Internal:40 External:	60 Total:100

COURSE OBJECTIVES

B.E Biomedical Engineering

- To Know about physiological control systems
- To Learn about the properties of blood and circulatory system
- To learn the digestion and heat transfer in human body
- To Learn the filtration system in human body
- To Acquire knowledge on transport mechanisms of lungs

COURSE OUTCOMES

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

- Identify the mathematical approaches in the physiological systems
- Explain the features of circulatory system
- Develop the model of thermal regulatory system
- Model the methods of waste removal in human body
- Build a physiological model of respiratory system

UNIT I PHYSIOLOGICAL SYSTEMS

System Analysis, examples of physiological control systems, differences between engineering and physiological control systems. Generalized system properties, mathematical approach, electrical analogs, 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

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

UNIT III THERMAL REGULATORY SYSTEM

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

UNIT IV ULTRA FILTRATION SYSTEM

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

UNIT V RESPIRATORY SYSTEM

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

Total periods : 45

9

9

0

TEXTBOOKS:

1. David O.Cooney,"Biomdical Engineering Principles", Marcel Decker Pub. Co,2017

REFERENCES:

1. Michael C. K. Kho, Physiological Control Systems, Prentice Hall of India, 2018.

2. John Enderly, Susan Blanchard, Joseph Bronzino, Introduction to Biomedical Engineering, Academic Press Series in Biomedical Engineering, 2005.

WEBSITES:

- 1. <u>https://nptel.ac.in/courses/102101068</u>
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
CO4	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
Avera	age	2.8	1.8	1	-	-	1	-	1	1	1	-	1	1	-

B.E Biomedical Engineering Elective **23BEBME4E02 INTRODUCTION TO CELL BIOLOGY 3H-3C** Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

COURSE OBJECTIVES

The goal of this course is for students,

- To Know about structure of cell and its organelles
- To Learn about the cell division
- To know about basic units of proteins, DNA & RNA
- To Learn the non- thermal applications of laser in medicine •
- To Acquire knowledge on enzyme activity

COURSE OUTCOMES

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

- Explain the structure and functions of cells and its organelles
- Infer the cell division and cell cultures
- Compare Passive and active transport across cell membrane
- Identify cell types using microscope
- Model the bioreceptors

UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES

Prokaryotic, Eukaryotic cells, Sub-cellular organelles and functions. Principles of membrane organization membrane proteins, cytoskeletal proteins. Extra cellular matrix, cell-cell junctions.

UNIT II CELL DIVISION, CANCER, APOPTOSIS AND IMMORTALIZATION OF CELLS

Cell cycle - Mitosis, Meiosis, Molecules controlling cell cycle, cancer, role of Ras and Raf in oncogenesis and apoptosis. Stem cells, Cell culture and immortalization of cells and its applications.

UNIT III TRANSPORT ACROSS CELL MEMBRANE

Passive and Active Transport, Permeases, Ion channels, ATP pumps. Na+ / K+ /Ca+2Tpumps, uniport, symport antiporter system. Ligand gated / voltage gated channels, Agonists and Antagonists.

UNIT IV SIGNAL TRANSDUCTION

Receptors – extracellular signaling, Cell surface / cytosolic receptors and examples, Different classes of receptors antocrine / paracrine / endocrine models, Secondary messengers molecules.

UNIT V TECHNIQUES USED TO STUDY CELLS

Cell fractionation and flow cytometry, Morphology and identification of cells using microscopic studies like SEM, TEM and Confocal Microscopy. Localization of proteins in cells – Immunostaining.

Total periods : 45

2023-2024

End Semester Exam:3 Hours

9

9

9

TEXTBOOKS:

1. Lodish, Harvey etal., Molecular Cell Biology, 7th Edition, W.H.Freeman, 2013

2. Cooper, G.M. and R.E. Hansman, The Cell: A Molecular Approach, 8th Edition, Oxford University Press, 2018

3. Alberts, Bruce etal. Molecular Biology of the Cell, W.W. Norton, 2014

REFERENCES:

- 1. Becker, W.M. etal., The World of the Cell, 9th Edition, Pearson Education, 2003.
- 2. Campbell, N.A., J.B. Recee and E.J. Simon, Essential Biology, VIIth Edition, Pearson International, 2007

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1		1	1	1	•	1	2	-
CO2	K2	2	1	-	-	-	1		1	1	1	•	1	2	-
CO3	K2	2	1	-	-	-	1		1	1	1	-	1	2	-
CO4	K3	3	2	1	-	-	1		1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1		1	1	1	-	1	2	-
Average		2.4	1.4	1	-	-	1	-	1	1	1	-	1	2	-

B.E Biomedical Engineering Elective 23BEBM5E01 **BIOMEMS 3H-3C** Marks: Internal:40 External:60 Total:100

Instruction Hours/week: L:3 T:0 P:0

End Semester Exam: 3 Hours

COURSE OBJECTIVES

The goal of this course is for students,

- To Know about MEMS and microsystems in healthcare
- To Learn about the various fabrication processes in MEMS
- To learn about the micromanufacturing and etching process
- To Learn the Bio MEMS and drug delivery systems
- To Acquire knowledge on biomechanical interactions

COURSE OUTCOMES

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

- Explain fabrication techniques in MEMs
- Illustrate the different types of actuators
- Contrast the properties of piezoelectric materials
- Explain the concepts of microfluidic systems •
- Construct BIOMEMS system

UNIT I MEMS MATERIALS AND FABRICATION

Typical MEMs and Microsystems, materials for MEMS - active substrate materials- Silicon and it 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

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

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

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumpscontinuousflow system, micromixers

9

9

9

9

2023-2024

UNIT V APPLICATIONS

9

CAD for MEMs, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR),DNA sensor, MEMS based drug delivery

Total periods : 45

TEXTBOOKS:

1.Tai-Ran Hsu, MEMS & Microsystems- Design, Manufacture and Nanoscale Engineering,2ndEdition, John Wiley & Sons, 2008.

Wanjun Wang & Steven A.Soper, BioMEMS- Technologies and applications, CRC Press, 1st Edition, 2007.

REFERENCES:

1. Nitaigour Premchand Mahalik, MEMS, Tata McGraw Hill, 2nd Reprint, 2008.

2. Chang Liu, Foundations of MEMS, Pearson Education International, New Jersey, USA, 2006

WEBSITES:

- 1. <u>https://nptel.ac.in/courses/102101068</u>
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	2
CO2	K3	2	1	-	-	-	1	-	1	1	1	-	1	1	2
CO3	K4	3	3	2	1	-	-	-	1	1	1	-	1	1	2
CO4	K3	2	1	-	-	-	1	-	1	1	1	-	1	1	2
CO5	K4	3	2	1	-	-	1	-	1	1	1	-	1	1	2
Average	è	2.8	2.2	1.5	1	-	1	-	-	1	1	-	-	1	2

COURSE OBJECTIVES

The goal of this course is for students,

23BEBME5E02

• To Learn about the medical standards and healthcare standards

- To learn about the medical data storage and automation in medicine
- To Learn the bioinformation technologies

• To Know about medical information systems

• To Acquire knowledge on recent trends in medical informatics

COURSE OUTCOMES

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

- Outline the concepts medical informatics
- Summarize the medical standards for healthcare industry
- Illustrate storage of medical data and automation
- Compare bioinformatics and healthcare informatics
- Model a medical informatics system

UNIT I: MEDICAL INFORMATICS

Introduction, Medical Informatics, Bioinformatics, Health Informatics, Structure of Medical Informatics Functional capabilities of Hospital Information System, On-line services and off, line services, History taking by computer, Dialogue with the computer

UNIT II: MEDICAL STANDARDS

Evolution of Medical Standards, IEEE 11073, HL7, DICOM, IRMA, LOINC, HIPPA, Electronics Patient Records, Healthcare Standard Organizations, JCAHO (Join Commission on Accreditation of Healthcare Organization), JCIA (Joint Commission International Accreditation), Evidence Based Medicine, Bioethics.

UNIT III: MEDICAL DATA STORAGE AND AUTOMATION

Plug in Data Acquisition and Control Boards, Data Acquisition using Serial Interface, Medical Data formats, Signal, Image and Video Formats, Medical Databases, Automation in clinical laboratories, Intelligent Laboratory Information System, PACS, Datamining.

UNIT IV : HEALTH INFORMATICS

Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training.

UNIT V : RECENT TRENDS IN MEDICAL INFORMATICS

Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment, Surgical simulation, Radiation therapy and planning, Telemedicine, virtual Hospitals, Smart Medical Homes, Personalized e-health services, Biometrics, GRID and Cloud Computing in Medicine.

Total periods : 45

BIOMEDICAL INFORMATICS Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100 End Semester Exam: 3 Hours

3H-3C

9

9

9
TEXTBOOKS:

1. R.D.Lele, Computers in medicine progress in medical informatics, Tata McGraw Hill Publishing computers Ltd, New Delhi, 2005.

- 2. Mohan Bansal, Medical informatics, Tata McGraw Hill Publishing Computers Ltd, NewDelhi, 2003.
- 3. N.Mathivanan, PC-Based Instrumentation, Prentice Hall of India Pvt Ltd, New Delhi, 2007

REFERENCES:

1. Orpita Bosu and Simminder Kaur Thukral, Bioinformatics Databases, Tools and Algorithms, Oxford University press, New Delhi, 2007.

2. Yi, Ping Phoebe Chen, Bioinformatics Technologies, Springer International Edition, NewDelhi, 2007.

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
Average	9	2.2	1.2	1	-	-	1	-	1	1	1	-	1	2	-

B.E Biomedical Engineering

23BEBME6E01

MICRO FLUIDICS

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 Know about basic microfluidics concept •
- To Learn about the materials and fabrication processes in microfluidics •
- To learn about the fluidic control and detection methods •
- To Learn the various technologies in microdevices •
- To know about the applications of microfluidics in biological systems •

COURSE OUTCOMES

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

- Explain the fundamentals of microfluidics and nanofluidics •
- Illustrate the fabrication techniqic in Microfluidics
- Compare microfluidic and nanofluidic structures •
- Select microdevice for given application
- Develop microfluidic based biological System •

UNIT I: BASIC MICROFLUDIC CONCEPTS

Introduction to Microfluidics- Introduction to Microfluidics- The microfluidic advantage- Fluidics and Transport Fundamentals: The continuum approximation- Laminar flow- Diffusion in microfluidic systems - Surface forces and droplets- 1 Pumps and valves- Electrokinetics- Electro-osmosis- Electrophoresis

UNIT II : MATERIALS AND FABRICATION PROCESSES FOR MICROFLUIDIC Q

Materials for Microfluidic Devices- Silicon Based Materials- Glass Based Materials- Polymers Based Material-Fabrication of Microfluidics devices- Photolithography & its techniques- Additive Techniques- Subtractive Techniques- Silicon microfabrication-Injection molding and Hot embossing- Casting & Lithography-Fabrication of microfluidic channels in SU-8- Microfluidic networks created in biodegradable materials.

UNIT III FLUIDIC CONTROL METHODS AND DETECTION METHODS

Fluid Control :Basic theory- Pressure -Driven Flow- Shear driven Flow- Shear driven flow examples-Electrokinetically -driven flow- Electrokinetically -driven flow problem and examples- Single Molecule Detection Methods- Optical detection methods- Electrochemical method examples- Measurement of Fluidic Properties: Nonintrusive flow measurement techniques- Current monitoring in electroosmotic flowcimetry- Laserinduced fluorescence photo bleaching anemometer with stimulated emission depletion

UNIT IV : MICRODEVICE TECHNOLOGIES

Actuators for micropumps- Actuators for Microvalves- Flow sensors- Microarrays- Microreactors- Pipettes and Dispensers- Microanalytical Chips- Electrochemical microfluidics devices- Paper Microfluidics devices- 3D Printed Microfluidic Devices

0

9

9

2023-2024 Elective

3H-3C

UNIT V : APPLICATIONS TO BIOLOGICAL SYSTEM

Electrophoresis:DNA separation- Case study :DNA separation- Shear-driven flow: Biomolecular separation- Case study : Biomolecular separation- Ion Transport with case study- Concentration with case study-Bioanalysis:Immunoassay- DNA analysis- On-chip separations and combinations- Sample injection and separation- Micro-gas chromatography: Micro gas sensors for micro GC- Case study for a micro GC- Micro-scale impedance measurements- Biosensor- Nano- Biosensors

Total periods : 45

TEXTBOOKS:

1. Patric Tabeling, Introduction to Microfluids, Oxford U. Press, New York, 2005.

2. Yujun Song, Daojian Cheng& Liang Zhao, Microfluidics: Fundamentals, Devices, and Applications, Wiley VCH, First edition, 2018.

3. Xiujun (James) Li and Yu Zhou, Microfluidic devices for biomedical applications, Woodhead Publishing Limited, 16th edition, 2013.

REFERENCES:

1. Wei-Cheng Tian, Erin Finehout, Microfluidics for Biological Applications, Springer, 2008.

2. Nam-Trung Nguyen, Steven T. Wereley, Fundamentals And Applications of Microfluidics, Artech Print on Demand, Second Edition, 2006.

WEBSITES:

- 1. <u>https://nptel.ac.in/courses/102101068</u>
- 2. <u>https://nptel.ac.in/courses/102105090</u>

		uio													
COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO4	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	2
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	2
Averag	ge	2.4	1.4	1	-	-	1	-	1	1	1	-	1	-	2

CO-PO MAPPING

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 116

23BEBME6E02

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 Know about structure and functions of nervous system •
- To Learn about the types of nervous system and neurotransmitters •
- To Familiarise the various neural imaging techniques •
- To Learn about the neuro stimulation •
- To Acquire knowledge on prosthetics in neuro •

COURSE OUTCOMES

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

- Explain the working principle of brain and its functions
- Infer the transmission process of nervous system
- Illustrate the principle of BCI techniques •
- Summarize the Software techniques for sensory prosthetics •
- model a neuroprosthetics system •

UNIT I: INTRODUCTION TO NEURONS AND NERVOUS SYSTEMS

Brain anatomy- Structure of neurons- Function of neurons- Types of neurons- Neuroglia- Myelinated and unmyelinated nerve fibers- Properties of nerve fibres- Excitability, conductivity, all-or none law, accommodation, adaptation, summation, refractory period, indefatiguability- Synapse- Glial cells- Myelination- Neuronal differentiation- Characterization of neuronal cells- Blood Brain barrier- Meninges- Cerebrospinal fluid

NEURO ENGINEERING

UNIT II: NEURO-TRANSMISSION AND NEURO TRANSMITTERS

Nervous system- Central nervous system - Peripheral nervous system- Neurotransmission- Stages in neurotransmission - Synaptic transmission - Chemical synaptic transmission - Electrical synaptic transmission-Neurotransmitters and their release - Types of neurotransmitters- Fast and slow neurotransmission

UNIT III: NEURAL IMAGING TECHNIQUES

Brain Computer Interface- History of BCI- Components of a BCI System- Functional Components- Feedback -Signal Acquisition- Invasive Techniques- Noninvasive Techniques- Feature Extraction and Translation Techniques- Types of BCI Signals- Signal Processing and Feature Extraction- BCI development-Electroencephalography (EEG)- Principle and working of EEG- Computerized axial tomography (CAT) scans in brain imaging- Functional Magnetic Resonance Imaging (fMRI)

UNIT IV: NEURAL STIMULATION

Sensory prosthetics- Retinal prosthetics- Visual prosthetics- Bionic eye- Auditory prosthetics- Cochlear implant-Bionic ear- Spinal cord stimulator- Motor prosthetics- Bladder control implant- Sacral anterior root stimulator-Prosthetics for conscious control of movements

9

9

9

9

Elective **3H-3C**

UNIT V : NEURO-PROSTHETICS

Deep brain stimulation- Spinal cord stimulation- Cortical stimulation- Transcranial direct current stimulation-Single neuron model- Hodgkin Huxley neuron model- Fitzhugh Nagumo models- Morris lecar model- Hind marsh rose model

Total periods : 45

TEXTBOOKS:

- 1. Bin He, Neural Engineering, Plenum Publishers, 2005.
- 2. Mathews G.G, Neurobiology, 2nd edition, Blackwell Science, UK,2000.

REFERENCES:

- 1. R.S.Khandpur, Handbook Of Biomedical Instrumentation, Mc Graw Hill, 3rd Edition, 2015.
- 2. Malcom Carpenter, Textbooks Of Neuroanatomy, Mc. Graw hill Edition, 1996.

WEBSITES:

- 1. <u>https://nptel.ac.in/courses/102101068</u>
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
Average	9	2.2	1.2	1	-	-	1	-	1	1	1	-	1	2	-

CO-PO MAPPING

B.E Biomedical Engineering

22BEBME6E07

BIOFLUID MECHANICS

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 Know about fundamentals of soft tissue mechanics
- To Learn about the basic concepts of biofluids
- To learn about the macrocirculation and microcirculation system
- To Learn the cardiac mechanics
- To Acquire knowledge on biofluid mechanics of organ systems

COURSE OUTCOMES

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

- Explain the fundamentals muscle contraction
- Identify the bio fluids in biological systems
- Illustrate the properties of cardiac mechanism
- Interpret the mechanics of cardiac system
- Construct a biofluid mechanic system

UNIT I: FUNDAMENTAL OF SOFT TISSUE MECHANICS

Introduction: Structural organization of skeletal muscle- Muscle fiber- Motor unit- Fiber types- Fiber architecture-Muscle function- Maximum Muscle Stress- Maximum Muscle Contraction Velocity- Types of Muscle Models-Huxley biochemical models- Hill phenomenological models- Constitutive models- Tendon-morphology- Tendonproperties- Ligament –morphology- Ligament –properties- Articular cartilage –morphology and properties

UNIT II: BASIC CONCEPT OF BIOFLUIDS

Introduction –Body fluids, Dimension and unit-Basic Concepts and Definitions of Fluid Mechanics-Fluid Kinematics and Viscosity-Newtonian Fluids-Non-Newtonian Fluids-Dimensionless Numbers of Biofluid Mechanics-Steady versus Unsteady Flow and Laminar Versus Turbulent Flow-Boundary Conditions and No Slip Boundary Condition -Navier Stokes Equations-Bernoulli Equation-Hagen Poiseuille Equation-Steady Flow Along Tube, Hematology and blood rheology

UNIT III: MACROCIRCULATION AND MICROCIRCULATION SYSTEM

Introduction of macrocirculation and microcirculation-Pulsatile flow properties-Arteries-Veins-Vascular bifurcations and branches-Blood flow through curved vessels-Mechanical and elasticity properties of vessels-Atherosclerosis characteristics-Blood flow through stenosis-Arterioles and blood flow aspects-Capillaries and venules-Fahraeus and Fahraeus lindqvist effects-Mass transport in tissue-Porosity, tortuosity and permeability-Governing equations in porous media-Fluid transport in poroelastic media

UNIT IV: CARDIAC MECHANICS

Introduction-Cardiac Geometry and Structure- Ventricular Geometry-Myofiber Architecture-Extracellular Matrix Organization-Cardiac Pump Function: Ventricular Hemodynamics-Ventricular Pressure--Volume Relations and Energetics-Myocardial Material Properties: Muscle Contractile Properties-Resting Myocardial Properties-Regional Ventricular Mechanics: Stress and Strain

2023-2024

Elective 3H-3C

9

9

UNIT V: BIOFLUID MECHANICS OF ORGANS SYSTEM

Kidney :Structure and function-Fluid flow in an artificial kidney model- Liver: structure and function-Hepatic acinus model-Fluid flow in hepatic acinus model- Lung : Structure and function-Elasticity of the lung blood vessels and alveoli-Pressure-volume relationship for air flow in the lungs-Oxygen/carbon dioxide diffusion and transport in the blood-Compressible fluid flow-Lubrication of joints: function-Formation of synovial fluid-Synovial fluid flow-Mechanical forces within joint.

Total periods : 45

TEXTBOOKS:

1. David A. Rubenstein, Wei Yin&Mary D. Frame, Biofluid mechanics: An introduction to fluid mechanics, macrocirculation and microcirculation (Biomedical Engineering), Elsevier, 2nd edition, 2012.

2. Clement Kleinstreuer, Biofluid Dynamics: Principles and Selected Applications, CRC Press; 1 edition, 2016.

REFERENCES:

- 1. Susan Hall, Basic Biomechanics, McGraw-Hill Education,6th edition,2011.
- 2. Ali Ostadfar, Biofluid Mechanics -Principles and Applications, Elsevier, 1st edition, 2016.

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
Avera	ge	2.4	1.4	1	-	-	1	-	1	1	1	-	1	2	-

CO-PO MAPPING

B.E Biomedical Engineering

23BEBME6E08

COURSE OBJECTIVES

The goal of this course is for students,

Instruction Hours/week: L:3 T:0 P:0

- To Know about fundamentals of cell mechanism •
- To Learn about the basic concepts of tissue
- To learn about various biomaterials and its interaction with cell and tissue
- To Learn the concepts of stem cells
- To Acquire knowledge on applications of tissue engineering

COURSE OUTCOMES

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

- Explain the concepts of cell mechanism •
- Infer the physiological functions of cells and tissue in wound healing mechanism •
- Compare the properties of degradable and non-degradable biomaterials •
- Illustrate the importance of stem cells •
- Model the applications of tissue Engineering

UNIT I FUNDAMENTALS OF CELL MECHANISM

Structure and functions of cells, cell membrane, transport across membrane, cell potential, cell growth & cycle, cell adhesion and migration, cellular interaction- cell-cell and cell matrix, cell transplantation.

TISSUE ENGINEERING

UNIT II BASIC TISSUE ENGINEERING

Introduction to Tissue Engineering, structure and organization of tissue, development of tissue- Tissue exchange and diffusion of simple metabolites, Tissue Equivalent - Wound Healing Process - Biocompatibility and toxicity assessment.

UNIT III BIOMATERIALS IN TISSUE ENGINEERING

Definition, Biological vs Non-biological materials, Extra Cellular Matrix, Collagen, Chitin & Degradable and Nondegradable materials, Polymer, Ceramics and Metals, Cell interaction with different materials, Scaffolds - Control releaser agents in Tissue Engineering, Cell interaction with suspension and gels, Tissue response to implants.

UNIT IV STEM CELLS IN TISSUE ENGINEERING

Introduction of Stem cells, Hemopoietic Stem cells, Embryonic Stem cells, Adult stem cells, Cancer Stem cells, Cord Blood cells, Induced Pluripotent Stem cells, Stem cell identification, Surface markers & FACS analysis, Differentiation, Dedifferentiation and Immortalization - Application of stem cells in tissue Engineering

UNIT V APPLICATIONS

Synthetic components, Artificial organs, Joints and dental prostheses, Connective Tissue Engineering, Cardiovascular Tissue Engineering, Neural Tissue Engineering, Cell and Drug Delivery systems.

Total periods : 45

9

Q

9

9

2023-2024

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

TEXTBOOKS:

1. Robert P Lanza, Robert Langer and Joseph Vacanti, Principles of tissue engineering, Academic Press, California, 2013.

2. Cecie Starr, Ralph Taggart, Cell biology and genetics, Brooks/Cole Publishers, California, volume 1 2015.

REFERENCES:

- 1. Bruce Alberts, et.al, Molecular Biology of the Cell, Garland Science Publications, New York, 2016.
- 2. Yoshito Ikada, Tissue engineering: Fundamentals and applications, Elsevier Ltd, UK,2006.

WEBSITES:

- 1. <u>https://nptel.ac.in/courses/102101068</u>
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	2	-	-	-	2	2	-	1	-	3
CO2	K3	3	2	1	-	2	-	-	-	2	2	-	1	-	3
CO3	K4	3	3	2	1	2	-	-	-	2	2	-	1	-	3
CO4	K3	3	2	1	-	2	-	-	-	2	2	-	1	-	3
CO5	K4	3	3	2	1	2	-	-	-	2	2	-	1	-	3
Average	9	2.8	2.2	1.5	1	2	-	-	-	2	2	-	1	-	3

23BEBME7E01 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

The goal of this course is for students,

- To illustrate the basic science behind the properties of materials at nanoscale
- To infer knowledge of Nanotechnology in the field of medicine.
- To inspect the Importance of nanomaterials in drug delivery.
- To explain nanomaterials and Nano systems in Medical Diagnostics and Therapeutics
- To infer nanotechnology in health monitoring systems.

COURSE OUTCOMES

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

- Explain the concepts of nanobiotechnology
- Utilize the nanobiotechnology in healthcare and medicine
- Interpret the role of nano materials in nano therapeutic device
- Apply nano materials and nano system in medical diagnostic
- Summarize the applications of Nano system

UNIT I –INTRODUCTION

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

Nanoparticles in Medical Diagnostics and Therapeutics, Targeted drug delivery, Magnetic Nanoparticles as Contrast Agents for Medical Diagnosis, Liposome based delivery, Bio Inspired Nano materials for a New Generation of Medicine.

UNIT III- THERAPEUTIC NANO DEVICES

Definition and scope, Synthetic Approaches: top-down versus bottom-up Approaches for Nano therapeutic Device Components, Applications for Nano therapeutic Devices.

UNIT IV-NANOSYSTEMS FOR HEALTHCARE MONITORING – I

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

Nano pore Methods for DNA Detection and Sequencing, Nano tube Based Membrane Systems, micro/nano fluidic systems for bio-object sorting, single chip electrophoresis system.

Total periods : 45

Elective

9

9 an

9

TEXTBOOKS:

1. Tuan Vo-Dinh, Nanotechnology in Biology and Medicine: Methods, Devices and Applications, CRC press, 2006.

2. Bharat Bhushan, Handbook of Nanotechnology, Springer, 2003.

REFERENCES:

- 1. Chala Kumar, Bio functionalization of nanomaterials, Wiley, 2005.
- 2. Charles Pooles, Frank J. Ownes, Introduction to Nanotechnology, Wiley, 2003.

WEBSITES:

- 1. <u>https://nptel.ac.in/courses/102101068</u>
- 2. https://nptel.ac.in/courses/102105090

001			9												
COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-		1	-	1	1	1	-	1	2	-
CO2	K3	3	2	1	-		1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-		1	-	1	1	1	-	1	2	-
CO4	K3	3	2	1	-		1	-	1	1	1	-	1	2	-
CO5	K2	2	1	-	-		1	-	1	1	1	-	1	2	-
Average	9	2.4	1.4	1	-		1	-	1	1	1	-	1	2	-

B.E Biomedical Engineering		2023-2024
		Elective
23BEBME7E02	BIOERGONOMICS	3H-3 C
Instruction Hours/week: L:3 T:0 P:0	Marks: Internal:40 E	xternal:60 Total:100

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, students will be able to:

- Explain the principles of ergonomics •
- Illustrate the physiological aspects of muscle •
- Interpret the controlling and display mechanisms of ergonomics •
- Apply the principles of good ergonomic in anthropometry •
- Analyze the ergonomic design for biomedical devices •

UNIT I - VISUAL AND AUDITORY ERGONOMICS

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

Muscle physiology -muscle metabolism-respiratory response-joint motion study- measure of physiological inefficiency 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

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

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 Equipment.

Total periods : 45

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 124

Q

End Semester Exam: 3 Hours

0

TEXTBOOKS:

- 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.

REFERENCES:

1. Martin Helander, Guide to Human Factors and Ergonomics, Second Edition, CRC Press, 2005.

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO4	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	2
CO5	K4	3	3	2	1	-	1	-	1	1	1	-	1	-	2
Average	e e e e e e e e e e e e e e e e e e e	2.4	1.6	1.5	1	-	1	-	1	1	1	-	1	-	2

		Elective
23BEBME7E07	GENETIC ENGINEERING	3H-3C
Instruction Hours/week: L:3 T:0 P:0		Marks: Internal:40 External:60

COURSE OBJECTIVES

Total:100

B.E Biomedical Engineering

The goal of this course is for students,

- To Know about basics of R DNA technology
- To Learn about the construction of DNA libraries
- To learn about the sequencing and amplifications of DNA
- To Learn the concepts of organization and structure of genomes
- To Acquire knowledge on genome sequencing projects

COURSE OUTCOMES

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

- Explain the concepts of clone genes.
- Infer the functions of chromosome.
- Interpret the process of PCR techniques
- Illustrate the process of genome sequence
- Identify the genomic applications

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY

Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosomal walking, Screening of DNA libraries using nucleic acid probes and antisera.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA

Maxam Gilbert's and Sanger's methods of DNA sequencing. Inverse PCR, Nested PCR, AFLP- PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT IV ORGANIZATION AND STRUCTURE OF GENOMES

Organization and structure of genomes, Genome sequencing methods, Conventional and shotgun genome sequencing methods, Next generation sequencing technologies, Ordering the genome sequence, Genetic maps and Physical maps, STS content based mapping, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation.

UNIT V CURRENT STATUS OF GENOME SEQUENCING PROJECTS

Current status of genome sequencing projects, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE, TOGA, Yeast Two hybrid System, Comparative Genomics, Proteogenomic, Web resources for Genomics, Applications of genome analysis and genomics.

End Semester Exam: 3 Hours

9

9

9

9

TEXTBOOKS:

1. ld RW, Primrose SB, Principles of Gene Manipulation, An Introduction to Genetic Engineering, Blackwell Science Publications,1993.

2. S.B.Primrose and R.M.Twyman, Principles of Genome Analysis and Genomics 3rd Ed. Blackwell Publishing.

REFERENCES:

1. Isil Aksan Kurnaz, Techniques in Genetic Engineering, CRC Press, 2015.

2. Oksana Ableitner, Introduction to Molecular Biology: Working with DNA and RNA (essentials), Springer International, 2022.

3. Arun K. Shukla, Proteomics in Biology, Academic Press, 2017.

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
Average	e	2.2	1.2	1	-	-	1	-	1	1	1	-	1	2	-

B.E Biomedical Engineeri	ng	2023-2024
		Electiv
23BEBME7E08	CLINICAL	INGINEERING 3H-3C
Instruction Hours/week: I	.:3 T:0 P:0	Marks: Internal:40 External:60 Total:100
		End Semester Exam:3 Hour
COURSE OBJECTIVES		
The goal of this course is fo	r students,	
• To provide a basic	understanding of the	linical engineering profession,
qualifications, roles	, activities, and expe	tations.
• To practice medical	equipment and analy	ze challenges with their
healthcare technolo	gy.	-

- To work as a team to address problems and errors in medical devices.
- To design better medical devices with computerized approaches.
- To explore the Health Technology Management systems with medical devices and supportive services with advanced application.

COURSE OUTCOMES

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

- Explain the role and Responsibilities of clinical engineers
- Infer the issues in management practices of medical technology
- Illustrate the methods of technology implementation in health care system
- Solve the clinical engineering issues. •
- Apply the patient safety methods in clinical practice

UNIT - I INTRODUCTION

Clinical engineering: Definition, Evolution, Role, Responsibilities, Functional status, History of clinical engineering and Technology in Health Care System, Enhancing patient safety.

UNIT – II MEDICAL TECHNOLOGY MANAGEMENT PRACTICES

Strategic Medical Technology Planning, Scope, Clinical necessity operational support, strategic planning process - Technology assessment: Technology audit, Budget strategies, Prerequist for medical technology assessment -Management Practice for Medical Equipment - Device evaluation, Risk reduction, Asset management, ESHTA.

UNIT - III ESSENTIAL HEALTH CARE TECHNOLOGY PACKAGE (EHTP)

Introduction – Health care technology management – Package development: Methodology, Logical framework, Implementation, Information promotion and dissemination - EHTP Justification - EHTP matrix - EHTP advantages - Impact Analysis.

UNIT - IV CLINICAL ENGINEERING PROGRAM INDICATOR

Clinical engineering: program services, Program database - Clinical Engineering Program management, Program indicator, Managing clinical engineering performance using program indicators – Indicator management process.

9

9

UNIT – V ADVANCED TECHNOLOGY FOR PATIENT SAFETY

9

Factors Contributing to Medical Errors: Heath Care Reimbursement, Health Care Failure Mode and Effect Analysis (HFMEA), Patient Safety Best Practices Model: Bar coding, Computerized Physician Order Entry (CPOE), and Clinical data repositories – Process analysis, Methodology. Computerized medical equipment management systems.

Total periods : 45

TEXTBOOKS:

1. Ernesto Iadanza, Joseph Dyro, Clinical Engineering Handbook, Elsevier, Academic Press, 2014.

REFERENCES:

1. Robert Miniati Clinical Engineering from Devices to Systems Academic Press 23-Dec2015

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
Average)	2.4	1.4	1	-	-	1	-	1	1	1	-	1	2	-

PROFESSIONAL ELECTIVES: HEALTHCARE COMMUNICATION SYSTEMS

B.E Biomedical Engineering

		Elective
23BEBME4E03	ANALOG AND DIGITAL COMMUNICATION	3H-3C

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100

COURSE OBJECTIVES

End Semester Exam:3 Hours

The goal of this course is for students

- To explain the basic principles and techniques used in analog and digital communications.
- To learn and compare analog and digital communication techniques
- To familiarize with source and error control coding and gain knowledge on multi-user radio communication.
- To introduce analytical techniques to evaluate the performance of communication systems.
- To explain the importance of synchronization in communication systems

COURSE OUTCOMES:

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

- Interpret the principles of analog communication systems
- Illustrate the working of digital modulation schemes
- Compare Pulse and data communication
- Summarize the role of error control codes in digital communication
- Analyze the standards of wireless communication systems

UNIT I- ANALOG COMMUNICATION

Noise: Source of Noise – External Noise- Internal Noise – Noise Calculation. 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 various Analog Communication System (AM – FM – PM).

UNIT II- DIGITAL COMMUNICATION

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

UNIT III- DATA AND PULSE COMMUNICATION

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

9

2023-2024

9

UNIT IV -SOURCE AND ERROR CONTROL CODING

Entropy Source encoding theorem, Shannon Fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes, convolution codes, Viterbi decoding algorithm.

UNIT V -MULTI-USER RADIO COMMUNICATION

Advanced Mobile Phone System (AMPS) – Global System for Mobile Communications (GSM) – Code Division Multiple Access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand off – Overview of Multiple Access Schemes – Satellite Communication – Bluetooth

Total Periods : 45

TEXT BOOKS:

1. Kennedy G, Kennedy's Electronic Communication Systems, McGraw Hill, 2014

2. Wayne Tomasi, Electronic Communication Systems: Fundamentals through Advanced Pearson Education, 2014

REFERENCE BOOKS:

- 1. Rappaport T.S, Wireless Communications: Principles and Practice, Pearson Education, 2010
- 2. B. P.Lathi, Modern Analog and Digital Communication Systems, Oxford University Press, 2011

001			U												
COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	1	-
CO5	K4	3	3	2	1	-	1	-	1	1	1	-	1	1	_
Average	e	2.2	1.4	2	1	-	1	-	1	1	1	-	1	1	-

CO-PO MAPPING

9

23BEBME4E04

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES:

The goal of this course is for students:

- To relate the recent trends and need for wearable systems.
- To acquire knowledge on choosing appropriate sensors and signal processing techniques for wearable systems.

WEARABLE DEVICES

- To appraise the knowledge about energy requirement for a wearable system.
- To identify techniques to design modern wearable system. •
- To Compare about sensors and signal processing

COURSE OUTCOMES:

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

- Explain the working of sensors in wearable systems. •
- Illustrate the signal processing techniques for wearable systems.
- Summarize the energy requirement for a wearable system. •
- Infer concepts of health monitoring systems. •
- Develop wearable systems for clinical applications. •

UNIT I SENSORS

Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Radiant thermal sensor, Wearable motion sensors, CMOS, Based Biosensors, E-Textiles, Bio compatibility.

UNIT II SIGNAL PROCESSING

Wear ability issues-physical shape and placement of sensor, Technical challenges-sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, light weight signal processing, Rejection of irrelevant information, Data mining.

UNIT III ENERGY HARVESTING FOR WEARABLE DEVICES

Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT IV WIRELESS HEALTH SYSTEMS

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges-System security and reliability, BAN Architecture, Introduction, Wireless communication techniques.

Elective **3H-3C**

End Semester Exam:3 Hours

Marks: Internal:40 External:60 Total:100

9

9

9

UNIT V APPLICATIONS

Medical Diagnostics, Medical Monitoring- Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics.

Total periods: 45

TEXT BOOKS:

1. Annalisa Bonfiglio, Danilo De Rossi, Wearable Monitoring Systems Springer, 2014

2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkatasubramanian Body Area Networks Safety, Security, and Sustainability, Cambridge University Press2013

REFERENCES:

1. Hang, Yuan-Ting, Wearable medical sensors and systems, Springer, 2013

2. Mehmet R. Yuce, Jamil Y.Khan, Wireless Body Area Networks Technology, Implementation and Applications, Pan Stanford Publishing Pvt. Ltd, 2012

WEBSITES:

- 1. .https://nptel.ac.in/
- 2. https://ocw.mit.edu/

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	2
Average	9	2.2	1.2	1	-	-	1	-	1	1	1	-	1	-	2

		Elective
23BEBME5E03	BODY AREA NETWORKS	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 acquire knowledge about Body Area Networks (BAN)
- To choose the hardwares related to BAN
- To understand about Wireless communication and Network
- To understand the issues associated with BAN
- To infer about the applications of BAN.

COURSE OUTCOMES:

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

- Outline fundamental concepts of body area networks
- Illustrate the working principle of BAN Hardware
- Infer the role of wireless communication network and its standards in BAN
- Summarize the coexistence issues of BAN
- Identify the applications of BAN in medicine

UNIT I INTRODUCTION

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BSN Architecture.

UNIT II HARDWARE FOR BAN

Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory, Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

UNIT III WIRELESS COMMUNICATION NETWORK

RF communication in Body, Antenna design and testing, Propagation, Base Station Network Topology-Stand, Alone BAN, Wireless personal Area Network Technologies IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV COEXISTENCE ISSUES WITH BAN

Interferences, Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues -Medical Device regulation in USA and Asia, Security and Self-protection Bacterial attacks, Virus infection, Secured protocols, Self-protection.

9

9

9

9

2023-2024

UNIT V APPLICATIONS

9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

Total Periods : 45

TEXT BOOKS:

1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2014.

2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkatasubramanian, "Body

Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013.

REFERENCES:

1. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems", Springer, 2013.

2. Guang -Zhong Yang (Ed.), "Body Sensor Networks", Springer, 2006.

3. Mehmet R. Yuce, Jamil Y. Khan, "Wireless Body Area Networks Technology,

Implementation, and applications", Pan Stanford Publishing Pte. Ltd, Singapore, 2012.

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	I
Average	9	2.2	1.2	1	-	-	1	-	1	1	1	-	1	2	-

Elective

23BEBME5E04

VIRTUAL REALITY AND AUGMENTED REALITY IN HEALTHCARE 3H-3C

Instruction Hours/week: L:3 T:0 P:0

End Semester Exam:3 Hours

Marks: Internal:40 External:60 Total:100

COURSE OBJECTIVES:

- To Learn the concepts and principles of virtual and augmented reality
- To Understand VR and AR environment and software
- To infer about Virtual Environment
- To understand the Hardware and Software tools
- To Gain knowledge about the applications for Biomedical Engineering.

COURSE OUTCOMES:

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

- Interpret basic concepts of virtual and augmented reality
- Illustrate the principles of geometric modelling and transformation
- Build Virtual Environment and Augmented Reality systems
- Experiment with the Hardware and Software tools
- Summarize the Virtual Reality applications.

UNIT -I INTRODUCTION TO AUGMENTED REALITY AND VIRTUAL REALITY

Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark. Augmented Reality Concepts: History of Augmented Reality, Multimodal displays: Haptic, Tactile and Tangible Displays, Visual Perception

UNIT – II GEOMETRIC MODELLING

Geometric Modelling: Introduction, From 2D to 3D, 3D space curves, 3D boundary representation. Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection

UNIT - III VIRTUAL ENVIRONMENT AND AUGMENTED REALITY SYSTEMS

Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object inbetweening, free from deformation, particle system. Augmented Reality Systems – Types, Taxonomy of Augmented Reality, Helmet, Headup display, Smart Glasses, Projection

UNIT – IV VR HARDWARE AND SOFTWARE

Human Factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML, Khronos Group – AR Toolkit – Augmented Reality Operating System – Role of Augmented Reality interfaces – Players and Platforms

UNIT - V AV/VR FOR BIOMEDICAL APPLICATIONS

Introduction, Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, Augmenting Dental Care, Virtual Reality for Rehabilitation, Medical Model Generation.

TEXT BOOKS :

1. John Vince, "Virtual Reality Systems", Pearson Education Asia, 2007.

2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", AddisonWesley Professional, 2016.

REFERENCE BOOKS:

1. Anand R., "Augmented and Virtual Reality", Khanna Publishing House, Delhi.

2. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 2000.

3. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley Inter Science, 2nd

Edition, 2006.

4. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application and Design", Morgan Kaufmann, 2008.

5. Jon Peddie, "Augmented Reality – Where We Will All Live", Springer International Publishing AG, 2017.

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
CO4	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
CO5	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
Average	9	2.4	1.4	1	-	-	1	-	1	1	1	-	1	2	-

		Liecuve
23BEBME6E03	TELEMEDICINE	3H-3C
Instruction Hours/week	: L:3 T:0 P:0	Marks: Internal:40 External:60 Total:100

COURSE OBJECTIVES:

The goal of this course is for students:

- To infer the key principles for telemedicine and health.
- To define telemedical technology.
- To build telemedicine standards, mobile telemedicine and it applications.
- To explain the principles of clinical telehealth
- To interpret 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:

- Explain the basic principles of telemedicine.
- Infer the working of communication networks in telemedicine
- Illustrate the rules and regulatory system of telemedicine
- Interpret the concept of image transmission
- Summarize the recent trends in telemedicine

UNIT I - FUNDAMENTALS OF TELEMEDICINE

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.

UNIT II - COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE

Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT III - ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE

Confidentiality, patient rights and consent: confidentiality and the law, the patient doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.

UNIT IV - PICTURE ARCHIVING AND COMMUNICATION SYSTEM

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

9

9

9

Flootivo

End Semester Exam:3 Hours

UNIT V - APPLICATIONS

Teleradiology, Telepathology, Telecardiology, Teleoncology, Teledermatology, Telesurgery, e Health and Cyber Medicine.

Total periods: 45

9

TEXT BOOKS :

- 1. Khandpur R S, TELEMEDICINE- Technology and Applications, PHI Learning Pvt Ltd, 2017
- 2. Norris A C Essentials of Telemedicine and Telecare, John Wiley, New York, 2002

REFERENCE BOOKS:

- 1. H K Huang PACS and Imaging Informatics: Basic Principles and Applications Wiley, New Jersey 2010
- 2. Richard Wootton, John Craig, Victor Patterson Introduction to Telemedicine Taylor & Francis 2017

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO5	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
Average	9	2	1	-	-	-	1	-	1	2	2	-	1	2	-

Elective

9

9

23BEBEBME6E04INTERNET OF THINGS IN HEALTHCARE3H-3CInstruction Hours/week:L:3 T:0 P:0Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for students is

- To Teach the internet concepts and design methodology
- To Teach fundamentals of embedded system
- To Teach importance of embedded and IoT in health care.
- To summarize about design and development of IoT systems.
- To build simple IoT Systems using Arduino and Raspberry Pi.

COURSE OUTCOMES

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

- Explain the fundamentals of Internet of things
- Illustrate the role of embedded system in health care applications.
- Infer the importance of ethical issues in digital health
- Analyse the recent trends in health care system
- Develop the IoT based health care applications

UNIT I INTERNET CONCEPTS AND INFRASTRUCTURE

Broad Band Transmission facilities, Open Interconnection standards, Local Area Networks, Wide Area Networks, Network management, Network Security, Cluster computers. Internet concepts, Capabilities and limitations of the internet. Interfacing Internet server applications to corporate databases HTML and XML Web page design through programming and the use of active components. Data analytics in medical data processing.

UNIT II EMBEDDED SYSTEMS

Generic Embedded Systems Structure- Components of Embedded Systems- Sensors and Actuatorsimportance of Analog/Digital Conversion- Embedded system based physiological monitoring system- Health care innovations using embedded system. Evolution of digital health- challenges and opportunities of digital health importance of digital health

UNIT III ETHICAL ISSUES IN HEALTH CARE

Ethical implications of digital health technologies- privacy, confidentiality and security of personal health data ethical framework and guidelines in digital health, principles of biomedical ethics.

UNIT IV IOT IN HEALTH CARE

IoT based health care- physiological parameter monitoring system- future challenges in health carehealth care echo system with IoT- IoT for personalized health care- wearable device characteristicsanalysis of power aware protocols. Artificial intelligence in health monitoring.

UNIT V STANDARDS FOR E-HEALTH APPLICATIONS

Social network analysis in health care, embedded health care system for senior resident using IoT

Total Periods : 45

TEXTBOOKS:

1. Eugene C. Nelson, Paul B. Batalden, Marjorie M. Godfrey, Quality By Design: A Clinical Microsystems Approach John Wiley & sons 2007.

2. Samuel A. Fricker, Christoph Thuemmler, Anastasius Gavras, Requirements Engineering for Digital Health, Springer 2015.

REFERENCES:

1. Klaus Pohl, HaraldHonninger, Reinhold Achatz, Manfred Broy, Model-Based Engineering of Embedded Systems: The SPES 2020 Methodology, Springer 2012

2. Adrian Mc Ewen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 2013.

3. Andrew S Tanenbaum, "Computer Networks", Pearson Education Pvt Ltd, New Delhi, 4th Edition, 2012.

4. Stallings, William, "Data and computer communications", Pearson Education Pvt Ltd, New Delhi, 2007

WEBSITES:

. 1. https://nptel.ac.in/

2. https://ocw.mit.edu/

001	0 1111		U												
COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO4	K4	3	3	2	1	-	1	-	1	1	1	-	1	-	2
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	2
Average	e	2.4	1.6	1.5	1	-	1	-	1	1	1	-	1	-	2

23BEBME6E09

LASER IN MEDICINE

Elective

2023-2024

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 Know about functioning of a laser system •
- To Learn about the working principle of laser
- To Familiarise the applications of laser in Urology, Gynecology and dentistry •
- To Learn the non- thermal applications of laser in medicine
- To Acquire knowledge on laser safety

COURSE OUTCOMES

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

- Explain the working principle of laser system
- Illustrate on technical aspects of a Laser system
- Interpret the role of laser in medical diagnostic
- Summarize the types of laser therapy
- Identify the laser applications in advanced medicine

UNIT I INTRODUCTION TO LASER SYSTEM

Laser - Definition-Properties of laser-Characteristics of Laser, Construction and working principle of laser system-Mono-chromaticity, Coherence-Directionality, Brightness-Laser Characteristics as applied to medicine and biology-Laser tissue Interaction

UNIT II TYPES OF LASER

Classification of Laser, Solid state Laser Construction- Working principle, Atomic laser Construction-Working principle- Molecular Laser Construction- Working principle, Dye Laser Construction

UNIT III NON-THERMAL DIAGNOSTIC APPLICATIONS

Optical coherence tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and Imaging, FLIM, Holographic and speckle application of lasers in biology and medicine.

UNIT IV THERAPEUTIC APPLICATIONS

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and nononcological applications of PDT - Bio stimulation effect, applications-Laser Safety Procedures, Laser hazards

UNIT V SURGICAL APPLICATIONS OF LASERS

Lasers in ophthalmology- Dermatology, Dentistry-Urology-Otolaryngology-Tissue welding. Applications of Lasers in Orthopedics, Applications of laser in neurology

9

9

TEXT BOOKS:

1. Markolf H. Niemz, "Laser-Tissue Interaction Fundamentals and Applications", Springer, 2019.

REFERENCE BOOK

Paras N. Prasad, "Introduction to Bio photonics", A. John Wiley and sons, Inc. Publications,
2003

0.0-1	U MA		G												
COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
Average	e	2.2	1.2	1	-	-	1	-	1	1	1	-	1	2	-

Instruction Hours/week: L:3 T:0 P:0

23BEBME6E10

BIOMETRIC SYSTEMS

Marks: Internal:40 External:60 Total:100 End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To understand the technologies and general principles of biometric systems.
- To gain knowledge about personal privacy
- To know about security implications of biometrics-based identification technology.
- To utilize the knowledge in face recognition system
- To analyse the concepts of voice biometrics

COURSE OUTCOMES

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

- Explain the performance and characteristics of biometric systems
- Illustrate the image processing techniques used in finger print technology
- Compare the features of biometric recognition models
- Analyze the concept of iris identification system
- Summarize the recent trends in biometric system

UNIT I INTRODUCTION TO BIOMETRICS

Introduction and back ground, biometric technologies, passive biometrics, active biometrics, Biometric characteristics, Biometric applications, Biometric Authentication systems- Taxonomy of Application Environment, Accuracy in Biometric Systems- False match rate- False non-match rate- Failure to enroll rate- Derived Metrics-Biometrics and Privacy.

UNIT II FINGERPRINT TECHNOLOGY

History of finger print pattern recognition-General description of finger prints-finger print sensors, finger print enhancement, Feature Extraction- Ridge orientation, ridge frequency, finger print matching techniques- correlation based, Minutiae based, Ridge feature based, finger print classification, Applications of finger prints, Finger scan strengths and weaknesses, Evaluation of fingerprint verification algorithms.

UNIT III FACE RECOGNITION AND HAND GEOMETRY

Introduction to face recognition, face recognition using PCA, LDA, face recognition using shape and texture, face detection in color images, 3D model-based face recognition in video images, Neural networks for face recognition, Hand geometry, scanning, Feature Extraction, classification.

UNIT IV IRIS RECOGNITION

Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wildes approach, Iris matching, Iris scan strengths and Weaknesses, System performance, future directions.

3H-3C

9

UNIT V MULTIMODAL BIOMETRICS

Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system, Integration strategies, Architecture, level of fusion, combination strategy, examples of multimodal biometric systems, Securing and trusting a biometric transaction, matching location, local host - authentication server, match on card (MOC)

TEXT BOOKS

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: A Machine Learning Approach Prentice Hall 2005

REFERENCE BOOKS

- 1. Paul Reid, Biometrics for Network Security, Pearson Education, 2004.
- 2. Nalini K Ratha, Ruud Bolle Automatic fingerprint Recognition System Springer 2003
- 3. Arun A. Ross, Karthik Nanda Kumar, Anil K. Jain Handbook of Multi biometrics Springer 2006

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K4	3	3	2	1	-	1	-	1	1	1	-	1	2	-
CO5	K3	2	1	-	-	-	1	-	1	1	1	-	1	2	-
Average	9	2.2	1.4	2	1	-	1	-	1	1	1	-	1	2	-

23BEBME7E03

SPEECH PROCESSING

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES

- To understand the fundamentals of speech processing
- To acquire knowledge on speech analysis and different speech modelling procedures.
- To be familiarize with Speech Synthesis Methods and its application.
- Explore various speech models
- To understand concepts of speech recognition

COURSE OUTCOMES

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

- Explain the concept of speech production mechanism
- Illustrate the methods of speech signal processing
- Develop the algorithms for speech signal parameter extraction
- Illustrate the principle of speech recognition models
- Apply speech synthesis methods in real time applications

UNIT I BASIC CONCEPTS

Speech Fundamentals: Articulatory Phonetics, Production and Classification of Speech Sounds; Acoustic Phonetics, Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

UNIT II SPEECH ANALYSIS

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures, mathematical and perceptual, Log, Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization, Dynamic Time Warping, Multiple Time, Alignment Paths.

UNIT III SPEECH MODELING

Hidden Markov Models: Markov Processes, HMMs, Evaluation, Optimal State Sequence, Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

UNIT IV SPEECH RECOGNITION

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system, acoustics and language models, n-grams, context dependent sub-word units; Applications and present status.

3H-3C

2023-2024 Elective

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

9

9

UNIT V SPEECH SYNTHESIS

9

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness, role of prosody, Applications and present status.

TEXT BOOKS

 Daniel Jurafsky and James H Martin, "Speech and Language Processing, An Introduction to Natural Language Processing", Computational Linguistics, and Speech Recognition, Pearson Education, 2019.

2. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 2008

REFERENCE BOOKS

1. Ben Gold and Nelson Morgan, "Speech and audio signal processing, Processing and Perception of Speech and Music", Wiley- India Edition, 2006 Edition.

2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing, Principles and Practice", Pearson Education, 2004

3. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pears Education, 2003.

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	_	1	1	1	-	1	2	-
Average	9	2.4	1.4	1	-	-	1	-	1	1	1	-	1	2	-

2023-2024

23BEBME7E09

COGNITIVE ENGINEERING

Elective 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 Learn the various soft computing frame works
- To Be familiar with design of various neural networks and fuzzy logic
- To Learn genetic programming and hybrid systems
- To understand the concepts of Cognitive Neuroscience,
- To enable design experiments related to Cognitive Engineering

COURSE OUTCOMES

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

- Illustrate the principles of soft computing frame works
- Compare the features of neural networks
- Infer the concepts of Fuzy logic
- Develop genetic algorithm for medical diagnostic applications
- Apply hybrid techniques for biomedical applications

UNIT I INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS

Characteristics- learning methods – taxonomy – Evolution of neural networks- McCulloch-Pitts neuron - linear separability - Hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron. Artificial intelligence in medical applications

UNIT II TYPES OF NEURAL NETWORKS

BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative autoassociative memory network & iterative associative memory network – unsupervised learning networks: Kohonenself organizing feature maps, LVQ – CP networks, ART network. Case studies on biomedical applications

UNIT III FUZZY LOGIC

Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic extension principle – fuzzy measures - formation of rules-decomposition of rules, fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making. Case studies on biomedical applications.

UNIT IV GENETIC ALGORITHM

Genetic algorithm and search space - general genetic algorithm, operators - Generational cycle, stopping condition, constraints. Classification, genetic programming, multilevel optimization, real life problem, Advances in GA. Case studies on biomedical applications using deep learning.

9

9

9
UNIT V HYBRID SOFT COMPUTING TECHNIQUES AND APPLICATIONS

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP. Case studies on biomedical applications. A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers. Case studies on biomedical applications.

9

TEXT BOOKS

1. Laurene V. Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications" Pearson Education, 2010.

2. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.

REFERENCE BOOKS

1. J.S.R.Jang, C.T. Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education 2004.

2. S.Rajasekaran and G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006

3. .Simon Haykin, "Neural Networks Comprehensive Foundation", Second Edition, Pearson Education, 2005.

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
Average	9	2.4	1.4	1	-	-	1	-	1	1	1	-	1	2	-

2023-2024

Elective **3H-3C 23BEBME7E04 BRAIN COMPUTER INTERFACE**

Instruction Hours/week: L:3 T:1 P:0

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

COURSE OBJECTIVES

- To Understand the fundamentals of EEG signal acquisition techniques
- To know about data acquisition for EEG signals
- To Learn the feature extraction methods
- To Design EEG based application
- To familiarize case studies on brain interface

COURSE OUTCOMES

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

- Explain the Concept of BCI
- Illustrate the working of human and computerized system
- Compare future extraction methods
- Model the BCI system for clinical applications
- Examine the diagnosis applications of BCI

UNIT I INTRODUCTION TO BRAIN COMPUTER INTERFACES

Concept of BCI, Invasive and Non-invasive Types, EEG Standards, Signal Features, Spectral Components, EEG Data Acquisition, Pre-processing, Hardware and Software, Artifacts, Methods to Remove, Near Infrared BCI. Machine learning for brain computer interface

UNIT II BCI APPROACHES

Movement Related EEG Potentials, Mental States, Visual Evoked Potential. P300 virtual platform. Design and construction, Interaction between human and computerized technical systems.

UNIT III FEATURE EXTRACTION

Time/Space Methods, Fourier Transform, Wavelets, AR models, Band pass filtering, PCA, Laplacian Filters, Linear and Non-linear Features. Deep learning and artificial intelligence in feature extraction methods

UNIT IV FEATURE TRANSLATION

LDA, Regression, Memory Based Vector Quantization, Gaussian Mixture Modeling, Hidden Markov Modeling

9

9

9

UNIT V APPLICATIONS

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. Non-invasive BCIs: P300 Mind Speller, Visual cognitive BCI, Emotion detection, Ethics of Brain Computer Interfacing

TEXT BOOKS

1. Rajesh.P.N.Rao, Brain-Computer Interfacing: AnIntroduction 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

REFERENCE BOOKS

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.

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
CO5	K4	3	3	2	1	-	1	-	1	1	1	-	1	2	-
Average	•	2.4	1.6	1.5	1	-	1	-	1	1	1	-	1	2	-

B.E Biomedical Engineering		2023-2024
		Elective
23BEBME7E10	COGNITIVE PSYCHOLOGY	3H-3 C
Instruction Hours/week: L:3 T:0 P:0	Marks: Internal:40 Externa	al:60 Total:100
	End Semes	ster Exam:3 Hours

COURSE OBJECTIVES

- To Understand the fundamentals of psychology
- To know about basic neural process
- To Learn the feature of cognitive development
- To know about memory processing
- To familiarize on language and thinking process

COURSE OUTCOMES

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

- Explain the concepts of psychological function of brain
- Illustrate the principle of cognitive learning process
- Interpret the function of memory system
- Summarize the role of linguistics in cognitive science
- Apply creative thinking to solve engineering problems

UNIT I INTRODUCTION

Pre-scientific era, structuralism, functionalism, associationism, behaviourism, gestalt psychology, psychoanalysis, humanistic & extistential psychology, cognitive psychology, fields, emerging fields; Physiological foundations of cognition: peripheral & central nervous systems, impulse transmission, brain imaging & basic neural processes

UNIT II COGNITIVE DEVELOPMENT

During infancy, early childhood, later childhood, adolescence, adulthood & old age, cognitive dissonance and cognitive framework in self-attribution; learning & cognition: basic learning processes- habituation, conditioning: classical & operant, cognitive learning, avoidance learning, punishment, generalization & discrimination, concept learning, verbal, motor learning and transfer of learning

UNIT III MEMORY

Basic neural operations, systems: sensory, STM, organization in STM, working memory, phonological Loop, visuo-spatial sketch pad, LTM, levels of processing, implicit vs. Explicit memory, autobiographical memory, constructive memory, measurement of retention, forgetting, theories, improving memories and loss of memory

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 152

9

9

UNIT IV LANGUAGE & COGNITION

Language elements, meaning & concepts, pragmatics, verbal & nonverbal communication and psycholinguistics; perceptual processes: vision, audition & other senses

UNIT V THINKING

9

Level of processing approach, role of symbols, images & language, concept attainment, problem solving: strategies & stages, reasoning, stages of creative thinking, artificial intelligence.

TEXT BOOKS

1. M. Eysenck and M. T. Keane, Cognitive Psychology: A Student's Handbook, 4 th Ed, Psychology Press, 2000.

2. M. W. Eysenck, Principles of Cognitive Psychology, 2 nd Ed, Psychology Press, 2001.

REFERENCE BOOKS

1. Parker, E. L. Wilding and T. J. Bussey, The Cognitive Neuroscience of Memory, Psychology Press, 2002.

2. Rapp, The Handbook of Cognitive Neuropsychology, Psychology Press, 2000

CO-PO MAPPING

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	2	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	2	-
Average	9	2.2	1.2	1	-	-	1	-	1	1	1	-	1	2	-

PROFESSIONAL ELECTIVES: MEDICAL DEVICE DESIGN AND DEVELOPMENT

B.E Biomedical Engine	eering		2023-2024
			Elective
23BEBME4E05	MEDICAL DEV	VICE DESIGN	3H-3 C
Instruction Hours/wee	k: L:3 T:0 P:0	Marks: Internal:40 E	External:60 Total:100
		End Semester H	Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for students,

- To illustrate the design procedure of medical devices.
- To introduce the medical device standards and requirements.
- To outline the quality assessment in design.
- To describe about the design realization.
- To understand the validation and verification of various medical devices

COURSE OUTCOMES

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

- Summarize the concept of medical device development.
- Analyze the medical device standards
- Illustrate the engineering design and project metrics.
- Apply medical equipment testing and validation
- Interpret the designing and manufacturing techniques of medical devices

UNIT-I NEEDS FINDING AND CONCEPT GENERATION

Strategic Focus – observation and problem identification – Need statement development. Ideation and Brainstorming – concept screening, concept selection: intellectual property basics – reimbursement basics – business models – prototyping – final concept selection. Safety and Risk Management - Tools, Documents and Deliverables.

UNIT-II MEDICAL DEVICES STANDARDS AND REQUIREMENTS

Signal representation, Signal in time and Frequency domain, Signal Estimation, Bioelectric Signals: ECG & EEG, Vital Signs, Biomagnetic Signals.

UNIT-III DESIGN ENGINEERING

Hardware Design, Hardware Risk Analysis, Design and Project Metrics, Design for Six Sigma, Software Design, Software Coding, Software Risk Analysis, Software Metrics.

UNIT-IV TESTING AND VALIDATION

Basis and Types of Testing, Hardware Verification and Data Analysis, Software Verification and Data Analysis.

9

9

9

UNIT-V DESIGN TRANSFER AND MANUFACTURING

9

Transfer to Manufacturing, Hardware Manufacturing, Software Manufacturing, Configuration Management, Intellectual Property-Copy Rights-Trademarks-Trade Secrets. Case Study.

Total periods : 45

TEXTBOOKS:

1. Zenios, Makower and Yock, —Biodesign – The process of innovating medical

technologies, Canbridge University Press, 2009

2. Theodore R. Kucklick, The Medical Device R&D Handbook, Second Edition, CRC Press, 2012.

3. Peter Ogrodnik, Medical Device Design Innovation from Concept to Market, Elsevier, 2013.

REFERENCES:

1. Richard C. Fries and Marcel Dekker AG, Handbook of Medical Device Design, 2ndedition, 2005.

2. Gail Baura, Medical Device Technologies: A Systems Based Overview Using Engineering, Elsevier science, 2012.

3. Matthew Bret Weinger, Michael E. Wiklund, Daryle Jean Gardner-Bonneau'Handbook of Human Factors in Medical Device Design',CRC press,2010.

4. Jagdish Chaturvedi, Inventing medical devices: A perspective from India, Create Space Independent Publishing Platform, 1st edition, 2015.

WEBSITES:

- 1. <u>https://nptel.ac.in/courses/102101068</u>
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO2	K4	3	3	2	1	-	1	-	1	1	1	-	1	-	2
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO4	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	2
CO5	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
Average	e	2.4	1.6	1.5	1	-	1	-	1	1	1	-	1	-	2

23BEBME4E06 APPLIED DESIGN THINKING FOR BIOMEDICAL ENGINEERS 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 tools & techniques of design thinking for innovative product
- To illustrate customer-centric product innovation using on simple
- To use cases Demonstrate development of Minimum usable prototypes
- To outline principles of solution concepts & their evaluation
- To summarize system thinking principles as applied to complex systems

COURSE OUTCOMES

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

- Explain the principles design thinking
- Illustrate clinical customer validations and innovations.
- Interpret the solution concept using the design thinking tools
- Infer the concept of design generation techniques.
- Apply system thinking concepts in medical field.

UNIT-I DESIGN THINKING PRINCIPLES

Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies

UNIT-II END USER-CENTRIC INNOVATION

Importance of customer-centric innovation - Problem Validation and Customer Discovery -Understanding problem significance and problem incidence - Customer Validation. Target user, 218 User persona & user stories. Activity: Customer development process - Customer interviews and field visit

UNIT-III DESIGN THINKING TOOLS

Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design

UNIT-IV CONCEPT GENERATION

Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts

9

9 Isto

9 &

UNIT-V SYSTEM THINKING

Transfer to Manufacturing, Hardware Manufacturing, Software Manufacturing, Configuration Management, Intellectual Property-Copy Rights-Trademarks-Trade Secrets. Medical/ Clinical Case Study.

Total periods : 45

TEXTBOOKS:

1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.

2. Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value.

3. Proposition Design: How to Create Products and Services Customers Want, Wiley

REFERENCES:

1. Donella H. Meadows, (2015), "Thinking in Systems - A Primer", Sustainability Institute.

2. Tim Brown,(2012) "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Harper Business.

WEBSITES:

https://nptel.ac.in/courses/102101068

- 1. https://nptel.ac.in/courses/102105090
- 2. https://www.ideou.com/pages/design-thinking#process
- 3. https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations49f253ca86
- 4. https://blog.forgefor ward.in/product-innovation-rubric-adf5ebdfd356
- 5. https://blog.forgefor ward.in/evaluating-product-innovations-e8178e58b86e
- 6. https://blog.forgefor ward.in/user-guide-for-product-innovation-rubric-857181b253dd
- 7. https://blog.forgefor ward.in/star tup-failure-is-like-true-lie-7812cdfe9b85

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	3
Average		2.2	1.2	1	-	-	1	-	1	1	1	-	1	-	3

2023-2024

23BEBME5E05 INTEGRATED MEDICAL PRODUCT DEVELOPMENT

Elective 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Mark

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 global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

COURSE OUTCOMES

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

- Explain the trends in product development.
- Interpret the requirements and design system.
- Illustrate the functions of design and testing.
- Summarize the sustenance engineering and end-of-life (eol) support.
- Develop the business dynamics in engineering services industry.

UNIT-I BASICS OF PRODUCT DEVELOPMENT

Global Trends Analysis and Product decision - Social Trends - Technical Trends - Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

UNIT-II REQUIREMENTS AND SYSTEM DESIGN

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling -System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT-III DESIGN AND TESTING

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation -Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping -Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

9

9

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 159

UNIT-IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal

UNIT-V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY

The Industry - Engineering Services Industry - Product Development in Industry versus Academia – The IPD Essentials - Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TEXTBOOKS:

1. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.

2. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, "Corporate Strategy – Managing the Business", Author House, 2013.

2. Peter F Drucker, "People and Performance", Butterworth - Heinemann [Elsevier], Oxford, 2004.

3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.

4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013.

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105

CO-PO MAPPING

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	3
Average	9	2.2	1.2	1	-	-	1	-	1	1	1	-	1	-	3

9

Total periods : 45

Elective

2023-2024

23BEBME5E06 SOFTWARE DESIGN TOOLS FOR BIOSENSING AND CONTROL **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 expose to the software tools available for sensor and control system design.
- To understand structural mechanics.
- To study the system characteristics through simulation softwares.
- To familiarize with modelling of physical systems, design and evaluation of control methods and to practice on implementation of simple controllers.
- To infer implementation of controllers in real time.

COURSE OUTCOMES

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

- Select the software design tools for biosensor design.
- Illustrate the structural mechanics of biosensors for medical applications.
- Analyze the software tools for micro bio sensing.
- Apply software tools for designing and control.
- Make use of controllers in real time biomedical applications. •

UNIT-I SOFTWARE TOOLS FOR SENSOR DESIGN

Introduction to history of sensor design software tools, importance and need of software tools. Recent developments in sensor design and analysis software tools. Introduction to COMSOL Multiphysics.

UNIT-II STRUCTURAL MECHANICS

Analysis of mechanical structures to static or dynamic loads. Stationary, transient, eigen mode/modal, parametric, quasi-static and frequency-response analysis. Electrical: AC/DC Module for simulating electric, magnetic, and electromagnetic fields in static and low-frequency applications. Design and simulation of biosensors and bioactuators using COMSOL.

UNIT-III SOFTWARE TOOLS FOR MICRO SENSOR DESIGN

Introduction to IntelliSuite, mechanism design, development of sensors and actuators. Introduction to Coventorware, Description of main modules, Architect, Designer, Analyzer and Integrator. System-level and physical-level design approaches. Introduction to meshing and result visualization. Design and simulation of sensors using Coventorware. Application in Biosensors design.

UNIT-IV SOFTWARE TOOLS FOR CONTROL DESIGN

Introduction to MATLAB, Simulink and Scilab. Introduction to toolboxes. Control design problems using classical control. Control design problems using state space approach.

9

9

UNIT-V IMPLEMENTATION OF CONTROLLERS IN REAL TIME

Introduction to various hardware platforms, control design and implementation for electrical/mechanical/electromechanical/chemical processes using dSPACE, LabVIEW and OPAL-RT. Example Biomedical applications.

Total periods : 45

TEXTBOOKS:

1. Roger W. Pryor, Multiphysics Modeling Using COMSOL®: A First Principles Approach, Jones and Bartlett Publishers, 1st Edition, 2011.

2. Tamara Bechtold, Gabriela Schrag and Lihong Feng, System-level Modeling of MEMS, Wiley-VCH Verlag GmbH & Co, 1st Edition, 2013.

3. Holly Moore, MATLAB for Engineers, Pearson Education, 5th Edition, 2017.

REFERENCES:

1. Mehrzad Tabatabaian, COMSOL 5 for Engineers, Mercury Learning & Information, 1st Edition, 2015. 2. S R Otto and J P Denier, An Introduction to Programming and Numerical Methods in MATLAB,

Springer-Verlag, 1st Edition, 2005.

3. Amos Gilat, MATLAB – An Introduction with Applications, John Wiley & Sons, Inc., 5th Edition, 2014.

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K3	3	2	1	-	1	1	-	1	1	1	-	1	-	3
CO2	K2	2	1	-	-	1	1	-	1	1	1	-	1	-	3
CO3	K4	3	3	2	1	1	1	-	1	1	1	-	1	-	3
CO4	K3	3	2	1	-	1	1	-	1	1	1	-	1	-	3
CO5	K3	3	2	1	-	1	1	-	1	1	1	-	1	-	3
Average	9	2.8	2	1.2	1	1	1	-	1	1	1	-	1	-	3

2023-2024 Elective

23BEBME6E04 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 understand the fundamentals and the codes of medical ethics
- To acquire an idea about intellectual property rights
- To get an idea about patents
- To get an idea about copyrights
- To develop an overall idea about trademarks and geographical indicators

COURSE OUTCOMES

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

- Outline the importance of medical ethics
- Infer the fundamentals of Intellectual Property Rights.
- Illustrate the principles and protocols of patents
- Interpret the process of copyrights
- Summarize the concepts of trademarks and geographical indication

UNIT-I CLINICAL TRIALS

Definition and historic evolution of bioethics - Definition and historic evolution of bioethics - Medical ethics:some basic issues - Teaching and learning medical ethics - Codes of conduct - Rights of patients - Rights of patients - Malpractice - Negligence - Care of the terminally ill - Distributive Justice in Health Care – Human experimentation and Clinical trials.

UNIT-II INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS

Introduction to Intellectual Property Rights - History of IPR - Importance and need for protection of intellectual property - Importance and need for protection of intellectual property - Patentable subject matter - Emerging trends and issues in IPR - Emerging trends and issues in IPR - Public Vs. Private - Public Vs. Private - World Intellectual Property Organization(WIPO) - World Trade Organisation (WTO) - General Agreement on Tariffs and Trade(GATT) agreement - Major Conventions on IP - Berne Convention - Paris Convention - TRIPS agreement - Basic forms of intellectual property rights.

UNIT-III PATENTS

Definition of patents - Purpose of a patent - What sort of things can be patented, Patentable and non-patentable inventions – What sort of things can be patented, Patentable and non-patentable inventions - Invention vs Innovation - Process Patent - Product Patent – Types of patent applications - Precautions while patenting - Patent specification, Patent claims - Disclosures and non-disclosures, Patent rights and infringement, Rights of a patent owner – Patent cooperation treaty - Paris convention for the protection of industrial property - Paris convention for the protection of industrial property

9

9

UNIT-IV COPYRIGHTS

What is copyright - Why copyright - Literature and artistic works - Literature and artistic works - Protection of copyright - Protection of copyright - Right of public performance- broadcasting, translation, Adaptation- Transfer of copyright - Transfer of copyright - Transfer of copyright - International conventions and treaties- Works that are protected by copyright.

UNIT-V TRADEMARKS AND GEOGRAPHICAL INDICATORS

Trademark and purpose of a trademark - Characteristics of trademark - Functions of trademarks – Guidelines for the registration of a trademark - Nontraditional trademarks - Major types of trademarks - Protection of a trademark, Purpose of a trademark – Madrid system for the International registration of trademarks - Industrial design-Purpose of industrial design - Protection of industrial design The Hague agreement Geographical indication - Appellation of origin - Protection of geographical indication(GI) – Protection of geographical indication(GI).

Total periods : 45

TEXTBOOKS:

1. Ramakrishna B and Anil Kumar H S, 'Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers', Notion Press, 2017.

2. C M Francis, Medical Ethics, Second Edition, Jaypee Brothers, 2004.

REFERENCES:

1. Chawla H S, Introduction To Intellectual Property Rights, Oxford and IBH Publishing, 2020.

WEBSITES:

- 1. <u>https://nptel.ac.in/courses/102101068</u>
- 2. https://nptel.ac.in/courses/102105090

CO-PO MAPPING

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO5	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
Average	9	2	1	-	-	-	1	-	1	1	1	-	1	-	2

2023-2024

Elective

3H-3C

23BEBME6E06 BIOMIMETICS

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 fundamentals of biomimetics and its applications and study the concepts of biomimetic materials and process
- To acquire an idea about the mechanism of cognition and open ended design automation
- To utilize the basic concepts of bio-inspired sensors and actuators
- To employ the skills about the biomimetics of human motion
- To get an overall idea about the application of biomimetic technologies

COURSE OUTCOMES

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

- Explain the concepts of biomimetic mechanism.
- Infer the mechanical aspects of cognition morphology
- Summarize the importance of sensors and actuators
- Illustrate the concepts in the biomechanics of motion
- Outline the application of biomimetic technologies.

UNIT-I INTRODUCTION TO BIOMIMETICS

Introduction : Biologically Inspired Mechanisms, Introduction : Biologically Inspired Mechanisms, Biologically Inspired Structures and Parts, Defense and Attack Mechanisms in Biology, Materials and Processes in Biology, Bio-Sensors. Robotics Emulating Biology- Robotics Emulating Biology, Muscle function, Muscle design, Muscle adaptation, Biomimetics of muscle design, Bio-inspired fiber composites.

UNIT-II MECHANISM OF COGNITION AND OPEN ENDED DESIGN AUTOMATION 9

Mechanized Cognition, Training and Education, Language Cognition, Sound Cognition, Visual Cognition, Machine Bodies and Brains: Evolving Controllers and Some Aspects of the Morphology, Evolving Bodies and Brains, Morphology Representations: Tree representations Developmental representations, Regulatory network representations, Evolving Machines in Physical Reality, Economy of Design Automation, Principles of Design, Research Methodology.

UNIT-III BIO-INSPIRED SENSORS AND BIOMIMETIC ACTUATORS

Biomimetic tactile sensing:Human sense of touch, Biomimetic artificial touch, Examples of bio-inspired tactile sensing, Bio-Inspired hair based interial sensors: Hair structures for inertial sensing, Cricketinspired accelerometer, Fly-inspired gyroscope, Olfactory sensor system for the e-nose, Olfactory classification-data processing, Polymer network actuators, Biomimetic vision systems, Novel biomimetic materials :Introduction, Design of self-oscillating polymer gel, Control of self-Oscillating chemomechanical behaviors, Design of biomimetic soft actuators, Design of autonomous mass transport systems, Self-oscillating fluids.

9

UNIT-IV BIOMIMETICS OF MOTION

Biomechanics of motion: Control center, Passive & Active external and internal actuation, Agonist Mechanism: Hygroscopic mechanism, Agonist Mechanism: Hygroscopic mechanism, Muscular Antagonism, Power amplification: Elastic amplification, Deformation of a constant volume, Mechanics of hydrostatic systems: Single compartment systems, Multiple compartment systems, Rhythmics of motion: Gait, Passive Locomotion, Limbless locomotion, Multiple limb locomotion.

UNIT-V APPLICATION OF BIOMIMETIC TECHNOLOGIES

Artificial intelligence through symbolic connectionism, Localist symbolic connectionism, Distributed symbolic connectionism, Symbolic connectionism in biological models, Neurofuzzy systems, Bio-Inspired adhesion technologies, Bio-Inspired adhesion technologies, Size and current technology, Quadruped robot system: Mechanical components, Electrical components of quadruped robot, Biologically inspired antenna array design Biologically inspired antenna array design.

Total periods : 45

TEXTBOOKS:

1. Yoseph Bar-Cohen, "BIOMIMETICS Biologically Inspired Technologies", CRC Press, 1 st Edition, 2006.

2. Trung Dung Ngo, "Biomimetic Technologies: Principles and Applications", Wood head Publishing Ltd, 1 st Edition, 2015.

REFERENCES:

1. Sandra Persiani, "Biomimetics of Motion: Nature-Inspired Parameters and Schemes for Kinetic Design", Springer, 1 st Edition, 2019.

2. P Gruber, D Bruckner, C Hellmich, · H B. Schmiedmayer, H. Stachelberger, I C. Gebeshuber, "Biomimetics – Materials, Structures and Processes Examples, Ideas and Case Studies", Springer, 1 st Edition, 2011

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

CO-PO MAPPING

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
CO5	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	2
Average	9	2	1	-	-	-	1	-	1	1	1	-	1	-	2

9

2023-2024

Elective 3H-3C

23BEBME6E11 RAPID PROTOTYPING

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 learn the need and fundamentals of rapid prototyping
- To understand the concepts of design and assembling of various parts
- To study the process and material selection for UV and Laser based AM
- To investigate the process of fused deposition moulding and sheet lamination
- To explore droplet formation and beam deposition process

COURSE OUTCOMES

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

- Explain the principle of protype developing process
- Interpret the assembly techniques for the desired task.
- Summarize the SLA techniques.
- Illustrate the process of fused deposition in sheet lamination
- Analyze the phases in printing process

UNIT-I INTRODUCTION

Overview –Need -Development of Additive Manufacturing Technology -Principle – AM Process Chain-Classification –Rapid Prototyping-Rapid Tooling –Rapid Manufacturing – Applications Benefits –Case studies.

UNIT-II DESIGN FOR ADDITIVE MANUFACTURING

Design tools: Data processing -CAD model preparation –Part orientation and support structure generation –Model slicing –Tool path generation-Design for Additive Manufacturing: Concepts and objectives-AM unique capabilities –DFAM for part quality improvement-Customised design and fabrication for medical applications.

UNIT-III PHOTO POLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Photo polymerization: SLA-Photo curable materials –Process -Advantages and Applications. Powder Bed Fusion: SLS-Process description –powder fusion mechanism –Process Parameters – Typical Materials and Application. Electron Beam Melting.

UNIT-IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES

Extrusion Based System: FDM-Introduction –Basic Principle –Materials –Applications and Limitations –Bio extrusion. Sheet Lamination Process: LOM-Gluing or Adhesive bonding –Thermal bonding.

UNIT-V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES

Droplet formation technologies –Continuous mode –Drop on Demand mode –Three Dimensional Printing –Advantages –Bioplotter -Beam Deposition Process: LENS-Process description –Material delivery –Process parameters –Materials –Benefits –Applications.

9

9

9

TEXTBOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, World Scientific Publishers, Third edition, 2010.

2. Liou L.W. and Liou F.W., Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2007.

3. Kamrani A.K. and Nasr E.A., Rapid Prototyping: Theory and practice, Springer, 2006.

REFERENCES:

1. Ian Gibson, David W.Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.

2. Tom Page Design for Additive Manufacturing, LAP Lambert Academic Publishing, 2012.

3. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

WEBSITES:

- 1. <u>https://nptel.ac.in/courses/102101068</u>
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	2
CO2	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	2
CO3	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	2
CO4	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	2
C05	K4	3	3	2	1	2	1	-	1	1	1	-	1	-	2
Average	9	2.8	1.4	2	1	2	1	-	1	1	1	-	1	-	2

2023-2024 Elective

3H-3C

23BEBME6E12 ROBOTICS AND AUTOMATION IN MEDICINE

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 mechanism of robotic subsystems.
- To gain knowledge on design, analysis and working principle of robotics in medical field.
- To outline the actuators and grippers.
- To describe about the manipulators & basic kinematics.
- To understand the power sources and sensors

COURSE OUTCOMES

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

- Outline the concept of robotics.
- Illustrate the testing and validation of actuators and grippers.
- Solve forward and inverse kinematic problems.
- Infer the principle of sensors with power source in robotics.
- Develop the robotic system applications in medical field.

UNIT-I INTRODUCTION OF ROBOTICS

Introduction to Robotics and its history, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Automation, Mechanisms and movements, Dynamic stabilization- Applications of robotics in medicine

UNIT-II ACTUATORS AND GRIPPERS

Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, Design consideration in vacuum and other methods of gripping, PD and PID feedback actuator model.

UNIT-III MANIPULATORS & BASIC KINEMATICS

Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems.

UNIT-IV POWER SOURCES AND SENSORS

Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors, laser range finder, variable speed arrangements, Path determination - Machinery vision, Ranging, Laser- Acoustic, Magnetic fiber optic and Tactile sensor.

UNIT-V ROBOTICS IN MEDICINE

Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric-, and General- Surgery, Gynecologic Surgery, General Surgery and Nano robotics.

9

9

9

9

TEXTBOOKS:

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2018.

2. Reza N.Jazar, Theory of Applied Robotics Kinematics, Dynamics and Control, Springer, First Indian Reprint 2016.

3. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and Sons, First edition, 2015.

REFERENCES:

1. Jacob Rosen, Blake Hannaford & Richard M Satava, "Surgical Robotics: System Applications & Visions", Springer 2011.

2. Constantinos Mavroidis, Antoine Ferreira, "Nanorobotics: Current approaches and Techniques", Springer 2011.

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	3
CO2	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	3
CO3	K3	3	2	1	-	2	1	-	1	1	1	-	1	-	3
CO4	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	3
CO5	K3	3	2	1	-	2	1	-	1	1	1	-	1	-	3
Average	e	2.4	1.4	1	-	2	1	-	1	1	1	-	1	-	3

Elective

22BEBME7E05 GRAPHICAL SYSTEM DESIGN FOR BIOMEDICALENGINEERS 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 basics of Programming Techniques
- To learn the data acquisition and control of a device by interfacing to a computer.
- To design virtual instruments for various biomedical measurements and applications.
- To describe about the design realization.
- To understand the validation and verification of various medical devices

COURSE OUTCOMES

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

- Explain the Concept of LabVIEW programming.
- Apply the front panel and block diagram objects of VIs software in simple program.
- Interpret the functions of data communication and synchronization.
- Build signal processing VIs using LabVIEW.
- Apply virtual instrumentation for biomedical applications.

UNIT-I LABVIEW PROGRAMMING PRINCIPLES & ENVIRONMENT

Data flow – Definition, and importance of data flow in LabVIEW – Identify programming practices that enforce data flow in block diagram, Virtual instrumentation (VI), and sub-VIs - Identify programming practices that break data flow – Polymorphism - Define polymorphism - Identify benefits of polymorphism - Determine output or intermediate values of data elements in VI that utilizes polymorphic inputs LabVIEW Environment -Front panel window, block diagram, and connector pane - Identify which types of VIs do not have a block diagram - Identify the purpose of the connector pane and icon – Palettes

UNIT-II SOFTWARE CONSTRUCTS & PROGRAMMING FUNCTIONS

Front panel window and block diagram objects - Controls, indicators, IO controls, and refnums - Property Nodes - Data types and data structures - Working with objects and data types on front panel windows – Program control structures and data storage - Flat and Stacked sequence structures - Event structures-FormulaNode - Arrays and clusters.

UNIT-III DATA COMMUNICATION & SYNCHRONIZATION

Local, global, and shared variables – Data Socket - TCP and UDP – Synchronization – Notifiers – Queues -VI Server - configuring the VI Server - Error handling VIs and functions - Debugging tools and techniques

UNIT-IV VIRTUAL INSTRUMENTATION (VI) DESIGN & SUBVI DESIGN TECHNIQUES

Simple state machine - User interface event handler - Queued message handler - Producer/consumer (data) and producer/consumer (events) - Functional global variables - Connector panes and connection types - Polymorphic subVIs - Options related to subVIs - Error handling – User interface design and block diagram layout - Modular and hierarchical design - SubVI icons and connector pane layout (standard) - VI properties Documenting VIs.

9

9

9

UNIT-V Applications

9

Applications of LabVIEW in displaying and monitoring vital parameters, Biomedical signal processing, controlling assistive devices.

Total periods : 45

TEXTBOOKS:

S. Sumathi, P.Surekha, "LabVIEW based Advanced Instrumentation Systems", Springer 2007.
Gary Jonson, 'LabVIEW Graphical Programming', McGraw Hill, New York, Fourth edition 2006.

REFERENCES:

1. Jon B Olansen and Eric Rosow, "Vitrual Bio-Instrumentation Biomedical, Clinical and Healthcare Applications in LabVIEW" 2001.

2. Rick Bitter, TaqiMohiuddin, Matt Nawrocki "LabVIEW: Advanced Programming Techniques" Second Edition, CRC press, 2007.

3. Lisa K. Wells & Jeffrey Travis, 'LabVIEW for Everyone', Prentice Hall Inc., First edition 1997.

4. S. Gupta, J.P. Gupta, 'PC interfacing for Data Acquisition & Process Control', Instrument Society of America, Second Edition, 1994.

WEBSITES:

1. https://nptel.ac.in/courses/102101068

2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	3
CO2	K3	3	2	1	-	2	1	-	1	1	1	-	1	-	3
CO3	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	3
CO4	K3	3	2	1	-	2	1	-	1	1	1	-	1	-	3
CO5	K3	3	2	1	-	2	1	-	1	1	1	-	1	-	3
Average	9	2.6	1.3	1	-	2	1	-	1	1	1	-	1	-	3

23BEBME7E06 MEDICAL SENSORS - MEMS & NEMS Instruction Hours/week: L:3 T:0 P:0 Marks:

COURSE OBJECTIVES

The goal of this course is for students,

- To understand the in depth and quantitative view of medical sensors and its characteristics
- To acquire knowledge of the current state of the art to micro sensor fabrication methods
- To apply the tools to design and development of sensors for the medical applications
- To describe about the medical sensors.
- To understand the validation and verification of software tools

COURSE OUTCOMES

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

- Explain the working principle of medical sensors
- Choose the design tools for product testing
- Identify the micro sensor and materials for device fabrication
- Infer the relevant challenges in the sensor design.
- Model the micro system for medical application.

UNIT-I CLASSIFICATION OF MEDICAL SENSORS

Sensors for Pressure Measurement- Sensors for Motion and Force Measurement- Sensors for Flow Measurement -Temperature Measurement- Sensors for speed, torque, vibration- smart sensors, design of interface system. Artificial intelligence in sensor technology.

UNIT-II MICROSYSTEM DESIGN

Technological Breakthrough, Dielectrics for Use in MEMS Applications, Piezoelectric Thin Films for MEMS Applications, Modelling of Piezoelectric MEMS, Interface Circuits for Capacitive MEMS Gyroscope, Advanced MEMS Technologies for Tactile Sensing and Actuation, MEMS-Based Micro Hot-Plate Devices, Inertial Sensor. Design of microsystem for sensing and control. Case study. Machine Learning tools in system design and analysis.

UNIT-III MATERIAL FOR MEMS AND NEMS WITH FABRICATION METHODS 9

Working principle of Microsystems, materials for MEMS and Microsystems, micromachining, System modelling, Properties of materials, Synthesis, selection and characteristics of materials. Artificial intelligence in material characteristics. Clean room, microfabrication methods, Lithography, epitaxy, sputtering, deposition, surface and bulk

micromachining.

UNIT-IV MEDICAL SENSORS

Mechanical sensors and actuators – beam and cantilever, piezoelectric materials, thermal sensors and actuators- micromachined thermocouple probe, Peltier effect, heat pumps, thermal flow sensors, micro gripper microlens, microneedle, micropumps-Testing of the performance using software tools. Deep learning in actuator design and analysis. Applications of Optimization tools.

3H-3C

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

9

9

UNIT-V SOFTWARE TOOLS

Modeling and design, using MatLab, Design of sensors, pressure sensor, vibration sensor, actuators Analysis using solvers, MatLab, Comsol, mechanical solver, electrical solver. Machine learning tools in design and analysis

Total periods : 45

TEXTBOOKS:

1. VikasChoudhary, Krzysztof Iniewski, "MEMS: Fundamental Technology and Applications", CRC Press, UK, 2017.

2. Tatsuo Togawa; Toshiyo Tamura; P. Ake Oberg, "Biomedical Sensors and Instruments", CRC Press, UK 2011.

REFERENCES:

1. Octavian Adrian Postolache and Subhas Chandra Mukhopadhyay, "Sensors for Everyday Life: Healthcare Settings (Smart Sensors, Measurement and Instrumentation), CRC Press, 2017.

2. Gabor Harsanyi, "Sensors In Biomedical Applications: Fundamentals, Technology & Applications", CRC Press, USA, 2000.

3. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002.

4. Marc J. Madou 'Fundamentals of Microfabrication: The Science of Miniaturization', CRC Press, 2002.

5. Mohammad Ilyas, Imad Mahgoub, "Handbook of Sensor Networks Compact Wireless and Wired Sensing Systems" CRC Press, USA. 2005.

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

	r	1	r	r	r	r	1	r	r	1	r		r	r	·
COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	3
CO2	K3	3	2	1	-	2	1	-	1	1	1	-	1	-	3
CO3	K3	3	2	1	-	2	1	-	1	1	1	-	1	-	3
CO4	K2	2	1	-	-	2	1	-	1	1	1	-	1	-	3
CO5	K3	3	2	1	-	2	1	-	1	1	1	-	1	-	3
Average	9	2.8	2.2	1.5	-	2	2	-	1	1	1	-	1	-	3

23BEBME7E11 QUALITY CONTROL FOR BIOMEDICAL 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 students,

- To utilize Quality, Quality control measures essential for an organization
- To Utilize the quality management principles and good management practices •
- To outline the various quality control tools. •
- To describe about the various quality management tools.
- To analyze the various standards applicable to healthcare globally and nationally
- To understand the Implement the global standards in healthcare

COURSE OUTCOMES

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

- Explain the quality management principles.
- Illustrate the medical devices standards and requirements. •
- Interpret the concepts of statistical process control. •
- Infer the parameters for quality management. •
- Apply the standards in medical device applications. •

UNIT-I INTRODUCTION TO QUALITY

Quality: Terminologies – Dimensions of Quality – Quality Planning. Basic concepts of Total Quality Management - Principles of TQM, Leadership - Concepts: Role of Senior Management - Quality Council – Quality Council – Strategic Planning Barriers to TQM Implementation.

UNIT-II MEDICAL DEVICES STANDARDS AND REQUIREMENTS

Customer satisfaction – Customer Perception of Quality, Customer Complaints – Service Quality – Customer Retention, Employee Involvement Motivation Empowerment Teams Team Work Recognition and Reward Recognition and Reward.

UNIT-III STATISTICAL PROCESS CONTROL

The seven tools of quality, Cause-and-effect diagram - Check sheet - Control chart Histogram - Pareto chart – Scatter diagram – Stratification – Six sigma.

UNIT-IV TQM TOOLS

Benchmarking - Reasons to Benchmark - Benchmarking Process - Quality Function Deployment (QFD) – House of Quality – QFD Process – Benefits Total Productive Maintenance (TPM) – Concept – Improvement Needs – FMEA Stages of FMEA.

9

9

9

UNIT-V STANDARDS FOR MEDICAL DEVICES

Standards, Need for standards, Types – Medical device safety – Medical device quality management systems requirements ISO 9000:2000 Quality System – Clauses – FDA Functions – ASTM International – Description – CE – CE marking – IEC – Specifications.

Total periods : 45

TEXTBOOKS:

1. Rose J.E, Total Quality Management, Kogan Page Ltd., 1993

2. Cesar A. Cacere, Albert Zana, The Practise of clinical Engineering, Academic Press, 1997

3. Greg Bounds, Beyond Total Quality Management-Toward the emerging paradigm, McGraw Hill, 2013.

REFERENCES:

1. Joseph J.Carr, Elements of Electronics Instrumentation and Measurement, 2nd ed., Pearson Education, 2003.

2. Jerrold T. Bushberg, John M. Boone, The essential physics of medical imaging, 3rd ed., Lippincott Williams & Wilkins, 2011.

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	3
Average)	2.2	1.2	1	-	-	1	-	1	1	1	-	1	-	3

CO-PO MAPPING

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES

The goal of this course is for students,

- To understand the needs for wearable devices and the technology
- To learn the concepts in digital health care and digital hospitals
- To apply the tools in design, testing and developing digital health care equipment.
- To describe about the digital health. •
- To understand the standards for interoperability.

COURSE OUTCOMES

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

- Explain the technology for wearable healthcare devices.
- Interpret the concepts of digital radiology.
- Select the modality for e-health.
- Utilize the ethical standards in digital health.
- Summarize the recent trends in e-health system. •

UNIT-I WEARABLE DEVICES AND M-HEALTH CARE

Introduction to mobile health caredevices-economy-average length of stay in hospital, outpatient care, health care costs, mobile phones, 4G, smart devices, wearable devices, Uptake of e-health and m-health technologies. Standards, system Design and case study.

UNIT-II DIGITAL RADIOLOGY

Digital radiology for digital hospital, picture archiving and communication, system integration, digital history of radiology, medical image archives, storage and networks.

UNIT-III E-HEALTH & MODALITY

Health care networking, medical reporting using speech recognition, physiological tests and functional diagnosis with digital methods, tele-consultation in medicine and radiology. Multimodality registration in daily clinical practice. Mobile healthcare.

UNIT-IV DIGITAL HEALTH

Requirements and best practices, Laws and regulations in Digital health, Ethical issues, barriers and strategies for innovation.

UNIT-V STANDARDS FOR INTER OPERABILITY

Selection and Implementation in e-Health project, design of medical equipment based on user needs. Security and privacy in digital health care.

Total periods : 45

HEALTHCARE SYSTEM DESIGN **23BEBME7E12**

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

9

9

9

9

9

2023-2024 Elective

3H-3C

TEXTBOOKS:

1. Wlater Hruby, "Digital revolution in radiology – Bridging the future of health care, second edition, Springer, New York. 2006.

2. Christoph Thuemmler, Chunxue Bai, "Health 4.0: How Virtualization and Big Data are Revolutionizing Healthcare", Springer, 1st ed. 2017.

3. Samuel A. Fricker, Christoph Thümmler, Anastasius Gavras, "Requirements Engineering for Digital Health", Springer, 2015.

REFERENCES:

1. Rick Krohn (Editor), David Metcalf, Patricia Salber, "Health-e Everything: Wearables and The Internet of Things for Health, ebook. 2013.

2. Khandpur,R.S,"Handbook of Biomedical Instrumentation ",Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003

3. John, G. Webster. Medical Instrumentation: Application and Design. Second Edition. Wiley Publisher, New Delhi. 2013.

WEBSITES:

- 1. https://nptel.ac.in/courses/102101068
- 2. https://nptel.ac.in/courses/102105090

COs / POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO2	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	3
CO3	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	3
CO4	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	3
CO5	K2	2	1	-	-	-	1	_	1	1	1	-	1	-	3
Average	9	2.4	1.4	1	-	-	1	-	1	1	1	-	1	-	3

LIST OF OPEN ELECTIVES SCIENCE AND HUMANITIES

23BESHOE01/23BTSHOE01 MASS COMMUNICATION 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

- Outline the basic concepts of communication and its types.
- Extend the knowledge with process of mass communication and their relevance.
- Explain the functions of mass communication with real time experience.
- Utilize the mass communication theories in media communication.
- Plan research proposals using international concepts in mass communication.

COURSE OUTCOMES

On completion of the course, student will be able to

- Identify the difference between various types of communication.
- Build the experience in the process of mass communication.
- Demonstrate the functions of mass communication.
- Relate the concepts of mass communication theories with real life situation.
- Identify the impact of media theory in international communication.

UNIT I BASIC CONCEPTS OF COMMUNICATION

Communication: Nature and process of human communication, functions of communication, verbal and non- verbal communication, intra-personal, inter-personal, small group, public and mass communication.

UNIT II MASS COMMUNICATION

Nature and process of mass communication, media o f mass communication, characteristics and typology of audiences. Social Functions of Mass Communication, Scope of Mass Communication.

UNIT III FUNCTIONS OF MASS COMMUNICATION

Functions of Mass Communications – Surveillance, Correlation, Cultural transport, Marketing Mass Culture- Evaluate the impact of issues of media monopoly.

UNIT IV MEDIA THEORY

Communication Theories: Authoritarian; Libertarian; Socialistic; social-responsibility; Normative theories; Development media theory; Democratic participation media theory.

UNIT V FOLK MEDIA AND INTERNATIONAL COMMUNICATION THEORY

Folk Media and Electronic Media; International Communication Theories: World Systems, Dependency and Structural Media Monopoly – Cross Media Ownership.

TEXT BOOKS

1. Mass Communication in India - By Keval J. Kumar, 1994

2. Mass Communication Theory: Foundations, Ferment and Future – By Stanley J. Baran and Dennis K. Devis, 2015.

3. Introduction to Communication Studies – By John Fiske, 2010.

4. Mcquail"s Mass Communication Theory – By Denis Mcquail, 2010.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	2	-	-	-	-	-	2	2	2
Avg	3	2.4	2	2	-	2	-	-	-	-	-	2	2	2

23BESHOE02/23BTSHOE02 FUZZY MATHEMATICS 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 for students is to

- Understand basic knowledge of fuzzy sets and fuzzy logic
- Apply basic knowledge of fuzzy operations.
- Know the basic definitions of fuzzy relations
- Apply basic fuzzy inference and approximate reasoning
- Know the applications of fuzzy Technology.
- Provide a firm basis for further reading and study in the subject.

COURSE OUTCOMES

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

- To gain the main subject of fuzzy sets.
- To understand the concept of fuzziness involved in various systems and fuzzy set theory.
- To gain the methods of fuzzy logic.
- To comprehend the concepts of fuzzy relations.
- The Engineers will have an exposure on various topics such as fuzzy algebra, fuzzy theory and fuzzy technology.
- Apply the basic knowledge of Mathematics in Engineering fields.

UNIT I FUZZY SETS

Fuzzy Sets: Basics Classical sets vs Fuzzy Sets – Need for fuzzy sets – Definition and Mathematical representations – Level Sets – Fuzzy functions - Zadeh"s Extension Principle

UNIT II OPERATIONS ON FUZZY SETS

Operations on Fuzzy Sets Operations on [0,1] – Fuzzy negation, triangular norms, tco norms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations

UNIT III FUZZY RELATIONS

Fuzzy Relations Fuzzy Binary and n-ary relations – composition of fuzzy relations – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Relational Equations

UNIT IV FUZZY MEASURES

Possibility Theory Fuzzy Measures – Evidence Theory – Necessity and Belief Measures – Probability Measures vs Possibility Measures

9

9

9

UNIT V FUZZY INFERENCE

Approximate Reasoning Fuzzy Decision Making - Fuzzy Relational Inference – Compositional rule of Inference - Efficiency of Inference - Hierarchical

SUGGESTED READINGS

- 1. George J Klir and Bo Yuan,(2003) Fuzzy Sets and Fuzzy Logic : Theory and Applications, Prentice Hall of India, New Delhi.
- 2. Zimmermann H.J.(2001) Fuzzy Set Theory and its Applications, Kluwer Academic publishers, USA.
- 3. Michal Baczynski and BalasubramaniamJayaram,(2008) Fuzzy Implications, Springer-Verlag publishers, Heidelberg.
- 4. Kevin M Passino and Stephen Yurkovich,(1998) Fuzzy Control, Addison Wesley Longman publishers,USA.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	2	-	-	-	-	-	2	2	2
Avg	3	2.4	2	2	-	2	-	-	-	-	-	2	2	2

CO-PO MAPPING

9

Total: 45

23BESHOE03/23BESHOE03 MATERIAL SCIENCES

COURSE OBJECTIVES

The goal of this course for the students is to

- Inculcate the fundamental principles and concepts of magnetic materials for different engineering applications.
- Impart basic knowledge of superconductivity and associated applications.
- To serve the fundamental concepts of dielectric materials for diverse applications in energy engineering.
- Divulge the basics of crystals, their structures and different crystal growth techniques.
- Make the students familiar in the fundamentals of ceramics, composites and nonmaterial"s.

COURSE OUTCOMES

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

- Students accumulate the knowledge on the basics of magnetic materials and its applications.
- Gain knowledge on the concepts of superconductivity, devices and their applications.
- Clarity on the concepts of dielectric properties of materials and their applications in engineering field
- Understand the basics of crystals, their structures and different crystal growth techniques.
- Clear idea of ceramics, composites and nanomaterials.

UNIT I MAGNETIC MATERIALS

Origin of magnetic moment; Bohr magneton; comparison of Dia, Para and Ferro magnetism; Langevin theory of diamagnetism and paramagnetism; Quantum theory of paramagnetism; Curie-Weiss law; Temperature dependence of saturation magnetization; Domain theory; Hysteresis; soft and hard magnetic materials; antiferromagnetic materials; Ferrites and its applications.

UNIT II SUPERCONDUCTING MATERIALS

Superconductivity, properties; Meissner effect; Type I and Type II superconductors; London equation; BCS theory of superconductivity (Qualitative), Flux quantization; High Tc superconductors; Josephson superconductor tunnelling, DC and AC Josephson effect; Applications of superconductors, SQUID, cryotron, magnetic levitation.

UNIT III DIELECTRIC MATERIALS

Electrical susceptibility, dielectric constant; electronic, ionic, orientational and space charge polarization; frequency and temperature dependence of polarisation; internal field; Clausius -Mossotti relation (derivation); dielectric loss; dielectric breakdown, uses of dielectric materials (capacitor and transformer); ferroelectricity and applications.

2023-2024

9

9

S 3H-3C Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

UNIT IV CRYSTAL PHYSICS

Lattice, Unit cell, Bravais lattice; Lattice planes; Miller indices; d spacing in cubic lattice; Calculation of number of atoms per unit cell, Atomic radius, Coordination number, Packing factor for SC, BCC, FCC and HCP structures; Crystal imperfections; Crystal growth techniques; solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative).

UNIT V NEW MATERIALS

Ceramics; types and applications; composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics; metallic glasses: types, glass forming ability of alloys, melt spinning process, applications; shape memory alloys: phases, shape memory effect, applications; nanomaterials: preparation (bottom up and top down approaches), properties and applications.

Total :45

TEXT BOOKS

- 1. C. Kittel, Introduction to Solid State Physics, 7th Edition, Wiley Eastern, New Delhi, 2006.
- 2. A. J. Dekker, Solid State Physics, Published by Macmillan India, 2000
- 3. William D CallisterJr, "Materials Science and Engineering An Introduction", John Wiley and Sons Inc.,7th edition, New York, 2006
- 4. S.O. Pillai, Solid State Physics. New Age International(P) Ltd., publishers, 2009
- 5. M.A. Wahab, Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009.
- 6. M. Arumugam, Materials Science. Anuradha publishers, 2010.

JOURNALS

- Nature Physics
- Journal of Applied Mechanics (ASME)
- Journal of Electronic Materials (IEEE/TMS)
- Applied Thermal Engineering (Elsevier)
- Physical Review B (American Physical Society).
- Nature Nanotechnology

WEBSITES

- 1. https://nptel.ac.in/courses/122/103/122103011/
- 2. https://nptel.ac.in/courses/113/104/113104081/
- 3. https://nptel.ac.in/courses/108/108/108108122/
- 4. http://hyperphysics.phy-astr.gsu.edu/hbase/optmod/lascon.html
CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	2	-	I	-	-	-	2	2	2
Avg	3	2.4	2	2	-	2	-	-	-	-	-	2	2	2

23BTSHOE04/23BTSHOE04 GREEN CHEMISTRY

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES

The goal of this course for students is to

- Make the students conversant about the green chemistry
- Make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
- Acquaint the student with concepts of green technology.
- Develop an understanding of the basic concepts of renewable energy resources.
- Acquaint the students with the basics information on catalysis.
- Apply the concepts of green catalysts in the synthesis.

COURSE OUTCOMES

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

- Outline the basic principles of green chemistry.
- Examine the different atom efficient process and synthesis elaborately. •
- Apply the concepts combustion of green technology. •
- Identify and apply the concepts of renewable energy. •
- Apply the concepts of green catalysts in the synthesis. •
- Integrate the chemical principles in the projects undertaken in field of engineering and technology.

UNIT I-INTRODUCTION TO GREEN CHEMICAL PRINCIPLES

Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorous solvents, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

UNIT II - ATOM EFFICIENT PROCESSES

Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis.

UNITIII-BIOTECHNOLOGY AND GREEN CHEMISTRY

Bio technology and its applications in environmental protection - Bio informatics-Bio remediation, biological purification of contaminated air. Green chemistry for clean technology- Significance of green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

9

9

3H-3C Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

UNIT IV-RENEWABLE RESOURCES

Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomass conversion.

UNIT V-CATALYSIS IN GREEN CHEMISTRY

Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecular oxygen.

SUGGESTED READINGS

- 1. Sanjay K. Sharma, Ackmez Mudhoo (2010) Green Chemistry for Environmental Sustainability CRC Press , London
- 2. Chandrakanta Bandyopadhyay (2019) An Insight into Green Chemistry, Books and Allied (P) Ltd, Kolkata.
- 3. Ahluwalia V. K. (2018) Green Chemistry A Textbook 4th Reprint Narosa Publishing House Pvt. Ltd, New Delhi.
- 4. Ahluwalia V. K. and M.Kidwai (2007) New Trends in Green Chemistry 2nd edition Anamaya publishers., New Delhi.
- 5. Dr. Sunita Ratan (2012) A Textbook of Engineering Chemistry S.K. Kataria and Sons., New Delhi
- 6. Mukesh Doble. Ken Rollins, Anil Kumar (2007) Green Chemistry and Engineering, 1st edition Academic Press, Elesevier., New Delhi.
- 7. Desai K. R. (2005) Green Chemistry Himalaya Publishing House, Mumbai.

WEBSITES

- 1. http://www.organic-chemistry.org/topics/green-chemistry.shtml
- 2. http://www.essentialchemicalindustry.org/processes/green-chemistry.html
- 3. http://www.chm.bris.ac.uk/webprojects2004/vickery/green_solvents.html
- 4. http://www.epa.gov/research/greenchemistry/
- 5. http://www.amazon.in/Green-Chemistry-Catalysis

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	2	-	-	-	-	-	2	2	2
Avg	3	2.4	2	2	-	2	-	-	-	-	-	2	2	2

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 188

9

9

Total: 45

LIST OF OPEN ELECTIVES ELECTRICAL AND ELECTRONICS ENGINEERING

23BEEEOE01 RENEWABLE ENERGY SYSTEMS

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 is to

- Gain the knowledge about environmental aspects of energy utilization.
- Understand the basic principles of solar cells, photovoltaic conversion.
- Understand the basic principles of wind energy conversion.
- Gain the knowledge about hydro and ocean energy.
- Understand the basic principles of Biomass, fuel cell, Geo thermal power plants and MHD.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.
- Selection, Operation and Operation of Solar PV System for different types of applications
- Selection and Operation of Wind Turbine system
- Selection and Operation of Hydroelectric Plant and Ocean Energy
- Biomass Power Generation Types, Applicability and Limitations, Selection and Operation of Fuel Cell, Geo thermal plants and MHD

UNIT I INTRODUCTION

Energy scenario - Different types of Renewable Energy Sources - Environmental aspects of energy utilization-Energy Conservation and Energy Efficiency-Need sand Advantages, Energy Conservation Act 2003.

UNIT II SOLAR ENERGY

Introduction to solar energy: solar radiation, availability, measurement and estimation–Solar thermal conversion devices and storage – solar cells and photovoltaic conversion –PV systems – MPPT Applications of PV Systems– solar energy collector sand storage.

UNIT III WINDENERGY

Introduction– Basic principles of wind energy conversion-components of wind energy conversion system - site selection consideration – basic–Types of wind machines. Schemes for electric generation – generator control, load control, energy storage – applications of wind energy – Interconnected systems.

3H-3C

9

9

UNIT IV HYDROENERGY

Hydropower, classification of hydropower, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean waveen energy conversion and tidal energy conversion.

UNIT V OTHER SOURCES

Bio energy and types – Fuel cell, Geo-thermal power plants ; Magneto-hydro-dynamic (MHD) energy conversion.

SUGGESTED READINGS

- 1. Rai.G.D, Non-conventional sources of energy Khannapublishers, 2011
- 2. Khan.B.H,Non-Conventional EnergyResources, TheMcGraw Hills, Secondedition, 2012
- 3. John W Twidell and Anthony D Weir, Renewable Energy Resources, Taylor and Francis – 3rdedition, 2015

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	2	3	2	2	1	1	3	2	2
CO2	3	2	2	1	1	1	3	1	1	1	2	3	2	2
CO3	3	2	3	1	2	1	3	1	1	1	1	3	1	2
CO4	2	2	2	1	2	1	3	1	1	1	2	3	2	2
CO5	2	1	2	1	2	1	3	1	1	1	1	3	2	2
Avg	2.2	1.6	2	1	1.6	1.2	3	1.2		1	1.4	3	1.8	2

9

Total:45

23BEEEOE02 HYBRID ELECTRIC VEHICLES

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 for the students is to

- To understand the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
- To familiarize the plug in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
- To analyze various electric drives suitable for hybrid electric vehicles.
- To discuss different energy storage technologies used for hybrid electric vehicles and their control.
- To demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals
- Analyze the use of different power electronics devices and electrical machines in hybrid electric vehicles.
- Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
- Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration.
- Analysis the performance of Energy Management strategies in HEVs.

UNIT I INTRODUCTION

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II HYBRID ELECTRIC DRIVE-TRAINS

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

3H-3C

9

UNIT III ELECTRIC PROPULSION UNIT

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV ENERGY STORAGE

Introduction Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT V ENERGY MANAGEMENT STRATEGIES

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

SUGGESTED READINGS

- 1. C.Mi,M.A.Masrurand D.W.Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley&Sons,2011.
- 2. S.Onori, L.Serrao and G.Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer,2015.
- 3. M.Ehsani, Y.Gao, S.E.Gayand A.Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
- 4. T.Denton,"Electric and HybridVehicles", Routledge, 2016.

WEBSITES

- 1. https://www.energy.gov/eere/electricvehicles/electric-vehicle-basics
- 2. https://swayam.gov.in/nd1 noc20 ee18/preview
- 3. https://nptel.ac.in/courses/108103009/

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	1	1	3						2	3
CO2	3	3	2	2	3		3						3	3
CO3	2	3	2	2	2	2	3						3	3
CO4	3	3	3	3	3	1	3						3	3
CO5	3	3	3	3	3	1	3							3
Avg	3	2.4	2	2	-	2	-	-	-	-	-	2	2	2

9

9

9

Total:45

LIST OF OPEN ELECTIVES

ELECTRONICS AND COMMUNICATION

ENGINEERING

REAL TIME EMBEDDED 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

23BEECOE01

The goal of this course for students is to :

- Introduce students to the embedded systems, its hardware and software.
- Introduce devices and buses used for embedded networking.
- Study about task management.
- Learn about semaphore management and message passing.
- Study about memory management.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Explain the Embedded systems and its hardware and software.
- Illustrate the devices and buses used for embedded networking.
- Construct about task management.
- Summarize semaphore management and message passing.
- Demonstrate the memory management system.

UNIT I INTRODUCTION TO EMBEDDED SYSTEM

Introduction- Embedded systems description, definition, design considerations & requirements-Overview of Embedded System Architecture (CISC and RISC)-Categories of Embedded Systemsembedded processor selection & tradeoffs- Embedded design life cycle -Product specificationshardware / software partitioning- iterations and implementation- hardware software integration product testing techniques-ARM7.

UNIT-II OPERATING SYSTEM OVERVIEW

Introduction-Advantage and Disadvantage of Using RTOS-Multitasking-Tasks - RealTime Kernels - Scheduler- Non-Preemptive Kernels - Preemptive Kernels - Reentrancy- ReentrantFunctions-Round Robin Scheduling- Task Priorities- Static Priorities- Mutual Exclusion-Deadlock- Inter task Communication-Message Mailboxes-Message Queues- Interrupts- TaskManagement-Memory Management-Time Management-Clock Ticks.

UNIT-III TASK MANAGEMENT

Introduction-µ C/OS-II Features-Goals ofµ C/OS-II-Hardware and Software Architecture-Kernel Structures: Tasks-Task States-Task Scheduling-Idle Task-Statistics Task-Interrupts Under C/OS-II-Clock Tick-µ C/OS- II Initialization. Task Management: Creating Tasks-Task Stacks- Stack Checking - Task"s Priority - Suspending Task - Resuming Task. Time Management: Delaying a Task-Resuming a Delayed Task-System Time. Event Control Blocks-Placing a Task in the ECB Wait List-Removing a Task from an ECB wait List.

9

9

UNIT IV SEMAPHORE MANAGEMENT AND MESSAGE PASSING

Semaphore Management: Semaphore Management Overview– Signaling a Semaphore. Message Mailbox Management: Creating a Mailbox –Deleting Mailbox–Waiting for a Message box–Sending Message to a Mailbox- Status of Mailbox. Message Queue Management: Creating Message Queue–Deleting a Message Queue–Waiting for a Message Queue–Sending Message to a Queue–Flushing a Queue.

UNIT-VMEMORY MANAGEMENT

Memory Management: Memory Control Blocks–Creating Partition-Obtaining a Memory Block– Returning a Memory Block. Getting Started withµ C/OS-II–Installingµ C/OS-II–Portingµ C/OS-II:Development Tools–Directories and Files– Testing a Port -IAR Workbench withµ C/OS-II-µ C/OS- II Porting on a 8051CPU– Implementation of Multitasking- Implementation of Scheduling and Rescheduling –Analyze the Multichannel ADC with help ofµ C/OS-II.

Total :45

SUGGESTED READINGS

- 1. JeanJ. Labrosse, Micro C/OS–II The Real Time Kernel, CMPBOOKS, 2009.
- 2. David Seal, ARM Architecture, Reference Manual, Addison-Wesley, 2008.
- 3. Steve Furbe, ARM System-on-Chip, Architecture, Addison-Wesley Professional, California, 2000.
- 4. K.C. Wang, Embedded and Real-Time Operating Systems, Springer, 2017.
- JanezPuhan, Operating systems, Embedded systems and Real-time systems, CIP Cataloging In Publication, 2015.

WEBSITES

- 1. https://nptel.ac.in/courses/10810505.
- 2. https://onlinecourses.nptel.ac.in/noc21_cs98/preview.
- 3. https://nptel.ac.in/courses/108102045.
- 4. https://archive.nptel.ac.in/courses/106/105/106105193/

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	1
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
Avg	3	3	2.6	2.2	2.2	-	-	-	-	-	•	-	2.8	2.2

9

B.E BIOMEDICAL ENGINEERING

23BEECOE02

CONSUMER ELECTRONICS

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES

The goal of this course for students is to:

- Study about various speakers and microphone.
- Learn the fundamental of television systems and standards.
- Learn the process of audio recording and reproduction.
- Study various telephone networks.
- Discuss about the working of home appliances.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Explain working of various type of loud speakers.
- Illustrate knowledge on various types of picture tubes.
- Demonstrate the working of various optical recording systems.
- Summarize various telecommunication networks.
- Describe the working of various home appliances.

UNIT I LOUDSPEAKERS AND MICROPHONES

Introduction Loudspeaker, types of loud speakers, Loudspeaker characteristics, Dynamic Loudspeaker, Electrostatic loudspeaker, Permanent Magnet Loudspeaker, Woofers and Tweeters - Introduction Microphone, Types of Microphone, Microphone Characteristics, Carbon Microphones, Dynamic Microphones and Wireless Microphones.

UNIT II TELEVISION STANDARDS AND SYSTEMS

Introduction to TV system - Components of a TV system-Scanning - types of scanning-interlacing-Colour TVFundamentals - Additive Mixing- Subtractive Mixing- Need for Synchronization-Aspect Ratio-Video Bandwidth -Positive and Negative Transmission-Advantages of Negative Transmissioncomposite video signal - Colour TV system- Luminance and Chrominance signal- Monochrome and Colour Picture Tubes- Color TV systems- NTSC, PAL, SECAM.

OPTICAL RECORDING AND REPRODUCTION UNIT III

Introduction to Audio disc - Audio Disc- Processing of the Audio signal-Readout from the Disc -Reconstruction of the audio signal-Introduction to Video Disc recording -video disc mastering and replication - Video disc formats- Recording Systems-Playback Systems.

End Semester Exam:3 Hours

2023-2024

9

3H-3C Marks: Internal:40 External:60 Total:100

UNIT IV TELECOMMUNICATION SYSTEMS

Introduction to telecommunication Systems – Modes of telecommunication system-line system characteristics – Radio system characteristics –Signaling- Station Interconnection - Telephone services-telephone networks–switching system principles–PAPX or PBX switching–Data Services - Circuit, Packet and Message Switching, Telephone Networks - LAN, MAN and WAN, Integrated Services Digital Network. Introduction to Mobile radio systems- Wireless Local Loop – the role of WLL – types of WLL - VHF/UHF radio systems- Limited range Cordless Phones –Introduction to cellular communication - cellular modems.

UNIT V HOME APPLIANCES

Introduction to home appliances – types of home appliances- Microwaves - Basic principle and block diagram of microwave oven -Washing Machine- electronic controller for washing machines - washing machine hardware and software –Introduction to air conditioners and refrigerators - Components of air conditioning systems – types of air conditioning systems- Refrigeration –Refrigeration systems – types of Refrigeration systems.

SUGGESTED READINGS

- 1. S.P. Bali," Consumer Electronics Pearson Education",2007
- 2. J.S.Chitode, "Consumer Electronics", Technical Publications, 2007
- 3. Philip Hoff, Philip Herbert Hoff, "Consumer Electronics for Engineers", Cambridge University Press, 1998
- 4. R.G.Gupta ,"Audio & Video Systems", Tata Mc Graw hill Publishing Company Ltd, 2004

WEBSITES

- 1. https://nptel.ac.in/courses/117105133
- 2. https://archive.nptel.ac.in/courses/117/104/117104127/
- 3. https://nptel.ac.in/courses/117102059
- 4. https://nptel.ac.in/courses/108101091

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	-	-	-	-	-	-	-	1	1
CO2	3	3	3	2	2	-	-	-	-	-	-	-	1	1
CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	2
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	2
CO5	3	3	3	3	2	-	-	-	-	-	-	-	2	2
Avg	3	3	2.6	2.6	2	-	-	-	-	-	-	-	2	2

Total : 45

LIST OF OPEN ELECTIVES FOOD TECHNOLOGY

23BTFTOE01 PROCESSING OF FOOD MATERIALS 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 for students is to

- Explain the milling, extraction and manufacture of tremendous products from cereals, pulses and oilseeds.
- Summarize the production and processing methods of fruits and vegetables.
- Discuss the chemical composition, processing, production, spoilage and quality of milk and milk products.
- Outline the overall processes involved in the production of meat, poultry and fish products.
- Review the production and processing methods of plantation and spice products.

COURSE OUTCOMES

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

- Discuss the basics of food processing.
- Demonstrate the various processing technologies involved in fruits and vegetables, dairy, cereals, meat, fish, egg and plantation products.
- Infer the basics on microbiology of food products.
- Describe the process of manufacture of various food products.
- Outline the various methods of food preservation.

UNIT I CEREAL, PULSES AND OILSEEDS TECHNOLOGY

Rice milling, Pulse milling, Wheat milling – Recent trends in milling process- Oil extraction – different methods in oil extraction - Methods of manufacture of Bread -different processes of manufacture- types of breads-buns, biscuits, cakes and cookies-Pasta products- Tortilla-Method of manufacture.

UNIT II FRUITS AND VEGETABLE PROCESSING

ProductionofFruitsandvegetablesinIndia,Maturitystandards,Causeforheavylosses,preservationtreatments -Basics of Canning, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing- Indian Food Regulation and Quality assurance Fruit Juice / pulp/Nectar/Drinks, concentrates.

UNIT III DAIRY PROCESSING

Basic dairy terminology, composition, General tests at reception, Dairy Processing -Method of manufacture of Standardized, toned and double toned milk, milk powder -Equipments - Pasteurizers, homogenizers and pumps - Method of manufacture of dairy products - Ice-cream, Cheese, Paneer, Yoghurt - Pasteurization and micro organisms involved in spoilage of

9

9

milk-Major pathogens, Plant construction, Sanitation management, Cleaning equipment.

UNIT IV-MEAT, POULTRYAND FISH PROCESSING

Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Common path ogens, Sanitation management, Sanitizers for meat & poultry plants, Fish and other Marine Products Processing, Sources of sea food contamination.

UNIT V-PLANTATIONPRODUCT TECHNOLOGY

Processing of Tea, Coffee and Cocoa – Outline of the methods of manufacture of-greentea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods of processing of Pepper, cardamom, ginger, vanilla and turmeric. By products from plantation crops and spices.

Total:45

SUGGESTED READINGS

- 1. Srivastava R.P. and Kumar S. Fruit and Vegetable Preservation: Principles and Practices. International BookDistributingCo.Lucknow.3rdEdition.2010.
- 2. ChakravertyA.,MujumdarA.S.,RaghavanG.S.VandRamaswamyH.S.Handbook of Postharvest Technology: Marcel Dekker Press. USA. 1st Edition.2003.
- 3. SukumarDe. Outlines of Dairy Technology. Oxford University Press. NewDelhi. 23rd impression. 2016.
- 4. JamesG.Brennan.2006.FoodProcessingHandbook.Wiley-VCHVerlagGmbH&Co. KGaA, Weinheim,Germany

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	2	1	-	2	2	2	-	-	2	2
CO2	1	2	1	3	2	1	-	2	2	2	-	-	2	2
CO3	1	2	1	3	2	1	-	2	-	-	-	-	2	2
CO4	1	2	1	3	2	1	-	2	-	-	2	-	2	2
CO5	1	2	1	3	2	1	-	2	-	2	-	-	2	2
Avg	1	2	1	3	2	1		2	2	2	2		2	2

CO-PO MAPPING

9

3H-3C

23BTFTOE02 NUTRITION AND DIETETICS

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 for students is to

- Explain the basic concepts of food and nutrition.
- Define the overall classification, function, and source of carbohydrates, lipids and proteins.
- Summarize the availability, source, deficiency and physiological role of fat and water- soluble vitamins.
- Outlinetheroleofhealthandnutritionalimportanceofmicroandmacrominerals.
- Discuss there cent trend sand developments in nutrition.

COURSE OUTCOMES

Upon completion of this course, students will be able to

- Explain the basics in the area of nutritional assessment in health and disease.
- Outline the biological functions of various macro molecules in terms of food and health.
- Discuss the balanced diet for healthy life to avoid or prevent the deficiency disorders.
- Infer an appropriate diet, products that prevent vitamin deficiency disorders.
- Identify the proper foods rich in minerals to live a healthy life.

UNIT I HUMAN NUTRITION

Six classes of nutrients - Historical perspective of nutrient requirements – Assessment of nutritional status - recommended dietary allowances of macronutrients for all age groups - Assessment of protein quality - Malnutrition and related disorders –Balanced Diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing.

UNIT II BIOMOLECULES

Carbohydrates-Definition, classification, Functions, Sources of Carbohydrates, Deficiency. Lipids – Definition, classification, function, sources, Properties of fats and oils, Refined & Hydrogenated fats process. Proteins - Definitions, Classification, Function, Amino Acids, Sources of Proteins, Texturized proteins.

UNIT III VITAMINS

Physiological role, bio-availability, requirements, sources and deficiency of FatSolubleVitamins:VitaminA,VitaminD,E&K.fWatersolublevitamins:VitaminC,Thiamine,Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12, VitaminB6.Stabilityunderdifferent food

9

9

processing conditions.

UNIT IV MINERALS AND WATER

Physiological role, bio-availability, requirements, sources and deficiency of Macrominerals : Calcium, Phosphorus Magnesium, Sodium, Potassium chloride. Microminerals: Iron, Zinc, copper, selenium, chromium, iodine, manganese, Molybdenum and fluoride - Chemistry and physical properties of free, bounded and entrapped water, water activity, quality parameters of drinking and mineral water.

UNIT V RECENT TRENDS IN NUTRITION

Principles of dietary managementing out, rheumatism, AIDS/HIV – Cancer – risk factors, symptoms, dietary management, and role of food in prevention of Cancer. Role of functional foods Health foods and novel foods, organically grown foods, personalized nutrition, recent concepts in human nutrition like nutrigenomics, nutraceuticalsetc.

SUGGESTED READINGS

- 1. Sunetra Roday. Food Science and Nutrition. Oxford Higher Education/Oxford University Press. 3rdedition 2018. (ISBN-13:9780199489084).
- Charis Galanakis. Nutraceutical and Functional Food Components. Academic Press, 1st edition, 2017. (ISBN:9780128052570).
- 3. Ashley Martin. Nutrition and Dietetics.Syrawood Publishing House.1stEdition,2016. (ISBN:9781682860588).
- 4. RobertE.C.Wildman.Handbook of Nutraceuticals and Functional Foods.CRCPress,2nd Edition, 2016.(ISBN-10: 9781498770637).
- 5. Srilakshmi. B. Nutrition Science. New Age International Pvt. Ltd, Publishers. 6thEdition.2017.(ISBN-13:9789386418883).

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	-	-	-	2	2	2	-	-	2	2
CO2	1	2	1	3	-	-	-	2	2	2	-	-	2	2
CO3	1	2	1	3	-	-	-	2	-	-	-	-	2	2
CO4	1	2	1	3	-	-	-	2	-	-	2	-	2	2
CO5	1	2	1	3	-	-	-	2	-	2	-	-	2	2
Avg	1	2	1	3	-	-	-	-	-	-	-	2	2	2

CO-PO MAPPING

9

9

Total: 45

23BTFTOE03 READY TO EAT FOOD

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES

The goal of this course for students is to

- Outline the current status of snack food Industry.
- Describe the production, processing and marketing trends of potato and tortilla chips.
- Outline the overall processing of popcorn.
- Explain the production and processing of fruits involved in snack food preparation.
- Summarize the sensory analysis methods and packaging techniques of snack foods

COURSE OUTCOMES

Upon completion of this course, students will be able to

- Outline the various manufacturing process in snack food industries.
- Summarize the current production and marketing status of Snack foods.
- Explain the advantages of Sensory Evaluation.
- Describe packaging technologies in Snack Food Industries.
- Demonstrate the equipments involved in the snack production processes.

UNIT I INTRODUCTION TO SNACK FOODS

Introduction- Types – processing methods - Nutrition- Quality and standards for snack foods - GHP and GMP for snack food industries - Outline of snack food industry –Domestic Snack Food Market-Global Market.

UNIT II POTATO AND TORTILLA CHIPS PROCESSING

Potato Production- selection and grading of potato - Potato snack Ingredients- Potato Analysis and Composition-Potato chip manufacturing process-Unit Operations-Other value added products from Potato. Tortilla chips - Raw Materials- Processing steps -Equipment involved- Reconstitution of Dry Maize Flour-Unit operations – Nutritional properties of potato and tortilla chips.

UNIT III POPCORN PROCESSING

Introduction – Raw popcorn selection and preparation – Popping Methods – Home preparation of Popcorn – Equipments - Industrial manufacturing process - Flavorings and Applicators-Popcorn Packaging-Relative Nutrition-Marketing.

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

9

3H-3C

UNIT IV FRUITBASED SNACKS

Introduction-production and processing of fruit crops – fruit purees – fruit powders –canned fruit snacks – alcoholic preservation of fruit snacks – fruit candies – fruit bars –exotic fruits – Nutritions and health benefits of fruit snacks.

UNIT V SENSORY EVALUATION AND PACKAGING

Introduction- importance of sensory evaluation–Analytical methods-Sensory methods - Sensory Aspect of Processing- Limitations of sensory evaluation- Quality properties of Snack Foods and Packaging Materials-Automated Bag- Pouch Packaging- Cartoning Case Packing- Labelling requirements – Current Issues in Snack Foods Packaging.

SUGGESTED READINGS

- 1. Lusas, E.W and Rooney, L.W. Snack Foods Processing. CRCPress, 1stEdition2001.
- 2. Panda, H. The Complete Technology Book on Snack Foods, National Institute of Industrial Research, Delhi. 2ndEdition 2013.
- 3. SergioO Serna-Saldivar, Industrial Manufacture of Snack Foods ,Kennedys Books Ltd. 2008.
- 4. Lusas, E. WandRooney, L.W. SnackFoodsProcessing. CRCPress, 1stEdition 2001.
- 5. SergioOSerna-Saldivar, Industrial Manufacture of Snack Foods, Kennedys BooksLtd. 2008.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	-	-	-	2	2	2	-	1	2	2
CO2	1	2	1	3	-	-	-	2	2	2	-	1	2	2
CO3	1	2	1	3	-	-	-	2	-	-	-	1	2	2
CO4	1	2	1	3	-	-	-	2	-	-	2	1	2	2
CO5	1	2	1	3	-	-	-	2	-	2	-	1	2	2
Avg	1	2	1	3	-	-	-	2	2	2	2	1	2	2

CO-PO MAPPING

9

9

Total :45

23BTFTOE04AGRICULTURAL WASTE AND BYPRODUCTS UTILIZATION3H-3C

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for students is to

- Categorize the types of agricultural wastes
- Outline the production and utilization of biomass
- Explain the various parameters considered to be important in the designing of biogas units
- Discuss the methods employed in the production of alcohol from agricultural wastes/ byproducts
- Summarize the overall aspects involved in the production of paperboards and particleboards from agricultural wastes

COURSE OUTCOMES

Upon successful completion of this, students will be able to

- List and classify the types of agricultural wastes
- Collect and generate number of value added products from agricultural wastes
- Recall the techniques involved in the production and utilization of biomass
- Assess the various parameters considered to be important in the designing of biogas units
- Illustrate the various methods employed in the production of alcohol from the by products of agricultural wastes
- Choose the appropriate materials to produce paperboards and particleboards from agricultural wastes

UNIT I TYPES OF AGRICULTURAL WASTES

Introduction and Background Agricultural Waste, Crop Waste, Agricultural Residues (annual crops), Technical terms, properties of agricultural waste- storage and handling - rice by-products utilization-rice bran and germ, rice bran oil, economic products from agriculture waste/by-products.

UNIT II BIOMASS PRODUCTION AND UTILIZATION

Biomass – types – production and utilization Technology used for the utilization of agricultural wastes:Biomass Gasifier, Nimbkar Agricultural Research Institute (NARI) Gasifier, Rice-Husk Based Gasifier, Heat andSteam from Sugarcane Leaf andBagasse.

UNIT III BIOGAS DESIGN AND PRODUCTION

Biogas: Definition, composition, history of biogas, Production of biogas – factors affecting the efficiency; types of biogasplant (floating drum type and fixed dome type) and their components (inlet, outlet, stirrer, slanting pipe, digester, gas holder and gas outer pipe), Selection and Design of biogasplant.

9

9

UNIT IV PRODUCTION OF ALCOHOL FROM WASTE MATERIALS

9

Production of Alcohol from waste materials: Introduction, Production methods, Cellulolysis (biological approach): Pretreatment, Cellulolytic processes (Chemical and Enzymatic hydrolysis), Microbial fermentation, Gasification process (thermochemical approach).

UNIT V PRODUCTION OF PAPER BOARD AND PARTICLE BOARDS FROM

AGRICULTURAL WASTE

9

Production and testing of Paperboards and Particleboards from Agricultural Waste: Introduction, History, Terminology and classification, Raw materials, Production steps- Pulping, Classifications of pulp, Bleaching, Plies, Coating, Grades.

REFERENCE BOOKS

- Efthymia Alexopoulou. Bio energy and Biomass from Industrial Crops on Marginal Lands. Elsevier, 1st Edition, 2020. (ISBN:9780128188644)
- 2 Navanietha Krishnaraj Rathinam, Rajesh Sani. Biovalorisation of Wastes to Renewable Chemicals and Biofuels. Elsevier, 1st Edition, 2019. (ISBN:9780128179529)
- 3. SimonaCiuta,DemetraTsiamis,MarcoJ.Castaldi.GasificationofWasteMaterials.Academic Press, 1st Edition, 2017. (ISBN:9780128127162)
- Nicholas E. Korres, Padraig O"Kiely, John A.H. Benzie, Jonathan S. West. Bioenergy Production by Anaerobic Digestion: Using Agricultural Biomass and Organic Wastes. Routledge, 1st Edition, 2013. (ISBN-13:9780415698405)
- Albert Howard, Yashwant Wad. The Waste Products of Agriculture. Benediction Classics, 1st Edition, 2011. (ISBN-13:9781849025)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	-	1	3	2	2	2	-	-	2	2
CO2	1	2	1	3	-	1	3	2	2	2	-	-	2	2
CO3	1	2	1	3	-	1	3	2	-	-	-	-	2	2
CO4	1	2	1	3	-	1	3	2	-	-	2	-	2	2
CO5	1	2	1	3	-	1	3	2	-	2	-	-	2	2
Avg	1	2	1	3	-	1	3	2	2	2	2	-	2	2

CO-PO MAPPING

Instruction Hours/week: L:3 T:0 P:0

23BTFTOE05 DESIGN OF FOOD PROCESS EQUIPMENT 3H-3C

COURSE OBJECTIVES

The goal of this course for students is to

- Illustrate the types of materials used in the food processing equipments.
- Discuss the materials and designing of differents to ragevessel.
- Explain the importance of reaction vessel and their destining techniques.
- Explain the materials and designing of heat exchanger and evaporators.
- Discuss the importance of dryersin food processing industries.

COURSE OUTCOMES

Upon successful completion of this, students will be able to

- Outline the materials suitable for the construction of equipment"s.
- Summarize the vessels used for food storage in the industries.
- Classify types of reaction vessel used for different purposes.
- Discuss the importance of heat exchanger in the designing of food processing equipment"s.
- Infer the significance of dryersin food processing.

UNIT I MATERIALS

Metals and non-metals, design of pressure vessels – cylindrical shell –internal and external pressure under continued loadings. Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings, corrosion prevention linings equipment, choice of materials, material codes Numerical problem and design of pressure vessel.

UNIT II STORAGE VESSELS

Design of storage vessels – Rectangular Tank without stiffeners – with stiffeners – shell design – Numerical problem and design. Design of agitators and baffles. Design considerations: Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations;

UNIT III REACTION VESSELS

Design of Reaction vessels – materials -classification – jackets-Design of vessel shell with half coil – Design of vessel shell with jacket – Numerical problem and design. Hazards in process industries, analysis of hazards, safety measures, safety measures in equipment design, pressure relief devices.

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

9

9

UNIT IV HEAT EXCHANGERS

Total:45

UNIT V DRYERS Types - General considerations – Design of Tray dryer, Rotary Dryer, fluidized bed dryer, spray dryer, vacuum dryer, microwave dryer - Material Balance, Thermal energy Requirements, electrical energy Requirements, Performance Indices

tubes - Numerical problem. -Design of Equipment. Evaporator: Materials of concentration - types -

design- consideration - Design of agitators - power requirements - Design based on Torque -

REFERENCE BOOKS

criticalspeed.

- 1. Maroulis Z.B. and Saravacos G.D. Food Process Design, Marcel Dekker Inc. ISBN-0824743113.2003.
- 2. Joshi M.V, "Process Equipment Design", Macmillan IndiaLtd., 1985
- 3. Coulson ,J.M. and Richardson, J. F,"Chemical Engineering "Butterworth-Heinemnn Elsevier, ISBN-0750644451,2002

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	-	1	-	2	2	2	-	-	2	2
CO2	1	2	1	3	-	1	-	2	2	2	-	-	2	2
CO3	1	2	1	3	-	1	-	2	-	-	-	-	2	2
CO4	1	2	1	3	-	1	-	2	-	-	2	-	2	2
C05	1	2	1	3	-	1	-	2	-	2	-	-	2	2
Avg	1	2	1	2	-	1	-	2	2	2	2	-	2	2

9

LIST OF OPEN ELECTIVES

MECHANICAL ENGINEERING

23BEMEOE01 BATTERY MANAGEMENT SYSTEM

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES

The goal of this course for students is to

- Learn various energy storage systems used for Hybrid Electric Vehicle(HEV) and Electric Vehicle(EV).
- Learn about design and operation of solid-state Li-ion battery.
- Gain knowledge on the high temperature application of battery.
- Learn various technologies for recycling used batteries.
- Understandthebatteryelectricalandthermalmanagementsystemsusingactiveandpassivecoolingsyst em.
- Analysis battery performance.

COURSE OUTCOMES

Upon successful completion of this, students will be able to

- Understand the performance and driving cycles of EVs.
- Can apply their knowledge to manufacture various types of Li-ion batteries.
- Can apply knowledge on use of Li-ion battery in large scale grid and spacecrafts.
- UnderstandTechno-economicaspectsofbatteryrecyclingandenvironmentalsafety.
- Understand battery cooling system and safety precautions for high voltage battery.
- Analysis battery performance.

UNIT I ENERGY STORAGE SYSTEMS

General background on alternative energy sources and sustainability, Introduction to electric-based transportation, Overview of on-road vehicle electrification, EVs configuration, Energy and power requirements for various HEVs and EVs Vehicle performance and driving cycles.

UNIT II LITHIUM BATTERIES

Li-ion batteries - Principle of operation, Battery components and design Electrode, cell and battery fabrications, Building block cells, battery modules and packs and applications. All solid-state batteries and future developments, Li-Sulphur battery, Li-Air battery, Sodium-battery, Magnesium battery, Aluminium battery, Silicon battery.

UNIT III HIGH TEMPERATURE BATTERIES FOR BACK-UP APPLICATIONS 9

Advance Ni-MH batteries for transportation, Future prospects of Ni-MH batteries vs. lithium ion batteries, Zebra cell, Li-iron sulphide cells, Vanadium and iron-based batteries, Semi-fluid flow

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

9

3H-3C

batteries for large scale grid application, Ni-H2cells for space applications.

UNIT IV FUEL CELLS AND BATTERY RECYCLING TECHNOLOGY

Introduction to fuel cells, Proton-exchange membrane and alkaline fuel cells for transportation, Solid oxidefuel cells, Technology and economic aspects of battery recycling, Environmental effect and controlling of poisonous chemicals contamination.

UNIT V BATTERY MANAGEMENT

Fundamentals of battery management systems and controls, Battery Thermal Management - Passive cooling, Active cooling-Liquids and air systems. Regulations and Safety Aspects of High Voltage Batteries, Code and Standards, Safe handling of Lithium Batteries, Safety of high voltage battery.

SUGGESTED READINGS

- 1. Gerardus Blokdyk, "Battery Management System A Complete Guide", Springer, 2019 Edition.
- 2. Reiner Korthauer,"Lithium-Ion Batteries: Basics and Applications,1stEdition. Springer,2018
- 3. Alfred Rufer, "Energy Storage: Systems and Components", 1st Edition, CRC Press, 2017.
- 4. Arno Kwade and Jan Diekmann, "Recycling of Lithium-Ion Batteries: The Litho Rec Way" (Sustainable Production, Life Cycle Engineering and Management),1st Edition. Springer, 2018.

WEB REFERANCES

1.https://nptel.ac.in/courses/108/103/108103009/

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	2	-	-	-	-	-	2	2	2
Avg	3	2.4	2	2	-	2	-	-	-	-	-	2	2	2

CO-PO MAPPING

9

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 for students is to

- Recognize and evaluate occupational safety and heal hazards in the workplace.
- Determine appropriate hazard controls following the hierarchy of controls.
- Analyses the effects of workplace exposures, injuries and illnesses, fatalities.
- Prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
- Teach student the concept of Industrial Safety & provide useful practical knowledge for work place safety.
- Prevent or mitigate harm or damage to people, property, or the environment.

COURSE OUTCOMES

Upon successful completion of this, students will be able to

- Recognize and evaluate occupational safety and health hazards in the workplace.
- Determine appropriate hazard controls following the hierarchy of controls.
- Analyze the effects of workplace exposures, injuries and illnesses, fatalities.
- Prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
- Underst and the concept of Industrial Safety & provide useful practical knowledge for work place safety.
- Prevent or mitigate harm or damage to people, property, or the environment.

UNIT I CONCEPTS

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety-Safety Committee-budgeting for safety.

UNIT II TECHNIQUES

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III ACCIDENT INVESTIGATION AND REPORTING

Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process –Response to accidents, India reporting requirement,

9

Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports.

UNIT IV SAFETY PERFORMANCE MONITORING

Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incidentrate, accident rate, safety "t" score, safety activity rate– problems.

UNIT V SAFETY EDUCATION AND TRAINING

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme ,safety campaign– Domestic Safety and Training.

Total : 45

9

9

REFERENCE BOOKS

- 1. Accident Prevention Manual for Industrial Operations, 3rdedition, N.S.C.Chicago, 2010(digital).
- Heinrich H.W. "Industrial Accident Prevention", 2ndedition, Tata McGraw-Hill Company, NewYork, 1941.
- Krishnan N.V, Safety Management in Industry, 1stedition, Jaico Publishing House, Bombay, 1997.
- 4. John R Ridley, Safety at Work, 3rdedition, Elsevier, 2014
- 5. Rol and P.Blake, Industrial Safety, 2ndedition, PrenticeHall, Inc., NewJersey, 1973
- 6. L M Deshmukh, Industrial safety management, 1stedition, TATA McGrawHill, 2005.

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	2	-	-	-	-	-	2	2	2
Avg	3	2.4	2	2	-	2	-	-	-	-	-	2	2	2

23BEMEOE03 NON DESTRUCTIVE TESTING

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 for students is to

- Introduce the concept of non-destructive testing among the students and make them understand various types of non-traditional practices available for manufacturing industry.
- Provide in-depth knowledge on various techniques of non-destructive testing.
- Provide an overview of destructive and non-destructive tests and state their applications
- Study the features of NDT techniques for various products and to understand the established NDE techniques and basic familiarity of emerging NDE techniques.
- Expose students to skills needed for selection of appropriate NDT technique(s) for new inspection jobs.
- Facilitate the understanding of standard application area of NDET

COURSE OUTCOMES

Upon successful completion of this, students will be able to,

- Understand the codes, standards and specifications related to NDT.
- Classify the destructive and non-destructive tests and state their applications.
- Develop NDT techniques for various products.
- Acquire skills needed for selection of appropriate NDT technique(s) for new inspection jobs
- Acquire sound knowledge of established NDE techniques and basic familiarity of emerging NDE techniques.
- Make use of standards application area of NDET

UNIT I INTRODUCTION

Properties of Engineering Materials – Types of Defects – Surface and Sub-Surface of a component – Characteristics of Ferrous, Non-ferrous and Alloys. Classification of Destructive testing and Non-Destructive testing – Uses and applications. Codes, Standards and Specifications of NDT (ASME, ASTM, AWS etc.). Importance and Scope of NDT, Non-destructive testing methods

UNIT II PENETRANT TESTING AND MAGNETIC PARTICLE INSPECTION

Introduction to Penetrant Testing – Liquid Penetrants and Dye Penetrants - Apparatus required for LPT - An Illustration of Penetrant Testing, Application, Advantages and Disadvantages of Penetrants Testing. Introduction to Magnetic Particle Inspection – MPT equipments and devices - An Illustration of Magnetic Particle Inspection, Advantages and Disadvantages of Magnetic Particle Crack Detection.

3H-3C

9

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore - 641 021 Page | 216

UNIT III ULTRASONIC FLAW DETECTION AND RADIOGRAPHY INSPECTION

Introduction to Ultrasonic Flaw Detection, UT equipments and devices, An Illustration of Ultrasonic Flaw Detection, Application, Advantages and Disadvantages of Ultrasonic Flaw Detection. Principle of Radiography Inspection, RT equipments and devices Radiation sources, uses of x-rays and gamma rays Attenuation in the specimen, Radiographic imaging, Inspection Techniques, Application and limitations, Safety from Radiation.

UNIT IV EDDY CURRENT TESTING AND VISUAL TESTING METHODS

Introduction to Eddy Current Testing. ECT equipments and devices, An Illustration of Eddy Current Testing Equipment, Application, Advantages and Disadvantages of Eddy Current Testing. Introduction to visual testing method, Equipments required for VT - An Illustration of visual testing method, Application, Advantages and Disadvantages of visual testing method.

UNIT V NON-DESTRUCTIVE INSPECTION(NDI) AND ITS APPLICATIONS

Inspection of Raw Products, Inspection for In-Service Damage, Power Plant Inspection, Storage Tank Inspection, Automobile component Inspection, Jet Engine Inspection, Pressure Vessel Inspection, Bridge Inspection, Pipeline Inspection.

REFERENCE BOOKS

- 1. Sadashiva.M Non Destructive Testing Paperback 15 July 2021.
- 2. Ramachandran.S and Anderson.A Non-Destructive Testing Kindle Edition 2018
- 3. J. Prasad and C. G. Krishnadas Nair Non-Destructive Test and Evaluation of Materials Hardcover - 1 July 2017.
- 4. Lari and Kumar Basics of Non Destructive Testing Paperback 1 January 2013.
- 5. Ravi Prakash Non Destructive Testing Techniques Hardcover 1 January 2010.
- 6. Louis Cartz Non destructive Testing 1st Edition, ASM International, Almere, Netherland, 2007(digital).

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	2	-	-	-	-	-	2	2	2
Avg	3	2.4	2	2	-	2	-	-	-	-	-	2	2	2

9

9

Total: 45

23BEMEOE04 OPERATIONS RESEARCH

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES

The goal of this course for the students is to

- Provide knowledge and training in finding optimal solutions under limited resources for the engineering and business problems.
- Study and acquire knowledge on engineering and Managerial solutions in Assignment and scheduling problems.
- Give exposure to inventory in industry.
- Make the student acquire sound knowledge on sequences to perform operation among various alternatives.
- Provide an overview of various tools in various sections of industries like marketing, material handling etc.
- Understand the Engineering and Managerial situations in Transportation.

COURSE OUTCOMES

Upon successful completion of this, students will be able to

- Understand the concepts of Linear programming technique.
- Apply LPP technique of Transportation models.
- Understand the techniques of scheduling and sequencing.
- Acquire knowledge in Inventory control and Queuing theory.
- Perform network analysis for a project.
- Understand the concept to replacement models.

UNIT I INTRODUCTION TO OPERATIONS RESEARCH

Operations research and decision-making – types of mathematical models and constructing the model – Role of computers in operations research –Linear Programming Techniques: Formulation of linear programming problem, applications and limitations, graphical method, simplex method – The Big –M method – the two–phase method.

UNIT II TRANSPORTATION PROBLEMS

Least cost method, North west corner rule, Vogel"s approximation method, modified distribution method, unbalanceanddegeneracyintransportationmodel, shortestroutealgorithm– dijkestra algorithm.

UNIT III ASSIGNMENT MODELS AND SCHEDULING

Assignment models - Hungarian algorithm, unbalanced assignment problems - maximization case in assignment problems, traveling salesman problem. Scheduling - processing n jobs through two

3H-3C

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

9

9

machines, processing n jobs through three machines, processing two jobs through "m" machines, processing n jobs through m machines.

UNITIV INVENTORY CONTROL AND QUEUING THEORY

Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, multi-item deterministic model. Queuing Models: Queues–Notation of queues, performance measures, The M/M/1queue, The M/M/mqueue, batch arrival queuing system, queues with breakdowns.

UNITV PROJECT MANAGEMENT AND REPLACEMENT MODELS

Basic terminologies, constructing a project network, network computations in CPM and PERT, cost crashing, Replacement Models: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy, Staff replacement

Total :45

9

9

SUGGESTED READINGS

- 1. Kanti Swarup, Operations Research, 12thedition, Sultan Chandand Sons, New Delhi, 2010.
- 2. Viswanathan N and Narahari Y, Performance Modeling of Automated Manufacturing
- 3. Systems, 2nd edition, PrenticeHallof India, New Delhi, 2005
- 4. Prem kumar Gupta and Hira D.S, Operation Research, 1st edition, S Chand and Company Limited, NewDelhi,2017

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	2	-	-	-	-	-	2	2	2
Avg	3	2.4	2	2	-	2	-	-	-	-	-	2	2	2

CO-PO MAPPING

LIST OF OPEN ELECTIVES

CIVIL ENGINEERING

Instruction Hours/week: L:3 T:0 P:0

23BECEOE01 HOUSING PLAN AND MANAGEMENT

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to

- Examine the role and tasks of basic housing policies and building bye laws
- Understand the process of integrated service delivery in the context of economic, social, environmental and institutional factors
- Analyze the Innovative construction methods and Materials
- Analyze city management strategies and strengthen the urban governance through a problem solving approach
- Know the Importance of basic housing policies and building bye laws
- Use Housing Programmes and Schemes

COURSE OUTCOMES

Upon ccompletion of the course, the students will be able to

- Know the Importance of basic housing policies and building bye laws
- Use Housing Programmes and Schemes
- Plan and Design of Housing projects
- Examine Innovative construction methods and Materials
- Know Housing finance and loan approval procedures
- Understand Construction as well as managing techniques

UNIT I INTRODUCTION TO HOUSING

Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNIT II HOUSING PROGRAMMES

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organizations.

UNIT III PLANNING AND DESIGN OF HOUSING PROJECTS

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

3H-3C

9

9

UNIT IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS 9

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation.

UNIT V HOUSING FINANCE AND PROJECT APPRAISAL

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing of Housing Units, Rents, Recovery Pattern (Problems).

Total: 45

9

TEXT BOOKS

- 1. Meera Mehta and Dinesh Mehta, Metropolitan Housing Markets, Sage Publications Pvt. Ltd., New Delhi, 2002.
- 2. Francis Cherunilam and Odeyar D Heggade, Housing in India, Himalaya Publishing House, Bombay, 2001.

REFERENCES BOOKS

- 1. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2002.
- 2. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 2000.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	-	-	2	-	2	2	2	2
CO2	3	3	3	3	3	2	-	-	2	-	2	2	2	2
CO3	3	3	2	2	2	2	-	-	2	-	2	2	2	2
CO4	3	3	3	3	2	2	-	-	2	-	2	2	2	2
CO5	3	3	2	2	2	2	-	-	2	-	2	2	2	2
Avg	3	3	2.6	2.4	2.2	2	-	-	2	-	2	2	2	2

CO-PO MAPPING
Instruction Hours/week: L:3 T:0 P:0

23BECEOE02

BUILDING SERVICES

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to

- Defining and identifying of engineering services systems in buildings.
- Know the role of engineering services systems in providing comfort and facilitating life of users of the building.
- Understand the basic principles of asset management in a building & facilities maintenance environment
- Learn the Importance of Fire safety and its installation techniques.
- Understand Electrical system and its selection criteria
- Use the Principles of illumination & design

COURSE OUTCOMES

Upon completion the course, the students will be able to

- Machineries involved in building construction
- Understand Electrical system and its selection criteria •
- Use the Principles of illumination & design •
- Know the principle of Refrigeration and application •
- Importance of Fire safety and its installation techniques •
- Know the principle behind the installation of building services and to ensure safety in buildings

UNIT I MACHINERIES

Hot Water Boilers - Lifts and Escalators - Special features required for physically handicapped and elderly - Conveyors - Vibrators - Concrete mixers - DC/AC motors - Generators - Laboratory services – Gas, water, air and electricity

UNIT II ELECTRICAL SYSTEMS IN BUILDINGS

Basics of electricity - Single / Three phase supply - Protective devices in electrical installations -Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiringsystems and their choice - Planning electrical wiring for building - Main and distribution boards - Transformers and switch gears - Layout of substations

UNIT III PRINCIPLES OF ILLUMINATION & DESIGN

Visual tasks - Factors affecting visual tasks - Modern theory of light and colour - Synthesis of light -Additive and subtractive synthesis of colour - Luminous flux - Candela - Solid angle illumination -Utilization factor - Depreciation factor - MSCP - MHCP - Classification of lighting - Artificial light

3H-3C

9

9

sources – Spectral energy distribution – Luminous efficiency – Colour temperature – Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.

UNIT IV REFRIGERATION PRINCIPLES & APPLICATIONS

Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent heat of fusion, evaporation, sublimation – saturation temperature – Super heated vapour – Sub cooled liquid – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Compressors – Evaporators – Refrigerant control devices – Electric motors – Starters – Air handling units – Cooling towers – Window type and packaged air-conditioners – Chilledwater plant – Fan coil systems – Water piping – Cooling load – Air conditioning systems for different types of buildings – Protection against fire to be caused by A.C. Systems

UNIT V FIRE SAFETY INSTALLATION

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers

TEXT BOOKS

- 1. E.R.Ambrose, "Heat Pumps and Electric Heating", John and Wiley and Sons, Inc., New York, 2002.
- 2. Handbook for Building Engineers in Metric systems, NBC, New Delhi, 2005.

REFERENCE BOOKS

- 1. Philips Lighting in Architectural Design, McGraw-Hill, New York, 2000.
- 2. A.F.C. Sherratt, "Air-conditioning and Energy Conservation", The Architectural Press, London, 2005.
- 3. National Building Code.

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	2	1	2	-	-	2	-	-	2	2	2
CO2	3	-	2	2	1	2	-	-	2	-	-	2	2	2
CO3	3	-	2	2	1	2	-	-	2	-	-	2	2	2
CO4	3	-	2	2	1	2	-	-	2	-	-	2	2	2
CO5	3	-	2	2	1	2	-	-	2	-	-	2	2	2
Avg	3	-	2	2	1	2	-	-	2	-	-	2	2	2

9

9

Total : 45

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES

The goal of this course for the students is to,

- Learn various distress and damages to concrete and masonry structures
- Know the influence of corrosion in durability of structures
- Understand the importance of maintenance of structures
- Study the various types and properties of repair materials
- Learn various techniques involved in demolition of structures
- Assess damage of structures and various repair techniques

COURSE OUTCOMES

After completing the course, the students will be able to

- Various distress and damages to concrete and masonry structures
- Durability of structures and corrosion mechanism
- The importance of maintenance of structures, types and properties of repair materials etc
- Assessing damage of structures and various repair techniques
- the various types and properties of repair materials
- Modern technique and equipment being adopted for the demolition of structures

UNIT I INTRODUCTION

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors.

UNIT II DURABILITY OF STRUCTURES

Corrosion mechanism – diagnosis- causes and effects - cover thickness and cracking, measurements for corrosion - methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

UNIT III MAINTENANCE AND REPAIR STRATEGIES

Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

9

9

UNIT IV MATERIALS FOR REPAIR

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete. eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete.

UNIT V TECHNIQUES FOR REPAIR AND REPAIR OF STRUCTURES

Non-destructive Testing Techniques, Corrosion protection techniques, Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning. Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure Engineered demolition techniques for dilapidated structures - case studies.

TEXT BOOKS

- 1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991.
- 2. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987
- 3. Shetty M.S., "Concrete Technology Theory and Practice", S.Chand and Company, 2008.

REFERENCE BOOKS

- 1. Ravishankar.K., Krishnamoorthy.T.S, "Structural Health Monitoring, Repair and
- 2. Rehabilitation of Concrete Structures", Allied Publishers, 2004.
- 3. Gambhir.M.L., "Concrete Technology", McGraw Hill, 2013
- 4. R. K. Rajput, Engineering Materials, S. Chand & Company Ltd., 2000.
- 5. M. S. Shetty, Concrete Technology (Theory and Practice), S. Chand & Company Ltd., 2003.
- 6. Sustainable Construction: Green Building Design and Delivery. Third Edition, Charles J.Kibert, New York: John Wiley & Sons, 2012.
- 7. Working Toward Sustainability: Ethical Decision Making in a Technological World, CJ Kibertet al, New York: John Wiley & Sons, 2011

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	3	2	2	2	1	2	-	-	2	-	1	2	2	2
CO2	3	2	2	2	1	2	-	-	2	-	1	2	2	2
CO3	3	2	2	2	1	2	-	-	2	-	1	2	2	2
CO4	3	2	2	2	1	2	-	-	2	-	1	2	2	2
CO5	3	2	2	2	1	2	-	-	2	-	1	2	2	2
Avg	3	2	2	2	1	2	-	-	2	-	1	2	2	2

CO-PO MAPPING

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 for the students is to

- Develop Parametric design and the conventions of formal engineering drawing
- Produce and interpret 2D & 3D drawings
- Communicate a design idea/concept graphically/ visually
- Examine a design critically and with understanding of CAD The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
- Get a Detailed study of an engineering artifact.
- To Communicate a design idea/concept graphically/ visually

COURSE OUTCOMES

After completing the course, the students will be able to

- Develop Parametric design and the conventions of formal engineering drawing
- Produce and interpret 2D & 3D drawings
- Communicate a design idea/concept graphically/ visually
- Examine a design critically and with understanding of CAD The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
- Get a Detailed study of an engineering artifact
- Planning and designing of structures

UNIT I INTRODUCTION

Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co- ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

UNIT II SYMBOLS AND SIGN CONVENTIONS

Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

UNIT III MASONRY BONDS

English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

9

9

UNIT IV BUILDING DRAWING

Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundationplan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity.

UNIT V: PICTORIAL VIEW

Principles of isometrics and perspective drawing. Perspective view of building, Software"s

TEXT BOOKS

- 1. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt.Ltd.,
- 2. Subhash C Sharma & Gurucharan Singh (2005), "Civil Engineering Drawing", Standard Publishers

REFERENCE BOOKS

- 1. (Corresponding set of) CAD Software Theory and UserManuals.
- 2. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd NewAsian.
- 3. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria&Sons.
- 4. Ajeet Singh (2002), "Workingwith AUTOCAD 2000 with updates on AUTOCAD200I", Tata- Mc Graw-Hill Company Limited, NewDelhi

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	1	2	1	-	2	-	1	2	1	-
CO2	3	2	-	2	1	2	1	-	2	-	1	2	1	-
CO3	3	2	-	2	1	2	1	-	2	-	1	2	1	-
CO4	3	2	-	2	1	2	1	-	2	-	1	2	1	-
CO5	3	2	-	2	1	2	1	-	2	-	1	2	1	-
Avg	3	2	-	2	1	2	1	-	2	-	1	2	1	-

CO-PO MAPPING

9

Total : 45

Instruction Hours/week: L:3 T:0 P:0

CONTRACTS MANAGEMENT

AGEMENT 3H-3C Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to

- Have developed a more detailed appreciation for construction planning and scheduling
- Apply their learned knowledge as it pertains to upper level construction management skills and procedures.
- Evaluate the best practices associated with the development of contract parameters.
- Understand the legal aspects of acts governing the contracts
- Discuss techniques for appropriate risks and changes, monitoring and measuring the contract closure
- Understand the basics of the bid process, important points in a tender document, and unbalanced contracts.

COURSE OUTCOMES

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

- Apply project Procurement management concepts in a project environment.
- Describe techniques used to procure resources within a project's scope and techniques to reduce procurement risks.
- Evaluate the best practices associated with the development of contract parameters.
- Understand the legal aspects of acts governing the contracts
- Discuss techniques for appropriate risks and changes, monitoring and measuring the contract closure
- Understand the basics of the bid process, important points in a tender document, and unbalanced contracts.

UNIT I CONTRACT MANAGEMENT

Introduction, Importance of Contracts, Overview of Contract Management, Overview of Activities in Contract Management; Planning and People- Resource Management; Types of Contracts, Parties to a Contract; Contract Formation, Formulation of Contract, Contract Start-Up, Managing Relationships; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price.

UNIT II CONTRACT PARAMETERS

Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Notices under contracts; Conventional and Alternative Dispute Resolution methods.

9

UNIT III VARIOUS ACTS GOVERNING CONTRACTS

Contract Administration and Payments- Contract Administration, Payments; Contract Management in Various Situations- Contract Management in NCB Works, Contract Management in ICB Works Contracts, Contract of Supply of Goods- Design, Supply and Installation Contracts, Contract Management in Consultancy,

UNIT IV BID PROCESS AND BID EVALUATION

Bid process, important points in a tender document, and unbalanced contracts. Material covered includes: Request For Proposal and problems Different types of proposals Design Conditions and Standard Component List-Tender document - Unbalanced proposals. Exercises: Evaluating Unit Prices Premium Portion Of The Overtime Rate Handling Bid Questions.

UNIT V MANAGING RISKS AND CHANGE

Managing Risks, Managing Change; Contract Closure and Review- Ending a Contract, Post-Implementation Review; Legal Aspects in Contract Management- Contract Management Legal View, Dispute Resolution, Integrity in Contract Management; Managing Performance- Introduction, Monitoring and Measurement.

TEXT BOOKS

- 1. R. K. Rajput, Engineering Materials, S. Chand & Company Ltd., 2000.
- 2. M. S. Shetty, Concrete Technology (Theory and Practice), S. Chand & Company Ltd., 2003.
- 3. Sustainable Construction: Green Building Design and Delivery. Third Edition, Charles J.Kibert, New York: John Wiley & Sons, 2012.

REFERENCE BOOKS

- 1. Working Toward Sustainability: Ethical Decision Making in a Technological World, CJ Kibertet al, New York: John Wiley & Sons, 2011.
- 2. Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
- 3. National Building Code, Bureau of Indian Standards, New Delhi, 2017.
- 4. Chudley, R., Construction Technology, ELBS Publishers, 2007.
- 5. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
- 6. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
- 7. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson EducationIndia, 2015
- 8. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM,Laxmi Publications,2016.

9

9

9

Total:45

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	3	1	-	2	1	2	1	-	2	-	2	2	1	-
CO2	3	1	-	2	1	2	1	-	2	-	2	2	1	-
CO3	3	1	-	2	1	2	1	-	2	-	2	2	1	-
CO4	3	1	-	2	1	2	1	-	2	-	2	2	1	-
CO5	3	1	-	2	1	2	1	-	2	-	2	2	1	-
Avg	3	1	-	2	1	2	1	-	2	-	2	2	1	-

AIR AND NOISE POLLUTION AND CONTROL **23BECEOE06 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 for the students is to

- To impart knowledge on the principles and design of control of indoor/ particulate / gaseous air pollutant and its emerging trends
- To induce operational considerations under the processing and control monitoring.
- To apply sampling techniques of gaseous contaminants.
- To control noise pollution by specific measurements, standard and preventive measures. •
- To enable to evaluate the behavior of air pollutants. •
- To have knowledge about appropriate control measures of air pollution

COURSE OUTCOMES

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

- Have knowledge about appropriate control measures of air pollution. •
- To apply sampling techniques and suggest suitable air pollution prevention equipment's and • techniques for various gaseous and particulate pollutants.
- Have knowledge about the air pollution monitoring and modeling. •
- Understand causes of air pollution and Analyze different types of air pollutants.
- Evaluate air pollutant behavior in the atmosphere. •
- Enable to evaluate the behavior of air pollutants.

UNIT I: INTRODUCTION

Structure and composition of Atmosphere - Sources and classification of air pollutants -Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of airPollutants on the atmosphere, Soil & Water bodies - Long- term effects on the planet - Global Climate Change, Ozone Holes - Ambient Air Quality and Emission Standards - Air Pollution Indices Emission Inventories.

UNIT II: AIR POLLUTION MONITORING AND MODELLIN

Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants -Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns-Transport & Dispersion of Air Pollutants – Modeling Techniques – Air PollutionClimatology.

UNIT III: CONTROL OF PARTICULATE CONTAMINANTS

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators, cyclones, Fabric filters, Particulate Scrubbers, Electrostatic Precipitators - Operational Considerations - Process Control and Monitoring - Costing of APC equipment – Case studies for stationary and mobile sources.

9

9

UNIT IV: CONTROL OF GASEOUS CONTAMINANTS

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

UNIT V: AUTOMOBILE AND NOISE POLLUTION

Vehicular Pollution: Automobile emission- Types of emissions- Exhaust emissions, evaporative emissions, crank-case emissions- Prevention and control of vehicular pollution. Noise Pollution: Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures. Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control.

Total: 45

TEXT BOOKS

- 1. Anjaneyulu D, "Air pollution and control technologies", Allied Publishers, Mumbai, 2002.
- 2. Khitoliya R K, "Environmental Pollution", 2/e, S. Chand Publishing, 2012.

REFERENCE BOOKS

- 1. Rao C.S, "Environmental pollution control engineering", Wiley Eastern Ltd., New Delhi, 1996.
- 2. Rao M.N, and Rao H.V.N, "Air Pollution Control" Tata-McGraw-Hill, New Delhi, 1996.
- 3. David H.F Liu, Bela G.Liptak, "Air Pollution", Lewis Publishers, 2000.
- 4. Mudakavi, J R, "Principles and Practices of Air Pollution Control and Analysis" IK International, 2010.
- 5. Air Pollution act, India, 1998.

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	1	2	1	-	2	-	2	2	1	-
CO2	3	2	-	2	1	2	1	-	2	-	2	2	1	-
CO3	3	2	-	2	1	2	1	-	2	-	2	2	1	-
CO4	3	2	-	2	1	2	1	-	2	-	2	2	1	-
CO5	3	2	-	2	1	2	1	-	2	-	2	2	1	-
Avg	3	2	-	2	1	2	1	-	2	-	2	2	1	-

9

LIST OF OPEN ELECTIVES

BIOTECHNOLOGY

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES

The goal of this course is for students to

- Elaborate the available tools and databases for performing research in bioinformatics.
- Expose students to sequence alignment tool in bioinformatics.
- Construct the phylogenetic rees for evolution.
- Discuss the 3D structure of protein and classification.
- Acquire basic knowledge in protein secondary structure prediction.
- Illustrate the brief knowledge in Microarray data analysis.

COURSE OUTCOMES

Upon completion this course, the students will be able to

- 1. Summarize the basic concepts and importance of Bio informatics in various sectors.
- 2. Demonstrate the sequence alignment tool in bioinformatics.
- 3. Outline the phylogenetic rees for evolution.
- 4. Illustrate the protein secondary structure prediction by comparative modeling.
- 5. Explain the microarray technology and applications of bio informatics in various sectors.

UNIT I OVERVIEW OF BIOINFORMATICS

Aims and tasks of Bioinformatics-applications of Bioinformatics-challenges and opportunities. The scope of bioinformatics; bioinformatics & the internet; useful bioinformaticssites. Data acquisition: sequencing DNA, RNA & proteins; determination of protein structure; gene& protein expression data; protein interaction data. Databases–contents, structure & annotation: fileformats; annotated sequence databases; miscellaneous databases.

UNIT II RETRIEVAL OF BIOLOGICAL DATA

Data retrieval with Entrez & DBGET/ LinkDB; data retrieval with SRS (sequence retrieval system).Searching sequence databases by sequence similarity criteria: sequence similarity searches; amino acid substitution matrices; database searches, FASTA & BLAST; sequence filters; iterative database searches & PSI-BLAST. Multiple-sequence alignment, gene & protein families: multiple-sequence alignment & family relationships; protein families & pattern databases; protein domain families.

Marks: Internal:40 External:60 Total:100 END SEMESTER EXAM:3 HOURS

3H-3C

UNIT III PHYLOGENETICS

Introduction to Phylogenetics, Molecular Evolution and Molecular Phylogenetics, Phylogenetic tree, Forms of Tree Representation, Rooted and un-rooted trees, Phylogenetic Tree Construction Methods: Distance based methods- NJ, UPGMA PGMA, cladistics & ontology; building phylogenetictrees; evolution of macro molecular sequences. Sequence annotation: principles of genome annotation annotation tools & resources.

UNIT IV STRUCTURAL BIOINFORMATICS

Protein sequence data-bases-Swiss Prot/TrEMBL,PIR, Sequence motifdatabases-Pfam, PROSITE,Protein structure databases, Protein DataBank-SCOP,CATH,KEGG, Chembank, Sequence, structure and function relationship. Conceptual models of protein structure; the relationship of protein three-dimensional structure to protein function; the evolution of protein structure & function; obtaining, viewing& analyzing structural data; structural alignment; classification of proteins of known three-dimensional structure; introduction to protein structure prediction; Protein structure prediction, modeling.

UNITV:MICROARRAYDATAANALYSIS

Microarray data, analysis methods; microarray data, tools & resources; sequence sampling &SAGE.Bioinformatics in pharmaceutical industry: informatics & drug discovery; pharmainformatics resources. Basic principles of computing in bioinformatics: running computer software; computer operating systems;software downloading & installation; database management.

TEXT BOOKS

- 1. Dan E krane Michael L Rayme. (2004). Fundamental concepts of Bioinformatics. PearsonEducation.
- 2. Andreas D Baxevanis B.F. Franchis Ouellette. (2004). Bioinformatics: A practical guide totheanalysis of genesand proteins. Wiley-Interscience.
- 3. DavidW.Mount.(2004).SequenceandGenomeAnalysis. ColdSpringHarborLaboratory.

REFERENCE BOOKS

- 1. JonathanPevsner.(2015).Bioinformaticsandfunctionalgenomics.wiley-Liss.
- Rastogi, S. C., Parag Rastogi, and Namita Mendiratta(2013). Bioinformatics Methods AndApplications: Genomics Proteomics And Drug Discovery. 4 th Edition, PHI Learning Pvt.Ltd.,

WEBSITES

- 1. https://www.ncbi.nlm.nih.gov/pmc/
- 2. https://biology.mit.edu/faculty-and-research/areas-of-research/computational-biology/

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	1	1	-
CO2	1	1	-	-	-	-	-	-	-	-	-	1	-	1
CO3	2	-	1	-	-	-	-	-	-	-	-	-	1	1
CO4	1	-	1	-	1	1	-	-	-	-	-	1	-	-
CO5	2	-	1	-	1	1	-	-	-	-	-	1	1	-
Avg	1.6	1.0	1.0	-	1.0	1.0	-	-	-	-	-	1.0	1.0	1.0

23BTBTOE02 FUNDAMENTALS OF NANO BIOTECHNOLOGY

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 skills in the field of nanobiotechnology and its applications.
- Acquire knowledge in the nanoparticles and its significance in various fields.
- Extend the knowledge in types and application of nanoparticles in sensors.
- Define the concepts of biomaterials through molecular self assembly.
- Equip students with clinical applications of nanodevices.
- $\bullet \quad Describe deeper understanding of the socio-economic is sues in nanobiotechnology.$

COURSE OUTCOMES

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

- 1. Develop skills in the field of nanobiotechnology and its applications.
- 2. Summarize the techniques involve in nanoparticlessynthesis and characterization.
- 3. Demonstrate the nanotechnology application in biomedical and drug delivery system.
- 4. Outline the clinical applications of nanodevices.
- 5. Explain the socio-economic issues in nanobiotechnology.

UNIT I INTRODUCTION

Introduction to Nanotechnology and nanobiotechnology: Properties at nanoscale, Scope andOverview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology,FutureofNanotechnology:NanoTechnologyRevolution,;Generalsynthesismethodsofn anoscale materials; top down and bottom up approaches; Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Nanotechnology in Different, Fields: Nano biotechnology, Materials, Medicine, Dental care.

UNIT II NANOPARTICLES

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 assemble dmonolayers/ Dip- pen Nanolithography, Soft Lithography, PDMS Molding, NanoParticles, Nanowires and Nanotubes.X-ray diffraction technique; Scanning Electron Microscopy with EDX; Transmission Electron Microscopy including high-resolution imaging;

3H-3C

9

UNIT III MEDICALNANOTECHNOLOGY

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. Case study on drug delivery of gold nanoparticles against breast cancer

UNIT IV NANOBIOTECHNOLOGY

Nanoscale devices for drug delivery: micelles for drug delivery; targeting; bioimaging; microarray and genome chips; Clinical applications of nanodevices. Artificial neurons. Realtime nano sensors- Applications in cancer biology. Nanomedicine. Synthetic retinyl chips based on bacteriorhodopsins. High throughput DNA sequencing with nano carbon tubules. 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.

TEXT BOOKS

1. Goodsell, D.S. (2004). Bionanotechnology. John Wiley and Sons, Inc.

2. Shoseyov, O. and Levy, I (2008).Nanobiotechnology: Bioinspired Devices and Materialso f the Future. Humana Press.

REFERENCE BOOKS

1. Bhushan,B.(2017).Springer H and book of Nanotechnology.Springer-Verlag BerlinHeidelberg.

2. Freitas JrR.A(2006) Nanomedicine.L and esBiosciences.

 $\label{eq:constraint} 3. Kohler, M. and Fritzsche, W. (2008). Nanotechnology-An Introduction to$

Nanostructuring Techniques.Wiley-VCH.

4. Niemeyer, C. M., and CA Mirkin, C. A., (2010); NanoBiotechnology II – More concepts, and applications. First edition, Wiley–VCH publications

WEBSITES

- 1. https://mitnano.mit.edu/
- 2. https://nptel.ac.in/courses/118102003

9

9

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	1	-	-	-	-	-	-	-	-	1
CO2	1	-	-	-	-	-	-	-	-	-	-	1	1	1
CO3	2	-	1	-	1	1	-	-	-	-	-	-	1	1
CO4	2	-	1	-	1	1	-	-	-	-	-	-	1	-
CO5	-	-	-	2	-	2		2	-	-	-	-	-	-
Avg	1.8	-	1.0	2.0	1.0	1.3	-	2.0	-	-	-	1.0	1.0	1.0

LIST OF OPEN ELECTIVES

COMPUTER SCIENCE AND ENGINEERING

B.E BIOMEDICAL ENGINEERING

INTERNET OF THINGS 23BECSOE01

3H-3C

Instruction Hours/week: L:3 T:0 P:0

End Semester Exam:3 Hours

Marks: Internal:40 External:60 Total:100

COURSE OBJECTIVES:

The goal of this course is for the students :

- To understand the basics of Internet of Things.
- To identify an idea of some of the application areas where Internet of Things can be applied.
- To infer the middleware for Internet of Things.
- To express the concepts of Web of Things. .
- To examine the concepts of Cloud of Things with emphasis on Mobile cloud computing.
- To inspect the IOT security protocols.

COURSE OUTCOMES:

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

- Explain about IoT architecture and its applications.
- Identify the feasibility and potential impact of IoT solutions in different industries. •
- Apply a systematic and structured approach to designing IoT solutions. •
- Summarize techniques to secure the elements of an IoT device.
- Illustrate security protocols in various domains of industrial applications.

UNIT I INTRODUCTION TO IOT

Introduction to IoT – IoT Architectures – Core IoT Functional Stack, Sensors and Actuators Layer, Communications Network Layer, Applications and Analytics Layer - IoT Data Management and Compute Stack, Fog Computing, Edge Computing, Cloud Computing – Sensors, Actuators, Smart Objects, Sensor networks. Middleware for IoT: Overview - Communication middleware for IoT -IoT Information Security, WSN and Sensing Model.

UNIT II IOT COMMUNICATION

Communications Criteria - Access Technologies - IP as IoT Network Layer - Business case -Optimization - Profiles and compliances - Application Protocols - Transport Layer - Application Transport Methods.

UNIT III DESIGN METHODOLOGY

Design Methodology – Case study – Basic blocks of IoT device – Raspberry Pi – Board, Interfaces, Linux, Setting up, Programming – Arduino – Other IoT Devices.

9

9

UNIT IV DATA ANALYTICS FOR IOT

Data Analytics for IoT – Big Data Analytics Tools and Technology – Edge Streaming Analytics – Network Analytics Applications. Security history, challenges, variations – Risk Analysis Structures – Application in Operational Environment.

UNIT V IOT IN INDUSTRY

Manufacturing, Architecture, Security Protocols – Utilities, Grid Blocks - Smart Cities, Architecture, Use cases – Transportation, Architecture, Use cases.

TEXT BOOKS:

Honbo Zhou "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,

2. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer Berlin, 2011

3. David Easley, Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010

REFERENCE BOOKS:

1. Olivier Hersent, Omar Elloumi and David Boswarthick,"The Internet of Things:

Applications to the Smart Grid and Building Automation", Wiley, 2018

2. Olivier Hersent, David Boswarthick, Omar Elloumi,"The Internet of Things – Key applications and Protocols", Wiley, 2019

WEBSITES:

- 1. <u>https://www.javatpoint.com/iot-internet-of-things</u>
- 2. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
- 3. <u>https://www.tutorialspoint.com/internet_of_things/index.htm</u>
- 4. <u>https://www.startertutorials.com/blog/physical-design-of-iot.html</u>
- 5. <u>https://www.guru99.com/iot-tutorial.html</u>

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	2	-	2	2	2	2
CO2	3	3	2	2	2	-	-	-	2	-	2	2	2	2
CO3	3	3	2	2	2	-	-	-	2	-	2	2	2	2
CO4	3	2	2	2	-	-	-	-	2	-	2	2	2	2
CO5	3	2	2	2	2	-	-	-	2	-	2	2	2	2
Average	3	2.4	2	2	2	-	-	-	2	-	2	2	2	2

CO-PO MAPPING

9

9

TOTAL: 45

B.E. BIOMEDICAL ENGINEERING

MACHINE LEARNING

3H-3C

2023-2024

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 understand Supervised and Unsupervised learning techniques.
- To study the various probability based learning techniques.
- To learn Dimensionality Reduction Techniques.
- To infer Evolutionary Models and Graphical models of machine learning algorithms.

COURSE OUTCOMES

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

- Discuss basics of machine learning concepts and its types.
- Classify machine learning techniques to solve any given problem.
- Illustrate Open-source Machine Learning libraries and its uses.
- Outline Similarity based learning for Predictive Data Analytics.
- Explain about online fraud detection and analysis.

UNIT I: MACHINE LEARNING BASICS

Introduction to Machine Learning (ML) - Essential concepts of ML – Types of learning – Machine learning methods based on Time – Dimensionality – Linearity and Non linearity – Early trends in Machine learning – Data Understanding Representation and visualization.

UNIT II: MACHINE LEARNING METHODS

Linear methods – Regression -Classification –Perceptron and Neural networks – Decision trees – Support vector machines – Probabilistic models —Unsupervised learning – Featurization

UNIT III: MACHINE LEARNING IN PRACTICE

Ranking – Recommendation System - Designing and Tuning model pipelines- Performance measurement – Azure Machine Learning – Open-source Machine Learning libraries – Amazon''s Machine Learning Tool Kit: Sagemaker

UNIT IV: MACHINE LEARNING AND DATA ANALYTICS

Machine Learning for Predictive Data Analytics – Data to Insights to Decisions – Data Exploration – Information based Learning – Similarity based learning – Probability based learning – Error based learning – Evaluation – The art of Machine learning to Predictive Data Analytics.

UNIT V: APPLICATIONS OF MACHINE LEARNING

Image Recognition – Speech Recognition – Email spam and Malware Filtering – Online fraud detection – Medical Diagnosis.

9

9

9

9

TEXT BOOKS:

1. Ameet V Joshi, Machine Learning and Artificial Intelligence, Springer Publications, 2020

2. John D. Kelleher, Brain Mac Namee, Aoife D" Arcy, Fundamentals of Machine learning for Predictive Data Analytics, Algorithms, Worked Examples and case studies, MIT press,2015

REFERENCES:

Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer Publications,

2. Stuart Jonathan Russell, Peter Norvig, John Canny, Artificial Intelligence: A Modern Approach, Prentice Hall, 2020 3. Machine Learning Dummies, John Paul Muller, Luca Massaron, Wiley Publications, 2021

WEBSITES:

- 1. <u>https://www.tutorialspoint.com/machine_learning/index.htm</u>
- 2. <u>https://www.hackerearth.com/practice/machine-learning/challenges-winning-approach/machine-learning-challenge-one/tutorial/</u>
- 3. https://www.javatpoint.com/machine-learning
- 4. <u>https://www.geeksforgeeks.org/machine-learning/</u>

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	3	2	-	2	-	-	-	-	-	2	2	2
CO3	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO5	3	2	1	2	-	2	-	-	-	-	-	2	2	2
Average	3	2.6	2	2	-	2	-	-	-	-	-	2	2	2

23BECSOE03

BLOCKCHAIN TECHNOLOGIES

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 comprehend the importance of the Blockchain framework and its practical uses.
- To scrutinize the verification of Bitcoin transactions through the utilization of the Blockchain.
- To recognize the constituent elements of smart contracts required for achieving consensus in a Permissioned Blockchain.
- To furnish the essential infrastructure and boost the effectiveness, efficacy, and transactions of diverse business procedures by utilizing Hyperledger.
- To examine the scope of utilization of Blockchain in diverse governmental and nongovernmental entities.

COURSE OUTCOMES:

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

- Explain block chain archetectuere and its applications.
- Describe the proof of work consensus algorithm used in Bitcoin and its significance in securing the network.

Discuss consensus algorithms used in permissioned blockchains, including Raft, Byzantine fault tolerance, and Paxos.

- Infer the transaction flow in Hyperledger Fabric and validation processes.
- Illustrate security aspects and its solutions in block chain technology.

UNIT I: INTRODUCTION

Introduction – Block Structure – Architecture – Block Header – Genesis Block – Merkle Trees – Hashing - Signature & Encryption Schemes - Business Applications **UNIT II: BITCOIN BASICS** 9

Bitcoin Basics - Wallet - Decentralized Consensus - Aggregate transactions - Proof of Work -Miners - Consensus Algorithms - Double Spending - Verifying Transactions - Fork - Reward

UNIT III: PERMISSIONED BLOCK CHAIN

Permissioned Block Chain - Smart Contracts - Consensus - Raft - Byzantine - Paxos - Degree of Decentralization - Asset Transfer - Enterprise Application **UNIT IV: FABRIC ARCHITECTURE** 9

Fabric Architecture - Transaction Flow - Channel - Ordering Service - Membership & Identity Management - Network Setup - Hyperledger Composer - Roles - Network Administration **UNIT V: BLOCKCHAIN USE CASES & SECURITY** 9

Financial Services – Supply Chain – Government – Digital Identities – Land Record Registry – Security Overview – Membership & Access Control – Privacy

TOTAL: 45

3H-3C

9

TEXT BOOKS:

1. Andreas M. Antonopoulos, "Mastering Bitcoin", 2nd Edition, O"Reilly Media, 2017

Melanie Swan, "Blockchain: Blueprint for a New Economy", 1st Edition, O'Reilly Media,
2017

REFERENCE BOOKS:

1. Nitin Gaur, Luc Desrosiers, Et al, "Hands-On Blockchain with Hyperledger", Packt Publisher, June 2018

2. Imran Bashir, "Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks", Packt Publisher, March 2017

WEBSITES:

- 1. <u>https://nptel.ac.in/courses/106105184</u>
- 2. https://www.hyperledger.org/projects/fabric
- 3. https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html
- 4. https://www.javatpoint.com/blockchain-tutorial

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	2	-	-	-	-	-	2	2	2
CO2	3	2	2	-	-	2	-	-	-	-	-	2	2	2
CO3	3	2	2	-	-	2	-	-	-	-	-	2	2	2
CO4	3	3	2	-	-	2	-	-	-	-	-	2	2	2
CO5	3	3	3	-	2	2	-	-	-	-	-	2	2	2
Average	3	2.4	2.2	-	2	2	-	-	-	-	-	2	2	2

23BECSOE04

CLOUD COMPUTING

3H-3C

2023-2024

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:

- To learn the basic concepts of cloud computing.
- To learn types of cloud services and its applications.
- To understand the key components of Amazon Web Services.
- To collaborate with real time cloud services.
- To understand the security risk and application of cloud computing.

COURSE OUTCOMES:

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

- Illustrate the basic concepts of cloud computing and its usage.
- Compare different types of cloud computing services.
- Outline the ways of collaborating cloud with web based communication tools..
- Summarize the concept of virtualization and load balancing.
- Demonstrate proficiency in using Google Web Services for cloud management.

UNIT I CLOUD INTRODUCTION

Cloud Computing Fundamentals: Cloud Computing definition, Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing, usage scenarios and Applications, Business models around Cloud – Major Players in Cloud Computing - Issues in Cloud - Eucalyptus - Nimbus – Open Nebula, CloudSim.

UNIT II CLOUD SERVICES AND FILE SYSTEM

Types of Cloud services : Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service – Communication as services. Service providers - Google App Engine, Amazon EC2, Microsoft Azure, Sales force. Introduction to MapReduce, GFS, HDFS, Hadoop Framework.

UNIT III COLLABORATING WITH CLOUD

Collaborating on Calendars, Schedules and Task Management – Collaborating on Event Management, Contact Management, Project Management – Collaborating on Word Processing ,Databases – Storing and Sharing Files- Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Collaborating via Social Networks – Collaborating via Blogs and Wikis.

UNIT IV ABSTRACTION AND VIRTUALIZATION

Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding Hyper visors, Understanding Machine Imaging, Porting Applications, Virtual Machines Provisioning and Manageability Virtual Machine Migration Services, Virtual Machine Provisioning

9

9

9

y

and Migration in Action, Provisioning in the Cloud Context.

UNIT V MANAGING AND SECURING CLOUD

Managing & Securing the Cloud: Administrating the Clouds, Cloud Management Products, Emerging Cloud Management Standards, Securing the Cloud, Securing Data, Establishing Identity and Presence. Case-Studies: Using Google Web Services, Using Amazon Web Services, Using **Microsoft Cloud Services**

TEXT BOOKS:

1. John Ritting house & James Ransome, "Cloud Computing Implementation Management and Strategy", CRC Press, 2018.

2. Rao M.N., Cloud Computing, PHI Learning Private Limited, 2018.

REFERENCES:

Bloor R., Kanfman M., Halper F. Judith Hurwitz "Cloud Computing for Dummies" 1. (Wiley India Edition), 2015.

2. Antohy T Velte, Cloud Computing: "A Practical Approach", McGraw Hill, 2018.

WEBSITES:

- 1. https://nptel.ac.in/courses/106105167/
- 2. https://www.javatpoint.com/cloud-computing

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	2	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	2	2	-	-	-	-	-	2	2	2
CO6	3	2	2	2	2	2	-	-	-	-		2	2	2
Average	3	2.8	2	2	2	2	-	-	-	-	-	2	2	2

CO-PO MAPPING:

TOTAL: 45

LIST OF OPEN ELECTIVES COMPUTER SCIENCE AND ENGINEERING (CYBER SECURUTY)

23BECYOE01 BASICS OF CYBER CRIME AND CYBER SECURITY 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 fundamental concepts of cybercrime.
- To explore knowledge on cybercrimes in wireless devices.
- To infer tools used in the cyber security.
- To familiar with various Indian IT Act in cybercrime and cyber security.
- To enhance the knowledge in handheld devices and digital forensics.

COURSE OUTCOMES:

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

- Illustrate basics of cyber-crime and information security.
- Apply the fundamentals concepts for identifying cyber-attacks. •
- Make use of tools and methods used in cyber security. •
- Analyze theoretical and cross-disciplinary approaches in Indian IT Act and in digital devices.
- Summarize the impact of cybercrime in digital devices on government, business, individual and society.

UNIT I INTRODUCTION

Introduction to Cyber Crime: Cyber Crime and Information Security - Classifications of Cyber Criminals -Cyber Cri\me Legal Perspective and Indian Perspective - Cyber Crime and Indian ITA - A Global perspective on Cybercrimes - Categories of Cybercrimes - Criminal plans for attack - Social Engineering -Cyber talking – Cyber cafe and cyber criminals – Botnet – Attack vector – Cloud Computing.

UNIT II CYBER CRIME MOBILE AND WIRELESS DEVICES

Cyber Crime Mobile and Wireless Devices: Proliferation – Trends in Mobility – Credit card frauds – Security challenges - Registry setting - Authentication service - Attacks - Security Implication for Organization - Organizational measures - Organizational Security Policies - Physical security counter measures.

TOOLS AND METHODS USED IN CYBER SECURITY **UNIT III**

Tools and methods used in cyber security: Proxy servers and anonymizers – Phishing – Password cracking – Keyloggers and spywares - Virus and worms - Trojan horse - Stegnography - DoS and DDoS attack - SQL Injection – Buffer overflow – Attacks on wireless networks – Phishing and Identity theft.

UNIT IV CYBER CRIME AND LEGAL LANDSCAPE

Cyber Crime and Legal landscape - Indian IT Act - Digital Signature and Indian IT Act - Amendments to the Indian IT Act - Cybercrime and punishment. Understanding Computer Forensics: Need for computer forensics - Cyber forensics and digital evidence - Digital forensics life cycle - Network forensics -

9

9

9

Computer forensics and steganography - Computer forensics from compliance perspective - Challenges

UNIT V SPECIAL TOOLS AND TECHNIQUES

Special tools and techniques –Hand held devices and digital forensics. Cyber security organizational implications: Cost of cybercrimes and IPR – Web threads for organizations – Security and privacy implications – Social media marketing – Incident handling – Forensics best practices for organization.

TEXT BOOKS:

1. Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley Publisher, First Edition, 2011

REFERENCE BOOKS:

1. Harish Chander, Cyber Laws and IT Protection, PHI Learning, First Edition, 2012

2. James Graham, Ryan Olson and Rick Howard, Cyber Security Essentials, CRC Press, First Edition, CRC Press, First Edition

WEBSITES:

- 1. www.lexology.com/library/
- 2. www.swayam.gov.in/nd2_ugc19_hs25/preview
- 3. www.educba.com/cyber-security-tools/
- 4. www.intaforensics.com
- 5. www.itu.int/en/ITU-D/Cybersecurity

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO3	3	3	3	3	-	2	-	-	-	-	-	2	2	2
CO4	3	3	3	3	-	2	-	-	-	-	-	2	2	2
CO5	3	3	2	2	-	2	-	-	-	-	-	2	2	2
Average	3	3	2.4	2.4	-	2	-	-	-	-	-	2	2	2

CO-PO MAPPING

9

TOTAL: 45

23BECYOE02 BASICS OF CYBER FORENSICS

3H-3C

9

9

9

Instruction Hours/week: L:3 T:0 P:0 Mark

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students

- To be aware of fundamentals on cyber forensics and usage of cyber forensics tools.
- To be familiar with the file systems and challenges in the Linux and mac operating system.
- To explore knowledge on the network and different operating systems on mobile devices.
- To learn various services like FaaS and MaaS.
- To enhance the knowledge on database, email and threats in crypto currency.

COURSE OUTCOMES:

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

- Infer the basic of Forensics investigation process.
- Discuss popular Linux distributions used for forensic analysis, file systems, processes, and artifacts associated with Linux systems.
- Outline challenges involved in iOS forensics and relevant data extraction procedure from iOS devices
- Analyze the challenges in cloud forensics.
- Describe Bitcoin forensics and Blockchain artifacts.

UNIT INTRODUCTION

Introduction to Cyber forensics: Forensics investigation process – Forensics protocol – Digital forensics standards –Digital evidence – Types of cyber crime – Notable data breaches – Case study - Challenges in Cyber security – Cyber forensics tools. Windows forensics: Digital Evidence – File systems – Time analysis – Challenges- Case Study.

UNIT II LINUX FORENSICS AND MAC OS FORENSICS

Linux forensics: Popular linux – File systems – Process – Artifacts – Linux distribution used for forensics analysis – Challenges – Case study. Mac OS forensics: File systems – Process – Artifacts – Information to collect Mac book forensics investigation – Case study. Anti-forensics: Data wiping and shredding – Trial obfuscation – Encryption – Data hiding – Anti-forensics detection technique

UNIT III NETWORK FORENSICS AND MOBILE FORENSICS

Network forensics: OSI Model – Artifacts – ICPM Attack – Analysis tools. Mobile forensics: Android operating system – Mutual Extraction – Physical acquisition – Chip-off – Micro-read – Challenges – iOS operating system.

UNIT IV CLOUD FORENSICS AND WEB ATTACK FORENSICS

Cloud forensics: Cloud computing model – Server-side forensics – Client-side forensics – Challenges – Artifacts – use – Forensics as a Service. Malware forensics: Types – Analysis – Tools – Challenges – Malware as a Service. Web attack forensics: Web attack test – Intrusion forensics – Database forensics– Log forensics – Content analysis – File metadata forensics

UNIT V EMAILS AND EMAIL CRIMINALS

Emails and email criminals: Protocols – Email criminals – Email forensics. Solid State device forensics: Components –Data wiping – Analysis. Bit coin forensics: Crypto currency – Block chain – Artifacts – Challenges.

TOTAL: 45

9

TEXT BOOKS:

1. Niranjan Reddy, Practical Cyber Forensics: An Incident-Based Approach to Forensic Investigations, Apress, First Edition, 2019

REFERENCE BOOKS:

1. Marjie Britz T, Computer Forensics and Cyber Crime: An Introduction, Prentice Hall, Third Edition, 2013

2. Albert Marcella J and Frederic Guillossou, Cyber Forensics: From Data to Digital Evidence, Wiley Publisher, .First Edition, 2012

WEBSITES:

- 1.
- 2. www.swayam.gov.in/nd2_ugc19_hs25/preview
- 3. www.educba.com/cyber-security-tools/
- 4. www.intaforensics.com
- 5. www.cs.nmt.edu/~df/lectures.html

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	-	2	2	-	-	-	-	-	2	2	2
CO3	3	3	3	3	2	2	-	-	-	-	-	2	2	2
CO4	3	3	3	3	2	2	-	-	-	-	-	2	2	2
CO5	2	2	2	1	-	2	-	-	-	-	-	2	2	2
Average	2.8	2.8	2.4	1.8	2	2	-	-	-	-	-	2	2	2

23BECYOE03CYBER LAWS AND INTELLECTUAL PROPERTY RIGHTS3H-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 need for cyber laws and intellectual property rights.
- To acquire knowledge about the protective measures of Intellectual property such as copyright, patent, Trademark.
- To examine the criminal remedies and defensive measures.
- To provide an insight about the role of certifying authority and cryptography.
- To be aware of Indian IT Act 2000 and 2008 cyber laws.

COURSE OUTCOMES:

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

- Outline the fundamental concepts of cyber laws and the various intellectual property rights for criminal activities.
- Illustrate the concept of work of employment and its implications in copyright infringement cases.
- Infer civil remedies available for design infringement and their application in different infringement scenarios.
- Identify the scope and significance of cyber laws that arises from the use of technology.
- Explain Information Technology Act and its subsequent amendments in cyberspace

UNIT I INTRODUCTION

Intellectual Property: Introduction – Protection of Intellectual Property – Copyright related rights – Patents – Industrial designs – Trademark – Unfair competition – Information technology related intellectual property rights – Computer software and intellectual property – Copyright protection – Reproducing – Defences – Patent protection.

UNIT II INFRINGEMENT

Ownership and enforcement of intellectual property – Defences in case of infringement copyright – Work of employment infringement – Defences for infringement – Trademarks – Rights – Protection of good will – Infringement – Passing off defences

UNIT III IP IINTELLECTUAL PROPERTY RIGHTS AND ENFORCEMENT 9

Designs – Defences of design infringement. Enforcement of intellectual property rights – Civil remedies – Civil remedies – Civil remedies – Border – Security measures. Practical aspects of licensing – Benefits – Determinative factors – Important clauses – Licensing clauses

9

UNIT IV CYBER LAW

Cyber law: Basic concepts of technology and law – Understanding the technology of internet – Scope of cyber laws. Cyber jurisprudence law of digital contracts: The essence of digital contracts – The system of digital signatures – The role and function of certifying authorities

UNIT V INTELLECTUAL PROPERTY ISSUES

The science of cryptography – IT Act 2000 and 2008 – Amendments in IT Act – IPC and Privacy threats in cyber law. Intellectual Property issues in cyber space: Domain names and related issues – Copyright in the digital media – Patents in the cyber world. rights of netizens and e-Governance.

TEXT BOOKS:

1.David I Bainbridge, Intellectual Property, Pearson Education, Eighth Edition,2010 2.Talat Fatima, Cyber Law in India, Wolters Kluwer, First Edition,2017

REFERENCE BOOKS:

1. Yatindra Singh, Guide to Cyber Laws, Universal Law, Fourth Edition, 2010

2. Information Technology Law and Practice- Cyber Laws and Laws Relating to E-Commerce, Universal Law, Third Edition, 2011

WEBSITES:

2.www.core.ac.uk/download/pdf/144527187.pdf

2.www.nptel.ac.in/courses/110/105/110105139/

3.www.icsi.edu/media/webmodules/FINAL_IPR&LP_BOOK_10022020.pdf

4.www.lawshelf.com/videocoursesmoduleview/

5.www.lawfaculty.du.ac.in/files/course_material/Old_Course_Material/

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	3	2	-	2	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	3	3	3	-	2	-	-	-	-	-	2	2	2
CO5	3	3	3	2	-	2	-	-	-	-	-	2	2	2
Average	3	2.8	2.6	2.2	-	2	-	-	-	-	-	2	2	2

CO-PO MAPPING

9

TOTAL: 45

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

PRE-REQUISITES: Network Security

COURSE OBJECTIVES:

The goal of this course is for the students :

• To decompose a block chain system"s fundamental components, how they fit together and examine a decentralization using block chain.

• To illustrate how Crypto currency works, from when a transaction is created to when it is considered part of the blockchain.

• To explain the components of Ethereum, programming languages for Ethereum and study the basics Hyperledger and Web3.

- To understand the nature of threats and cyber security management goals and technology
- To infer the landscape of hacking and perimeter defense mechanisms

COURSE OUTCOMES:

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

- Illustrate the technology components of Block chain and its working principles.
- Describe Ethereum model and code execution and the architectural components.
- Discuss components of a Hyperledger along with its development framework.
- Demonstrate the nature of threats and cyber security management goals and framework.
- Outline malicious software attack and wireless network attack.

UNIT I INTRODUCTION OF BLOCKCHAIN TECHNOLOGY

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization. Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin Limitations – Name Coin – Prime Coin – Zcash. – Smart Contracts – Ricardian Contracts.

UNIT II ETHEREUM NETWORK

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

UNIT III FRAMEWORK FOR HYPERLEDGER FABRIC

Introduction to Web3 – Contract Deployment – POST Requests – Development frameworks – Hyperledger as a protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger –Corda-Alternative Blockchains.

3H-3C

9

9

UNIT IV CYBER SECURITY

Introduction – Cyberspace – Cyber Crime – Nature of Threat – Cyber security – Policy, Mission and Vision of Cyber security Program. Cyber security management system – goals, technology categories –perimeter defense and encryption.

UNIT V WEB APPLICATION ATTACKS

Malicious Attacks, Threats, and Vulnerabilities- Malware –malicious software attack – social engineering attack – wireless network attack – web application attack –Countermeasures. Creating Mechanisms for IT Security.

TEXT BOOKS:

1. Imran Bashir "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained" Packt Publishing, Second Edition 2018.

2. Arshdeep Bahga, Vijay Madisetti "Blockchain Applications: A Hands-On Approach" VPT Publications, First Edition 2017.

3. David Kim and Michael G. Solomon "Fundamentals of Information Systems Security" Jones & Bartl Learning, Third Edition 2018.

4. Peter Trim and Yang –Im Lee "Cyber Security Management- A Governance, Risk and Compliance Framework" Gower Publishing, First Edition 2014.

REFERENCE BOOKS:

1. Andreas Antonopoulos, Satoshi Nakamoto "Mastering Bitcoin", O'Reilly Publishing, Second Edition 2017.

2. Alex Leverington "Ethereum Programming", Packt Publishing, First Edition 2017.

3. John G. Voeller "Cyber Security" John Wiley & Sons, First Edition 2014.

WEB SITES:

- 1. www.nptel.ac.in/courses/106/104/106104220/
- 2. www.icaew.com/technical/technology/blockchain/blockchain-articles/what-isblockchain/history
- 3. www.ibm.com/topics/blockchain-security
- 4. https://blockgeeks.com/guides/ethereum/

5. https://world101.cfr.org/global-era-issues/cyberspace-and-cybersecurity/what-are-cyberspaceand-cybersecurity

9

TOTAL: 45
CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO2	3	2	2	2	2	2	-	-	-	-	-	2	2	2
CO3	3	2	2	2	2	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	2	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	2	2	-	-	-	-	-	2	2	2
Average	3	2.2	2	2	2	2	-	-	-	-	-	2	2	2

LIST OF OPEN ELECTIVES ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

23BTADOE01

01 FUNDAMENTALS OF DATA SCIENCE

3H-3C

Instruction Hours/week:L:3 T:0 P:0

Marks:Internal:40 External:60 Total:100 End Semester Exam: 3Hours

COURSE OBJECTIVES:

The goal of this course is for the students:

- To study the basic concepts of Data Science and data life cycle
- To understand the theoretical and mathematical aspects of Data Science models
- To learn common random variables and their uses, and with the use of empirical distributions
- To obtain the knowledge in data management tools
- To explore the major techniques for data science

COURSE OUTCOMES:

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

- Express the key concepts in data science and data processing.
- Describe sampling and probabilistic models to a real time application.
- Discuss about data normalization and data management tools.
- Identify the difference between supervised and unsupervised machine learning techniques.
- Illustrate the different analytics used in business intelligence.

UNIT I INTRODUCTION

The Big Picture: What is Data Science? –The data life cycle: pre-processing, analysis, post-processing – Pre-processing: Data gathering, cleansing, visualization, and understanding (Mean, Variance, Standard Deviation. Percentiles.)–Data Storage (Relational databases, e.g. MySQL)

UNIT II PROBABILISTIC MODELS

Sampling – Probability Models for Statistical Methods: Discrete and continuous probability distributions, density functions. Random variables, expected values, variance, correlation.

UNIT III NORMALIZATION

Data Normalization (z-values, transforms) –Random processes –Data Management: Tools for Data Analysis, Case Study: Data analysis using Python-Arrays, Visualization.

UNIT IV DATA MINING

Major Techniques in Data Science: Data mining, Data warehousing, Data mining vs Data warehouse–Machine Learning- Supervised Learning, Unsupervised Learning.

9

9

9

UNIT V BUSINESS INTELLIGENCE AND ANALYTICS

Business Intelligence –Descriptive Analytics, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics– Cloud computing-definition, Cloud services, types of clouds, some of commercial and non commercial cloud service providers.

TEXT BOOKS:

 Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, John Wiley & Son Publication, Second Edition, 2014.
Saltz Jeffrey S, An Introduction to Data Science, Sage Publications Inc, Second Edition, 2019.

REFERENCE BOOKS:

1. Murtaza Haider, Getting Started with Data Science: Making Sense of Data with Analytics, IBM Press, First Edition, 2015.

2. Peter Bruce & Andrew Bruce, Practical Statistics for Data Scientists, O"Reilly Publication, First Edition, 2017.

WEBSITES:

- 1. https://www.inferentialthinking.com/chapters/intro
- 2. https://swayam.gov.in/nd1_noc20_cs36/preview
- 3. https://swayam.gov.in/nd1_noc19_cs60/preview
- 4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0002-

introduction-to-computational-thinking-and-data-science-fall-2016/

	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO
CONO	1	2	3	4	5	6	7	8	9	0	1	2	1	2
CO1	3	3	3	2	2	2	-	I	2	-	2	2	2	2
CO2	3	3	3	3	3	2	-	-	2	-	2	2	2	2
CO3	3	3	2	2	2	2	-	-	2	-	2	2	2	2
CO4	3	3	3	3	2	2	-	-	2	-	2	2	2	2
CO5	3	3	2	2	2	2	-	-	2	-	2	2	2	2
Average	3	3	2.6	2.4	2.2	2	-	-	2	-	2	2	2	2
1														

CO-PO MAPPING

TOTAL: 45

Instruction Hours/week:L:3 T:0 P:0

Marks: Internal: 40 External:60 Total:100

End Semester Exam: 3Hours

3H-3C

COURSE OBJECTIVES:

The goal of this course is for the students:

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To represent knowledge in solving AI problems.
- To illustrate the different ways of designing software agents
- To know the various applications of AI.

COURSE OUTCOME:

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

- Identify the performance of search algorithms and its applications.
- Infer the different methods of knowledge representation.
- Discuss about Description logic and conceptional dependencies.
- Make use of strategies for optimal decision-making in the context of game-playing scenarios.
- Illustrate the properties of Markov process and the concept of transition probabilities.

UNIT I INTRODUCTION

Introduction: Objective, scope and outcome of the course Meaning and definition of artificial intelligence, Physical Symbol System Hypothesis, production systems, Characteristics of production systems; Breadth first search and depth first search techniques. Heuristic search Techniques: Hill Climbing, Iterative deepening DFS, bidirectional search. Analysis of search methods. A* algorithm, and their analysis. Introduction to Genetic Algorithms.

UNIT II KNOWLEDGE REPRESENTATION

Knowledge Representation, Problems in representing knowledge, knowledge representation using propositional and predicate logic, logical consequences, syntax and semantics of an expression, semantic Tableau. Forward and backward reasoning. Proof methods, substitution and unification, conversion to clausal form, normal forms, resolution, refutation, deduction, theorem proving, inferencing, monotonic and non monotonic reasoning. Introduction to prolog.

9

UNIT III NETWORK-BASED REPRESENTATION

Network-based representation and reasoning, Semantic networks, Conceptual Graphs, frames. Description logic (DL), concept language, reasoning using DL. Conceptual dependencies (CD), scripts, reasoning using CD. Introduction to natural language processing.

UNIT IV GAME THEORY

Adversarial search and Game theory, classification of games, game playing strategies, prisoner's Dilemma. Game playing techniques, minimax procedure, alpha-beta cut-offs. Complexity of alphabeta search. Automated planning, classical planning problem, forward planning, partial order planning, planning with proposal logic, hierarchical task planning, multiagent planning.

UNIT V FUZZY LOGIC

Reasoning in uncertain environments, Fuzzy logic, fuzzy composition relation, operations on fuzzy sets. Probabilistic reasoning, Bayes theorem, construction of Bayesian networks, belief propagation. Markov processes and Hidden Markov models.

TOTAL: 45

TEXT BOOKS:

- 1. "Artificial Intelligence", ElaineRich, Kevin Knight, Mc-GrawHill, 2020.
- 2. "Introduction to AI & Expert System", Dan W.Patterson, PHI, 2020.

REFERENCE BOOKS:

- 1. "Artificial Intelligence" by Luger (Pearson Education),2020.
- 2. Russel&Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2020.

WEBSITES:

1. https://www.pluralsight.com/blog/data-professional/fundamentals-of-artificial-intelligence

CO-PO MAPPING:

CO No	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO12	PSO1	PSO2
	1	2	3	4	5	6	7	8	9	0	1			
CO1	3	3	3	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	3	2	-	2	-	-	-	-	-	2	2	2
CO3	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	2	-	-	-	-	-	2	2	2
Average	3	2.6	2.4	2	-	2	-	-	-	-	-	2	2	2

9

9

INTERNET PROGRAMMING

3H-3C

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal: 40 External:60 Total:100 End Semester Exam:3Hours

COURSE OBJECTIVES:

The goal of this course is for the students:

• Recall fundamental tags used in HTML5 and CSS to create simple web application.

• Rephrase the concept to create static and dynamic webpage with validation controls and event handling methods.

- Make use of servlets and JSP tag to develop server-side scripting.
- Summarize the tags in PHP and XML to create simple php web application.
- Interview the basic concept and tags are used in web service application using ajax.

COURSE OUTCOMES:

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

- Develop a basic website using HTML and Cascading Style Sheets.
- Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
- Examine server-side programs using Servlets and JSP.
- Model a simple web pages in PHP and represent data in XML format.
- Illustrate on simple web service application using Ajax.

UNIT I – WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0

Web Essentials: Clients, Servers and Communication – The Internet – Basic Internet protocols – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Semantic elements – Drag and Drop – Audio – Video controls – CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations.

UNIT II - CLIENT-SIDE PROGRAMMING

Java Script: An introduction to JavaScript–JavaScript DOM Model-Date and Objects, -Regular Expressions- Exception Handling-Validation-Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files – Http Request – SQL.

UNIT III – SERVER-SIDE PROGRAMMING

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- Installing and Configuring Apache Tomcat Web ServerDATABASE CONNECTIVITY: JDBC perspectives, JDBC program example – JSP:

2023-2024

9

9

Understanding Java Server Pages-JSP Standard Tag Library (JSTL)-Creating HTML forms by embedding JSP code

UNIT IV – PHP AND XML

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation- Regular Expressions – File handling – Cookies – Connecting to Database. XML: Basic XML- Document Type Definition- XML Schema DOM and Presenting XML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS and ATOM).

UNIT V – INTRODUCTION TO AJAX AND WEB SERVICES

AJAX: Ajax Client Server Architecture-XML Http Request Object-Call Back Methods; Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application -SOAP.

TEXT BOOKS:

1. Anuratha A Puntembekar,"Internet Programming", Technical Publication, 2020.

John Dean, "Web Programming with HTML5,CSS and JavaScript", Jones & Partleft 2. Learning,2018.

Sriram K Vasudevan, Meenakshi Sundaram, and Chandni Suresh"Essential of Internet 3. Programming"DreamTech Press, Willey, 2015.

REFERENCE BOOKS:

- 1. Abiket Nagane,"Internet Programming II", Nirali Prakashan, 2016.
- 2. Max Bramer,"Web Programming With PHP and MySQL", A Practical guide, Springer, 2015
- 3. Gopalan N.P. and Akilandeswari J., -Web Technology, Prentice Hall of India, 2011.
- 4. UttamK.Roy, —Web Technologies, Oxford University Press, 2011.

WEBSITES:

- 1. https://www.geeksforgeeks.org/internet-and-web-programming/
- 2. http://www.eie.polyu.edu.hk/~em/it0506pdf/4%20Internet%20Programming.pdf
- 3. https://www.techopedia.com/definition/23898/web-programming
- 4. https://www.tutorialspoint.com/internet_technologies/index.htm

9

TOTAL: 45

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	-	-	2	-	-	2	3	3
CO2	3	3	3	2	2	2	-	-	2	-	-	2	3	3
CO3	3	3	3	2	2	2	-	-	2	-	-	2	3	3
CO4	3	3	3	3	2	2	-	-	2	-	-	2	3	3
CO5	3	3	2	2	2	2	-	-	2	-	-	2	3	3
Average	3	3	2.8	2.2	2	2	-	-	2	-	-	2	3	3

23BTADOE04

ROBOTICS AND AUTOMATION

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 functional elements of Robotics.
- To impart knowledge on the forward and inverse kinematics. •
- To interpret the manipulator differential motion and control. •
- To educate on various path planning techniques. •
- To understand about hydraulics system.

COURSE OUTCOMES:

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

- Apply basic concept of robotics fundamental principles, components, and applications of robotic systems.
- Discuss the dynamics of robotic systems and implications for planning and control.
- Outline the principles of state estimation, prediction, and update steps involved in the Kalman filtering process.
- Analyze the components, working principles, and applications of Pneumatic and Hydraulic system.
- Model the principles of fluidic devices and fluidic logic circuits and their applications in automation.

UNIT I KINEMATICS CONCEPTS

Introduction - Actuators - Sensors - Rigid body - coordinate systems - Kinematics - Forward Kinematics & Inverse Kinematics - Velocity Kinematics - Angular velocity - Linear velocity -Singularity – Force and torque.

UNIT II MOBILE ROBOTS

Dynamics – Mobile Robots – Planning and Control – Path & Trajectory planning – Probabilistic Roadmaps – Localization.

UNIT III PROBABILISTIC METHODS FOR ROBOTICS

Basics of probability - Kalman Filtering - Extended Kalman - Particle filter - Localization -Computer Vision – Vision Based Controls.

UNIT IV AUTOMATION FUNDAMENTALS AND PRINCIPLES

Automation - Basic Laws and Principles - Basic Pneumatic and Hydraulic system - Pumps and compressors – Fluid accessories.

9

9

9

UNIT V ELECTRICAL AND ELECTRONIC CONTROLS

Cylinders and Motors – Control valves – Circuits – Pneumatic logic circuits – Fluidics – Electrical and electronic controls – Transfer devices and Feeders.

TEXT BOOKS:

1. "Robot Modeling and Control", Mark W.Spong, Seth Hutchinson and Vidyasagar. M, Wiley Publishers, Second Edition, 2020.

2. "Robot Building for Beginners", David Cook, Apress Publishers, Third Edition, 2015.

REFERENCE BOOKS:

1. "Industrial Automation and Robotics", Gupta. A.K and S.K Arora, University Science Press, Third Edition, 2013.

2. "Industrial Robotics", Groover. M.P., Weiss. M., Nageland. R.N and Odrej. N.G., Tata McGraw Hill, Singapore, Second Edition, 2017.

3. "Embedded Systems & Robotics", Ghoshal. S, Cengage Learning, First Edition, 2009.

4. "Introduction to Robotics Mechanics and Control", John J.Craig, Pearson Education, Third Edition, 2009.

WEBSITES:

- 1. www.nptel.ac.in/courses/112/101/112101099/
- 2. www.nptel.ac.in/courses/112/101/112101098/
- 3. www.toptal.com/robotics/programming-a-robot-an-introductory-tutorial
- 4. www.cyberbotics.com/doc/guide/tutorial-1-your-first-simulation-in-webots
- 5. www.ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	2	-	2	2	2	2
CO2	2	2	2	2	-	2	-	-	2	-	2	2	2	2
CO3	3	3	3	3	-	2	-	-	2	-	2	2	2	2
CO4	3	3	3	3	-	2	-	-	2	-	2	2	2	2
CO5	3	3	3	3	2	2	•	-	2	-	2	2	2	2
Average	2.8	2.8	2.6	2.6	2	2	-	-	2	-	2	2	2	2

LIST OF OPEN ELECTIVES FACULTY OF PHARMACY

23BP804ETPHARMACEUTICALREGULATORYSCIENCE3H-3CInstruction Hours/week: L:3 T:0 P:0Marks: Internal:40 External:60 Total:100

COURSE OBJECTIVES

The goal of this course is for students to

- Learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.
- To know the process of drug discovery, development and generic product development
- To understand the regulatory approval process and registration procedures for API and drugproducts in various countrie
- To learn the basic understanding of regulations of India with other global regulated markets
- It gives basic understanding of developing clinical trial protocols

COURSE OUTCOMES

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

- Explain the process of drug discovery, development and generic product development
- Describe the regulatory approval process and registration procedures for API and drug products nvarious countries.
- Understand the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals in India and other global regulated markets.
- Explain basic understanding of developing clinical trial protocols
- Understand the concept of pharmacovigilance and its significance.
- Understand the guidance and laws in regulations is regulatory market.

UNIT I NEW DRUG DISCOVERY AND DEVELOPMENT

Stages of drug discovery, Drug development process, pre- clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

UNIT II REGULATORY APPROVAL PROCESS

Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA

End Semester Exam:3 Hours

/ ANDA.

Regulatory authorities and agencies: Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)

UNIT III REGISTRATION OF INDIAN DRUG PRODUCT IN OVERSEAS MARKET 9

Registration of Indian drug product in overseas market: Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD),electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD) research.

UNIT IV CLINICAL TRIALS

Clinical trials: Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safetymonitoring in clinical trials.

UNIT V REGULATORY CONCEPTS

Regulatory Concepts: Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book.

SUGGESTED READINGS

- 1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.
- The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berr y and Robert P.Martin, Drugs and the Pharmaceutical Sciences, Vol.185. Informa Health care Publishers.
- 3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences, Vol.190.
- 4. Guidebook for drug regulatorysubmissions / Sandy Weinberg. By John Wiley & Sons. Inc.

FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics/edited by Douglas J. Pisano, David Mantus.

- 5. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143.
- 6. Clinical Trials and Human Research: A Practical Guide to Regulatory ComplianceBy Fay A. Rozovsky and Rodney K. Adams.
- 7. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene.
- 8. Drugs: From Discovery to Approval, Second Edition By Rick Ng.

9

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	2	-	-	-	2	-	-
CO2	-	-	-	-	-	3	3	2	-	-	-	2	-	-
CO3	-	-	-	-	-	3	3	2	-	-	-	2	-	-
CO4	-	-	-	-	-	3	3	2	-	-	-	2	-	-
CO5	-	-	-	-	-	3	3	2	-	-	-	2	-	-
Avg	-	-	-	-	-	3	3	2	-	-	-	2	-	-

9

9

23BP809ET

COSMETIC SCIENCE THEORY

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

- Know the cosmetics in day to day life.
- Understand the formulation characteristics of cosmetic preparations
- Understand the role of herbs in cosmetic science
- Demonstrate the evaluation procedures in the formulation of cosmetics
- Identify the problems encountered during the usage of cosmetics
- Illustrate the role of nutraceuticals in day to day life

COURSE OUTCOMES

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

- Discover the cosmetics in day-to-day life.
- Formulation"s Development and characteristics of various cosmetic products.
- Understand about principles and building blocks of skin and hair care products.
- Understand the role of herbs in cosmetic science
- Understand the principles of cosmetic evaluation including various parameters
- Illustrate the important role of nutraceuticals in day -to -day life.

UNIT I INTRODUCTION

Classification of cosmetic and cosmeceutical products definition of cosmetics as per Indian and EU

regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs

Cosmetic excipients: Surfactants, rheology modifiers, humectants, emollients, preservatives.

Classification and application.

Skin: Basic structure and function of skin.

Hair: Basic structure of hair. Hair growth cycle.

Oral Cavity: Common problem associated with teeth and gums.

UNIT II BUILDING BLOCKS OF SKIN CARE PRODUCTS

Principles of formulation and building blocks of skin care products: Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals. **Antiperspants & deodorants**- Actives & mechanism of action.

Principles of formulation and building blocks of Hair care products: Conditioning shampoo, Hairconditioner, anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phylene diamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.

UNIT III ROLE OF HERBS IN COSMETICS

Sun protection, Classification of Sunscreens and SPF.

Role of herbs in cosmetics: Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove

Analytical cosmetics: BIS specification and analytical methods for shampoo, skin- cream and toothpaste.

UNIT IV PRINCIPLES OF COSMETIC EVALUATION

Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties Soaps, and syndet bars. Evolution and skin benefits.

UNIT V COSMETIC PROBLEMS

Oily and dryskin, causes leading to dryskin, skin moisturisation. Basic understanding of the terms comedogenic, dermatitis. Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor. Antiperspirants and Deodorants- Actives and mechanism of action

SUGGESTED READINGS

- 1. Harry"s Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin.
- 2. Cosmetics Formulations, Manufacturing and Quality Control,

P.P. Sharma, 4thEdition, Vandana Publications Pvt. Ltd., Delhi.

3. Text book of cosmelicology by Sanju Nanda & Roop K. Khar, Tata Publishers.

9

9

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	-	-	-	-	-	2	-	-	-	-	-	2	-	-
CO2	-	-	-	-	-	2	-	-	-	-	-	2	-	-
CO3	-	-	-	-	-	2	-	-	-	-	-	2	-	-
CO4	-	-	-	-	-	2	-	•	-	-	-	2	-	-
CO5	-	-	-	-	•	2	•	I	-	•	•	2	-	-
Avg	-	-	-	-	-	2	-	I	-	-	-	2	-	-

LIST OF OPEN ELECTIVES FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

23MBAPOE301

ORGANISATIONAL BEHAVIOUR 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 basic concepts of organizational behaviour.
- Analyze the individual behaviour traits required for performing as an individual or group.
- Obtain the perceiving skills to judge the situation and communicate the thoughts and ideas.
- Understand how to perform in group and team and how to manage the power, politics andconflict.
- Recognize the importance of organizational culture and organizational change.

COURSE OUTCOMES

Upon completion o fthis course the students will be able to

- Analyse organizational behaviour issues in the context of the organizational behaviour theories and concepts.
- Assess the behaviour of the individuals and groups in organization and manage the stress.
- Manage team, power, politics and conflict arising between the members.
- Explain how organizational change and culture affect the working relationship within organizations.
- Understand and exhibit the communication skills to convey the thoughts and ideas of case analysis to the individuals and group.

UNIT I - ORGANIZATION BEHAVIOUR: INTRODUCTION

Organization Behavior: Meaning and definition - Fundamental concepts of OB - Contributing disciplines to the OB field - OB Model - Significance of OB in the organization success -Challenges and Opportunities for OB.

UNIT II- BEHAVIOUR AND PERSONALITY

Attitudes – Sources - Types - Functions of Attitudes. Values – Importance - Types of Values. Personality - Determinants of personality- Theories of Personality - psycho-analytical, social learning, job-fit, and trait theories.

3H-3C

UNIT III- PERCEPTION

Perception – factors influencing perception - Person Perception – Attribution Theory – Frequently Used Shortcuts in Judging Others- Perceptual Process- Perceptual Selectivity - Organization Errors of perception – Linkage between perception and Decision making.

UNIT IV- GROUP AND STRESS MANAGEMENT

Foundation of Group Behavior - Types of Groups - Stages of Group Development - Group Norms - Group Cohesiveness – Stress – Causes of stress – Effects of Occupational Stress- Coping Strategies for Stress.

UNIT V- ORGANIZATION CULTURE AND CHANGE

Organizational culture- Characteristics of Culture- Types of Culture – Creating and Maintaining an Organizational Culture. Organizational change – Meaning - Forces for Change - Factors in Organizational Change - Resistance to change- Overcoming resistance to change.

Total: 45

TEXT BOOKS

- 1. Fred Luthans. (2017). Organizational Behavior: An Evidence Based Approach, 12thedition, Mcgraw Hill Education, NewDelhi.
- 2. Steven Mcshane and Mary Ann VonGlinow (2017), Organizational Behavior, 6th edition, McGraw Hill Education, NewDelhi
- 3. Robbins, S. P., and Judge, T.A. (2016). Organizational Behaviour.(16thedition).New Delhi: Prentice Hall of India.

REFERENCES BOOKS

- 1. Laurie J. Mullins (2016), Management and Organisationalbehaviour, 10thedition, Pearson Education, NewDelhi
- 2. Robbins, S. P., and Judge, T.A. (2016). Essentials of Organizational Behavior.13 edition, Pearson Education.

WEBSITES

1. https://nptel.ac.in/courses/110/105/110105033/

9

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO3	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO4	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO5	-	-	-	-	-	-	-	-	-	-	-	1	1	1
Average	-	-	-	-	-	-	-	-	-	-	-	1	1	1

MATERIAL CHARACTERIZATION

3H-3C

2023-2024

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:

- Study materials is always important, for any application, including fabrication of satellites.
- Introduce various methods available for characterizing the materials. The characterization of materials specifically addresses that portfolio with which researchers and educators must have working familiarity.
- Provide an introduction to materials characterization and its importance
- Discuss different types of characterization techniques and their uses.
- Introduce the students to the principles of optical and electron microscopy, X-ray diffraction and various spectroscopic techniques Introduction:

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Handle with X-ray, thermal, microscopic, and electrical methods of characterization.
- Understand and describe the fundamental principles behind the methods of characterization which are included in the curriculum
- Analyze, interpret and present observations from the different methods.
- Evaluate the uncertainty of observations and results from the different methods.
- Understand the history of materials science with basic understanding of metals, binary alloys, magnetic materials, dielectric materials and polymers

UNIT I- X-RAY TECHNIQUE

X-ray techniques for materials characterization X-ray diffraction: Principle, measuring system and applications for characterization of powdered materials. X-ray diffraction profile and analysis: FWHM and line broadening, Crystallite size effect and Scherrer formula, Effect of strain (tensile vs compressive, uniform vs. non-uniform) Introduction to Extended X-ray absorption fine structure (EXAFS), Surface extended X-ray absorption (SEXAFS).

UNIT II- MICROSCOPIC TECHNIQUES

Microscopic techniques Principles, instrumentations and applications of Optical microscope, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) for

9

characterization of different samples. Energy dispersive X-ray microanalysis (EDS) - Basic aspects of Atomic force microscopy (AFM).

UNIT III- SPECTROSCOPIC METHODS

Spectroscopic methods Principle, instrumentation and applications of UV-Visible Diffuse Reflectance (UV-Vis DRS) spectroscopy, Ft-Ir, Raman and Fluorescence spectroscopy. Hand of experience on operation of UV-Vis-DRS, FT-IR, Raman and data analysis..

UNIT IV- THERMOANALYTICAL METHODS

Thermoanalytical Methods Principle, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Temperature Analysis (DTA) and Differential Scanning Calorometry (DSC). Factors affecting the TGA/DTA/DSC results and their interpretations. Hand on on experience of operation of TG/DSC and data analysis.

UNIT V- ELECTROANALYTICAL TECHNIQUES

Electroanalytical Techniques Voltammetric principles, hydrodynamic voltammetry, stripping voltammetry, cyclic voltammetry, criteria of reversibility of electrochemical reactions, quasi-reversible and irreversible processes, qualitative and quantitative analysis current-potential relation applicable for Linear Sweep Voltammetry (LSV) and Cyclic Voltammetry (CV), interpretation of cyclic voltammograms and parameters obtainable from voltammograms. Hand on experience on operation of CV and data analysis.

Total: 45

TEXT BOOKS

- 1. Theory and Applications of UV Spectroscopy, H.H.Jaffe and M.Orchin, IBH-Oxford.
- 2. Inorganic spectroscopic methods, A.K. Brisdon, Oxford Chem. Primers, 1997, New York.
- 3. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L.Ho, Wiley Inter science.

REFERENCES BOOKS

- 1. Introduction to Spectroscopy, Pavia, Brooks/Cole Cenage, 4th edition, 2009, Belmont.
- 2. Introduction to Photoelectron Spectroscopy, P.K.Ghosh, John Wiley.
- 3. Fundamental of Molecular Spectroscopy, C. N. Banwell and E. McCash, Tata McGraw Hill, 4th edition, 1994, New Delhi.

9

WEBSITES

https://onlinecourses.nptel.ac.in/noc22_mm14/preview

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	-	1	1	1
CO2	1	1	1	1	-	-	-	-	-	-	-	1	1	1
CO3	2	2	2	2	-	-	-	-	-	-	-	1	1	1
CO4	1	1	1	1	-	-	-	-	-	-	-	1	1	1
CO5	1	1	1	1	-	-	-	-	-	-	-	1	1	1
Average	1.3	1.3	1.3	1.3	-	-	-	-	-	-	-	1	1	1

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

- Computational physics may be broadly defined as 'the science of using computers to assist in the solution of physical problems, and to further physics research.
- Equip the students of M.Sc. Physics with knowledge of programming in C, roots of equation, interpolation, curve fitting, numerical differentiation, numerical integration, solution of ordinary differential equations
- Introduce students to computational methods for simulating physical systems and solving problems arising in physics and astronomy, as well as in other related fields
- Computers now play a role in almost every branch of physics like large scale quantum mechanical calculations in nuclear, atomic, molecular and condensed matter physics, large scale calculations in such fields as hydrodynamics, astrophysics, plasma physics, meteorology and geophysics etc.
- The huge increase in the power of computers in recent years has made an impact on the role of computational physics.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Programme numerical methods and their implementation like applying to problem in physics, including modeling of classical physics to quantum system as well as data analysis (Linear and non linear).
- Analysis techniques for propagating error, representing data graphically. Create, solve and interpret basic mathematical tool.
- Program independently computers using leading-edge tools,
- Formulate and computationally solve a selection of problems in physics,

UNIT I INTRODUCTION

Errors, different type of errors. Representation of numbers in computer, computer arithmetic, zero in floating point number.

UNIT II OPERATORS

Operators –finite differences, average, differential, etc., their inter-relations. Difference of polynomials. Difference equation. Interpolation. Lagrange's methods, error terms. Uniqueness of interpolating polynomial.

UNIT III INTERPOLATION

Newton's fundamental interpolation. Forward, backward and central difference interpolations. Interpolation by iteration. Spline interpolation, comparison with Newton's interpolation. Hermite's interpolation. Bivariate interpolation, Lagrange and Newton's methods. Inverse interpolation.

UNIT IV APPROXIMATION

Approximation of function. Least square method. Use of orthogonal polynomials. Approximation by Chebyshev polynomials, Max-min principle. Economization of power series.

UNIT V PYTHON PROGRAMMING

Python Programming –Loops- Conditional statements- Functions- Object-oriented programming-Array computing- 2 and 3d visualizations

Total: 45

TEXT BOOKS

- 1. E. Balagurusamy, "Numerical Methods", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1999
- 2. W.H. Press, B.P. Flannery et al., "Numerical Recipes: Art of Scientific Computing", 3rd Edition, Cambridge Press, 2007.
- 3. J. M. Mathews and K. Fink, "Numerical Methods using MATLAB ", 4rd Edition, Prentice Hall Publication, 2004
- 4. Dr. B.S. Grewal, "Numerical Methods in Engineering and Science ", Khanna Publication.
- 5. Robert J schilling, Sandra l harries, " Applied Numerical Methods for Engineers using MATLAB and C.", Thomson Brooks/cole.

REFERENCES BOOKS

- 1. Richard L. Burden, J. Douglas Faires, "Numerical Analysis", Thomson / Brooks/cole
- 2. John. H. Mathews, Kurtis Fink ,"Numerical Methods Using MATLAB" ,Prentice Hall publication
- 3. Jaan kiusalaas, "Numerical Methods in Engineering with MATLAB", Cambridge publication

9

9

WEBSITES

1. https://archive.nptel.ac.in/content/

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	-	1	1	1
CO2	2	2	2	2	-	-	-	-	-	-	-	1	1	1
CO3	2	2	2	2	-	-	-	-	-	-	-	1	1	1
CO4	1	1	2	2	-	-	-	-	-	-	-	1	1	1
CO5	1	1	1	1	2	-	_	-	-	-	-	1	1	1
Average	1.6	1.6	1.8	1.8	2	-	-	-	-	-	-	1	1	1

23CAPOE301

ROBOTICS PROCESS AUTOMATION

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100 **End Semester Exam:3 Hours**

COURSEOBJECTIVES

The goal of this course is for the students

- Learn the concepts of RPA, its benefits, types and models
- Gain the knowledge in application of RPA in Business Scenarios
- Identify measures and skills required for RPA
- Adopt to the implementations of Automation
- Able to process information and draw inference

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Demonstrate the benefits and ethics of RPA K1, K2
- Understand the Automation cycle and its techniques K2
- Draw inferences and information processing of RPA K3, K4
- Understand the Automation concepts
- Implement & Apply RPA in Business Scenarios K5

UNIT I – INTRODUCTION

Introduction to RPA - Overview of RPA - Benefits of RPA in a business environment - Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA - Centre of Excellence – Types and their applications - Building an RPA team - Approach for implementing RPA initiatives.

UNIT II - AUTOMATION

Role of a Business Manager in Automation initiatives - Skills required by a Business Manager for successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation - Part 1 - Understanding the Automation cycle - First 3 automation stages and activities performed by different people

9

9

2023-2024

3H-3C

UNIT III - AUTOMATION IMPLEMENTATION

Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows

UNIT IV - ROBOT

Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.

UNIT V –ROBOT SKIL

Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.

Total: 45

TEXT BOOKS

- Tom Taulli, February 2020. "The Robotic Process Automation Handbook" Apress, Reference Books 1 Steve Kaelble" Robotic Process Automation" John Wiley & Sons, Ltd.
- 2. Alok Mani Tripathi, March 2018. "Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool", Packet Publishing Limited

WEBSITES

- 1. https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.ht mhttps://www.javatpoint.com/rpa 3
- 2. https://onlinecourses.nptel.ac.in/noc19_me74/preview

9

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	2	-	-	-	2	1	1
CO2	1	1	1	-	-	-	-	-	-	-	-	2	1	1
CO3	-	-	-	-	-	-	-	-	-	-	-	2	1	1
CO4	2	2	2	2	-	-	-	-	-	-	-	2	1	1
CO5	2	2	2	2	-	-	-	-	-	-	-	2	1	1
Average	2	2	2	2	-	-	-	2	-	-	-	2	1	1

NUTRITION AND DIETETICS

3H-3C

2023-2024

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 Fundamentals of food, nutrients, and their relationship to health
- To identify deriving maximum benefit from available food resources
- To understanding of the consequences of vitamin and mineral deficiency/ excess vitamin
- To describe the nutrition deficiency diseases and their consequences
- To explain Food adulteration and prevention of food adulteration.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Understand the fundamentals of nutrition and their relationship to health
- Identify the maximum benefits from available food resources
- Outline the consequences of vitamin and mineral deficiency/excess vitamin
- Illustrate nutrition deficiency diseases and their consequences
- Explain the sources of food adulteration and measures to prevent it

UNIT I BASIC CONCEPTS

Basic concepts in food and nutrition- Understanding relationship between food, nutrition and health, Functions of food- Physiological, psychological and social. Dietary guidelines for Indians food pyramid. Junk foods and its causes.

UNIT II NUTRIENTS

Nutrients - Functions, dietary sources and clinical manifestations of deficiency/ excess of the following nutrients: Carbohydrates, lipids and proteins, Fat soluble vitamins-A, D, E and K, Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C, Minerals – calcium, iron and iodine

UNIT III PHYSIOLOGICAL CHANGES

Physiological changes, RDA, nutritional guidelines, nutritional concerns and healthy food choices -Adult, Pregnant woman, Lactating mother, Elderly. Nutrition during childhood -Growth and development, nutritional guidelines, nutritional concerns and healthy food choices -Infants, Preschool children, School children, Adolescents. Nutritional needs of nursing mothers and

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021 Page | 289

9

9

infants, determinants of birth weight and consequences of low birth weight, Breastfeeding biology, Breastfeeding support and Counselling, Infant and young child feeding and care - Current feeding practices and nutritional concerns, guidelines for infant and young child feeding, Breast feeding, weaning and complementary feeding. Assessment and management of moderate and severe malnutrition among children, Micronutrient malnutrition among preschool children. Child health and morbidity, neonatal, infant and child mortality.

UNIT IV NUTRITIONAL DEFICIENCY DISEASES

Introduction to Nutritional deficiency diseases -Causes, symptoms, treatment, prevention of the following: Protein Energy Malnutrition (PEM), Vitamin A Deficiency (VAD), Iron Deficiency Anaemia (IDA), Iodine Deficiency Disorders (IDD), Zinc Deficiency, Flurosis Nutritional needs during pregnancy, common disorders of pregnancy (Anaemia, HIV infection, Pregnancy induced hypertension), relationship between maternal diet and birth. Maternal health and nutritional status, maternal mortality and issues relating to maternal health.

UNIT V DIETETICS

Dietetics : Diet for diabetes mellitus-Nutrition recommendations for patient with diabetes, Meal planning, Exchange list of different food groups, Glycemic index based formulation of diet for diabetic individual, Diabetic diets menu wise. Diet for Cardiovascular Diseases -Dietary management and general guidelines for coronary heart disease, Dietary recommendations of WHO. Diet for Acute cardiac diseases. Influence of diet on carcinogenesis, Dietary risk factors and cancers at various sites in the human body, diet therapy, diet for cancer patients, managing eating problems during treatment. Hormonal imbalance-Poly cystic ovarian syndrome, hypogonadism, cushing syndrome. Causes of hormonal imbalance. Treatment- Dietary and stress management protocols to be followed.

Total: 45

9

9

SUGGESTED READING

- 1. Gordon M, Wardlaw and Paul M. (2012). Perspectives in Nutrition: U.S.A. McGraw Hill Publishers. 9rd Edition. New Delhi
- **2.** Srilakshmi.B.(2014) Nutrition Science:New Age International (P) Ltd.Publishers.4th Edition. New Delhi.
- 3. Srilakshmi.B. (2015) Food Science:. New Age International (P) Ltd. Publishers. 6nd Edition., New Delhi
- 4. Darshan Sohi (2012). A Comprehensive Textbook of Nutrition & Therapeutic Diets. Jaypee Brothers Medical Publishers Pvt. Ltd.

WEBSITES

- 1. https://nptel.ac.in/courses/126104004
- 2. https://onlinecourses.swayam2.ac.in/cec19_ag02/preview

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	2	-	2	2
CO2	2	1	-	-	-	-	-	-	-	-	1	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	1	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	1	-	2	2
CO5	2	1	-	-	-	-	-	-	-	-	1	-	2	2
Average	2	1	-	-	-	-	-	-	-	-	1.2	-	2	2

23BECSPOE301

CYBER FORENSIS

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

- Understand about computer forensics and investigations.
- Know about digital evidence and crime.
- Analyse and validate forensics data.
- Know about e-mail investigation.
- Understand about mobile device forensics.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Define, understand and explain various investigation procedures and summarize duplication of digital evidence.
- Apply the knowledge of digital evidences.
- Design and develop various forensics tools and analyse the network forensics.
- Demonstrate the systematic study of high-tech forensics
- Understand the importance of reports.

UNIT I INTRODUCTION

Computer forensics and investigations as a profession – Preparing for computer investigations – Taking a systematic approach–Procedures for corporate high-tech investigations–Data recovery work stations and software– Conducting an investigation.

UNIT II DATA ACQUISITION

Data acquisition – Storage formats for digital evidence – Validating data acquisitions – Processing crime and incident scenes–Identifying digital evidence–Collecting evidence in private sector incident scenes – Preparing for search-seizing digital evidence at the scene-storing digital evidence –Reviewing a case.

UNIT III FORENSICS TOOLS

Current computer forensics tools–Software tools–Hardware tools–The Macintosh file structure and boot process – Computer forensics analysis and validation – Addressing data –Hiding techniques.

9

9

UNIT IV VIRTUAL MACHINES

Virtual machines – Network forensics – Developing standard procedures – Live acquisitions – email investigations – Investigating e-mail crimes and violations – Understanding e-mail servers – Cell phone and mobile device forensics.

UNIT V MOBILE DEVICE FORENSICS

Understanding mobile device forensics – Acquisition procedures –Report writing for high-tech investigations – Importance of reports – Guidelines for writing reports –Expert testimony in high-tech investigations.

Total: 45

TEXT BOOKS

- 1. Bill Nelson, Amelia Phillips and Christopher Steuart. (2018). Computer Forensics and Investigations, Cengage Learning, 5th Edition.
- 2. Eoghan Casey. (2017). "Handbook of Digital Forensics and Investigation", Academic Press, 1st Edition.

REFERENCES BOOKS

1. John R Vacca, (2016). "Computer Forensics", Cengage Learning, 2nd Edition.

WEBSITES:

- 1. www.cps.brockport.edu/~shen/cps301/figures/figure1.pdf
- 2. www.forensicsguru.com/devicedataextractionsimcell.php
- 3. www.nptel.ac.in/courses/106101060
- 4. www.samsclass.info/121/ppt/ch11.ppt
- 5. www.garykessler.net/library/role_of_computer_forensics.html
- 6. www.ukessays.com/essays/information-technology/computer-forensics-and-crime investigations-information-technology-essay.php

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	-	2	1	1
CO2	3	3	3	-	-	-	-	-	-	-	-	2	1	1
CO3	3	2	2	2	-	-	-	-	-	-	-	2	1	1
CO4	2	2	2	2	-	-	-	-	-	-	-	2	1	1
CO5	1	1	1	1	-	-	-	-	-	-	-	2	1	1
Average	2.2	2.2	2.2	1.75	-	-	-	-	-	-	-	2	1	1

CO-PO MAPPING
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

- Familiarize with regard to the concept of Investment Planning and its methods
- Examine the scope and ways of Personal Tax Planning;
- Analyze Insurance Planning and its relevance
- Develop an insight in to retirement planning and its relevance.
- Construct an optimal portfolio in real life situations

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Familiarize with regard to the concept of Investment Planning and its methods
- Examine the scope and ways of Personal Tax Planning;
- Analyze Insurance Planning and its relevance
- Develop an insight in to retirement planning and its relevance.
- Construct an optimal portfolio in real life situations

UNIT I - INTRODUCTION TO FINANCIAL PLANNING

Introduction to Financial Planning - Financial goals, Time value of money, steps in financial planning, personal finance/loans, education loan, car loan & home loan schemes. Introduction to savings, benefits of savings, management of spending & financial discipline, Net banking and UPI, digital wallets, security and precautions against Ponzi schemes and online frauds such as phishing, credit card cloning, skimming.

UNIT II - INVESTMENT PLANNING

Investment Planning - Process and objectives of investment, Concept and measurement of return & risk for various assets class, Measurement of portfolio risk and return, Diversification & Portfolio formation. Gold Bond; Real estate; Investment in Greenfield and brownfield Projects; Investment in fixed income instruments- financial derivatives & Commodity market in India. Mutual fund schemes including SIP; International investment avenues.

9

UNIT III -PERSONAL TAX PLANNING

Tax Structure in India for personal taxation, Scope of Personal tax planning, Exemptions and deductions available to individuals under different heads of income and gross total income, Special provision u/s 115BAC vis-à-vis General provisions of the Income-tax Act, 1961. Tax avoidance versus tax evasion.

UNIT IV - INSURANCE PLANNING

Insurance Planning Need for Protection planning. Risk of mortality, health, disability and property. Importance of Insurance: life and non-life insurance schemes. Deductions available under the Income-taxAct for premium paid for different policies.

UNIT V - RETIREMENT BENEFITS PLANNING

Retirement Benefits Planning - Retirement Planning Goals, Process of retirement planning, Pension plans available in India, Reverse mortgage, New Pension Scheme. Exemption available under the Income-tax Act, 1961 for retirement benefits.

Total: 45

TEXTBOOKS

- 1. Indian Institute of Banking & Finance. (2017). Introduction to Financial Planning. New Delhi: Taxmann Publication.
- 2. Pandit, A. (2014). The Only Financial Planning Book that You Will Ever Need. Mumbai: Network Publications Ltd.
- 3. Sinha, M. (2008). Financial Planning: A Ready Reckoner. New York: McGraw Hill Education.

REFERENCESBOOKS

- 1. Halan, M. (2018). Let's Talk Money: You've Worked Hard for It, Now Make It Work for You. New York: HarperCollins Publishers.
- 2. Tripathi, V. (2017). Fundamentals of Investment. New Delhi: Taxmann Publication.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO3	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO4	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO5	-	-	-	-	-	-	-	-	-	-	-	1	1	1
Average	-	-	-	-	-	-	-	-	-	-	-	1	1	1

9

CHEMISTRY IN EVERYDAY LIFE

3H-3C

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

COURSEOBJECTIVES

The goal of this course is for the students

- Gain knowledge in the importance of chemistry in food industry.
- Understand the chemistry of medicines and cosmetics.
- Evaluate the solar energy utilization and its storage.
- Knowledge about the production of electricity by a nuclear reactor.
- Know about the chemistry of soaps, detergents and textiles.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Know the importance of chemistry in food industry.
- Understood the chemistry of medicines and cosmetics.
- Evaluate the solar energy utilization and its storage.
- Understood the production process of electricity by a nuclear reactor.
- Know about the chemistry of soaps, detergents and textiles.

UNIT I - IMPORTANCE OF CHEMISTRY IN FOOD

Chemicals in food, colouring agents, artificial preservatives, flow stabilizers, binding substance, flavours and sweeteners, antioxidants, minerals, vitamins. Chemistry at the breakfast table, raising agents- gluten, the taste maker- glutamic acid, stimulants-Caffeine, chemistry of onion, garlic and curcumin.

UNIT II - CHEMISTRY IN MEDICINES AND COSMETICS

Elements in the human body, drugs and their classification, drug-target interaction, action of different classes of drugs, antiseptics and disinfectants.

Cosmetics: Chemistry behind the lotions, fragrances, talcum powder, sunblock and sunscreen, toothpaste, lipsticks, nail polishes.

9

UNIT III - CHEMISTRY IN ENERGY

Solar energy - fuel from sun light - splitting of water - hydrogen from sunlight - hydrogen economy - fuel cells - batteries - photovoltaics - stealing the sun - nuclear energy - nuclear fission and fusion - production of electricity by a nuclear reactor - radioactivity and the hazards of radioactivity - living with nuclear power.

UNIT IV - IMPORTANCE OF CHEMISTRY IN SOAPS, DETERGENTS AND TEXTILES

Detergents and soaps, types of soaps and detergents, saponification, cleansing action of soaps and detergents, perfumes used in soaps.

Textiles: Chemistry behind wool, silk, jute, cotton, glass fibre, polyester, acrylic, nylon, and other raw materials.

UNIT V - CHEMISTRY OF POLYMERS, FUEL AND AGRICULTURE

Polymers, types, polyethylene, plastics, disposal of plastics, degradation of polymers and plastics using nano materials. Petrochemistry, petrol, diesel, LPG, CNG, kerosene, oils, and other fuels. Agriculture: fertilizers, herbicides, insecticides, and fungicides.

Total: 45

TEXT BOOKS

- 1. Tripathy, S. N., &Sunakar Panda (2004). Fundamentals of Environmental Studies (II Edition). New Delhi: Vrianda Publications Private Ltd.
- 2. Arvind Kumar (2004). A Textbook of Environmental Science. New Delhi: APH Publishing Corporation.
- 3. Anubha Kaushik, C. P., & Kaushik (2004). Perspectives in Environmental Studies. New Delhi: New Age International Pvt. Ltd. Publications.

REFERENCES BOOKS

- 1. Seymour R. B., & Charles, E. (2003). Seymour's Polymer Chemistry: An Introduction. Marcel Dekker, Inc.
- 2. Stocchi. E, (1990). Industrial Chemistry (Vol–I). UK: Ellis Horwood Ltd.
- 3. Jain, P. C., & Jain, M. (2004). Engineering Chemistry. Delhi: Dhanpat Rai & Sons.
- 4. Sharma, B. K., & Gaur, H. (1996). Industrial Chemistry. Meerut : Goel Publishing House.

9

WEBSITES

- 1. https://nptel.ac.in/courses/104106119
- 2. https://nptel.ac.in/courses/104105103

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO4	-	-	-	2	-	-	-	-	-	-	I	1	1	1
CO5	-	-	-	-	-	-	-	-	-	-	-	1	1	1
Average	2	-	-	2	-	-	-	-	-	-	-	1	1	1

23MBPOE301

FERMENTATION 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 the students

- Encompass the use of microorganisms in the manufacture of food or industrial products on the basis of employment.
- Get equipped with a theoretical and practical understanding of industrial microbiology
- Appreciate how microbiology is applied in the manufacture of industrial products
- Know how to source microorganisms of industrial importance from the environment
- Know about the design of bioreactors, factors affecting growth and production, heat transfer, oxygen transfer
- Understand the rationale in medium formulation & amp; design for microbial fermentation, and sterilization of medium and air.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Provides knowledge in the large scale production of industrial product, and teaches the modern employment trends to cater the needs of industry.
- Students will differentiate the types of fermentation processes.
- Understand the biochemistry of various fermentations.
- Identify techniques applicable for Improvement of microorganisms based on known biochemical pathways and regulatory mechanisms.
- Comprehend the techniques and the underlying principles in downstream processing.
- Students can able to explore the practical skills in research activities.

UNIT I - BASICS OF FERMENTATION PROCESSES

Definition, scope, history, and chronological development of the fermentation industry. Component parts of the fermentation process. y. Component parts of fermentation process. Microbial growth kinetics, batch and continuous, direct, dual or multiple fermentations; scaleup of fermentation, comparison of batch and continuous culture as investigative tools, examples of the use of fed batch culture.

UNIT II ISOLATION AND PRESERVATION

Isolation, preservation, and strain improvement of industrially important microorganisms. Use of recombination system (Parasexual cycle, protoplast fusion techniques), application of recombinant strains, and the development of new fermentation products.

UNIT III -SCREENING AND INOCULUM DEVELOPMENT

Screening (primary and secondary screening); detection and assay of fermentation products (Physico-chemical assay, biological assays). Inoculum development, criteria for transfer of inoculum, development of inoculum: Bacteria, Fungi and Yeast.

UNIT IV-MICROBIAL PRODUCTION

Fermentation type reactions (Alcoholic, bacterial, mixed acid, propionic acid, butanediol and acetone-butanol). Microbial production of enzymes (amylases, Proteases, cellulases, pectinases and lipases) primary screening for producers, large scale production. Immobilization methods.

UNIT V – ALCOHOLS AND BEVERAGES

Fermentative production of industrial alcohol, production of beverages. Production of organic acids: citric acid, aminoacids: glutamic acid, production of vitamins. fungal enzymes and Single cell protein.

SUGGESTED READINGS

- 1. Casida, L.E.2007. Industrial microbiology, New age international (P) Ltd., New Delhi.
- 2. Clark, D.P and Pazdernik, N.J.2009. Biotechnology applying the genetic revolution, Elsevier Academic Press, UK.
- 3. Glazer, A and Nikaido.1995. Microbial biotechnology fundamentals of applied microbiology, W.H.Freemn and company, USA.
- 4. Glick, B.R and Pasternak, J.J.2003. Molecular Biotechnology Principles and Applications of Recombinant DNA, 3rd edition, ASM Press, USA.
- 5. Harider, S.I. and Ashok, A. 2009. Biotechnology, A Comprehensive Training Guide for the Biotechnology Industry, CRC Press, New York.
- 6. Sridhar, S.2010. Industrial Microbiology, Dominant Publishers, New Delhi.
- 7. Tanuja.S and Purohit, S.S. 2008. Fermentation Technology, Agrobios Publication, Jodhpur, India.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	1	1	2	2
CO2	2	1	2	-	-	-	-	-	-	-	1	1	2	2
CO3	2	-	-	-	-	-	-	-	-	-	1	1	2	2
CO4	2	1	2	-	-	-	-	-	-	-	1	1	2	2
CO5	2	-	-	-	-	-	-	-	-	-	1	1	2	2
Average	2.2	2	2	-	-	-	-	-	-	-	1	1	2	2

23MBPOE301 ENGLISH FOR COMPETITIVE EXAMINATIONS 3H-3C Marks: Internal:40 External:60 Total:100

Instruction Hours/week: L:3 T:0 P:0

COURSEOBJECTIVES

The goal of this course is for the students

- Train learners to crack competitive exams •
- Know of various tools that is essential for competitive exams
- Enhance their ability to speak in english and face an interview. •
- Make the student apply, prepare and clear the competitive exams. •
- Prepare the student to concentrate, stay positive and confident. ٠

COURSE OUTCOMES

Upon completion of this course the students will be able to

- The student may settle in life with a government job. •
- The student may develop various skills
- The successful student may guide other students to success. •
- Analyse logical reasoning questions, error analysis, and correct usage of words
- Develop the knowledge of grammatical system of English language.

Number-Subject, Verb and Agreement-Articles-Sequences of Tenses-Common Errors

UNIT II WORD POWER	9
Idioms and Phrases-One word substitution-Synonyms-Antonyms-Words often confused	
UNIT III PARAGRAPH	9
Expansion of an idea	
UNIT IV WRITING	9
Essay- Letters-Memos-Agenda-Resume writing	
UNIT V SPEAKING	9
Public Speaking-Group discussion-Interview-Spoken English	

2023-2024

End Semester Exam:3 Hours

9

Total: 45

TEXT BOOKS

1. V. Saraswathi, Maya K. Mudbhatkal (2014). English for Competitive Examinations. Emerald: Chennai.

WEBSITES

- 1. https://onlinecourses.nptel.ac.in/noc23_hs52/preview
- 2. https://onlinecourses.nptel.ac.in/noc22_hs33/preview

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	3	2	2
CO2	-	-	-	-	-	-	-	-	-	3	-	3	2	2
CO3	-	-	-	-	-	-	-	-	-	3	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	3	-	3	2	2
CO5	-	-	-	-	-	-	•	-	-	3	I	3	2	2
Average	-	-	-	-	-	-	-	-	-	3	-	3	2	2

SERICULTURE

3H-3C

9

9

2023-2024

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

- Apply knowledge and skills of seribiotechnology for development new mulberry variety and silkworm breeds suitable for varied agro-climatic zones.
- Apply tools and techniques of biostatics for critical analysis and interpretation of data accrueded.
- Use bioinformatics tools and techniques for the analysis and interpretation of bimolecular data for better understating mulberry and silkworm.
- Demonstrate communication skills, scientific writing, data collection and interpretation abilities in all the fields of seribiotechnology.
- Thorough knowledge and application of good laboratory and good manufacturing practices in sericulture and biotech industries.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Know the different components and chain link of sericulture industry.
- Understand concepts of sericulture industry and demonstrate interdisciplinary skills
- Acquired in mulberry plant cultivation and silkworm rearing.
- Demonstrating the Laboratory and field skills in mulberry cultivation and silkworm
- rearing with an emphasis on technological aspects.

UNIT I INTRODUCTION

Introduction to Sericulture - History of Sericulture - Sericulture organization in India, By products of silk industry. Mulberry and Non - mulberry silkworm types–Morphology and Life cycle of Bombyxmori

UNIT II MULBERRY CULTIVATION

Mulberry Cultivation: Mulberry Varieties – Methods of Irrigation –Nutrient Management and Weed control. Pruning and Harvesting – Crop improvement – Mechanism in Moriculture – Pest and Disease, deficiencies and symptoms in Mulberry.

UNIT III REARING OF SILKWORM

Rearing of silkworm – Rearing Appliances – rearing operation. Harvesting and marketing of cocoons. Cocoon processing and reeling - Appliances used for reeling. Pre reeling process – Cocoon boiling. Reeling technology – re-reeling technology.

UNIT IV SCOPE OF NON-MULBERRY SERICULTURE

Non – Mulberry Sericulture Scope of Non-mulberry Sericulture - Non-mulberry silk varieties and fauna, tasar, muga, eri – Silk Production and Marketing – Tropical tasar / muga – Morphology, anatomy grainage

UNIT V DISEASES OF SILKWORM

Diseases of silkworm –Pebrine Protozoan, Flacherie bacterial, Nuclear Polyhedrosisviral and Muscardine fungal diseases. Pests of Silkworm.

Total: 45

TEXT BOOKS

- Krisnamoorthy S., Improved Method of Rearing Young Age Silk Worms: Reprinted by CSB, Bangalore, 1986.
- 2. Tanaka Y., Sericology, CSB, Pub., Bangalore, 1964.
- Ullal S.R., and Narasimhan M.N., Hand Book of Practical Sericulture, CSB, Bangalore, 1987.
- 4. HisaoAruga, Principles of sericulture, Oxford and IBH Publishing Company, 1994.
- Hrccrama Reddy, G. 1998. Silkworm Breeding, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
- Otsuki el.al. 1987. Silkworm Egg Production (Translated from Japanese Language), Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.

REFERENCES BOOKS

- 1. Yasuji Hamamura, 2001 Silkworm Rearing on Artificial Diet (Translated from Japanese Language),Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.
- 2. Mahadevappa, D. Halliyal, V.G., Sankar, D.G and Bhandiwad, R. 2000. Mulberry Silk Reeling Technology, Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.
- 3. Dandin, S.B et.al. 2003. Advances in Tropical Sericulture, National Academy of Sericulture Sciences India, Central Silk Board, Bangalore, India.
- 4. Ganga G., Sulochanachetty. J. An Introduction of Sericulture. Oxford, New Delhi 1977.
- 5. Johnson M., and Kesary M., Sericulture, CSI Press, Marthandam, 2008.

9

6. Text Book of Tropical Sericulture, Pub., Japan Overseas Volunteers, 1975

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	2	-	-	-	3	-	-	-	-	2	1	1
CO2	-	-	2	-	-	-	3	-	-	-	-	2	1	1
CO3	-	-	2	-	-	-	3	-	-	-	-	2	1	1
CO4	-	-	2	2	-	-	3	-	-	-	-	2	1	1
CO5	-	-	2	2	-	-	3	-	-	-	-	2	1	1
Average	-	-	2	2	-	-	3	-	-	-	-	2	1	1

CODING THEORY

3H-3C

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

COURSEOBJECTIVES

The goal of this course is for the students

- Elements of coding theory and its applications.
- Understand the concept of bounds in coding theory.
- About the encoding and decoding.
- Analyze the concept of cyclic coding
- Acquiring the knowledge special cyclic codes.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Recognize the basic concepts of coding theory.
- Understand the importance of finite fields in the design of codes.
- Detect and correct the errors occur in communication channels with the help of methods of coding theory.
- Apply the tools of linear algebra to construct special type of codes.
- Use algebraic techniques in designing efficient and reliable data transmission methods.

UNIT I - ERROR DETECTION, CORRECTION AND DECODING

Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighbourhood minimum distance decoding – Distance of a code.

UNIT II - LINEAR CODES

Linear codes – Self orthogonal codes – Self dual codes – Bases for linear codes – Generator matrix and parity check matrix – Enconding with a linear code – Decoding of linear codes – Syndrome decoding.

UNIT III - BOUNDS IN CODING THEORY

The main coding theory problem – lower bounds - Sphere covering bound – Gilbert Varshamov bound – Binary Hamming codes – q-ary Hamming codes – Golay codes – Singleton bound and MDS codes – Plotkin bound.

9

9

UNIT IV - CYCLIC CODES

Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes.

UNIT V - SPECIAL CYCLIC CODES

BCH codes - Parameters of BCH codes - Decoding of BCH codes - Reed Solomon codes.

Total: 45

TEXTBOOKS

- 1. San Ling and Chaoping Xing (2004). Coding Theory: A first course, Cambridge University Press.
- 2. Lin. S & Costello. D. J. (1983). Jr., Error Control Coding: Fundamentals and Applications, Prentice-Hall, Inc., New Jersey.

REFERENCES BOOKS

- 1. Vera Pless (1982). Introduction to the Theory of Error Correcting Codes, Wiley, New York.
- 2. Berlekamp E.R. (1968). Algebriac Coding Theory, Mc Graw-Hill.
- 3. H.Hill (1986). A First Course in Coding Theory, OUP.

WEBSITES

- 1. https://www.youtube.com/watch?v=XepXtl9YKwc
- 2. https://www.youtube.com/watch?v=oeQWxhlnCHM
- 3. https://www.youtube.com/watch?v=Z-QGtxlQWak

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	-	-	-	-	-	-	-	1	1	1
CO2	2	2	2	1	-	-	-	-	-	-	-	1	1	1
CO3	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO4	-	-	-	-	2	-	-	-	-	-	-	1	1	1
CO5	2	2	2	2	2	-	-	-	-	-	-	1	1	1
Average	2.3	2.3	2.3	1.3	2	-	-	-	-	-	-	1	1	1

LIST OF OPEN ELECTIVES OFFERED TO OTHER DEPARTMENT FROM BIOMEDICAL ENGINEERING

23BEBMEOE01 HUMAN ANATOMY AND PHYSIOLOGY

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

- Discuss all the organelles of an animal cell and their function.
- Perceive structure and functions of the various types of systems of human body.
- Outline about eye, ear and Endocrine glands of human
- Learn organs and structures involving in system formation and functions.
- Infer basic understanding of the inter connection of various organ systems in human body

COURSE OUTCOMES

Upon completion of this course, students will be able to

- Explain the basic structure and functions of cells and organells .
- Outline the anatomy and physiology of cardiac and nervous system).
- Illustrate the working mechanism of human respiratory and musculoskeletal system .
- Infer the functions of digestive, excretory and lymphatic system .
- Model the sensory and endocrine systems of human body .

UNIT I CELL

Structure of Cell– Organelles and description–Function of each component of the cell– Membranepotential–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-.Homeostasis - Tissue: Types – Specialized tissues– functions.

UNIT II CARDIAC AND NERVOUS SYSTEM

Heart, Major blood vessels– Cardiac Cycle – ECG-Conducting system of heart--importance of blood groups – identification of blood groups- Nervous Control of Heart-Cardiac output–Coronary and Peripheral Circulation– Structure and function of Nervous tissue–Neuron-Synapse-Reflexes-Receptors-Brain-Brainstem-Spinalcord– Reflexaction.

3H-3C

UNIT III RESPIRATORY SYSTEM AND MUSCULOSKELETAL SYSTEM

Physiological aspects of respiration–Trachea and lungs -Exchange of gases–Regulation of Respiration - Disturbance of respiration function -Pulmonary function test-Types of respiration - Oxygen and carbon dioxide transport and acid base regulation-Muscles-tissue-types-structure of skeletal muscle-types of muscle and joints.

UNIT IV DIGESTIVE, EXCRETORY AND LYMPHATIC SYSTEM

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 SweatGland–Temperature regulation, Lymphatic: Parts and Functions of Lymphatic systems– TypesofLymphaticorgansandvessels.

UNIT V EYE, EAR&ENDOCRINE GLANDS

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.

TEXTBOOKS

1. Textbook Equity Edition, Anatomy and Physiology : Volume 2 of 3, Lulu.com, 2014

REFERENCE BOOKS

- 1. William F. Ganong, Review of Medical Physiology, Mc Graw Hill, New Delhi, 26th Edition, 2019
- 2. Arthur C. Guyton, Text book of Medical Physiology, Elsevier Saunders, 12th Edition, 2011

WEBSITES

- 1. https://dth.ac.in/medical/course.php
- 2. https://onlinecourses.swayam2.ac.in/cec20_bt19/preview

CO-PO MAPPING

COs/POs	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	-
CO2	K2	2	1	-	-	-	1	_	1	1	1	-	1	-	-
CO3	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	-
CO5	K3	3	2	1	-	-	1	-	1	1	1	-	1	-	-
Avg		2.2	1.2	1	-	I	1	-	1	1	1	•	1	-	-

Total:45

9

9

23BEBMEOE02 ARTIFICIAL ORGANS AND IMPLANTS

Instruction Hours/week: L:3 T:0 P:0

COURSE OBJECTIVES

The goal of this course for students is to

- Have an overview of artificial organs &transplants
- Describe the principles of implant design with a case study
- Explain the implant design parameters and solution
- Study about various blood interfacing implant
- Study about soft tissue replacement and hard tissue replacement

COURSE OUTCOMES

Upon completion of this course, students will be able to

- Outline the concepts of organ replacements.
- Infer the principles of implant design.
- Interpret the implant design parameters.
- Summarize the functions of neural and cardiovascular implants.
- Illustrate the artificial organ implants in gastrointestinal and cosmetic applications.

UNIT I ARTIFICIAL ORGANS & TRANSPLANTS

ARTIFICIAL ORGANS:-Introduction, Outlook for organ replacements, Design consideration – Evaluation process.

TRANSPLANTS:-Overview, Immunological considerations, Blood transfusions, Individual organs -kidney, liver, heart and lung, bone marrow, cornea.

UNIT II PRINCIPLESOFIMPLANTDESIGN

Principles of implant design - body response to implants, Clinical problems requiring implants for solution, The missing organ and its replacement, Tissue engineering, scaffolds, Biomaterials, Regenerative medicine & Stem cells.

9

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

9

3H-3C

REFERENCES

- 1. J D Bronzino, Biomedical Engineering handbook Volume II, (CRC Press / IEEE Press), 2000.
- 2. R S Khandpur, Handbook of Biomedical Instrumentation, Tata Mc Graw Hill, 2003
- 3. Joon B Park, Biomaterials An Introduction, Plenum press, New York, 1992.

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, 2011

- 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. Standard Handbook of Biomedical Engineering & Design , Myer Kutz, McGrawHill, 2003

WEBSITES

1. <u>https://ocw.mit.edu/courses/mechanical-engineering/2-782j-design-of-medical-devices-and-implants-spring-2006/</u>

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION

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. Limb prosthesis, Externally Powered limb Prosthesis.

UNIT IV BLOOD INTERFACING IMPLANTS

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

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS

Gastrointestinal system, Dentistry, Soft tissue replacement & Hard tissue replacement –sutures, surgical tapes, adhesive, percutaneous implants, internal fracture fixation devices, joint replacements. Maxillofacial and craniofacial replacement, Recent advancement and future directions.

TEXT BOOKS



Total :45

9

9

CO-PO MAPPING

COs/POS	KL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	-
CO2	K2	2	1	-	-	-	1	1	1	1	1	-	1	-	-
CO3	K2	2	1	-	-	-	1	1	1	1	1	-	1	-	-
CO4	K2	2	1	-	-	-	1	-	1	1	1	-	1	-	-
C05	K2	2	1	-	-	-	1	-	1	1	1	_	1	-	-
Avg		2	1	-	-	-	1	1	1	1	1	-	1	-	-

23BECC151 DESIGN THINKING Instruction Hours/week: L:1 T:0 P:2Marks: Internal:100 Total:100 End Semes COURSE OBJECTIVES: The goal of this course is for the students to • Illustrate design thinking concepts and principles • Utilize design thinking methods in every stage of the problem	SEMESTER-I 2H - 2C ter Exam:3 Hours
DESIGN THINKING Instruction Hours/week: L:1 T:0 P:2Marks: Internal:100 Total:100 End Semes COURSE OBJECTIVES: The goal of this course is for the students to Illustrate design thinking concepts and principles Utilize design thinking methods in every stage of the problem	2H - 2C ter Exam:3 Hours
Instruction Hours/week: L:1 T:0 P:2Marks: Internal:100 Total:100 End Semes COURSE OBJECTIVES: The goal of this course is for the students to Illustrate design thinking concepts and principles Utilize design thinking methods in every stage of the problem	ter Exam:3 Hours
 COURSE OBJECTIVES: The goal of this course is for the students to Illustrate design thinking concepts and principles Utilize design thinking methods in every stage of the problem 	
 The goal of this course is for the students to Illustrate design thinking concepts and principles Utilize design thinking methods in every stage of the problem 	
Illustrate design thinking concepts and principlesUtilize design thinking methods in every stage of the problem	
 Identify the different phases of design thinking Plan for various product and service communication in design th Interpret the use of tools for the design process COURSE OUTCOMES:	ninking
Upon completion of the course, students will be able to	
 Recognize the design thinking process, tool and theories. Identify the types of users and the requirement of customers. Follow the stages of prototyping the product. Replicate design thinking in product and service design. Customize existing products by utilizing design thinking strateg 	ies.
UNIT I INTRODUCTION Understanding design thinking and tools - Human-Centric Design Proce Process - DT Activity with case studies.	6 ess - Design Thinking
UNIT II EMPATHISE WITH USERS Five Whys - Needs of user - Types of user research -Customer Journ Observational Research	6 ey Mapping -
UNIT III PROTOTYPING Ideas to presentable concepts - Scenario-based Prototyping – Testing pr and ergonomic testing - Rapid prototyping.	6 cototypes - Usability
UNIT IV PRODUCT AND SERVICE DESIGN Product Design - Interaction Design - Service Design - Communication Transportation Design.	n Design -
UNIT V DESIGN AND INNOVATION DT For strategic innovations - Extreme Competition - Experience design Humanization - Creative Culture	n - Standardization -
TO	TAL HOURS: 30

Text Books:

- 1. Bala Ramadurai, "Karmic Design Thinking", 2020.
- 2. Christian Mueller-Roterberg, "Handbook of Design thinking", Amazon Digital Services LLC KDP Print US, 2018.
- 3. Tim Brown, "Change by Design", Harper Business Publisher, 2019
- 4. Hasso Plattner, Christoph Meinel and Larry Leifer, "Design Thinking: Understand Improve – Apply", Springer, 2011
- 5. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	2	1	-	-	1	1	2	1	-	2	-	2
CO2	-	-	2	1	-	-	1	1	2	1	-	2	-	2
CO3	-	-	2	1	-	-	1	1	2	1	-	2	-	2
CO4	-	-	2	1	I	-	1	1	2	1	-	2	-	2
CO5	-	-	2	1	-	-	1	1	2	1	-	2	-	2
Average	-	-	2	1	-	-	1	1	2	1	-	2	-	2

CO-PO Mapping

23BEMC152/23BTMC152 (Common to all	2023-2024	
23BEMC152		SEMESTER - I
SPORT	'S AND YOGA	1H-0C
Instruction Hours/week: L:1 T:0 P:0	Marks: Internal:10	0 External:0 Total:100

The goal of this course, is for the students:

- To have knowledge of Physical fitness and exercise management to lead better quality life
- To enable to officiate, supervise various sports events and
- organize sports events
- To acquire the knowledge of Physical Education, Sports and Yoga and
- understand the purpose and its development
- To gain knowledge to plan, organize and execute sports events

COURSE OUTCOMES:

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

- Practice physical activities and yoga for strength, flexibility and relaxation.
- Use techniques for increasing concentration and decreasing anxiety for stronger academic performance.
- Perform yoga exercises in various combination and forms.
- Improve personal fitness through participation in sports and yoga activities.
- Follow sound nutritional practices for maintaining good health and physical performance.

Unit – I INTRODUCTION TO PHYSICAL FITNESS

Explain importance of physical education - Describe importance of Physical Fitness & Wellness - Explain the components of physical fitness - Demonstrate healthy life style - Prevent health threats by changing life style

Unit – II FUNDAMENTALS OF ANATOMY & PHYSIOLOGY IN SPORTS & YOGA

Explain importance of anatomy and physiology - Describe effects of exercise in various body systems - Describe concept of correct posture - Explain corrective measures for posture deformities.

Unit-III YOGA & PRANAYAMA

Explain importance of yoga - Perform various pranayama for increasing concentration - Use meditation and other relaxation techniques for improving concentration.

TEXT BOOKS:

- 1. AjmerSingh, ModernTrendsandPhysicalEducation class 11&class12, KalyaniPublication,NewDelhiISBN:9789327264319.
- 2. B.K.S.Iyengar, LightonYoga, Thomson's Publication, New DelhiISBN: 8172235011
- 3. V.K.Sharma, HealthandPhysicalEducation, NCERT Books; Class11,12SaraswatiHousePublication,NewDelhi
- 4. AcharyaYatendra, YogaandStressManagement, FingerprintPublishingISBN:938905303X
- 5. SwamiVivekanand, PatanjaliYogaSutras, Fingerprint PublishingISBN:9389567351.
- 6. Ramdev, PranayamRahasya, Patanjali-DivyaPrakashan,HaridwarISBN:978-8189235017
- 7. Ramdev, YogaitsPhilosophy&Practice, DivyaPrakashan,Haridwar.

23BEMC153/23BTMC153 (Common to all branch	2023-2024	
23BEMC153		பருவம் -I
தமிழர் மரபும் ப	பண்பாடும்	1H-0C
கற்பிக்கல் நோம்/வாாம்: L:1 T:0 P:0	மகிப்பெண்:	இடைக்கோ்வ: 100

மொத்தம்:100

பாடத்திட்ட பயன் விளைவு:

- வரலாற்றிற்கு முற்பட்ட தமிழகத்தை மாணவர்களுக்கு அறிமுகப்படுக்துகல்
- பழந்தமிழர் பண்பாடு சார்ந்த வாழ்க்கை முறையை மாணவர்கள் அறிய ஊக்குவித்தல்
- தமிழ்மொழியின் பழைமையும், திராவிடமொழிகளில் தமிழ்மொழியின் தனிச்சிறப்பையும் மாணவர்களுக்கு அறிமுகப்படுத்துதல்.
- தமிழர்களின் வாழ்வியல், தமிழர்கலைகள், ஆற்றங்கரைப்பண்பாடுகள் குறித்து மாணவர்கள் அறியச்செய்தல்.
- இந்தியக்குடியுரிமைப்பணி முதலான போட்டித்தேர்வுகளில் விருப்பப்பாடமாக இடம்பெறுகின்ற தமிழ்நாகரிகமும் பண்பாடும் குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்

பாடத்திட்டப் பொதுநோக்கம்:

- 1. இந்தியக்குடியரிமைப்பணி போட்டித்தேர்வுகளில், முதலான 'தமிழ்இலக்கியவரலாறு' விருப்பப்பாடமாக இடம்பெறுகின்ற, குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
- கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத்தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
- 3. தமிழின்வளர்ச்சித்துறையாகிய, 'அறிவியல்தமிழ்'; இணையதமிழ்' குறித்த ஆய்வுச்சிந்தனை மேம்பாடு. 4. வேலைவாய்ப்புக்குரிய படைப்பாக்குச்சினை பன்நோக்கு அணுகுமுறையிலான
- சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
- மற்றும் வாழ்வியல் 5. சமுதாய மதிப்புகளைப்பேணுவதற்குக்கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மைவளர்ச்சி. மொழிபெயர்ப்புத்துறை சார்ந்த வேலைவாய்புத்திறன் பெற்றிருத்தல்.

அலகு:1 தமிழர் மரபு

மரபு-விளக்கம்-சங்ககால தமிழர் மரபு – திணைப்பகுப்பும் தமிழர் மர்பும்-உலகப்பொதுமை – அகத்தின்ண் மரபு – புறத்தின்ண் மரபு-இடைக்காலத்தமிழர் மரபு – பிற்கால மரபும் மாற்ற(மும் – தற்கால தமிழர்மரபு - வளர்ச்சி.

அலகு: 2 தமிழர் பண்பாடு

பண்பாடு – விளக்கம் – பழந்தமிழர் பண்பாடு – இயற்கை சார்ந்த வாழ்வியல் – தமிழர் சமயம் – அரசியல் நிலை–சமூகப் பழக்கவழக்கங்கள் – நம்பிக்கைகள் – வாழ்வியல் அறங்கள் – வணிகம் போன்றவை.

அலகு:3 தமிழர் கலைகள்

தமிழகத்தில் கலைகளின் வளர்ச்சி – சிற்பக்கலை வளர்ச்சி –கோயில் கலை – கற்கோவில்கள் - ஓவியக்கலை – அழகுக்கலைகள் -கூத்துக்கலை – மருத்துவக்கலை – நாடகக்கலை– இசைக்கலை போன்றவை.

அலகு: 4 தமிழர் சமயும்

பழந்தமிழரின் 'சமயம் – சங்ககால சமயம் – தொல்காப்பியத்தில் சமயம் – சைவ சமயம் – வைணவம் – தமிழ்ப் பண்பாட்டில் பௌத்தம் – தமிழ்ப் பண்பாட்டில் சமணத்தின் தாக்கம்–தமிழ்ப் பண்பாட்டில் இசுலாம் மற்றும் கிறித்துவ சமயத்தின் தாக்கம்- தமிழர் பண்பாட்டில் விழாக்கள்- கோயில்களும் விழாக்களும்- சமூக ஒருங்கிணைப்பில் விழாக்களின் பங்கு-சங்க இலக்கியத்தில் விழாக்கள் பற்றிய குறிப்புகள்-இடைக்கால இலக்கியங்களில் விழாக்கள் பற்றிய செய்திகள் – விழாக்களின் சமூகப்பங்களிப்பு – தற்காலத்தில் தமிழர் விழாக்கள் - விளையாட்டும் விழாக்களும்.

அலகு: 5 இலக்கியங்களில் தமிழர் பண்பாட்டுப் பதிவுகள்

சங்க இலக்கியமும் வாழ்வியலும்-திருக்குறளில் வாழிவியல் நெறிகள் – இரட்டைக் காப்பியங்களும் வாழ்வியலும் – சிற்றிலக்கியங்களில் வாழ்வியல் பதிவுகள்-இக்கால இலக்கியமும் வாழ்வியலும்.

பார்வைதூல்கள்:

- தமிழ் இலக்கிய வரலாறு தமிழண்ணல், மீனாட்சி புத்தக நிலையம்- மதுரை-இரண்டாம் பதிப்பு-ஜூலை – 2000.
- தமிழர் நாகரிகமும் பண்பாடும், அ. தட்சிணாமூர்த்தி, ஐந்திணைப் பதிப்பகம், சென்னை, திருத்திய பதிப்பு – 2022.
- தமிழர் வரலாறும் பண்பாடும், நா. வானமாமலை, நியூசெஞ்சுரி புக் ஹவுஸ், சென்னை, ஆறாம்பதிப்பு - 2007.
- தமிழக வரலாறு மக்களும் பண்பாடும், கே.கே. பிள்ளை, உலகத் தமிழராய்ச்சி நிறுவனம், சென்னை.

23BEMC251/23BTMC251 (Common to all	branches) 2023 - 2024
	SEMESTER-II
Soft S	Skills 1H - 0C
Instruction Hours/week: L:1 T:0 P:0	Marks: Internal:100 Total:100
	End Semester Exam:3 Hours

The goal of this course is for the students to

- Encourage all round development of the students by focusing on soft skills.
- Make the students aware of critical thinking and problem-solving skills.
- Develop leadership skills and organizational skills through group activities.
- Function effectively with heterogeneous teams.
- Develop social and work-life skills as well as personal and emotional well-being.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Memorize various elements of effective communicative skills.
- Interpret people at the emotional level through emotional intelligence.
- Apply critical thinking skills in problem solving.
- Analyze the needs of an organization for team building.
- Judge the situation and take necessary decisions as a leader.

Unit-1 Communication Skills

Introduction, meaning, significance of soft skills –definition, significance, types of communication skills -Intrapersonal & Inter-personal skills

Unit-2 Critical Thinking

Active Listening –Observation –Curiosity –Introspection –Analytical Thinking –Openmindedness –Creative Thinking- Public Speaking

Unit -3 Problem Solving & Decision Making

Meaning & features of Problem Solving –Managing Conflict –Conflict resolution –Methods of decision making –Effective decision making in teams –Methods & Styles - Time Management

Text Books

- 1. Personality Development and Soft Skills (English, Paperback, Mitra Barun K.) Publisher: Oxford University Press; Pap/Cdr edition (July 22, 2012)
- 2. Personality Development and Soft Skills: Preparing for Tomorrow, Dr Shikha Kapoor Publisher : I K International Publishing House; 0 edition (February 28, 2018)
- 3. Soft skills: personality development for life success by Prashant Sharma, BPB publications 2018

23BEMC252/23BTMC252 (Common to all branches except ECE)	2023 - 2024
	SEMESTER-II

Women Safety and Se	ecurity	1H - 0C
Instruction Hours/week: L:1 T:0 P:0	Marks: Ir	nternal:100 Total:100
	End Sem	ester Exam:3 Hours

The goal of this course is for the students to

- Highlight the social construction of gender in Indian society and the role of social institutions in the socialization process.
- Make aware about the practical issues concerning gender and politics.
- Classify the students in engendering national policies and programmes.
- Observe the liability of women and women's work in the context of globalization.
- Acquaint knowledge about the political participation of women and the gendered structures of governance and polity.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Infer into the basic concepts related to sex, gender, femininity etc.
- Demonstrate the rationale for women"s studies
- Compare Gender Equality Issues and Movements in Women"s Studies
- Summarize the Social construction of Gender, Gender Roles and Gender stereotyping.
 - Illustrate Social Structures, Changing Status of Women in India.

Unit I: Fundamental Concepts of Women's Studies

Definition- Objectives of Women's Studies; Importance of Women's Studies; Women's Studies as an Academic Discipline; Role of UGC Centre for Women's Studies

Unit II: Social Empowerment

Women in Higher Education; Gender issues in Health, Environment, Family welfare Measures, Indecent representation of Women in media; Women in Difficult circumstances; Constitutional.

Unit III: Political Empowerment

Women leaders in politics- Women in Local Governance- Barriers- Reservation policies-Women's Political Rights, Property Rights - Violence against Women - Women's work

TEXT BOOKS

- 1. Amy S. Wharton. (2005). "The Sociology of Gender: An Introduction to Theory and Research". (KeyThemes in Sociology) Blackwell Publishing, UK, Indian Reprint, Kilaso Books, New Delhi.
- 2. Devaki Jain and Pam Rajput (Ed). (2003). "Narratives from the Women"s Studies Family: Recreating Knowledge, Sage, and New Delhi.
- 3. Jasbir Jain (Ed). (2005). "Women in Patriarchy: Cross Cultural". Rawat Publication Jaipur.

B.E Biomedical Engineering		2023 - 2024
		SEMESTER - III
23BEMC351	Aptitude & Reasoning	1H - 0C
Instruction Hours/week: L:1 T	::0 P:0	Marks: Internal:100 Total:100
		End Semester Exam:3 Hours

The goal of this course is for the students to

• Categorize, apply, and use thought processes to distinguish between concepts of

Quantitative methods.

• Prepare and explain the fundamentals related to various possibilities and probabilities

related to quantitative aptitude.

- Critically evaluate numerous possibilities related to puzzles.
- Understand and solve puzzle-related questions from specific and other competitive tests.
- Solve questions related to Time and distance and time and work etc.

COURSE OUTCOMES:

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

- Understand the basic concepts of quantitative ability
- Understand the basic concepts of logical reasoning Skills
- Acquire satisfactory competency in the use of reasoning
- Solve campus placements aptitude papers covering Quantitative Ability, Logical
- Gaun Reasoning Ability Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

UNIT - I Quantitative Ability (Basic Mathematics)

- 1.1. Number Systems
- 1.2. LCM and HCF
- 1.3. Decimal Fractions
- 1.4. Simplification
- 1.5. Square Roots and Cube Roots
- 1.6. Problems on Ages
- 1.7. Surds & Indices
- 1.8. Percentages

UNIT – II Quantitative Ability (Applied & Engineering Mathematics)

- 2.1. Logarithm
- 2.2. Permutation and Combinations
- 2.3 Probability
- 2.4 Profit and Loss
- 2.5 Simple and Compound Interest
- 2.6. Time, Speed and Distance
- 2.7. Time & Work
- 2.8. Ratio and Proportion
- 2.9. Area
- 2.10 Mixtures and Allegation

UNIT – III Verbal - Aptitude

- 1. Words
- 2. Idioms
- 3. Phrases in Context
- 4. Reading comprehension techniques
- 5. Narrative sequencing
- 6. Data interpretation

Text books:

- 1. A Modern Approach to Verbal & Non-Verbal Reasoning By R S Agarwal
- 2. Analytical and Logical Reasoning By Sijwali B S
- 3. Quantitative aptitude for Competitive examination By R S Agarwal
- 4. Analytical and Logical Reasoning for CAT and other management entrance tests By Sijwali B S
- 5. Quantitative Aptitude by Competitive Examinations by Abhijit Guha 4th edition

WEB SITES:

- 1. https://prepinsta.com/
- 2. <u>https://www.indiabix.com/</u>
- 3. https://www.javatpoint.com/

2023 - 2024

SEMESTER-III 23BEMC352/23BTMC352A FOREIGN LANGUAGE –GERMAN 1H - 0C

Instruction Hours/week: L:1 T:0 P:0

Marks: Internal:100 Total:100 End Semester Exam:3 Hours

COURSE OBJECTIVE:

The goal of this course is for the students to,

- Discuss topics utilizing basic vocabulary from a variety of themes/topics including:
- use correct verb forms (conjugation)
- Identify the correct gender and plural forms of nouns and use appropriate pronouns
- distinguish between the nominative and accusative cases (definite and indefinite articles)
- Identify numbers for use in counting, dates, and telling time

COURSE OUTCOMES:

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

- Learn the proper pronunciation of words
- Use two tenses of verbs(present tense and present perfect), in the active voice;
- Conduct simple conversations in German by using learned patterns;
- Translate short passages of German to English;
- Use German language in e-communication

Unit-I : Herzlich willkommen! -Wie ist dein Name ? -Ich trinke gern Kaffee.-Wir konjugieren die Verben.

Unit-II : A bit of history and ZAHLEN - Verben, W-Fragen, Ja-Nein Fragen, Imperativ-das Alphabet, die Woche, das Jahr - Was sind deine Hobbys ? Formular $ausf\tilde{A}^{1/4}$ llen

Unit-III : Mein Lehrbuch | Meine pers \tilde{A} ¶nlichen Daten-Mein Arbeitsbuch -Wir beginnen Lektion -Wir lesen Lektion 3

Unit-IV : formeller Brief- Wie lernst du Deutsch ? -Wir hören ein deutsches Lied- Wir lernen Hörverständnis | Wir beginnen Lektion

 ${\bf Unit}\; {\bf V}:$ Eine E-Mail schreiben | Eine Wohnung beschreiben- Im Kaufhaus | Welche/Diese-Gesund und munter

Total Period : 15 Hours

Books and references:

- 1. NETZWERK Deutsch als Fremdsprache A1(Goyal, New Delhi, 2015)
- 2. Schulz-Griesbach: Deutsch als Fremdsprache. Grundstufe in einem Band (for Grammar)

Web Resources:

https://www.tatsachen-ueber-deutschland.de/en www.leo.org https://www.goethe.de/en/spr/kup/prf/prf/sd1/ueb.html http://www.deutschkursepassau.de/JM/images/stories/SKRIPTEN/a1_skript_gr.pdf https://www.schubert**B.E./B.Tech.** (Common to all branches)

SEMESTER-III 23BEMC352/23BTMC352B FOREIGN LANGUAGE – FRENCH 1H - 0C Instruction Hours/week: L:1 T:0 P:0 Marks: Internal:100 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVE:

The goal of this course is for the students to

- To facilitate students to develop proficiency in communication in French Language and to be globally competent
- To develop creative and innovative abilities using French Language, to meet the challenges of the constantly evolving industry and to identify entrepreneurial opportunities
- To enable students to be leaders and develop inter personal skills to perform effectively in diverse teams of MNC using French Language.
- To appraise the students of the different customs, traditions, sociohistorical aspects and trends in French society and literature.
- To assess and interpret authentic documents in French Language

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Explain linguistic requirements of French Language grammar and vocabulary
- Demonstrate basic written communicative skills with emphasis on creative writing in French Language.
- construct syntactically correct answers in basic French Language comprehension
- Develop basic oral skills in French Language for possible situations.
- Use of French Language in e-communication

Unit- I : Recognize the French letters, Identify the letter-combinations that are characteristic of the French language, Identify the remaining letter-combinations that are characteristic of the French language,

Unit - II : Use the imperative in the affirmative form, Say the time in French, Talk about the weather in French, .Talk about actions that just happened, Speak about actions that are yet to happen

Unit - III: Learn a few basic and commonly used 2nd group verbs, Understand the concept of French "modal verb, Learn a few basic and commonly used 3rd group verbs, Learn what reflexive verbs, Distinguish between moods and tenses

Unit – **IV** : Place an order in a restaurant, Learn a third past tense, .Identify a direct object, Identify an indirect object, Use direct and indirect objects pronouns in a single sentence

Unit-V: Learn the various positions of the object pronouns - Use object pronouns in the negative imperative - Use object pronouns in the affirmative imperative - Learn the word order specific to the indirect object pronouns associated with the 3rd person singular and plural

Total Period : 15 Hours

Books and references:

- 1. Alter Ego Méthode de Français, A1 (2006): Berthet, Hugot et al., Hachette
- 2. Alter Ego Cahier d'activités, A1 (2006): Berthet, Hugot et al., Hachette
- 3. Écho Méthode de Français, A1 (2013): Girardet, Pecheur, CLE International
- 4. Écho Cahier personnel d'apprentissage, A1 (2013): Girardet, Pecheur, CLE International
- 5. A votre service 1, A1 (2011): Chanderasekar, Hanga et al., Hachette

		SEMESTER - IV
23BEMC451	Foundation of Entrepreneurship	1H - 0C
Instruction Hou	rs/week: L:1 T:0 P:0	Marks: Internal:100 Total:100
		End Semester Exam:3 Hours

The goal of this course is for the students to

- Equip and develop the learners entrepreneurial skills and qualities essential to undertake business.
- Impart the learners entrepreneurial competencies needed for managing business efficiently and effectively.
- Understand basic concepts in the area of entrepreneurship
- Develope personal creativity and entrepreneurial initiative
- Adopt the key steps in the elaboration of business idea

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Gain entrepreneurial competence to run the business efficiently.
- Undertake businesses in the entrepreneurial environment
- Prepare business plans and undertake feasible projects.
- Be efficient in launching and develop their business ventures successfully
- Monitor the business effectively towards growth and development

Unit I Entrepreneural Competence

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful Entrepreneurs – Knowledge and Skills of an Entrepreneur.

Unit II Entrepreneural Environment

Business Environment - Role of Family and Society - Entrepreneurship Development

Unit III Business Plan Preparation

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership

Unit IV Launching Of Small Business

Finance and Human Resource Mobilization - Operations Planning - Market and Channel Selection - Growth Strategies

Unit V Management Of Small Business

Monitoring and Evaluation of Business - Effective Management of small Business - Case Studies.
Text Books

- 1. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2016.
- 2. R.D.Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2018.
- 3. Rajeev Roy ,Entrepreneurship, Oxford University Press, 2nd Edition, 2011.
- 4. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage Learning, 2012

2023 - 2024

SEMESTER - IV

23BEMC452Essence of Traditional Indian Knowledge and Heritage1H - 0CInstruction Hours/week:L:1 T:0 P:0Marks: Internal:100 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Impart a holistic understanding about Indian Culture and Thoughts from a Historical perspective.
- Encourage critical appreciation of the Indian thoughts and cultural manifestations.
- Introduce the students to important concepts from the diverse intellectual traditions of India.
- Make use of Indian cultural heritage and various epistemological inquiries.
- Gain knowledge of Indian heritage.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Understand the cultural diversity
- Infer the need of cultural unty
- Know the Dravidian culture
- Realize the power of Indian educational system called gurukul
- Come to know the concepts of vedic thought

UNIT I Introduction to Indian thought and Culture

Plurality of Indian culture - Cultural Diversity and Cultural Unity -Different manifestations of Indian Culture: Indus valley culture -Vedic culture and Dravidian culture.-The Medieval Bhakti Culture

UNIT II Traditional knowledge Systems of India

Introduction to the Traditional Indian Education system of Gurukul - Parampara -Understanding Indian Philosophy: Vedic thought and the nine schools of philosophy - Indigenous Knowledge and Women in India

Text books:

1. Chatterjee, Satishchandra and Dhirendramohan Datta. (2007) Introduction to Indian Philosophy. Rupa Publications, New Delhi.

2. Husain, S. Abid. (2003). The National Culture of India. National Book Trust, New Delhi.

COURSE OBJECTIVES:

- To understand the field of digital security and concepts of access control mechanism.
- To introduce keywords and jargons involved in securing browser
- To understand network basic and familiarize on security of network protocols
- To understand cyber-attacks and data privacy
- To learn the tools and methods used in cyber security

COURSE OUTCOMES:

- Infer the importance of a network basics and brief introduction on security of network protocols
- Apply a solid foundation in digital security and measures taken to protect device from threats.
- Discuss about cyber-attacks and data privacy issues and preventive measures.
- Make use of tools and methods used in cyber security.
- Explain Cyber security organizational implications.

UNIT I NETWORKING BASICS

Networking basics (home network and large-scale business networks), Networking protocols, Security of protocols, sample application hosted on-premises.

UNIT II BASICS OF DIGITAL SECURITY

Basics of digital security, protecting personal computers and devices, protecting.World Wide Web (www), the Internet and the HTTP protocol, security of browser to web server interaction

UNIT III INTRODUCTION TO CYBER-ATTACKS

Introduction to cyber-attacks, application security (design, development and testing), operations security, monitoring, identifying threats and remediating them.

UNIT IV TOOLS AND METHODS

Tools and methods used in cyber security: Proxy servers and anonymizers – Phishing – Password cracking – Keyloggers, Attacks on wireless networks – Phishing and Identity theft.

UNIT V CYBER SECURITY ORGANIZATIONAL IMPLICATIONS

Cyber security organizational implications: Cost of cyber crimes and IPR – Web threads for organizations – Security and privacy implications – Social media marketing – Incident handling – Forensics best practices for organization.

Total periods : 15

TEXT BOOKS:

- 1. Sammons, John, and Michael Cross. The basics of cyber safety: computer and mobile device safety made easy. Elsevier, 2016.
- 2. Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley Publisher, First Edition, 2011

REFERENCES BOOKS:

- 1. Charles P. Pfleeger, Shari Lawrence, Pfleeger Jonathan Margulies; Security in Computing, Pearson Education Inc . 5th Edition, 2015
- 2. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cyber security essentials. John Wiley & Sons, 2018
- 3. Harish Chander, Cyber Laws and IT Protection, PHI Learning, First Edition, 2012
- 4. James Graham, Ryan Olson and Rick Howard, Cyber Security Essentials, CRC Press, First Edition, CRC Press, First Edition

COURSE OBJECTIVES:

The goal of this course is for students:

- To see the need for developing a holistic perspective of life
- To facilitate the development of a Holistic perspective among students towards life and profession
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct
- To sensitise the student about the scope of life individual, family (inter-personal relationship), society and nature
- To develop more confidence and commitment to understand, learn and act accordingly

COURSE OUTCOMES:

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

- Build comfortable relationship with each other
- Recall technical education without study of human values can generate more problems than solutions
- Infer that lack of understanding of human values is the root cause of most of the present day problems
- Demonstrate that the natural acceptance (intention) is always for living in harmony
- Differentiate between the characteristics and activities of different orders

UNIT I- ASPIRATIONS AND CONCERNS

Individual academic – career - Expectations of family – peers - society - nation - Fixing one's goals

UNIT II- SELF MANAGEMENT

Self confidence- peer pressure- time management- anger- stress- Personality development- self improvement

UNIT III- HARMONY OF THE SELF AND BODY

Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body-Mental and physical health -Health issues- healthy diet- healthy lifestyle -Hostel life

UNIT IV- HARMONY IN RELATIONSHIP

Harmony in the Family – the Basic Unit of Human Interaction - Values in Human-to-Human Relationship- gratitude towards parents, teachers and others - Ragging and interaction- Competition and cooperation -

Peer pressure

UNIT V- HARMONY IN THE SOCIETY

Understanding Harmony in the Society- Participation in society- Participation in nature/ existence.

Total periods : 15

TEXT BOOKS:

1R R Gaur, R Asthana, G P Bagaria,
and Professional EthicsA Foundation Course in Human Values
2nd Revised Edition, Excel Books, New Delhi 2019

2 A.N. Tripathi Human ValuesNew Age Intl. Publishers, New Delhi2004

WEBSITE:

http://uhv.ac.in http://www.uptu.ac.in http://www.storyofstuff.com