BE-ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SYLLABI 2024
(Choice Based Credit System)

FACULTY OF ENGINEERING

Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

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EACHANARI POST, COIMBATORE 641021, INDIA

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Eachanari, Coimbatore-641 021. INDIA

FACULTY OF ENGINEERING

DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY

REGULAR PROGRAMME
REGULATIONS 2024
CHOICE BASED CREDIT SYSTEM

These regulations are effective from the academic year 2024 – 2025 and applicable tothe candidates admitted to B. E. / B. Tech programmes. during 2024 - 2025 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 have 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 University 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.

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 University will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)

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

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

1.3 Migration from other University

Candidates who are willing to migrate to Karpagam Academy of Higher Education for admission to their next semester of B. E./B. Tech programme may get admitted from 2nd semester onwards upto 7th semester. 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 Competent authority, he/she has undergone. Equivalence Certificate shall be provided by the respective Head of the Department of Karpagam Academy of Higher Education.

2 . PROGRAMMES OFFERED

A candidate may undergo a programme in any one of the branches of study approved bythe 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 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 practicalcourses 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, internship, 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.
- 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 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 6and practical courses not exceeding 4.

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 andProject/Thesis reports is English except Tamil/French.

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 interested students would be trained, for the holistic development to enhance employment opportunity.

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

5. DURATION OF THE PROGRAMME

5.1 The prescribed duration of the programme shall be

Programme	Min. No. of semesters	Max. No. ofsemesters
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 least75% 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) shall be given exemption from prescribed minimum 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 concerned. However, the candidate has to execute a one-time bond (Stamp paper) with an undertaking from the parent and the student that this situation never arises in the future.

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 theacademic 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 beginningof 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 weightage 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 Headof the Department. However, if the students of different branches are mixed in a class (like the firstsemester 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 throughDean.

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 "CourseCommittee" comprising all the teachers handling the common course with one of the nominatedas 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 course will becontinuously assessed by the respective teachers as per the guidelines given below:

a. THEORY COURSES

S. No.	CATEGORY	MAXIMUM MARKS
1.	Assignment	5
2.	Seminar *	5
3.	Attendance	5
4.	Test – I	12.5
5.	Test – II	12.5
Continuous Internal Assessment: TOTAL		40

*Evaluation shall be made by a committee.

PATTERN OF TEST QUESTION PAPER (Test I & II)

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part – A	Question no. 1 to 10 Two Mark Questions, covering 2.5 units of the syllabus. **(10 x 2= 20 Marks)**
Part- B	Question 11 to 15 will be of either-or type, covering 2.5 units of the syllabus. Each Question may have subdivision. **(5 x 16=80 Marks).**

b. PRACTICAL COURSES:

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

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

c. **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	12.5
5.	Test –II	12.5
Continuous Internal Assessment: TOTAL		40

The external evaluation of integrated practical component from End semester Examination is conducted 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 andpractical 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 normally in-house. However, as a special case, if a student is able toget a project from a government organization or private or public sector company, the student may be permitted to do his/her project work in that institution/research organization/industry.

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 course in a semester and passed the Examination is not entitled to reappear in the same course of the semester for improvement of grade.

12 END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each course, for 100 marks, later scaleddown to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part – A	Question no. 1 to 10 Two Mark Questions, covering all the 5 units. **(10 x 2= 20 Marks)**
Part- B	Question 11 to 15 will be of either or type, covering Fiveunits of the syllabus. Each Question may have subdivision. **(5 x 16=80 Marks).**

13 PASSING REQUIREMENTS

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

13.2 The minimum marks to pass for Value Added Course /Skill Development is 50 marks out of 100marks. There will be two tests, the first covering 50% of syllabus for 50 marks and the other for 50 marks.

13.3 If the candidate fails to secure a pass in ESE of a particular course, 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 were 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 CIA of a particular course, 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 /Skill Development course, he/she has to appear for the tests when course is conducted subsequently.

13.4 CREDIT TRANSFER THROUGH MOOC

The MOOC coordinator shall assist the students for the online courses offered by the SWAYAM platform periodically and also monitor their course.

Open Elective Courses shall be considered for the credit transfer. Only courses available in SWAYAM platform (which are totally beyond the scope of the programme under consideration) shall be considered as open elective courses and get completed at any time within the duration of the Programme before the last semester. This is a mandatory requirement for completion of the programme. At least 2 Open Electives (3 credits each) to be completed for the credit transfer.

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

14.2 GRADE SHEET

After results are declared, Grade sheet will be issued to each student which will contain thefollowing 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 semesteronwards.

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.

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

CGPA will be calculated in a similar manner, considering all the courses enrolled from Firstsemester. **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 applyfor 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 corresponding to his/her programme within the stipulated time.

The award of the degree must be approved by the Board of Management of KarpagamAcademy 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 numberof semesters (vide Clause 5.1) securing a CGPA of not less than **7.5** shall be declared to have passed the Examination in First Class with Distinction.

16.2 A regular candidate or a lateral entrant is eligible to register forBE(Honors), B.Tech.(Honors). If, he / she has passed all the courses in the first appearance and holds / maintains a CGPA of 7.5 upto VIII Semester, he / she has to take an additional 20 credits bystudying online courses through Swayam/NPTEL. Such a candidate is eligible for the award of BE(Honors), B.Tech.(Honors). However, if he / she fails in securing 20 additional credits but maintains CGPA of 8 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 havepassed 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 **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.

18 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 in to 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 punitiveaction as prescribed by the University from time to time.

19 ADVANCED LEARNERS, ON-DEMAND EXAMINATION

Students

1. Who secure 7.5 CGPA and maintain an attendance of 75% in every semester

2. Clear all the courses in their first appearance itself are referred to as advanced learners. When a student fails

to maintain any of the above conditions at any given time, he cannot be an advanced learner further.

When a student fails to maintain any of the above conditions at any given time, he cannot be an advanced learner further. These students can request for an on-demand examination for the courses in their forthcoming semester(s). These students on prior permission can appear for such examinations well in advance and complete the entire courses well before the prescribed period of study and can progress for a full time Research Project/Internship/Minor Project during the remaining prescribed period of study. The Internal and External examinations will be conducted for these courses as like the other courses. One or more faculty mentors will be allocated based on the number of students/courses enrolled for the on-demand examination.

Also, these advanced learners can also register for online courses from NPTEL/SWAYAM/SWAYAM Plus portals on prior and proper approval from the department. The credits earned from those courses will be transferred to the mark statement of the students.

20 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.

21 CREDIT TRANSFER THROUGH ONLINE / INTERNATIONAL STUDIES

Students are encouraged to enroll in courses offered by MOOC platforms and international institutions of higher learning, either virtually or in person. The equivalent credits for these courses will be determined by a committee named Subject Equivalency Committee comprising the Dean, Head of Department (HoD), and one faculty member nominated by the Vice Chancellor. The committee's decision will be submitted for ratification/approval by the Board of Studies (BoS) and the Academic Council. Additionally, the equivalent grade points for marks/grades/grade points awarded by various MOOC platforms and international institutions of higher learning will be determined by a committee named Grade Equivalency Committee duly constituted by the Vice-Chancellor. The decisions of this committee will also be submitted for ratification/approval by the Academic Council. This shall be approved to be implemented from the even semester of the academic year 2024-25.

22 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 beincorporated in the university Program Regulations 2023-24 and implement from this academic year.

21.1 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.

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

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

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.

Program Outcomes as defined by NBA (PO)

Engineering Graduates will be able to:

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

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **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.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **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.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **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.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES(PSOs)

Engineering Graduates will be able to

1) Design and Develop solutions for present-day problems with the continuous learning in the field of Embedded systems, VLSI design, Communication and Signal Processing and hold expertise in the modern tools for quenching the techno-thirsty society.

2) Contribute to the society as a socio-responsible electronics and communication engineer with leadership, teamwork skills and adaptable to the lifelong learning in multidisciplinary environment

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs):

1. To impart skill-based training to apply engineering practices to design, implement model and analyse real time problems and interpret the result.

2. To impart students with strong fundamental knowledge in the field of Electronics and Communication Engineering to meet the emerging industrial needs and to promote Research

3. To build and lead cross-functional teams upholding the professional responsibilities & ethical values.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
FACULTY OF ENGINEERING
UG PROGRAM (CBCS) – B.E –ECE (FULL TIME)
(2024–2025 Batch and onwards)

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER I												
24BECC101	Technical English I	HS	5,8,9,10,12	2	3	0	0	3	40	60	100	01
24BECC102	Matrices and Calculus	BS	1,2,3,12	1,2	3	1	0	4	40	60	100	04
24BEEC141	Semiconductor Physics	BS	1,2,3,6,9,12	1,2	3	0	2	4	40	60	100	06
24BEEC142	Electric Circuit Analysis	ES	1,2,3,8,9, 10	1,2	3	0	2	4	40	60	100	09
24BECC143	Programming in C	ES	1,2,3,9,10 ,12	1	3	0	2	4	40	60	100	12
24BEMC151	Women Safety and Security	MC	-	-	1	0	0	0	100	-	100	15
24BEMC152	தமிழர் மரபும் பண்பாடும்	MC	-	-	1	0	0	0	100	-	100	17
			Semester Total		17	1	6	19	400	300	700	
SEMESTER II												
24BECC201	Technical English II	HS	5,8,9,10,12	2	3	0	0	3	40	60	100	19
24BECC202A/ 24BECC202B/ 24BECC202C	Graph Theory / Computational Methods for Engineers/ Transforms and its Applications	BS	1,2,3,12	1,2/ 1,2/ 1,2	3	1	0	4	40	60	100	22 25 27
24BEEC241	Environmental Chemistry	BS	1,2,3,4,6, 7,8,9,12	-	3	0	2	4	40	60	100	29
24BEEC242	Digital System Design	ES	1,2,3,9,10 ,12	1,2	3	0	2	4	40	60	100	32
24BECC243	Data Structures	ES	1,2,3,9,10 ,12	1	3	0	2	4	40	60	100	35
24BEEC244	Electron Devices	ES	1,2,3,9,10 ,12	1,2	3	0	2	4	40	60	100	38
24BECC211	Communication Skills Laboratory	ES	5,8,9,10,12	2	0	0	2	1	100	-	100	41
24BEMC251	Yoga	MC	-	-	0	0	4	2	100	-	100	43

			Semester Total		18	1	14	26	440	360	800	
SEMESTER III												
24BECC301	Probability and Random Process	BS	1,2,3,12	1	3	1	0	4	40	60	100	45
24BEEC302	Signals and Systems	PCC	1,2,3,10,12	1,2	3	1	0	4	40	60	100	48
24BEEC303	Control Systems Engineering	PCC	1,2,3,4,12	1	3	1	0	4	40	60	100	51
24BEEC304	Design Thinking	PROJ	1,2,3,4,6,7,8,9,10,12	2	2	0	0	1	100	0	100	54
24BEEC341	Electronic Circuits	PCC	1,2,3,4,10,12	1,2	3	0	2	4	40	60	100	56
24BEEC342	OOPS and JAVA	EC	1,2,3,9,10,12	2	3	0	2	4	40	60	100	59
24BEEC343	Microprocessors and Microcontrollers	PCC	1,2,3,6,10,12	1,2	3	0	2	4	40	60	100	62
24BEMC351	Aptitude and Reasoning	MC	-	-	1	0	0	0	100	0	100	65
24BEEC391	Internship I / Mini Project I	PROJ	1,2,3,4,6,7,8,9,10,12	2	0	0	2	1	100	0	100	67
			Semester Total		21	3	8	26	540	360	900	
SEMESTER IV												
24BEEC401	Electromagnetic Fields	PCC	1,2,3,10,12	1,2	3	1	0	4	40	60	100	68
24BEEC441	Digital Signal Processing	PCC	1,2,3,4,10,12	1,2	3	0	2	4	40	60	100	72
24BEEC442	Analog Integrated Circuits	PCC	1,2,3,10,12	1	3	0	2	4	40	60	100	75
24BEEC443	Web Programming	ES	1,2,3,5,9,10,12	2	3	0	2	4	40	60	100	78
24BEEC444	Embedded Systems and IoT	PCC	1,2,3,5,10,12	1,2	3	0	2	4	40	60	100	81
24BEEC4E**	Professional Elective I	PE	-	-	3	0	0	3	40	60	100	127-144
24BEEC411	Skill Development I	SD	-	-	0	0	2	1	100	0	100	84
24BEEC412	Community Engagement and Social Responsibility	HS	-	-	0	0	4	2	100	0	100	86
24BEMC451	Foundation of Entrepreneurship	MC	-	-	1	0	0	0	100	0	100	87
24BEMC452	Essence of Traditional Indian Knowledge and Heritage	MC	-	-	1	0	0	0	100	0	100	89
			Semester Total		20	1	14	26	640	360	1000	
SEMESTER V												
24BEEC501	Transmission Lines and Waveguides	PCC	1,2,3,4,10,12	1,2	3	1	0	4	40	60	100	91
24BEEC541	Industrial Automation	PCC	1,2,3,4,12	1,2	3	0	2	4	40	60	100	93

24BEEC542	Analog and Digital Communication	PCC	1,2,3,4,10,12	1,2	3	0	2	4	40	60	100	96
24BEEC543	VLSI Design	PCC	1,2,3,4,5,11,12	1,2	3	0	2	4	40	60	100	98
24BEEC5E**	Professional Elective II	PE	-	-	3	0	0	3	40	60	100	145-158
24BEEC5E**	Professional Elective III	PE	-	-	3	0	0	3	40	60	100	159-175
24BEEC591	Internship II/ Mini Project II	PROJ	1,2,3,4,6,7,8,9,10,12	2	0	0	2	1	100	0	100	101
24BEEC511	Skill Development II	SD	-	-	0	0	2	1	100	0	100	102
24BEMC551	Cryptography and Cyber Security	MC	-	-	1	0	0	0	100	0	100	104
				Semester Total	19	1	10	24	540	360	900	
SEMESTER VI												
24BEEC601	Wearable Devices	PCC	1,2,3,4,6,7	1,2	3	0	0	3	40	60	100	106
24BEEC602	Antenna and Wave Propagation	PCC	1,2,3,5,6,7,12	1,2	3	1	0	4	40	60	100	109
24BEEC603	Universal Human Values	HS	6,8,9	2	2	0	0	2	100	0	100	112
24BEEC641	Wireless Communication	PCC	1,2,3,5,10,12	1,2	3	0	2	4	40	60	100	115
24BEEC642	Microwave and Optical Communication	PCC	1,2,3,4,10,12	1,2	3	0	2	4	40	60	100	118
24BEEC6E**	Professional Elective IV	PE	-	-	3	0	0	3	40	60	100	176-192
24BE**OE**	Open Elective 1	OE	-	-	3	0	0	3	40	60	100	
24BEEC691	Mini Project III	PROJ	1,2,3,4,6,7,8,9,10,12	2	0	0	2	1	100	0	100	121
				Semester Total	20	1	6	24	440	360	800	
SEMESTER VII												
24BEEC701	Principles of Management and Engineering Ethics	HS	1,2,3,4,10,12	1,2	3	0	0	3	40	60	100	122
24BE**OE**	Open Elective II	OE	-	-	3	0	0	3	40	60	100	
24BEEC791	Project Work Phase I and Viva Voce	PROJ	1,2,3,4,5,6,7,8,9,10,11,12	1,2	0	0	8	4	100	0	100	125
				Semester Total	6	0	8	10	180	120	300	
SEMESTER VIII												
24BEEC891	Project Work Phase II and Viva Voce	PROJ	1,2,3,4,5,6,7,8,9,10,11,12	1,2	0	0	16	8	120	180	300	126
				Semester Total	0	0	16	8	120	180	300	

SKILL DEVELOPMENT COURSES

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SKILL DEVELOPMENT I												
24BEEC411	Robotics	PROJ	-	-	0	0	2	1	100	0	100	84
SKILL DEVELOPMENT II												
24BEEC511	PCB Designing	PROJ	-	-	0	0	2	1	100	0	100	102

PROFESSIONAL ELECTIVES

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
PROFESSIONAL ELECTIVE I												
24BEEC4E01	IoT Processors, Protocols and Architectures	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	127
24BEEC4E02	Robotics and Automation	PE	1,2,3,4, 10,12	1,2	3	0	0	3	40	60	100	130
24BEEC4E03	Sensors and Transducers	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	133
24BEEC4E04	Industrial IoT and Industry 4.0	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	136
24BEEC4E05	Healthcare Systems using IoT	PE	1,2,10,1 2	1,2	3	0	0	3	40	60	100	139
24BEEC4E06	Advanced Microprocessors and Microcontrollers	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	142
PROFESSIONAL ELECTIVE II												
24BEEC5E01	System on Chip	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	145
24BEEC5E02	Low Power IC Design	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	148
24BEEC5E03	Physical Design and Verification	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	150
24BEEC5E04	ASIC Design	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	152
24BEEC5E05	FPGA based System Design	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	154

24BEEC5E06	CMOS VLSI Design	PE	1,2,3,4, 10,12	1,2	3	0	0	3	40	60	100	156
PROFESSIONAL ELECTIVE III												
24BEEC5E07	Wireless Sensor Networks	PE	1,2,3,4, 10,12	1,2	3	0	0	3	40	60	100	159
24BEEC5E08	Cognitive Radio	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	162
24BEEC5E09	Satellite Communication	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	165
24BEEC5E10	Machine Learning Techniques	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	168
24BEEC5E11	4G/5G Networks	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	170
24BEEC5E12	Data Communication and Networks	PE	1,2,3,4, 10,12	1,2	3	0	0	3	40	60	100	173
PROFESSIONAL ELECTIVE IV												
24BEEC6E01	Body Area Networks	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	176
24BEEC6E02	Digital Image Processing	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	179
24BEEC6E03	Speech Processing	PE	1,2,3,4, 10,12	1,2	3	0	0	3	40	60	100	182
24BEEC6E04	Advanced DSP	PE	1,2,3,4, 10,12	1,2	3	0	0	3	40	60	100	185
24BEEC6E05	Human Assist Devices	PE	1,2,3,4, 10,12	1,2	3	0	0	3	40	60	100	188
24BEEC6E06	Medical Imaging Systems	PE	1,2,3,10 ,12	1,2	3	0	0	3	40	60	100	190

OPEN ELECTIVES

Course Code	**Name of the course**	**Category**	**Outcomes**		**Instruction hours/week**			**Credits**	**Maximum Marks**		
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**
									40	**60**	**100**
	Open Elective I (Swayam NPTEL)	OE	-	-	0	0	0	3	40	60	100
	Open Elective II (Swayam NPTEL)	OE	-	-	0	0	0	3	40	60	100
				Total	**0**	**0**	**0**	**6**	**80**	**120**	**200**

Semester-I

24BECC101 **TECHNICAL ENGLISH I** **3H-3C**

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

End Semester Exam:3 Hours

PRE-REQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course for the students to

- To acquire the fundamental reading and writing skills, proper grammar usage, listening, and speaking
- To understand and improve skills in listening and speaking, in expressing oneself formally in writing, and in deducing meaning from what one reads
- To apply one's receptive (reading and listening) and productive (writing and speaking) language skills

COURSE OUTCOMES:

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

- Replicate grammar usage in reading, speaking, and writing skills. P2
- Describe precise transitions while reading, writing, and speaking to enhance communication coherence and clarity. A2
- Report the interpretation of linguistic parameters in day-to-day reading, listening, and speaking interactions. A2
- Point out errors to restructure paragraphs, compose, compile, and synthesize documents for presentations. P2
- Demonstrate proficiency in reading, writing, and critical listening and the ability to interpret and articulate complex ideas persuasively in written and oral forms. A3

***P- Psychomotor skills, A-Affective Domain Skills**

UNIT I **9**

Grammar **:** Parts of Speech – Gerunds and infinitives – Sentence Pattern

Reading **:** Reading comprehension: (vocabulary, referents, and inferences/conclusions)

Writing **:** Business letter – e-mail Writing

Listening **:** Listening to different short recordings – Listen to a longer recording

Speaking **:** Introduction to Phonetics, Diphthongs

UNIT II **9**

Grammar **:** Tenses: Simple Tenses – Concord – Types of Sentences

Reading **:** Identifying main and secondary information

Writing **:** Check lists – Building Itineraries

Listening **:** Listening Comprehension – Job Description

Speaking **:** Pronunciation – Describing people, places, jobs and things – Asking and answering questions

UNIT III **9**

Grammar **:** Tenses: Progressive Tenses – Direct and Indirect speech – Concord

Reading **:** Identifying, organizing, comparing and Interpreting information

Writing **:** Writing Articles – Paragraph Writing

Listening **:** Telephonic conversation

Speaking **:** Stress, Intonation – Self Introduction

UNIT IV **9**

Grammar **:** Tenses: Perfect Tenses – Active and Passive voice

Reading **:** Reading Comprehension (Reconstruction, Rewording)

Writing **:** Memo – Notice – Agenda

Listening **:** Critical Listening

Speaking **:** Oral presentation

UNIT V **9**

Grammar **:** Tenses: Perfect Continuous Tenses – Reported Speech

Reading **:** Reading Comprehension (Cause and Effect identification)

Writing **:** Creative writing – Copy Writing

Listening **:** Listening and Interpretation of ideas

Speaking **:** Group Discussion

TOTAL HOURS: 45

SUGGESTED READINGS:

1. Richards J C, Hull J, et al., "Interchange 2 Student's Book", 5th Edition, Cambridge University Press, 2022.
2. Kumar Sanjay and Pushp Latha, "English Language and Communication Skills for Engineers", 1st Edition, Oxford University Press, 2018.
3. Swan Michael and Walter Catherine, "Oxford English Grammar Course", 1st Edition, Oxford University Press, 2019.
4. Sudharshana N P and Savitha C, "English for Engineers", 1st Edition, Cambridge University Press, 2018.
5. Brook-Hart G, "Business Benchmark: Upper intermediate: Business Vantage: Student's Book", 2nd Edition,Cambridge University Press, 2021.

WEB REFERENCES:

1. www.onestopenglish.com
2. www.britishcouncil.org
3. www.cambridgeenglish.org/learning-english/

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	2	-	-	2	2	3	-	2	-	1
CO2	-	-	-	-	2	-	-	2	2	3	-	2	-	1
CO3	-	-	-	-	2	-	-	2	2	3	-	2	-	1
CO4	-	-	-	-	2	-	-	2	2	3	-	2	-	1
CO5	-	-	-	-	2	-	-	2	2	2	-	2	-	1
Average	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**2**	**2.8**	**-**	**2**	**-**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-I

24BECC102 MATRICES AND CALCULUS 4H-4C

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

End Semester Exam:3 Hours

PRE-REQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course for the students to

- To provide sufficient knowledge in calculus and matrix algebra in the respective fields
- To find an extremum value for a function of several variables subject to a given constraint.
- To provide knowledge in evaluating double and triple integrals
- To apply mathematical tools to solve second and higher order ODE and PDE 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 K3
- Utilize differential calculus of multivariable to optimization problems. K3
- Apply multiple integrals for finding area and volume. K3
- Solve the n^{th} order Ordinary Differential Equations (ODE) and Homogeneous equation of Euler's type. K3
- Solve the n^{th} order Partial Differential Equations. K3

UNIT – I MATRICES **12**

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 –Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers.

UNIT – III MULTIPLE INTEGRALS **12**

Definite and Indefinite Integrals – Double integrals – Change of order of integration – Double integrals in polar coordinates – Area using double integrals – Evaluation of Triple Integrals- Volume of Solids.

UNIT – IV ORDINARY DIFFERENTIAL EQUATIONS **12**

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

UNIT – V PARTIAL DIFFERENTIAL EQUATIONS **12**

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

TOTAL HOURS: 60

SUGGESTED READINGS:

1. Hass, Heil and Weir, "Thomas Calculus", 14th Edition, Pearson Education, 2018.
2. Dennis G. Zill, "Advanced Engineering Mathematics", 7th Edition, Jones & Bartlett Learning, 2022.
3. Rogawski, Adams and Franzosa, "Calculus", 4th Edition, W. H. Freeman, 2019.
4. Boyce, DiPrima and Meade, "Elementary Differential Equations and Boundary Value Problems", 12th Edition, John Wiley & Sons, 2021.
5. Alexander Graham, "Matrix Theory and Applications for Scientists and Engineers", 1st Edition, Dover Publications Inc.,2018.
6. Grewal, B. S.,Higher engineering mathematics. 2018, Khanna Publishers, New Delhi.

WEB REFERENCES:

1. www.classcentral.com/course/matrix-methods-13644
2. www.classcentral.com/course/brilliant-calculus-ii-59290
3. www.classcentral.com/course/differential-equations-engineers-13258

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-I

24BEEC141	SEMICONDUCTOR PHYSICS (THEORY & LABORATORY)	5H-4C

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60**Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITE: Nil

(i) THEORY

COURSE OBJECTIVES

The goal of this course for the students to

- Instill knowledge on physics of semiconductors, determination of charge carriers and device applications
- Establish a sound grasp of knowledge on different properties of materials such as magnetic and super conducting
- Make the students to understand the nano materials and its applications

COURSE OUTCOMES

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

- Relate the quantum concepts in electron microscope K2
- Identify the types of semiconductors and its carrier concentration using Hall effect K3
- Outline the basics of crystals, structures and its defects K2
- Utilize magnetic properties for finding B - H Curve K3
- Illustrate the properties of nano materials and its fabrication methods K2

UNIT I – QUANTUM PHYSICS 9

Black body radiation - Energy Distribution laws (Qualitative): Stefan Boltzmann's law, Wein's Displacement law-Rayleigh Jeans Law. Photo electric effect (Qualitative) – 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 – Particle in one dimensional box- Scanning Electron Microscope and Transmission Electron Microscope.

UNIT II SEMICONDUCTORS **9**

Properties of semiconductor, Types: Intrinsic and extrinsic semiconductors – Intrinsic carrier concentration, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier transport: diffusion and drift - Hall Effect – Determination of Hall coefficient – Applications

UNIT III – CRYSTAL PHYSICS **9**

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– Defects in crystal: Point & Line defect.

UNIT IV MAGNETIC AND SUPER CONDUCTING MATERIALS **9**

Magnetic moment, magnetic dipoles - magnetic permeability and susceptibility, types of magnetic materials - Ferromagnetism, Domain Theory, Hysteresis on the basis of domains, hysteresis loss, soft and Hard magnetic materials – Superconductivity – Properties – Meissner effect – Effect of magnetic field – Types of superconductors – BCS theory of superconductivity — Applications of superconductors, cryotron and magnetic levitation.

UNIT V NANO MATERIALS **9**

Low-dimensional systems such as quantum wells, wires, and dots – Nanostructures: Synthesis of nanomaterials- top-down approach (Ball milling, Pulsed laser deposition and bottom-up approach (Chemical Vapour Deposition, Physical Vapour Deposition) – Carbon nanotubes: Properties and applications.

TOTAL HOURS: 45+30

(ii) LABORATORY

LIST OF EXPERIMENTS – PHYSICS

1. Determination of Band gap of a semiconductor.
2. Characteristics of photo diode.
3. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille's flow.
4. Laser- Determination of the wave length of the laser using grating
5. Laser – Determination of Particle size
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.

SUGGESTED READINGS

1. Bhattacharya D.K. & Poonam T., Engineering Physics, Oxford University Press, (2015).
2. S.O. Pillai, "Solid State Physics", 9th Edition. New Age International Publishers, 2020.
3. B.K. Pandey, S. Chaturvedi, Engineering Physics, Cengage Learning India Pvt. Ltd. 2nd Edition, (2022).
4. S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, wiley Publishers, (2006).
5. William T Silfvast, Laser Fundamentals, Cambridge Univ Press. 2012.
6. Halliday.D. Resnick R. & Walker. J, Principles of Physics, Wiley, 2015.
7. Charles Kittel, Kittel's, Introduction to Solid State Physics, Wiley India Edition, 2019.
8. Donald A. Neamen, Semiconductor Physics and Devices, McGraw Hill Education private limited; 4 edition, (2021).
9. LeszekMalkinski, Advanced Magnetic Materials, Published by InTech, (2012).
10. Michael Shur, Physics of Semiconductor Devices, Published by Pearson Education; First edition, (2019).
11. Kulkarni, Sulabha K, Nanotechnology: Principles and Practices, Springer International Publishing, (2015).
12. R P Khare, Fiber Optics and Optoelectronics, Oxford, 2012

WEB REFERENCES:

1. www.nptel.ac.in/courses/115102025/
2. www.nptel.ac.in/courses/108/108/108108122/
3. www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/lecture-notes/MIT6_012F09_lec01.pdf

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	2	2	-	1	1	1
CO2	3	2	-	-	-	-	-	-	2	2	-	1	1	1
CO3	3	2	-	-	-	-	-	-	2	2	-	1	1	1
CO4	3	3	2	-	-	1	-	-	2	2	-	1	1	1
CO5	2	1	-	-	-	-	-	-	-	1	-	1	1	1
Average	**2.8**	**2.0**	**2.0**	**-**	**-**	**1.0**	**-**	**-**	**2.0**	**1.8**	**-**	**1.0**	**1.0**	**1.0**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-I

24BEEC142 ELECTRIC CIRCUIT ANALYSIS (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:02 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITE: Nil

(i) THEORY

COURSE OBJECTIVES:

The goal of this course for the students to

- To understand the concept of circuit elements, electrical connections, laws and networks
- To examine the electrical network using various analysis techniques and network theorems
- To explain the concept of types of AC circuits and its applications.

COURSE OUTCOMES:

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

- Compute the electric circuit parameters using Kirchhoff's laws K3
- Utilize the network theorems for calculation of parameters in electric network K3
- Examine the steady state and transient conditions of electrical networks K4
- Compute design parameters of resonance circuit and coupled circuit K3
- Solve three phase circuit for different loads and configurations K3

UNIT I BASIC CIRCUIT CONCEPTS 10

Basic electrical parameters – Terminologies – Ohm's law – Kirchhoff's laws – Source transformation – Voltage division – Current division – Series and parallel connections – Classification of circuit elements – Classification of networks – Star delta transformation – Introduction to AC circuits – Analysis of purely resistive, inductive, and capacitive circuits – Analysis of RL, RC, RLC series and parallel circuits.

UNIT II NETWORK THEOREMS 9

Mesh and Nodal analysis – Superposition Theorem – Thevenin's theorem – Norton's theorem – Maximum power transfer theorem – Reciprocity theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 9

Series resonance – Parallel resonance – Frequency response – Quality factor and bandwidth – Self and mutual inductance – Coupling coefficient – Dot rules – Single tuned circuits.

UNIT IV THREE PHASE CIRCUITS **9**

Introduction to three phase circuits – Three phase star and delta connections – Phase sequence – Line and phase quantities – Analysis of three phase circuits with star and delta connected balanced and unbalanced loads – Two wattmeter method of power and power factor measurements in three phase circuits.

UNIT V TRANSIENT RESPONSE ANALYSIS **8**

Introduction to transients – Charging and Discharging a Capacitor – Switching inductive circuits – Laplace and Inverse Laplace transforms – Transient response of RL,RC and RLC circuits with Step and Sinusoidal inputs.

TOTAL: 45

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Verification of Ohm's law and Kirchhoff's laws
2. Verification of Nodal analysis and Mesh analysis
3. Verification of Superposition theorem
4. Verification of Thevenin's theorem and Norton's theorem
5. Verification of Maximum power transfer theorem
6. Transient Response of RL and RC circuits

TOTAL: 30

TEXT BOOKS:

1. Robert Boylestad L, Brian A. Olivari, "Introductory Circuit Analysis", 14th Edition, Pearson Education, 2022.
2. Thomas L. Floyd, David M. Buchla, "Principles of Electric Circuits", 10th Edition, Pearson Education, 2019.

REFERENCE BOOKS:

1. William Hayt H, Jr Jack E. Kemmerly, Jamie D.Phillps and Steven M. Durbin, "Engineering Circuit Analysis", 9th Edition, Tata McGraw Hill, 2020.
2. Kothari D P and Nagrath I J, "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill Education, 2019.
3. Charles K. Alexander and Mathew N. O. Sadiku, "Fundamentals of Electric Circuits", 7th Edition, Tata McGraw Hill, 2022.
4. John Bird, "Electrical Circuit Theory and Technology", 7th Edition, Routledge, 2022.
5. Allan H. Robbins and Wilhelm C Miller, "Circuit Analysis: Theory and Practice", 5th Edition, Cengage Learning India Private Limited, 2012.

WEB REFERENCES:

1. www.eie.polyu.edu.hk/~cktse/linear_circuits/main/node1.html
2. www.studysmarter.co.uk/explanations/physics/electricity-and-magnetism/circuit-analysis/
3. www.mit.edu/search/?q=circuit+theory#gsc.tab=0&gsc.q=circuit%20theory&gsc.page=1

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-I

24BECC143	**PROGRAMMING IN C (THEORY & LABORATORY)**	**5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITES: Nil

i) THEORY

COURSE OBJECTIVES

The goal of this course for students is to:

- Understand problem solving using C
- Learn the arrays, strings and functions of C Language
- Develop C Programs using structures, unions and file handling

COURSE OUTCOMES:

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

- Interpret problem solving aspect using C programming K2
- Construct solutions for computational problems by utilizing C constructs to ensure optimized performance and accuracy in program development. K3
- Develop applications in C using functions and file handling K3
- Make use of pointers, structures, unions and arrays in C K3
- Solve the real-world problems using programming logics in C K3

UNIT I INTRODUCTION 9

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 **9**

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.

UNIT III FUNCTIONS **9**

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.

UNIT IV POINTERS **9**

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 **9**

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 – files and Binary files – File handling – Text File Input/output – Preprocessor directives.

TOTAL: 45

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Create a program using operators and expressions in C.
2. Implement programs using arrays in C.
3. Develop programs to perform sort operations in C.
4. Write programs using functions and storage classes in C.
5. Create programs using pointers and function pointers in C.
6. Develop programs using structures and unions in C.
7. Construct programs using file handling and preprocessor directives in C.

TOTAL: 30

TEXT BOOKS:

1. Brian Kernighan and Dennis Ritchie, "The C Programming Language", 2nd Edition, Pearson, 2017.
2. Behrouz A. Forouzan, Richard F.Gilberg, "Computer Science: A Structured Programming Approach Using C", 3rd Edition, CENGAGE, 2022.

REFERENCES:

1. Reema Thareja, "Programming in C", AICTE Edition, Oxford University Press, 2019.
2. Balagurusamy, "Programming in ANSI C", 8th Edition, Mc Graw Hill Education, 2019.
3. Yashwant Kanetkar, "Let Us C", 17th Edition, BPB Publications, 2020.
4. Herbert Schildt, "C: The Complete Reference", 4th Edition, Mc Graw Hill Education, 2019.

WEBSITES:

1. https://www.programiz.com/c-programming
2. https://www.geeksforgeeks.org/c-programming-language/
3. https://onlinecourses.nptel.ac.in/noc24_cs02/preview

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-I

24BEMC151 WOMEN SAFETY AND SECURITY 1H-0C

Instruction Hours/week: L:1T:0 P:00 **Marks:** Internal**:100** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course 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 9

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 9

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 9

Women leaders in politics- Women in Local Governance- Barriers- Reservation policies- Women's Political Rights, Property Rights - Violence against Women - Women's work.

TOTAL HOURS: 15

SUGGESTED READINGS

1. Amy S. Wharton. (2005). “The Sociology of Gender: An Introduction to Theory and Research”. (Key Themes 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.

பருவம் -I

24BEMC152 ***தமிழர் மரபும் பண்பாடும*** **1 H – 0 C**

*கற்பித்தல் நேரம்/வாரம்***: L:1 T:0 P:0** ***மதிப்பெண்*: இடைத்தேர்வு: 100**

***மொத்தம்*:100**

***பாடத்திட்ட பயன் விளைவு*:**

- *வரலாற்றிற்கு முற்பட்ட தமிழகத்தை மாணவர்களுக்கு அறிமுகப்படுத்துதல்*
- *பழந்தமிழர் பண்பாடு சார்ந்த வாழ்க்கை முறையை மாணவர்கள் அறிய ஊக்குவித்தல்*
- *தமிழ் மொழியின் பழைமையும், திராவிட மொழிகளில் 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. *இந்தியக்குடியுரிமைப்பணி முதலான போட்டித்தேர்வுகளில், விருப்பப்பாடமாக இடம்பெறுகின்ற, 'தமிழ்இலக்கியவரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.*
2. *கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத்தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.*
3. *தமிழின்வளர்ச்சித்துறையாகிய, 'அறிவியல்தமிழ்'; 'இணையதமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச்சிந்தனை மேம்பாடு.*
4. *வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .*
5. *சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப்பேணுவதற்குக்கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மைவளர்ச்சி. மொழிபெயர்ப்புத்துறை சார்ந்த வேலைவாய்புத்திறன் பெற்றிருத்தல்.*

அலகு*:1 *தமிழர் மரபு

மரபு-விளக்கம்-சங்ககால தமிழர் மரபு – திணைப்பகுப்பும் தமிழர் மரபும்-உலகப்பொதுமை – அகத்திணை மரபு – புறத்திணை மரபு- இடைக்காலத்தமிழர் மரபு – பிற்கால மரபும் மாற்றமும் – 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 சமயம்

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 வாழ்வியல் நெறிகள் – இரட்டைக் காப்பியங்களும் வாழ்வியலும் – சிற்றிலக்கியங்களில் வாழ்வியல் பதிவுகள்-இக்கால இலக்கியமும் வாழ்வியலும்.

பார்வைநூல்கள்:

1. தமிழ் இலக்கிய வரலாறு – தமிழண்ணல், மீனாட்சி புத்தக நிலையம்- மதுரை-இரண்டாம் பதிப்பு-ஜூலை – 2000.
2. தமிழர் நாகரிகமும் பண்பாடும், அ. தட்சிணாமூர்த்தி, ஐந்திணைப் பதிப்பகம், சென்னை, திருத்திய பதிப்பு – 2022.
3. தமிழர் வரலாறும் பண்பாடும், நா. வானமாமலை, நியூசெஞ்சுரி புக் ஹவுஸ், சென்னை, ஆறாம்பதிப்பு - 2007.
4. தமிழக வரலாறு மக்களும் பண்பாடும், கே.கே. பிள்ளை, உலகத் தமிழராய்ச்சி நிறுவனம், சென்னை.

Semester-II

24BECC201	TECHNICAL ENGLISH II	3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BECC101 TECHNICAL ENGLISH I

COURSE OBJECTIVES:

The goal of this course for students to

- To acquire the context of grammar and the importance of Listening, Speaking, Reading and Writing
- To understand and develop critical Listening, Speaking, Reading, and Writing skills
- To apply students' capability to listen vigilantly, read proficiently, innovative writing, and speak fluently

COURSE OUTCOMES:

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

- Demonstrate the aspects of writing, speaking, reading, and listening with grammar. **P2**
- Refine speaking, listening, reading, and writing skills in the social milieu. **P3**
- Justify the text critically in reading, writing, speaking, and listening. **A3**
- Differentiate grammatical structures in reading and listening and apply the structure in speaking and writing. **A3**
- Adapt writing, reading, listening, and speaking rules in formal and informal situations. **P3**

***P- Psychomotor skills, A-Affective Domain Skills**

UNIT I **9**

Grammar : Prepositions – Adjectives – Adverbs

Reading : Reading comprehension: Skimming and Scanning

Writing : Letter writing (Formal and Informal) – Letter to Editor

Listening : Listening to Business talks – TED Talks

UNIT II **9**

Grammar : Use of sequence words – Modal Verbs

Reading : Mind Mapping (Structured thinking and related ideas)

Writing : Interpreting visual materials – Note Making – Recommendations

Listening : Listening to specific tasks – Focused Listening – Note Taking.

Speaking : Making presentations on given topics – Speaking in formal Situations

UNIT III **9**

Grammar : Contextual usage of Tenses – Connectives

Reading : Cohesion and Coherence in Reading

Writing : Paragraph writing: Compare and Contrast – Cause and Effect – Jumbled Sentences

Listening : Listening and responding to video lectures

Speaking : Role-play – Group Interaction

UNIT IV **9**

Grammar : WH Questions – Identifying Common Errors

Reading : Critical Reading Shifting facts from opinions

Writing : Resume writing with cover letter – Free writing

Listening : Watching videos or documentaries and answering

Speaking : Responding to questions – Mock Interviews

UNIT V **9**

Grammar : Use of Imperatives – Confusing words in English

Reading : Reading and making inference

Writing : Essay writing – Report – Proposals

Listening : Listening to different accents – Listening to Speeches

Speaking : Impromptu Speeches – Describing a process

TOTAL HOURS: 45

SUGGESTED READINGS:

1. Richards J C, Hull J, et al. “Interchange 3 Student's Book”, 5th Edition, Cambridge University Press, 2022.
2. Harding, Keith, and Appleby, Rachel, "International Express: Pre-Intermediate: Student's Book", 3rd Edition, Oxford University Press, 2019.
3. Swan, Michael and Walter Catherine, “Oxford English Grammar Course”, 1st Edition, Oxford University Press, 2019.
4. Sudharshana N P and Savitha C, “English for Engineers”, 1st Edition, Cambridge University Press, 2018.
5. Brook-Hart G, “Business benchmark: Upper intermediate: Business vantage: Student’s book”, 2nd Edition, Cambridge University Press, 2021.

WEBSITE REFERENCES:

1. www.myenglishpages.com
2. www.cambridgeenglish.org/learning-english/
3. www.eslvideo.com/index.php

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	2	-	-	2	2	3	-	2	-	1
CO2	-	-	-	-	2	-	-	2	2	3	-	2	-	1
CO3	-	-	-	-	2	-	-	2	2	3	-	2	-	1
CO4	-	-	-	-	2	-	-	2	2	3	-	2	-	1
CO5	-	-	-	-	2	-	-	2	2	2	-	2	-	1
Average	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**2**	**2.8**	**-**	**2**	**-**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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

PRE-REQUISITES: 24BECC102 MATRICES AND CALCULUS

COURSE OBJECTIVES:

The goal of this course is for the students;

- To provide the basic concepts of graphs
- To impart the knowledge of trees and its properties.
- To afford the adequate knowledge on matrix representation of graphs, coloring and dominating sets.
- To understand the concepts and significance of lattices

COURSE OUTCOMES:

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

- Infer the basic terminologies of directed and undirected graphs K2
- Illustrate the properties of trees, connectivity, fundamentals of circuits, cutset through algorithms K2
- Apply matrix representation of graphs to explore spectra and energy of graphs K3
- Interpret the coloring and domination of a given graph K2
- Explain Lattice theory and its operations on discrete structural areas of computing K2

UNIT I GRAPHS 12

Graphs: Directed and undirected graphs – Konigsberg bridge problem – Handshaking Theorem– Walk, Trail, Path, Circuit, Cycle, sub graphs, induced and spanning subgraphs, connected graphs, complement of a graph – Euler, Hamiltonian graphs - Isomorphism of graphs.

UNIT II TREES 12

Properties of trees – Distance and centers in tree – Rooted and binary tree Spanning trees –Connectivity and separability – Fundamental Circuits and Cut sets – Algorithm on spanning trees: Kruskal’s and Prim’s Algorithm – Dijkstra’s shortest path algorithm.

UNIT III MATRIX REPRESENTATION OF GRAPHS **12**

Matrix Representation of Graphs: Adjacency matrix, Incidence matrix, Circuit matrix, Fundamental circuit matrix, Laplacian matrix, rank of these matrices and its properties – Spectra and Energy of Graphs.

UNIT IV COLORING, COVERING AND PARTITIONING **12**

Coloring, Covering and Partitioning: Chromatic number – Chromatic Partitioning: Dominating set – Minimal Dominating set – Domination number- Chromatic Polynomial– Matching – Four color theorem (Statement only).

UNIT V LATTICE THEORY **12**

Partial ordering – Posets – Lattices as posets – Properties of lattices – Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices.

Total Hours: 45+15

TEXT BOOKS:

1. Narsingh Deo., "Graph Theory with applications to Engineering and Computer Science", 1st Edition, Prentice Hall Series, 2021.
2. Karin R Saoub., "Graph Theory – An Introduction to Proofs, Algorithms and Applications", 1st Edition, CRC Press, 2021.
3. Kenneth H. Rosen., "Discrete Mathematics and Applications", 7thEdition, Tata McGraw Hill, 2012.

REFERENCE BOOKS:

1. Allan Bickle, "Fundamentals of Graph Theory", American Mathematical Society,2020.
2. LonathanI, Gross, Jay Yellen and Mark Anderson, "Graph Theory and Its Applications", 3rd Edition, CRC press, 2019.
3. Madhumangal Pal, SovanSamanta and Anita Pal, "Advanced Applications of Graph Theory in Modern Society", IGI Global, 2021.
4. J. P. Tremblay, R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, India, 1st Edition,1997

WEB REFERENCES:

1. www.classcentral.com/subject/graph-theory
2. www.nitttrc.edu.in/nptel/courses/video/106106183/lec292.pdf
3. www.digimat.in/nptel/courses/video/106108054/L17.html

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECC202B /24BTCC202B **Semester-II**

COMPUTATIONAL METHODS FOR ENGINEERS **4H-4C**

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

End Semester Exam: 3 Hours

PRE-REQUISITES: 24BECC102 MATRICES AND CALCULUS

COURSE OBJECTIVES:

The goal of this course is for students:

- To provide the knowledge of Vector differentiation and Integration.
- To inculcate the concepts of Number Theory.
- To introduce the concepts of graphs and algorithm on spanning trees.
- To afford adequate knowledge of Linear Programming Problems.

COURSE OUTCOMES:

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

- Make use of vector calculus for finding area and volume K3
- Interpret the concepts of divisibility, prime number, congruence and number theorems K2
- Explain the terminology of basic graphs and its matrix representation K2
- Illustrate the properties of trees, connectivity, fundamentals of circuits, cut set through algorithms K2
- Solve linear programming models by Graphical method, Simplex method and Dual simplex method K3

UNIT I VECTOR CALCULUS **12**

Vector differential operator – Gradient, divergence and curl – Identities (Statement only) – Directional derivatives – Irrotational and solenoidal vector fields –Conservative vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving square, rectangle, cubes and rectangular parallelopipeds.

UNIT II NUMBER THEORY **12**

Divisibility – Fundamental Properties – Euclidean algorithm – Euclid's lemma – Fundamental theorem of arithmetic – Congruence – Fermat's Little theorem – The Fermat-Euler theorem.

UNIT III GRAPH THEORY **12**

Incidence and degree – Finite and Infinite graphs – Sub graphs – Isomorphism of graphs – Walks, Paths and Circuits – Eulerian and Hamiltonian graphs – Planar graph – Matrix representation of graphs – Incidence and Adjacency matrices

UNIT IV TREES **12**

Trees: Properties of trees – Distance and centers in tree – Rooted and binary tree – Spanning trees– Properties of trees –Algorithm on spanning trees – Kruskal's algorithm.

UNIT V LINEAR PROGRAMMING PROBLEM **12**

Formulation of Linear Programming Problem– Advantages and disadvantages of LPP – Algebraic solution of a LPP - Graphical method - The Simplex method - Principle of duality - Dual and primal problems - Dual Simplex method.

TOTAL HOURS: 45+15

TEXT BOOKS:

1. Jonathan L. Gross, Jay Yellen, Mark Anderson, "Graph Theory and Its Applications", 3rd Edition, Chapman and Hall, 2023.
2. Satyabrota Kundu, SupriyoMazumder, "Number Theory and Its Applications", 1st Edition, CRC Press, London, 2022.

REFERENCE BOOKS:

1. Colley, Susan Jane, "Vector Calculus", 4th Edition, Pearson Education, 2019.
2. Pio J Arias, "Elementary Number Theory", 1st Edition, Toronto Academic Press, 2024.
3. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall Series, 2021.
4. Hamdy A. Taha, "Operations Research: An Introduction", 10th Edition, Pearson Education, 2019.

WEB REFERENCES:

1. www.khanacademy.org/computing/computer-science/cryptography/random-algorithms-probability/fermat-s-little-theorem-visualization
2. www.udemy.com/course/linear-programming-basics/
3. www.udemy.com/course/graph-theory

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	3	2
CO2	2	1	-	-	-	-	-	-	-	-	-	1	2	1
CO3	2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO4	2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	1
Average	2.4	1.4	1	-	-	-	-	-	-	-	-	1	1.6	1.2

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24BECC202C /24BTCC202C **Semester-II**

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

PRE-REQUISITE: 24BECC102 MATRICES AND CALCULUS

COURSE OBJECTIVES:

The goal of this course for students to

- To understand the concept of periodic functions and represent it as Fourier series.
- To provide knowledge of Fourier series techniques in solving heat flow problems and wave equations.
- To acquaint Fourier transforms techniques used in various applications.
- To impart the knowledge of Laplace Transforms and Inverse Laplace Transforms techniques and its applications.

COURSE OUTCOMES:

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

- Illustrate Fourier series representation of periodic functions. K2
- Apply Fourier series in one dimensional heat flow and wave equation. **K3**
- Make use of Fourier transform for converting elementary functions into frequency domain. K3
- Utilize Laplace Transform to convert time-domain systems into frequency-domain systems K3
- Apply Inverse Laplace Transform in linear differential equations. K3

UNIT I FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series in the interval (0,2l) & (-l,l) – Half range sine series –Half range cosine series –Parseval's Identity – 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 **12**

Fourier Integral Theorem – Fourier transform pair –Fourier sine and cosine transforms –Properties – Convolution theorem – Parseval's identity of Fourier transform.

UNIT IV LAPLACE TRANSFORM **12**

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

UNIT V INVERSE LAPLACE TRANSFORM **12**

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

TOTAL HOURS: 60

SUGGESTED READINGS:

1. Boyce, Diprima and Meade, "Elementary Differential Equations and Boundary Value Problems", 12th Edition, John Wiley & Sons, 2021.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, 2017
3. T. Hillen, "Partial Differential Equations", 2nd Edition, Friesen Press, 2019.
4. Dennis G. Zill, "Advanced Engineering Mathematics", 7th Edition, Jones and Bartlett Publishers, 2020.
5. Richard Haberman, "Applied Partial Differential Equations with Fourier Series and Boundary Value Problems", 5th Edition, Pearson, 2021.
6. Grewal B.S., "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.

WEB REFERENCES:

1. www.infocobuild.com/education/audio-video-courses/mathematics/Transform Techniques For Engineers-IIT-Madras/lecture-01.html
2. www.infocobuild.com/education/audio-video-courses/mathematics/ordinary-and-partial-differential-equations-iit-roorkee.html
3. www.electrical4u.com/laplace-transformation/

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	3	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1	3	1
CO3	3	2	1	-	-	-	-	-	-	-	-	1	3	1
CO4	3	2	1	-	-	-	-	-	-	-	-	1	3	1
CO5	3	2	1	-	-	-	-	-	-	-	-	1	3	1
Average	**3**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-II

24BEEC241	ENVIRONMENTAL CHEMISTRY (THEORY & LABORATORY)	5H-4C

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITE: NIL

(i) THEORY

COURSE OBJECTIVES:

The goal of this course for students to

- Summarize the importance of water and its treatment processes.
- Create a basic understanding of energy resources, storage devices and pollution eradication.
- Clarify the concepts of corrosion and analytical techniques.

COURSE OUTCOMES:

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

- Identify the problems associated with water and appropriate technologies. K3
- Infer the alternate energy sources and storage devices. K2
- Summarize the problems of environmental pollution and its control measures. K2
- Illustrate the types of corrosion and its prevention methods. K2
- Demonstrate the principle and working of analytical techniques. K3

UNIT I – WATER AND ITS TREATMENT **9**

Sources -surface and ground water – problems of over-exploitation - Surface water treatment -Water quality parameters -Alkalinity- Types of alkalinities and determination - Hardness - Types and estimation by EDTA method - Boiler feedwater - Requirements - Disadvantages of using hard water in boilers - Internal conditioning (Phosphate, Calgon and Carbonate conditioning methods) - External conditioning - Demineralization process - Desalination - Reverse osmosis.

UNIT II- ENERGY SOURCES AND STORAGE DEVICES **9**

Renewable and Non - Renewable resources -Nuclear energy (Fission and fusion)- light water nuclear power plant- Wind energy-Hydroelectric power-Geothermal energy- solar energy conversion - solar cells-Batteries, Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell

UNIT III-ENVIRONMENTAL POLLUTION **9**

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

UNIT IV -CORROSION AND ITS CONTROL **9**

Chemical corrosion and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion-Factors influencing the rate of corrosion-Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings - Organic coatings (Paints - Constituents and functions) - Metallic coatings (Inorganic coatings) - Electroplating (Au) and Electro less plating (Ni).

UNIT V – ANALYTICAL TECHNIQUES AND APPLICATIONS **9**

Introduction-Instrumentation and applications of Colorimetry, Flame Photometry, Potentiometry, Conductometry (Strong acid with strong base, Mixture of acids with strong base, precipitation titrations)-Electronic spectroscopy- Vibrational Spectroscopy-Atomic Absorption spectroscopy.

TOTAL HOURS: 45+30

SUGGESTED READINGS:

1. Anubha Kaushik., and Kaushik, C.P. 7Th Edition, 2021. Perspectives in Environmental Studies. NewAge International Pvt. Ltd. Publications, New Delhi.
2. Erach Bharucha, “A Textbook of Environmental Studies for UG Courses” 3rd Edition, University Press India ltd, 2021.
3. P C Jain & Monica Jain, (2022). Engineering Chemistry, 18th edition, Dhanpat Rai Publishing Company
4. Prabhakar S Mithra, “Methodologies for environmental studies”, 1st Edition, Academic Apirations, 2021.
5. B. H. Mahan, (2010).University chemistry, Pearson Education.
6. C. N. Banwell, (2001) Fundamentals of Molecular Spectroscopy, McGraw-Hill.
7. G.Tyler Miller and Scott Spoolman, “Living in the Environment”, 20th Edition, Cengage Learning, 2021.
8. M.J. Sienko and R.A. Plane,(1976) Chemistry: Principles and Applications. 5thedition, McGraw-Hill Higher Education.
9. Sing, J.S., Sing. S.P. and Gupta, S.R. 2022. Ecology, Environmental Science andConservation. S. Chand & Publishing Company, New Delhi.
10. Linda D Williams, “Environmental Science” 1st Edition, Tata McGraw Hill, 2017.

WEB REFERENCES:

1. https://www.insightsonindia.com/2013/09/06/environment-biodiversity
2. https://www.nptelvideos.in/2012/11/energy-resources-and-technology.html
3. https://www.bspublications.net/downloads/0523ff2e4a5331_chemistry_ch_01_JNTUK.pdf

(ii) LABORATORY

LIST OF EXPERIMENTS

1. Determination of Sodium Carbonate and Sodium Hydrogen Carbonate in a mixture using volumetric titration
2. Determination of Ca / Mg using complexometric titration
3. Determination of chloride content of water
4. Determination of the rate of corrosion by weight loss method
5. Conductometry - Determination of conductance of solutions (strong acid Vs strong base)
6. pH Metry - Determination of Acid/Base
7. Potentiometry - Estimation of iron content in a water sample.

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	1	1	1	1	-	-	1	-	-
CO2	2	2	1	1	-	1	1	1	1	-	-	1	-	-
CO3	2	1	-	-	-	2	2	2	-	-	-	1	-	-
CO4	2	1	-	-	-	1	1	1	-	-	-	1	-	-
CO5	2	1	-	-	-	1	1	1	-	-	-	1	-	-
Average	**2**	**1.4**	**1**	**1**		**1.2**	**1.2**	**1.2**	**1**	**-**	**-**	**1**	**-**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-II

24BEEC242 DIGITAL SYSTEM DESIGN (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:02 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITE: NIL

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students to

- To understand about Boolean theorem
- To analyze and design of combinational and sequential logic circuits
- To explain about various memory devices and Verilog HDL

COURSE OUTCOMES:

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

- Explain the fundamental concepts of various number systems, combinational and sequential circuits and digital logic families. K2
- Make use of the postulates of Boolean algebra for optimization and implementation of digital circuits. K3
- Construct combinational logic circuits and sequential logic circuits. K3
- Outline the structural and functional aspects of semiconductor memory and programmable devices. K2
- Illustrate the HDL modelling standards and the syntax of Verilog HDL essentials. K2

UNIT I BOOLEAN THEOREMS AND LOGIC REDUCTION 9

Review of Number Systems - Decimal, Binary, Octal and Hexadecimal, Signed Number Representation, Basic Theorems and Properties of Boolean Algebra - Boolean Functions, Canonical and Standard Forms - Sum of Products Form, Product of Sum Form, Gate level minimization - Karnaugh - Map Method, Prime Implicants, Essential Prime Implicants, Implementation of basic Logic Gates using NAND and NOR Implementation.

UNIT II COMBINATIONAL LOGIC CIRCUIT AND DESIGN 9

Binary Arithmetic Operations, Binary adders - Half adder, Full adder, Binary Subtractor - Half Subtractor, Full Subtractor, 4-bit ripple Carry Adder/Subtractor, BCD Adder, 8-to-3-line Conventional Encoder, 4 to 2 line Priority Encoder, 3 to 4 line Decoder, 8x1 Multiplexers, 1x8 De-multiplexers, 2-bit Magnitude Comparator, Binary codes – Gray Code, BCD, Excess 3 Code, Code convertor – 4-bit Binary to Gray, 4-bit Gray to Binary, 4-bit Parity Generator and Checker.

UNIT III SEQUENTIAL LOGIC CIRCUIT AND DESIGN 9

Introduction to Sequential Circuits, Latches and Flip-Flops - Characteristic table, Characteristic Equation, Excitation table, Realization of Flip-Flops, General model of Sequential Circuits - State table - State diagram, State Reduction, FSM representation using Mealy/Moore models - Design of Synchronous sequential circuits - Shift Registers - SISO, SIPO, PISO, PIPO and Universal Shift Register, Counters – 2-bit UP/DOWN counter, Ring counters, Johnson counters, Sequence Generator, Sequence Detector, Hazards logic circuits- Hazard free realization Logic, Introduction to Asynchronous Sequential Circuit.

UNIT IV SEMICONDUCTOR MEMORY AND PROGRAMMABLE DEVICES 9

Semiconductor memories - Memory Hierarchy, Classification of memories, Programmable Logic Devices, Logic Implementation with PROM, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Concept of Field Programmable Gate Arrays (FPGA).

UNIT V INTRODUCTION TO VERILOG HDL 9

Introduction to Verilog HDL – Levels of Hierarchy model – Modeling: Data flow model, Behavioral model, Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators, Concurrency.

TOTAL HOURS: 45

SUGGESTED READINGS:

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.
2. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
3. Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011.
4. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.
5. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI, 2nd edition ,2006.
6. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis”, 2nd Edition, Pearson Education, 2003.

WEB REFERENCES:

1. https://examupdates.in/digital-logic-design-books/
2. http://american.cs.ucdavis.edu/academic/ecs154a.sum14/postscript/cosc205.pdf
3. https://nptel.ac.in/courses/117106086/
4. https://nptel.ac.in/content/syllabus_pdf/108105113.pdf

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Design and verification of the truth tables of Full adder / Subtractor circuits.
2. Verification of the truth table of the 8x1 Multiplexer and 1x8 De-Multiplexer.
3. Verification of the truth table of the 4-to-2-line Priority Encoder and 2-to-4-line Decoder
4. Verify the truth table of a J-K Flip-Flop.
5. Design and implement a 2-bit UP/DOWN counter using T Flip-Flop
6. Implement and verify the operation of SISO and PISO Registers

TOTAL HOURS: 30

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-II

24BECC243	DATA STRUCTURES (THEORY & LABORATORY)	5H-4C

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITES: 24BECC143 PROGRAMMING IN C

i)THEORY

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Understand the concepts of abstract data types
- Learn linear and non-linear data structures
- Understand sorting, searching and hashing algorithms

COURSE OUTCOMES:

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

- Interpret the concepts of linear and non-linear data structures K2
- Identify appropriate linear/non–linear data structure operations for solving a given problem K3
- Experiment with linear and non-linear data structure operations to understand their implementation, performance, and practical applications K3
- Apply searching and sorting algorithms for solving a problem K3
- Develop the application using suitable data structures K3

UNIT I LISTS **8**

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 **8**

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 **8**

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 9

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 9

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.

CONTEMPORARY TOPICS 3

TOTAL HOURS: 45

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Implement array implementation of Stack, Queue, and Circular Queue ADTs.
2. Develop the implementation of a singly linked list.
3. Create linked list implementation of stack and linear queue ADTs.
4. Implement the evaluation of postfix expressions and infix to postfix conversion.
5. Develop the implementation of binary search trees and AVL Trees.
6. Implement insertion sort, merge sort and quick sort.
7. Create open addressing (Linear probing and Quadratic probing).

TOTAL HOURS: 30

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2019.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", 4th Edition, MIT Press, 2022.

REFERENCE BOOKS:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", 1st Edition, Career monk Publications, 2019.
2. Langsam, Augenstein and Tanenbaum, "Data Structures Using C and C++", 2nd Edition, Pearson Education, 2020.
3. Jan Wengrow, "A Common–Sense Guide to Data Structures and Algorithm", 2nd Edition, O'Reilly Publications, 2020.
4. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB publications, 2022.

WEBSITES:

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

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	3	-
CO2	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO3	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO4	3	2	1	-	-	-	-	-	2	2	-	2	3	-
CO5	3	2	1	-	-	-	-	-	2	2	-	2	3	-
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-II

24BEEC244 ELECTRON DEVICES (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:02 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC141 SEMICONDUCTOR PHYSICS

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students to

- Illustrate biasing characteristics of semiconductor diodes, transistors, and special purpose electronic devices
- Clarify construction procedures for power supplies, BJT, FET amplifier circuits using BJT and FET devices
- Explicate various special purpose semiconductor devices

COURSE OUTCOMES:

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

- Explain the biasing characteristics of semiconductor diodes, transistors and other special purpose electronic devices. K2
- Illustrate basic electronic devices such as diodes and transistors K2
- Identify rectifier specifications, BJT and FET amplifier parameters K3
- Construct different types of power supplies, BJT and FET based amplifier circuits K3
- Make use of semiconductor devices for specific applications K3

UNIT – I SEMICONDUCTOR DIODES 9

PN junction diode, Current equations, Energy Band diagram, Transition Capacitance, Diffusion Capacitance, Switching Characteristics, Breakdown in PN Junction Diodes, Diode as a Circuit Element.

UNIT – II BIPOLAR JUNCTION TRANSISTORS 9

NPN – PNP Transistors, Types of Configurations: CE–CB–CC configurations–Breakdown in Transistors, Bias Stability: Thermal Runaway, Stability Factor – Methods of Transistor Biasing: Fixed Bias, Emitted Feedback Bias, Collector Feedback Bias.

UNIT – III FIELD EFFECT TRANSISTORS 9

JFET: Construction and Operation of N Channel JFET, Characteristic Parameters, Biasing of JFET, Applications - Use of JFET as Voltage Variable Resistor. MOSFET: Enhancement and Depletion MOSFET, Handling Precautions, Comparisons, Applications.

UNIT – IV SPECIAL PURPOSE ELECTRONIC DEVICES 9

Metal-Semiconductor Junction- MESFET, Schottky barrier diode - Zener diode -Varactor diode –Tunnel diode- Gunn Diode - LASER diode, PIN and Avalanche photodiodes, LDR.

UNIT – V POWER DEVICES AND DISPLAY DEVICES 9

Thyristors: SCR– TRIAC-DIAC -GTO Thyristors, UJT, LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD.

TOTAL HOURS: 45

ii) LABORATORY

LIST OF EXPERIMENTS:

1. VI Characteristics of PN junction diode and Zener diode
2. Half wave and Full wave Bridge Rectifiers
3. Characteristics of BJT in CE configurations
4. Characteristics of MOSFET in CS configuration
5. Characteristics of SCR

TOTAL HOURS :30

SUGGESTED READINGS

1. Donald A Neaman, “Semiconductor Physics and Devices”, Fourth Edition, Tata Mc GrawHill Inc. 2012
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, “Electronic Devices and circuits”, Third Edition, Tata McGraw- Hill, 2008.
3. Robert L Boylestead and Louis Nashelsky,” Electronic Devices and circuit theory”, 11th Edition, Pearson Education, 2017.
4. David A Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2008.
5. Thomas L Floyd, “Electronic Devices”, 11th Edition, Pearson Education India, 2018.
6. Millman J Grabel A, “Microelectronics”, 2nd edition, Tata McGraw-Hill Publishing Company Ltd., 2017.

WEB REFERENCES:

1. www.electrical4u.com/electrical-engineering-articles/electronics-devices/
2. www.britannica.com/technology/electronics
3. www.sciencedirect.com/topics/nursing-and-health-professions/electronic-device

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester II

24BECC211	COMMUNICATION SKILLS LABORATORY	2H-1C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BECC101 TECHNICAL ENGLISH I

OBJECTIVES:

The goal of this course is;

- To acquire different listening techniques for understanding different kinds of audio content, including lectures, conversations, videos, etc. and to effectively communicate their ideas using a variety of media
- To understand the "English language skills" by engaging them in listening and reading activities that are relevant to authentic contexts and to help learners use language effectively in academic /work contexts
- To apply the communicative competence of learners in listening, speaking, reading and writing

OUTCOMES:

Learners will be able to,

- Organize the context, topic, and pieces of specific information of English through all four skills. **P1**
- Identify the purpose and clarity of facts and reflect their thoughts, opinions, and knowledge through all the language skills. **A1**
- Put together skimming, scanning, and listening techniques effectively to acquire the gist from the context. **P2**
- Demonstrate in communication more effectively with their peers, instructors, and colleagues. **A2**
- Master public speaking techniques, business writing, and listening with professional speaking techniques. **P3**

***P-Psychomotor Skills, A- Affective Domain Skills**

LIST OF EXPERIMENTS:

S.No.	SKILLS	TOPICS
1	Listening	Dialogues from TV/radio/Ted talk/Podcast
2	Listening	Listening for gist
3	Reading	Reading for detail, global understanding
4	Speaking	Presentations and interactive communication – Pair presentations
5	Listening	Listen and respond appropriately
6	Reading	Reading different genres
7	Writing	Documentary and Movie review
8	Writing	Informational or Analytical Reports
9	Speaking	Mock Interview
10	Speaking	Group Discussion

TOTAL: 30

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	2	-	-	2	3	3	-	2	-	1
CO2	-	-	-	-	2	-	-	2	3	3	-	2	-	1
CO3	-	-	-	-	1	-	-	2	3	3	-	2	-	1
CO4	-	-	-	-	1	-	-	1	2	3	-	2	-	1
CO5	-	-	-	-	1	-	-	1	2	3	-	2	-	1
Average	-	-	-	-	1.4	-	-	1.6	2.6	3	-	**2**	-	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

nd Semester Exam:3 Hours

Semester II

24BEMC251 YOGA 4H-2C

Instruction Hours/week: L: 0 T: 0 P: 4 **Marks:** Internal**: 100** External**: 0 T**otal**:100**

PRE-REQUISITE: NIL

COURSE OBJECTIVES:

The goal of this course for students to

- 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 5

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 5

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 5

Explain importance of yoga - Perform various pranayama for increasing concentration - Use

meditation and other relaxation techniques for improving concentration.

TOTAL: 15

SUGGESTED READINGS

1. Ajmer Singh, Modern Trends and Physical Education class 11 & class 12, Kalyani Publication, New Delhi ISBN: 9789327264319.
2. B.K.S. Iyengar, Light on Yoga, Thomson's Publication, New DelhiISBN: 8172235011
3. V.K.Sharma, Health and Physical Education, NCERT Books; Class11,12 Saraswati House Publication, New Delhi
4. Acharya Yatendra, Yoga and Stress Management, Fingerprint Publishing ISBN: 938905303X
5. Swami Vivekanand, Patanjali Yoga Sutras, Fingerprint Publishing ISBN 9389567351.
6. Ramdev, Pranayam Rahasya, Patanjali-Divya Prakashan, HaridwarISBN: 9788189235017
7. Ramdev, Yoga its Philosophy & Practice, Divya Prakashan, Haridwar.

Semester III

24BECC301 PROBABILITY AND RANDOM PROCESS 4H-4C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BECC202 TRANSFORMS AND ITS APPLICATIONS

COURSE OBJECTIVES:

The goal of this course is for students:

- To provide the required fundamental concepts of probability theory, Random variables and its distributions.
- To impart the knowledge of Measures of Central tendencies and Dispersions
- To impart the knowledge of correlation and Regression
- To inculcate the knowledge of testing of hypothesis using small and large sampling tests.

COURSE OUTCOMES:

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

- Infer the fundamentals of probability and random variables. K2
- Explain standard distributions of random variables. K2
- Make use of statistical data for finding the measures of central tendency and measures of dispersion. K3
- Interpret the data using correlation and regression. K2
- Apply small and large sample tests in testing of hypothesis. K3

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Concept of Probability – Addition and multiplication laws – Conditional probability – Total Probability – Baye's theorem and its applications – One dimensional Random Variables (Discrete and Continuous) – Mathematical Expectation.

UNIT II THEORETICAL DISTRIBUTIONS 12

Discrete distributions – Binomial, Poisson, Geometric Distributions – Continuous distributions – Uniform, Exponential and Normal Distributions.

UNIT III DESCRIPTIVE STATISTICS **12**

Measures of Central Tendency – Mean, Median, Mode – Measures of Dispersion – Mean deviation – Standard deviation – Coefficient of variation

UNIT IV CORRELATION AND REGRESSION **12**

Correlation – Pearson's Correlation coefficient – Spearman's Rank correlation coefficient – Regression – Regression lines- Linear, Multiple Regression- Logistic Regression - Polynomial Regression.

UNIT V TESTING OF HYPOTHESIS **12**

Large sample tests based on normal distribution – Test for single mean – Difference between means – Proportion – Difference between proportions – Small sample test – Student-t test – Test for single mean – Difference between means – Snedecor's F test – Chi-square test for goodness of fit, independence of attributes.

TOTAL HOURS: 60

TEXT BOOKS:

1. Geoffrey Grimmett and David Stirzaker, "Probability and Random Processes", Oxford University Press, 4th Edition, 2020.
2. Allen Craig Rober V Hogg,Joseph W Mckean, "Introduction to Mathematical Statistics",Pearson,8th Edition,2021.
3. Gupta, S.C and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 1999.

REFERENCE BOOKS:

1. Sheldon M Ross, "Introduction to Probability and statistics for Engineers and scientists", Elsevier, 6thEdition, 2021.
2. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", John Wiley, 7th Edition, 2019.
3. Freund John, E and Miller, Irvin, "Probability and Statistics for Engineering", 5th Edition, Prentice Hall, 1994.

4. Jay, L.Devore, “Probability and Statistics for Engineering and Sciences”, Brooks Cole Publishing Company, Monterey, California, 1982.

WEB REFERENCES:

1. www.britannica.com/science/probability
2. www.britannica.com/science/density-function
3. www.khanacademy.org/math/statistics-probability

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

Semester III

24BEEC302 SIGNALS AND SYSTEMS 4H-4C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BECC202 TRANSFORMS AND ITS APPLICATIONS

COURSE OBJECTIVES.

The goal of this course is for the students:

- Distinguish the characteristics and differences between Continuous Time (CT) and Discrete Time (DT) signals and systems.
- Illustrate of CT Fourier Transform (CTFT) and Laplace Transforms (LT), DT Fourier transform for signal and system analysis.
- Present varied examples of CT and DT systems analysis with block representation and state space model using impulse response, frequency response, and convolution

COURSE OUTCOMES

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

- Classify signals as Continuous time (CT) signals or Discrete time (DT) signals, systems as CT systems and DT systems K2
- Sketch the effect of various types of operations on the CT and DT signals K3
- Make use of signal Transform CT and DT signal analysis. K3
- Compute Impulse response, Frequency response and Convolution for CT systems and DT Systems K3
- Identify the state space representations for CT systems and DT systems K3

UNIT I FUNDAMENTALS OF SIGNALS AND SYSTEMS 12

Continuous Time signals (CT signals) – Discrete time signals (DT signals) - Classification of CT and DT signals – Periodic and aperiodic – Energy and power – Even and odd – Deterministic and random signals – Transformation on independent variables – CT systems and DT systems – Properties of systems – Linearity – Causality – Time invariance – Stability – Invertibility and LTI Systems.

UNIT II CT SIGNAL ANALYSIS 12

Fourier series analysis – Spectrum of CT signals – Continuous Time Fourier Transform (CTFT) and Laplace transform (LT) – Properties – CTFT and LT in signal analysis – Parseval's theorem – Inverse LT in signal analysis.

UNIT III LTI CT SYSTEMS 12

CTFT and Laplace transforms in LTI CT System analysis – Convolution integral – Differential equation – Impulse response – Frequency response – Block diagram representation in CT systems – State variable equation and matrix in CT systems.

UNIT IV DT SIGNAL ANALYSIS 12

Sampling theorem and aliasing - Discrete Fourier Series – Spectrum of DT Signals – Discrete Time Fourier Transform (DTFT) and Z transform – Properties - DTFT and Z transform in signal analysis – Inverse Z transform in signal analysis.

UNIT V LTI DT SYSTEMS 12

DTFT and Z transforms in LTI DT System analysis – Convolution sum – Difference equation – Impulse response – Frequency response – Block diagram representation in DT systems – State variable equation and matrix in DT systems.

TOTAL HOURS: 60

SUGGESTED READNGS:

1. Alan V Oppenheim, Alan S Wilsky Hamid Nawab S, "Signals and Systems", 2nd Edition, Pearson Education, 2002.
2. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, John Wiley, New Delhi, 2007.
3. Michael J Roberts, "Fundamentals of Signals and Systems", 2nd Edition, Tata McGraw Hill, New Delhi, 2017.
4. Lathi B P, "Principles of Linear Systems and Signals", 2nd Edition, Oxford Press, 2009.
5. Roberts M J, "Signals and Systems Analysis using Transform method and MATLAB", 3rd Edition, Tata McGraw Hill, 2009.

WEB REFERENCES:

1. www.udemy.com/course/signals-and-systems-from-basics-to-advance/

2. www.ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/pages/introduction/
3. www.users.ece.utexas.edu/~bevans/courses/signals/lectures/index.html

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-III

24BEEC303 CONTROL SYSTEMS ENGINEERING 4H-4C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC244 ELECTRON DEVICES

24BECC202 TRANSFORMS AND ITS APPLICATIONS

COURSE OBJECTIVES:

The goal of this course for students is

- To understand the fundamental concepts of control systems, its components, mathematical Modeling - transfer function of various systems.
- To analyze the time response and frequency response of the system analytically and graphically
- To learn the state space model and electrical systems.

COURSE OUTCOMES:

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

- Summarize elements in control systems, different types of control system, working principle of different types of motor and state space representation K2
- Interpret the time domain response, frequency domain response and stability of the control system K2
- Make use of Root Locus technique, Bode plot for compensator construction. K3
- Examine the transfer function of P-PI-PID, controllers controllability and observability of state space representation of the system
- Make use of state space analysis and concepts of electrical systems K4

UNIT I INTRODUCTION 12

Introduction to control systems — Definition — Basic elements in control systems — Open loop and Closed loop Systems — Mechanical translational and mechanical Rotational Systems — Transfer function — Block Diagram Reduction Techniques — Mason's Gain Formula and Signal Flow graph.

UNIT II TIME RESPONSE ANALYSIS 12

Test Signals — Order of a system — Type of a system — Time Response Analysis — First order and Second Order System Response for unit step input — Time Domain Specifications — Error coefficients — Generalized Error coefficients — Steady State Error, PID control, Effects and Transfer function of PD — PI — PID controllers.

UNIT III FREQUENCY RESPONSE ANALYSIS 12

Correlation between Time and Frequency response, Frequency Response Analysis — Bode Plot — Polar Plot —Phase margin, gain margin – Design of Cascade lead compensation, Cascade lag compensation and Cascade lag-lead compensation using Bode Plot.

UNIT IV STABILITY ANALYSIS 12

Concept of stability-Bounded Input Bounded Output - Routh Array Technique and Routh Hurwitz Criterion — Analysts of control system using Root Locus technique, Nyquist Stability Criterion.

UNIT V STATE SPACE ANALYSIS AND ELECTRICAL SYSTEMS 12

State Space Representation of Control Systems — State Transition Matrix using Eigen vectors — Cayley Hamilton Theorem — Check for Controllability and Observability. Construction and Working Principle — Permanent Magnet Stepped Motor — Field Controlled DC Motor— Armature Controlled DC motor — Tachometer — AC servomotor — DC servomotor.

TOTAL HOURS: 60

SUGGESTED READINGS

1. Ogata K, “Modern Control Engineering”, Prentice Hall of India, Fifth Edition (Revised).2017
2. Nagrath G and Gopal I J, “Control System Engineering”, New Age International Edition, Fifth Edition (Reprint),2016.
3. Benjamin C Kuo “Automatic Control Systems”, Prentice Hall of India, Seventh Edition (Reprint), 2016
4. Gopal M, “Control Systems”, Tata McGraw-Hill, fifth Edition (Reprint),2012.
5. Norman S Nlse, Control Systems Engineering. Wiley, Sixth Edition (Reprint),2017.
6. TheraJa B L and Theraa A K, A Text book of Electrical Technology: AC and DC Machines (Volume II), S Chand, First Revised Edition,2008.

WEB REFERENCES:

1. www.web.iitd.ac.ml-Danas/courses/eel30l.htm
2. www.mathworks.fn/academia/student_center/tutorials/controls-tutoria1.html
3. www.controlsystem.co.ml
4. www.facstaff.bucknell.edu/mastascu/econtro1html/Intro/intro1.html

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	3	2	1	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
Average	**2.6**	**1.8**	**1.3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester III

24BEEC304 DESIGN THINKING 2H - 1C

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

End Semester Exam:3 Hours

PREREQUISITES: NIL

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
- Identify the different phases of design thinking
- Plan for various product and service communication in design thinking
- Interpret the use of tools for the design process

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Explain the design thinking process, tools and theories. K2
- Identify the types of users and the requirements of customers. K3
- Examine the concepts of Prototyping and its testing. K4
- Analyze design thinking strategies in product and service design. K4
- Inspect the existing products by utilizing design thinking strategies. K3

UNIT 1 INTRODUCTION **6**

Understanding Design thinking and tools - Human-Centric Design Process - Design Thinking Process- DT Activity with case studies.

UNIT II EMPATHISE WITH USERS **6**

Five Whys - Needs of user - Types of user research -Customer Journey Mapping - Observational Research

UNIT III PROTOTYPING **6**

Ideas to presentable concepts - Scenario-based Prototyping – Testing prototypes - Usability and ergonomic testing - Rapid prototyping.

UNIT IV PRODUCT AND SERVICE DESIGN **6**

Product Design - Interaction Design- Service Design - Communication Design - Transportation Design.

UNIT V DESIGN AND INNOVATION **6**

DT For strategic innovations - Extreme Competition - Experience design - Standardization - Humanization - Creative Culture.

TOTAL HOURS: 30

SUGGESTED READINGS:

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.

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	1	1	1	-	3	-	2
CO2	3	2	1	-	-	-	-	2	1	1	-	3	-	2
CO3	3	2	2	1	-	2	1	2	2	2	-	3	-	2
CO4	3	3	2	1	-	2	1	2	2	2	-	3	-	2
CO5	3	3	2	1	-	2	1	2	2	2	-	3	-	2
Average	**2.8**	**2.2**	**1.6**	**1**	**-**	**2**	**1**	**1.8**	**1.6**	**1.6**	**-**	**3**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

Semester III

24BEEC341 ELECTRONIC CIRCUITS (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC244 ELECTRON DEVICES

i)THEORY

COURSE OBJECTIVES

The goal of this course is for students to

- To understand the biasing methods of BJT and MOSFET.
- To study the concepts of Small Signal amplifiers and its Frequency Analysis.
- To understand the analysis and design of feedback amplifiers, Oscillators and Large Signal Amplifiers.

COURSE OUTCOMES

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

- Compare the biasing circuit for BJT and MOSFET K2
- Apply Small signal amplifiers of BJT. K3
- Inspect the performance characteristics of BJT and MOSFET. K4
- Analyze the performance of feedback amplifiers and oscillators. K4
- Examine the different types of Large Signal and Tuned Amplifiers. K4

UNIT I BIASING OF DISCRETE BJT AND MOSFET 9

Introduction -DC Load line, operating point, various biasing methods for BJT-Design Stability-Bias compensation, Thermal stability, Design of biasing for JFET, Design of biasing for MOSFET.

UNIT II SMALL SIGNAL AMPLIFIERS 9

Small signal Analysis of Common Emitter-AC Load line, Voltage swing limitations, Common collector and common base amplifiers – Differential amplifiers- CMRR- Darlington Amplifier- Bootstrap technique - Cascaded stages - Cascode Amplifier -Small signal Analysis of MOSFET and JFET - BiMOS Cascode amplifier**.**

UNIT III FREQUENCY ANALYSIS OF BJT AND MOSFET AMPLIFIERS 9

Low frequency and Miller effect, High frequency analysis of CE and MOSFET CS amplifier, short circuit current gain, cut off frequency – fα and fβ unity gain and Determination of bandwidth of single stage and multistage amplifiers.

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Basic principles and types of feedback - Gain of an amplifier employing feedback - Effect of feedback (negative) on gain, stability, distortion and bandwidth of an amplifier. Types of feedback Topologies-Barkhausen criterion for oscillations - Different oscillator circuits - Tuned collector, Hartley Colpitts, phase shift, Wien's bridge, and crystal oscillator.

UNIT V LARGE SIGNAL AND TUNED AMPLIFIERS 9

Large Signal Amplifiers - Class A, Class B, Class AB, and Class C amplifiers, Series and parallel resonant circuits and bandwidth of resonant circuits, Tuned Amplifiers - Single and double tuned amplifiers - Stagger tuned amplifiers –Stability of tuned amplifiers

TOTAL HOURS:45

(ii) LABORATORY

LIST OF EXPERIMENTS:

1. Differential Amplifiers- Transfer characteristic, CMRR Measurement
2. Frequency Response of CE amplifier
3. RC and LC Oscillator
4. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance.
5. Single Tuned Amplifier

TOTAL HOURS:30

SUGGESTED READINGS

1. Milmam and Halkias, "Integrated Electronics", TMH, 2017.
2. Donald.A. Neamen, Electronic Circuit Analysis and Design –2 nd Edition,Tata Mc Graw Hill, 2009.
3. Adel S. Sedra and Kenneth C.Smith, "Microelectronic Circuits", Oxford University Press, 7th

Edition, 2017.

4. Christos C. Halkias, Satyabrata Jit, Jacob Millman, "Electronic Devices and Circuits" 4th Edition 2015.
5. Balbir Kumar and Shail B. Jain," Electronic Devices and Circuits", Kindle eBook 2014.
6. Sedra and Smith, "Microelectronic Circuits", Oxford University Press, 6th Edition, 2010.
7. Bogart," Electronic Devices and Circuits", Pearson – 2011

WEB REFERENCES

1. https://circuitdigest.com/electronic-circuits
2. https://www.elprocus.com/simple-electronic-circuits-for-beginners/

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO2	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO3	3	3	2	1	-	-	-	-	-	1	-	2	3	1
CO4	3	3	2	1	-	-	-	-	-	1	-	2	3	1
CO5	3	3	2	1	-	-	-	-	-	1	-	2	3	1
Average	**2.8**	**2.4**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2.8**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester III

24BEEC342	**OOPS AND JAVA (THEORY & LABORATORY)**	**5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

PREREQUISITE: 24BECC143 PROGRAMMING IN C

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is to:

- Learn the fundamental concepts of Java programming
- Acquire the knowledge of inheritance, abstraction, exception and package in Java
- Obtain the knowledge of Java Collection API, Multithreading, JDBC and Lambda expression in Java

COURSE OUTCOMES:

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

- Infer the fundamental concepts, architecture, and features of Java Programming K2
- Solve programming challenges using object-oriented paradigms K3
- Build applications using multi-tasking mechanisms, and exception handling strategies K3
- Construct robust and efficient Java applications using JDBC, lambda expressions and interface K3
- Develop Java applications by amalgamating object-oriented design, collection usage and advanced data manipulation.

UNIT I INTRODUCTION TO JAVA 9

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 9

Inheritance – Types of Inheritance – Super and Sub Classes – super keyword – final class and methods – Object class –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 **9**

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

UNIT IV COLLECTION API AND LAMBDA **9**

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 – Functional Interfaces – Lambda Expressions – Accessing local variables – Accessing class variables – Predicates – Functions – Suppliers – Consumers – Stream API – Filter – Sorted – Map – Reduce – Count – Parallel Streams.

UNIT V JDBC AND MULTITHREADING **9**

JDBC – Introduction to JDBC – Establishing connection – Executing query – Processing results – Prepared Statement – Callable Statement – Transactions – Meta Data objects – Multithreading: Introduction to Multithreading – Process Vs Thread –Thread life cycle – Thread class – Runnable Interface – Thread creation – Thread control and priorities – Thread synchronization.

TOTAL: 45

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Develop programs using flow control statements and arrays to manage execution flow and data organization effectively.
2. Implement programs using inheritance and polymorphism to promote code reusability and dynamic method binding.
3. Develop programs incorporating packages, abstract classes, and interfaces to structure code modularly and enforce abstraction.
4. Implement programs using exception handling mechanisms to ensure robust error detection and graceful recovery.
5. Create programs using the Collection API and lambda expressions to manage groups of objects with flexibility and high performance.
6. Implement programs using JDBC to establish and manage database connections for data persistence and retrieval.
7. Develop programs using multithreading to achieve concurrent execution and improve application performance.

TOTAL: 30

TEXT BOOKS:

1. Herbert Scheldt, " Java: The Complete Reference", 12th edition, Tata McGraw-Hill, 2022.
2. Cay S Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals", 12th edition, Prentice Hall, 2021.

REFERENCE BOOKS:

1. David Flanagan and Benjamin Evans, "Java in Nutshell", 8th edition, O'Reilly Media, 2022.
2. Kathy Sierra, Bert Bates, Trisha Gee, "Head First Java ", 3rd edition, O'Reilly Media, Inc, 2022.
3. Joshua Bloch, "Effective Java", 3rd Edition, Addison-Wesley Professional, 2018.

WEB REFERENCES:

1. www.https://docs.oracle.com/javase/tutorial/java/nutsandbolts
2. www. https://javabeginner.com/learn-java
3. www. https://dev.java/learn
4. https://www.w3schools.com/java/java_intro.asp

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	3
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-III

24BEEC343 MICROPROCESSORS AND MICROCONTROLLERS (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3, T:0, P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PREREQUISITES: 24BECC142 PROGRAMMING IN C

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is

- To comprehend the organization of registers, system bus and memory in basic computer architecture
- To impart knowledge about the architecture of Intel 8086 microprocessor, Intel 8051 microcontroller and ARM7TDMI Core, and interfacing of IO devices with Intel 8051
- To develop 8086 ALP, 8051 ALP and 8051 embedded C programming skills and Intel 8051 applications

COURSE OUTCOMES:

At the end of this course students will be able to

- Interpret the fundamentals of computer architecture and architecture of Intel 8086 microprocessor, Intel 8051 microcontroller and ARM7TDMI core. K2
- Develop 8086 ALP, 8051 ALP and 8051 embedded C code by using respective instruction sets and syntaxes K3
- Identify the suitable hardware and programming modules for the given specification K3
- Build interface schemes of basic IO devices, sensors and actuators with Intel 8051 K3
- Construct simple embedded applications using Intel 8051 K3

UNIT I INTRODUCTION TO COMPUTER ARCHITECTURE 9

Terminology: Microprocessor, Microcontroller and Microcomputer – Basic building blocks of a microprocessor – Memory mapping schemes – Outline to computer architectures and comparisons: Von Neumann, Harvard, CISC and RISC – Data flow path – Polling and Interrupt concept – DMA operation

– Software development tools.

UNIT II ARCHITECTURE OF INTEL 8086 MICROPROCESSOR 9

Intel 8086 microprocessor: Features, Architecture, CPU signals, 2-stage Pipeline, Memory segmentation, Registers, Logical and physical address, Physical address generation, memory banking concept, addressing modes, Instruction set, 8086 Assembly Language Program.

UNIT III ARCHITECTURE OF INTEL 8051 9

Intel 8051 microcontroller: Features, Functional block diagram and control signals – External program memory and data memory interfacing with 8051 – 8051 Internal RAM Memory organization and Memory mapping of Special Function Registers (SFRs) – 8051 Machine cycle – Addressing modes and Instruction set of Intel 8051 – 8051 Assembly Language Program (ALP).

UNIT IV PROGRAMMING OF 8051 PERIPHERALS 9

Working and Programming of 8051 peripherals using embedded C: IO Ports, Timer/Counter, Interrupt controller and full duplex UART – Power control modes: Idle mode and Power down mode –Architecture of ARM7TDMI Core – Operating modes.

UNIT V PROGRAMMING OF I/O DEVICES WITH 8051 9

Working, Interfacing and programming of basic IO devices: Monochrome LED, Tricolor LED, Push button switch, seven segment display, Matrix keyboard – Working, Interfacing and programming of basic sensors and actuators: Temperature sensor, LDR sensor, Ultrasonic sensor, Relay ON/OFF control, Buzzer, Stepper motor and Servo motor – 8051 applications: Speed control of DC motor, Automatic Street light control system, RFID based attendance system.

TOTAL HOURS: 45

ii) LABORATORY

EXPERIMENTS:

1. 8086 Assembly Language Programs: Addition, Subtraction, Multiplication and division
2. 8086 Assembly Language Programs: String manipulations, BIOS Interrupt call
3. 8051 Assembly Language Programs: Addition, Subtraction, Multiplication and division
4. 8051 Embedded C Program: Interfacing of Switch, LED and Buzzer with 8051

5. 8051 Embedded C Program: 8051 Serial UART programming
6. Stepper motor control using 8051 microcontrollers
7. Temperature monitoring and control using 8051 microcontrollers with ADC0809

TOTAL HOURS: 30

SUGGESTED READINGS:

1. Muhammad Ali Mazidi, Janice G.Mazidi, Rolin, D.McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson Education Limited, 2019.
2. Douglas V Hall, "Microprocessors and Interfacing", 3rd edition, Tata McGraw Hill Education, 2017.
3. Muhammad Tahir, Kashif Javed, "ARM Microprocessor Systems", 1st Edition, CRC Press, 2017.
4. Soumitra Kumar Mandal, "Microprocessors and Microcontrollers Architecture, Programming and Interfacing Using 8085, 8086 and 8051", 3rd Edition, Tata McGraw Hill Education, 2017.
5. Krishna Kant, "Microprocessors and Microcontrollers – Architecture, Programming and system design 8085, 8086, 8051, 8096" 2nd Edition, PHI Learning Private Limited, 2014.

WEB REFERENCES:

1. https://edge.edx.org/c4x/BITSPilani/EEE231/asset/8086_family_Users_Manual_1_.pdf
2. https://web.mit.edu/6.115/www/document/8051.pdf
3. https://www.microchip.com/en-us/

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester III

24BEMC351 APTITUDE AND REASONING 1H - 0C

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

End Semester Exam:3 Hours

PREREQUISITES: NIL

COURSE OBJECTIVES:

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

- Interpret the basic concepts of quantitative ability K2
- Illustrate the basic concepts of logical reasoning Skills K3
- Acquire satisfactory competency in the use of reasoning K3
- Solve campus placements aptitude papers covering Quantitative Ability, Logical K3
- Gain Reasoning Ability Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc. K2

UNIT - I 1. Quantitative Ability (Basic Mathematics) 5

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 2. Quantitative Ability (Applied & Engineering Mathematics) 5

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 3. Verbal – Aptitude 5

1.1 Words

1.2 Idioms

1.3 Phrases in Context

1.4 Reading comprehension techniques

1.5 Narrative sequencing

1.6 Data interpretation

TOTAL HOURS:15

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 REFERENCES

1. https://prepinsta.com/
2. https://www.indiabix.com/
3. https://www.javatpoint.com/

Semester III

24BEEC391 INTERNSHIP I /MINI PROJECT I 2H - 1C

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for students is

- To bridge the gap between academia and industry in providing an industry exposure for satisfying local industrial needs.
- To enable the students to get connected with Industry / Laboratory / Research Institute.
- Get practical knowledge on production process in the industry and develop skills to solve related problems.
- Develop skills to carry out research in the research Institutes / Laboratories.
- To learn the design methodologies and documentation process.

COURSE OUTCOMES:

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

- Apply the acquired knowledge on various tools used in industry. K3
- Examine technological advancement happening in industry. K4
- Analyse System-level design processes, verification and validation techniques, manufacturing and production processes in the firm or research facilities in the Laboratory/Research Institute. K4
- Analyse of industrial / research problems and their solutions. K4
- Make use of documentation of system specifications, design methodologies, process parameters, testing parameters and results and preparing of technical report and presentation. The students individually undergo training in reputed Firms/ Research Institutes / Laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. K4

TOTAL HOURS :30

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	1	1	1	-	3	-	2
CO2	3	3	2	2	-	-	-	2	1	1	-	3	-	2
CO3	3	3	2	2	-	2	1	2	2	2	-	3	-	2
CO4	3	3	2	2	-	2	1	2	2	2	-	3	-	2
CO5	3	2	1	1	-	2	1	2	2	2	-	3	-	2
Average	**3**	**2.6**	**1.6**	**1.75**	**-**	**2**	**1**	**1.8**	**1.6**	**1.6**	**-**	**3**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC401	ELECTROMAGNETIC FIELDS	4H-4C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC302 SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

The goal of this course for students is

- Gain knowledge on the fundamental concepts, units, and definitions related to electromagnetic fields and waves, such as electric and magnetic flux densities, electric field intensity, magnetic field intensity, and key laws
- Perform basic calculations involving static electric and magnetic fields, including computing electric fields due to various charge distributions, magnetic fields due to current-carrying conductors, and simple capacitance and inductance values.
- Recognize different coordinate systems (rectangular, cylindrical, spherical) and apply basic operations such as converting between coordinate systems, and computing the gradient, divergence, and curl of vector fields.

COURSE OUTCOMES:

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

- Apply vector calculus operations, Divergence theorem and Stokes' theorem to solve problems in electromagnetics. K3
- Apply Coulomb's law and Gauss's law to calculate the electric field due to various charge distributions and determine the capacitance of different capacitor configurations. K3
- Identify the magnetic field intensity using Biot-Savart's law and Ampere's circuital law for different geometries and determine self and mutual inductance. K3
- Interpret Maxwell's equations in both integral and differential forms and solve the wave equations for electric and magnetic fields in free space. K2
- Apply the principles of wave propagation, reflection, refraction, polarization, and Poynting's theorem to determine the behavior of plane electromagnetic waves in different media and compute related parameters such as intrinsic impedance, propagation constant, and skin depth. K3

UNIT I VECTORS ANALYSIS **12**

Sources of Electromagnetic fields - Electromagnetic model, Units and constants - Scalar and Vector fields –Vector Calculus - Introduction to co-ordinate systems: Rectangular, Cylindrical and Spherical coordinate systems - Conversion of coordinate systems – Definitions of line – Surface and Volume Integrals – Gradient of a scalar field – Divergence of a vector field - Curl of a vector field – Divergence theorem - Stokes' theorem.

UNIT II STATIC ELECTRIC FIELD **12**

Coulomb's Law: vector form – Principle of Superposition - Gauss law and its application: Infinite line of charge and Infinite sheet of charge- Electric potential due to point charge and electric dipole - Electric flux density -– Electrostatic boundary condition - Capacitance – Parallel capacitors – Cylindrical capacitors – Spherical capacitors –Poisson's and Laplace's equations.

UNIT III STATIC MAGNETIC FIELD **12**

Lorentz force equation - Biot-Savart's law and Ampere's circuital law – Magnetic field intensity on an infinite line - along the axis of a circular loop – along the axis of a rectangular coil and Square - Magnetic flux density (B) –Boundary conditions –Inductance: Self and Mutual Inductance, Inductance of solenoid, Inductance of toroid, Inductance of coaxial cable and Inductance of transmission line.

UNIT IV TIME-VARYING FIELDS AND MAXWELL EQUATIONS **12**

Faraday's law of electromagnetic induction - Lenz's law - Displacement current - Integral and differential forms of Maxwell's equation for Ampere's law - Faraday's law – Gauss's law for electrostatic field - Gauss's law for magnetostatic field - Electromagnetic boundary conditions - Wave equation for free space in terms of electric filed - Wave equation for free space in terms of magnetic field.

UNIT V PLANE ELECTROMAGNETIC WAVES **12**

Wave parameters: velocity, intrinsic impedance, propagation constant –Plane waves and properties:

reflection and refraction, polarization, phase and group velocity, skin depth and Brewster angle Plane waves in lossless media, Plane waves in lossy dielectrics medium - Plane waves in lossy media good conductors - Pointing theorem, instantaneous average and complex pointing vector.

TOTAL: 60 PERIODS

SUGGESTED READINGS:

1. William H Hayt, "Engineering Electromagnetics", 9th Edition, Tata McGraw Hill, 2021.
2. Ryder J D, "Networks, Lines and Fields", 8th Edition, Prentice Hall of India (PHI) Learning, 2020.
3. D.K. Cheng, Field and wave electromagnetics, 2nd edition, Pearson (India), 2014.
4. Ghosh S and Lipika Datta, "Electromagnetic field Theory", 5th Edition, Tata McGraw Hill, 2022.
5. Jordan E C and Balmain K G, "Electromagnetic Waves and Radiating Systems", 7th Edition, Prentice Hall of India (PHI) Learning, 2021.
6. Mathew N. O. Sadiku, "Electromagnetic Theory", 8th Edition, Prentice Hall of India (PHI) Learning, 2022.
7. Clayton R Paul, "Introduction to Electromagnetic fields", 9th Edition, Tata McGraw Hill, 2021.
8. B Somanathan Nair, "Transmission Lines and Wave guides", 8th Edition, Sanguine Technical Publishers, 2021

WEB REFERENCES:

1. http://freevideolectures.com/course/2340/electromagnetic-fields
2. http://www.infocobuild.com/education/audio-video-courses/physics/IntroToElectromagnetism-IIT-Kanpur/lecture-33.html
3. http://www.infocobuild.com/education/audio-video-courses/electronics/electromagnetic-fields-iit-madras.html

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	1	-	1	2	1
CO2	3	2	1	-	-	-	-	-	-	1	-	1	2	1
CO3	3	2	1	-	-	-	-	-	-	1	-	1	2	1
CO4	3	2	1	-	-	-	-	-	-	1	-	1	2	1
CO5	2	2	1	-	-	-	-	-	-	1	-	1	2	1
Average	**2.8**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC441	DIGITAL SIGNAL PROCESSING (THEORY & LABORATORY)	5H-4C

Instruction Hours/week: L:3, T:0, P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC302 SIGNALS AND SYSTEMS

(i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is

- To study discrete Fourier, transform and its applications.
- To design IIR and FIR Filter
- To learn the effect of finite word length and Processors.

COURSE OUTCOMES:

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

- Apply DFT and FFT for the analysis of digital signals and systems K3
- Design and realize IIR filter K4
- Design FIR digital filters and realization of it K4
- Utilize the effects of word length for designing filters K3
- Illustrate architecture of DS processors and its applications K2

UNIT I DISCRETE FOURIER TRANSFORM **9**

Discrete Fourier Transform (DFT) - Properties of DFT - Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Radix-2 Decimation-in- frequency (DIF) Fast Fourier transform (FFT). Filtering long data sequences - overlap save and overlap add method.

UNIT II IIR FILTER DESIGN **9**

Characteristics of practical frequency selective filters, Characteristics of commonly used analog filters - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations

UNIT III FIR FILTER DESIGN **9**

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

UNIT IV FINITE WORD LENGTH EFFECTS **9**

Fixed point and floating-point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

UNIT V DIGITAL SIGNAL PROCESSORS **9**

Introduction to Commercial Digital Signal Processors- Architecture- addressing mode- Features – Applications of DSP and Applications of DSP processors in Smart phones.

TOTAL HOURS: 45

(ii) LABORATORY

LIST OF EXPERIMENTS:

Simulation Using MATLAB / Equivalent Software Package

1. Generation of Signals and Calculation of FFT
2. Linear and circular convolution of two sequences
3. Design of Butterworth IIR filters.
4. Design of Chebyshev IIR filters
5. Design of FIR filters using windows
6. Waveform Generations and Arithmetic Operations Using TMS Processor

TOTAL HOURS: 30

SUGGESTED READINGS:

1. S.K.Mitra, Digital Signal Processing: A computer basedapproach.TMH,2019.
2. A.V.Oppenheim and Schafer, Discrete Time Signal Processing,3rd edition, Prentice Hall, 2009.
3. John G.Proakis and D.G.Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Pearson Education, 4/e, 2007.
4. Emmanuel C.Ifeachor, "Digital Signal Processing A Practical Approach"2nd edition, Pearson Education, 2011.
5. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall,2018.
6. B.Venkataramani M Bhaskar, Digital Signal Processors, McGrawHillEducation,2019.

WEB REFERENCES:

1. https://www.coursera.org/learn/dsp
2. https://www.tutorialspoint.com/digital_signal_processing/index.htm.

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO2	3	3	2	1	-	-	-	-	-	1	-	2	3	1
CO3	3	3	2	1	-	-	-	-	-	1	-	2	3	1
CO4	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO5	2	1	-	-	-	-	-	-	-	1	-	2	2	1
Average	**2.8**	**2.2**	**1.5**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2.8**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC442 ANALOG INTEGRATED CIRCUITS (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3, T:0, P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITE24BEEC341 ELECTRONIC CIRCUITS

(i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is

- To Illustrate the IC fabrication procedure.
- To Understand the applications of Op-amp.
- To Categorize the Functional blocks and the applications of special ICs.

COURSE OUTCOMES:

At the end of this course students will be able to

- Explain the IC fabrication methods, types of monolithic IC techniques and packing procedures. K2
- Outline the biasing techniques and load configurations for IC MOSFET amplifiers. K2
- Construct OP-amp based amplifiers, signal conditioning circuits and conversion circuits. K3
- Illustrate the characteristics and key features of 555 Timer, IC-566 VCO, and IC-565 PLL. K2
- Summarize the operation of IC based power management and voltage regulation circuits. K2

UNIT I IC FABRICATION 9

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Metallization and PV Cell.

UNIT II BASICS OF OPERATIONAL AMPLIFIERS 9

Ideal OP-AMP characteristics, General operational amplifier stages -and internal circuit diagrams of IC 741, DC characteristics, AC characteristics, frequency response of OP-AMP, slew rate, IC biasing Current steering circuits for IC amplifiers- current mirrors, - current sources- PMOS and NMOS current sources, Cascade current source, Widlar current source. Amplifier with resistive load, active Load-Depletion load, current source load, Differential amplifiers with active load.

UNIT III OPERATIONAL AMPLIFIERS AND ITS APPLICATIONS 9

Basic applications of op-amp – Inverting and Non-inverting Amplifiers-V/I & I/V converters, Voltage

Follower, summer, subtractor, differentiator and integrator. Instrumentation amplifier, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters, S /H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using OP-AMPs.

UNIT IV SPECIAL ICs **9**

Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage-controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs.

UNIT V APPLICATION ICs **9**

AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variability voltage regulators, switching regulator- SMPS – ICL 8038 function generator IC.

TOTAL HOURS: 45

(ii) LABORATORY

LIST OF EXPERIMENTS:

1. Inverting, non-inverting and differential amplifiers.
2. Active Low Pass and Band Pass filter.
3. Clippers and Clampers
4. Schmitt Trigger using op-amp.
5. Astable and Monostable using NE555 Timer
6. Simulation of Experiments 2,5 using PSpice / MultiSim

TOTAL HOURS: 30

SUGGESTED READINGS:

1. David A. Bell, ‘Op-amp & Linear ICs’, Oxford, Third Edition, 2011
2. D. Roy Choudhary, Sheil B. Jani, ‘Linear Integrated Circuits’, New Age, Fourth Edition, 2018.
3. Ramakant A.Gayakward, ‘Op-amps and Linear Integrated Circuits’, IV edition, Pearson Education, PHI 2021.
4. J. Millman and A. Grabel, “Microelectronics”, 2nd edition, McGraw Hill, 2017.
5. Ramakant A.Gayakwad, “Op-Amps and Linear Integrated Circuits, Prentice Hall of India, New Delhi, 2015.

6. P. Horowitz and W. Hill, “The Art of Electronics”, 2nd edition, Cambridge University Press,2006.
7. A.S. Sedra and K.C. Smith, “Microelectronic Circuits”, Oxford University Press, Incorporated, Edition IV, 2019.

WEB REFERENCES:

1. https://archive.org/details/ApplicationsOfOperationalAmplifiers3rdGenerationTechniques
2. http://ocw.mit.edu/resources/res-6-010-electronic-feedbacksystems-spring-2013/textbook/
3. http://www.nptel.ac.in/courses/117106088/1
4. http://analogcorner.net/
5. https://nptel.ac.in/courses/117101106/

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

Semester-IV

24BEEC443	WEB PROGRAMMING (THEORY & LABORATORY)	5H-4C

Instruction Hours/week: L:3, T:0, P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITES: Nil

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Understand the principles of web design
- Acquire basic knowledge of HTML elements, CSS and various layouts for styling a web page
- Understand designing interactive web pages using JavaScript and Bootstrap

COURSE OUTCOMES:

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

- Outline the components for web development K2
- Demonstrate structural aspects of HTML, CSS and JavaScript for interactive web pages K2
- Apply CSS and layouts for styling web pages K3
- Build dynamic web pages using JavaScript K3
- Develop responsive web pages by using Bootstrap framework K3

UNIT I ESSENTIALS OF WEB DESIGN AND HTML 9

Web design – Internet versus the web – Web browsers – Design process – Design principles – HTML – Document structure – Paragraphs – Headings – Lists – iFrame – div – span – Hyperlinks – Adding images – Table markup – Forms – HTML5 Advanced Elements – Embedded media.

UNIT II CASCADING STYLE SHEETS 8

CSS – Units of measurement – Formatting text with css3 – Colors and backgrounds – Padding – Borders – Margins – Floating and positioning – CSS layout with flexbox and grid - CSS Animations and Transitions – Responsive Design with Media Queries.

UNIT III DYNAMIC WEB PAGES USING JAVA SCRIPT 9

JavaScript – JavaScript Fundamentals – Variables – Data types – Operators – Control Structures – Functions – Function expressions – Arrow functions – Objects – Object methods – Constructor – Strings – Arrays – Array methods – Destructuring – JSON – Error handling – Closures

UNIT IV ADVANCED JAVASCRIPT CONCEPTS 8

Browser object – Events – DOM – Promises – Callbacks – Promises chaining – Promise API – Fetch API – Async/await – Modules – Export and Import – Polyfills – JavaScript libraries : jQUERY.

UNIT V RESPONSIVE WEB DESIGN USING BOOTSTRAP 8

Bootstrap – Setting up bootstrap – Structuring web page using bootstrap – Grid system – Typography – Tables – Forms – Images – Effects – Icons – Components

CONTEMPORARY TOPICS 3

TOTAL: 45

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Develop static web pages using HTML.
2. Create an HTML-based web page to demonstrate the use of inline, internal, and external CSS.
3. Develop web pages using HTML and CSS Flexbox.
4. Create dynamic web pages using JavaScript.
5. Implement a web page that includes JavaScript code to demonstrate arrays, strings, and JSON.
6. Write JavaScript code to work with Promises, Async/Await, and Modules.
7. Develop a responsive website using Bootstrap components.

TOTAL: 30

TEXT BOOKS:

1. Jennifer Niederst Robbins, “Learning Web Design”, 5th Edition, O’Reilly Media, Inc, 2018.
2. Jorg Krause, “Introducing Bootstrap 4”, 2nd Edition, A press Media LLC, 2020.

REFERENCE BOOKS:

1. Jason Beaird, James George and Alex Walker, "The Principles of Beautiful Web Design", 4th Edition, Site Point Pty. Ltd., 2020.
2. Ben Frain, "Responsive Web Design with HTML5 and CSS", 3rd Edition, Packt Publishing, 2020.
3. Sufyan bin Uzayr, "Mastering Bootstrap A Beginner's Guide", 1st Edition, CRC Press, 2022.

WEB REFERENCES:

1. www.w3schools.com/html/
2. www.udacity.com/course/responsive-web-design-fundamentals--ud893
3. www.getbootstrap.com/docs/4.6/getting-started/introduction/

CO, PO, PSO Mapping

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC444 EMBEDDED SYSTEMS AND IOT (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3, T:0, P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PREREQUISITE: 24BEEC343 MICROPROCESSORS & MICROCONTROLLERS

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is

- To study and familiarize the fundamental concepts of real time operating system
- To learn the architecture of embedded microcontrollers embedded design processes and embedded applications
- To apply the knowledge of serial communication protocols and internet of things

COURSE OUTCOMES:

At the end of this course students will be able to

- Outline the architecture & functional flow of Embedded Systems K2
- Explain the concepts of Cortex M3 Microcontroller K2
- Utilize the various protocols used for serial data communication applications K3
- Develop an RTOS based (framework) application for embedded systems K3
- Apply the knowledge gained for Programming ARM Cortex M3 for different applications K3

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS AND INTERNET OF THINGS 9

Introduction to Embedded systems: Definition – Classifications – Real Time Systems – Classifications – General Purpose computing systems vs Embedded systems – Design Metrics – Components of Embedded systems: Reset Circuit - Brown-out Protection Circuit - Oscillator Unit - Real Time Clock - Watchdog Timer, Introduction to IoT: Overview of IoT - architecture – Facilitating Technologies – Communication.

UNIT II STUDY OF CORTEX M3 MICROCONTROLLER 9

Overview of Cortex-M3- Cortex-M3 Basics: Registers- Operation Modes - Exceptions and Interrupts - Vector Tables - Stack Memory Operations - Reset Sequence-Pipeline - Block Diagram, Bus Interfaces on Cortex-M3: I-Code Bus - D-Code Bus - System Bus - External PPB - DAP Bus.

UNIT III COMMUNICATION STANDARDS AND PROTOCOLS 9

Serial wired communication standards and protocols: SCI - I2C - SPI - RS485- USB and CAN Bus, PC Parallel port programming, Wireless Protocols: Wi-Fi – Bluetooth - BLE - NFC.

UNIT IV REAL TIME OPERATING SYSTEM 9

Overview of RTOS: scheduler –dispatcher - objects - services - characteristics of an RTOS- hard real time and soft real time - difference between general purpose OS and RTOS - Task - Threads – Multi tasks and multi processes – Context Switching – Operating Systems Scheduling policies - Inter Process Communication - Synchronization mechanisms.

UNIT V DESIGN METHODOLOGIES AND CASE STUDIES 9

Overview of Design Methodologies – Testing and debugging Methodologies – Applications and Case study of embedded systems (Vending Machine, Digital camera, Fitness Bands, Elevator Control system, Biometric authentication system, RFID).

TOTAL HOURS: 45

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Interfacing of LED and Switch with ARM Cortex M-microcontroller
2. Interfacing Relay and Buzzer with ARM Cortex M-microcontroller
3. Interfacing a 4x4 matrix keypad with ARM Cortex M-microcontroller
4. Interfacing of Temperature Sensor and LDR with ARM Cortex M-microcontroller
5. Generate PWM and vary its duty cycle using the internal PWM module of ARM Cortex-M controller
6. Demonstrate the use of an external interrupt to toggle an LED ON/OFF
7. Interfacing of RFID using ARM Cortex M-microcontroller

TOTAL HOURS: 30

SUGGESTED READINGS:

1. Rajkamal,"Embedded Systems –Architecture, Programming and Design", 3rd Edition, Tata McGraw Hill, 2017.
2. Alexander G Dean,"Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach", 2nd Edition, Arm Education Media,2021.
3. Daniel W. Lewis, "Fundamentals Of Embedded Software With The Arm Cortex - M3", 2nd Edition, Pearson,2015
4. Peckol, James K.," Embedded Systems-A Contemporary Design Tool", 2nd Edition, Wiley & Sons Ltd, 2019.
5. Sriram V Iyer,Pankaj Gupta, :Embedded Real time Systems Programming" ,1st Edition, Tata McGraw Hill, 2017.

WEB REFERENCES:

1. https://archive.nptel.ac.in/courses/106/105/106105193/
2. https://documentation-service.arm.com/static/62053c120ca305732a3a5c14?token=
3. www.arm.com/products/silicon-ip-cpu?families=cortex-m&showall=true

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	-	1	-	1	2	1
CO2	2	1	-	-	2	-	-	-	-	1	-	1	1	1
CO3	3	2	1	-	2	-	-	-	-	1	-	1	1	1
CO4	3	2	1	-	2	-	-	-	-	1	-	1	2	1
CO5	3	2	1	1	2	-	-	-	-	1	-	1	2	1
Average	**2.6**	**1.8**	**1.3**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1.6**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC411	ROBOTICS	2H-1C
Instruction Hours/week: L:0 T:0 P:2	**Marks:** Internal**:100** External**:0** Total**:100**	

COURSE OBJECTIVES:

The goal of this course for students is

- To learn the various programming languages used in robotics.
- To create effective robotic programs in motion Interpolation.
- To identify the robots for different applications.

COURSE OUTCOMES:

At the end of this course students will be able to

- Explain the basic programming used in robotics K2
- Analyze the function of sensors in the robot K4
- Design robots for different applications K4
- Apply suitable robotic programs in motion interpolation K3
- Understand the economic impact of integrating robots into manufacturing and other systems K2

UNIT I FUNDAMENTALS OF ROBOTICS 10

Elements of robots -- joints, links, actuators, and sensors, Introduction to programming, On-line and off-line programming, programming examples, Various Teaching Methods, Survey of Robot Level Programming Languages

UNIT II ROBOT PROGRAMMING 10

Robot Program as a Path in Space, Motion Interpolation, various Textual Robot Languages, Typical Programming Examples such as Palletizing, Loading a Machine Etc.

UNIT III ROBOT APPLICATIONS 10

Robots in manufacturing and non- manufacturing applications, a robot-based manufacturing system, robot cell design considerations and selection of robot, Robot Economics, Functional Safety in Robotic Application.

TOTAL HOURS: 30

SUGGESTED READINGS:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 1999.
2. Bijoy K. Ghosh, T. J. Tarn, Ning X, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 2011.
3. Deb.S.R., Robotics technology and flexible Automation, John Wiley, 2010.
4. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
5. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
6. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
7. Issac Asimov I Robot, Ballantine Books, New York, 1986.

WEB REFERENCES:

1. https://doc.lagout.org/science/0_Computer%20Science/8_Electronics%20%26%20Robotics/Robotics%20and%20Automation%20Handbook.pdf
2. https://swayam.gov.in/nd1_noc20_me03/preview

24BEEC412 COMMUNITY ENGAGEMENT AND SOCIAL RESPONSIBILITY 4H-2C

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

PRE-REQUISITE: Nil

COURSE OBJECTIVES:

The goal of this course is for students to:

- Achieve socio economic development through active community engagement.
- Improve the quality of both teaching and research for better understanding of issues in the society.

COURSE OUTCOMES:

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

- Explain the role of community engagement in the development of the nation.
- Understand the social problems, social contribution of community networking and various government schemes supporting the community engagement.
- Understand the role of Indian citizens towards community development by adopting a village and carrying out the field work

UNIT I INTRODUCTION **5**

Concept, Ethics and Spectrum of Community engagement- Local Community-Appreciation of rural society-Rural and local economy and livelihood – Rural development programs and Rural

UNIT II SOCIAL PROBLEMS **5**

Inequality in America- The Working Poor and Hunger- Homelessness- Inequity in Education- Racism- Crime and Punishment- Refugees and Immigration- Social contribution of community networking-Contribution of self-help groups- Various government schemes

UNIT III FIELD WORK **20**

Spreading awareness about the electrical safety, government schemes in renewable energy, Skill development for employment opportunities.

Total : 30 hours

TEXT BOOKS:

1. Principles of Community Engagement, 2nd Edition, NIH Publication No. 11-7782, Printed June 2011

WEB SITES:

1. https://onlinecourses.swayam2.ac.in/ugc23_ge04/preview

Semester IV

24BEMC451	FOUNDATION OF ENTREPRENEURSHIP	1H - 0C

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

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
- Develop 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

- Interpret entrepreneurial competence to run the business efficiently. K2
- Undertake businesses in the entrepreneurial environment K3
- Prepare business plans and undertake feasible projects. K3
- Be efficient in launching and develop their business ventures successfully K3
- Monitor the business effectively towards growth and development K3

UNIT I ENTREPRENEURIAL COMPETENCE 5

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful Entrepreneurs – Knowledge and Skills of an Entrepreneur.

UNIT II ENTREPRENEURIAL ENVIRONMENT 5

Business Environment - Role of Family and Society - Entrepreneurship Development

UNIT III BUSINESS PLAN PREPARATION 5

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product – Ownership.

TOTAL HOURS:15

SUGGESTED READINGS

1. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, NewDelhi, 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.

Semester IV

24BEMC452 ESSENCE OF TRADITIONAL INDIAN KNOWLEDGE AND HERITAGE 1H - 0C

Instruction Hours/week: L:1 T:0 P:0 **Marks:** 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 K2
- Infer the need of cultural unity K2
- Know the Dravidian culture K2
- Realize the power of the Indian educational system called gurukul K2
- Come to know the concepts of Vedic thought K2

UNIT I INTRODUCTION TO INDIAN THOUGHT AND CULTURE 5

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 5

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

UNITIII PROTECTION OF TRADITIONAL KNOWLEDGE 5

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, the value of TK in the global economy, Role of Government to harness TK.

TOTAL HOURS:15

SUGGESTED READINGS:

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.

Semester V

24BEEC501 TRANSMISSION LINES AND WAVEGUIDES 4H - 4C

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

End Semester Exam: 3 Hours

PRE-REQUISITE: 24BEEC401 ELECTROMAGNETIC FIELDS

COURSE OBJECTIVES:

The goal of this course for students is:

- To introduce the various types of transmission lines and to discuss the losses associated.
- To give thorough understanding about impedance transformation and matching.
- To impart knowledge on filter theories and waveguide theories

COURSE OUTCOMES:

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

- Illustrate the propagation of signals through transmission lines. K2
- Analyze signal propagation at Radio frequencies. K4
- Explain radio propagation in guided systems. K2
- Analyze the Various types of Filters K4
- Utilize cavity resonators. K3

UNIT I TRANSMISSION LINE THEORY 12

General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading and different methods of loading - Line not terminated in Z0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short-circuited lines - reflection factor and reflection loss.

UNIT II HIGH FREQUENCY TRANSMISSION LINES 12

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short-circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES **12**

Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

UNIT IV PASSIVE FILTERS **12**

Characteristic impedance of symmetrical networks – filter fundamentals, Design of filters: Constant K – Low Pass, High Pass, Band Pass, Band Elimination, m- derived sections – low pass, high pass composite filters.

UNIT V WAVE GUIDES AND CAVITY RESONATORS **12**

General Wave behaviours along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves between parallel plates, TM and TE waves in rectangular wave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides, Rectangular and circular cavity Resonators.

TOTAL:60 PERIODS

SUGGESTED READINGS

1. John D Ryder, “Networks, lines and fields”, 2nd Edition, Prentice Hall India, 2010.
2. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006.
3. G.S.N Raju "Electromagnetic Field Theory and Transmission Lines" , Pearson Education, First edition 2005

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	1	-	1	2	1
CO2	3	3	2	1	-	-	-	-	-	1	-	1	2	1
CO3	2	2	-	-	-	-	-	-	-	1	-	1	2	1
CO4	3	3	2	1	-	-	-	-	-	1	-	1	2	1
CO5	3	2	1	-	-	-	-	-	-	1	-	1	2	1
Average	**2.6**	**2.40**	**1.67**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**-**	**1.00**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

Semester-V

24BEEC541	**INDUSTRIAL AUTOMATION (THEORY & LABORATORY)**	**5H-4C**

Instruction Hours/week: L:3 T:0 P:02 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC444 EMBEDDED SYSTEMS AND IOT

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is:

- To provide knowledge on the basics, building blocks of virtual instrumentation.
- To learn the programming concepts of LabVIEW and perform the simulations of programs.
- To design a real time virtual instrumentation based industrial application.

COURSE OUTCOMES:

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

- Illustrate the concept of virtual instrumentation program K2
- Design virtual instrument using various programming functions K4
- Analyze the various sensor data and image K4
- Perform simulation of virtual instruments using different functions. K3
- Analyze case studies of virtual instrumentation based industrial automation K4

UNIT I INTRODUCTION TO INDUSTRIAL AUTOMATION 9

Introduction to Industrial Automation - Evolution of Virtual Instrumentation-Architecture of Virtual Instrumentation – Virtual instruments versus traditional Instruments – Role of hardware and software – Conventional and graphical Programming- advantages of LabVIEW–Data types – Data flow programming

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UNIT II VIRTUAL INSTRUMENTATION SOFTWARE 9

Components of LabVIEW- Creating and saving a VI - Front panel and block diagram Tool bar – Palettes — Creating and saving a Sub VI – Creating and saving an Express VI – Structures – Case structure – Sequence structures – Timed structures – Loops –Shift registers – Formula nodes – Local and global variables – Control timings- Waveform chart Arrays and array operations – Clusters and cluster functions – String and file I/O

UNIT III DATA ACQUISTION SYSTEM **9**

Concepts of data acquisition and signals types- Signal conditioning and grounding – Hardware and software configuration – Analog and digital I/O – Timers and counters – DAQ assistant and DAQmx – Selecting and configuring a data acquisition device - Components of computer-based measurement system-GPIB – Hardware and software – Instrument I/O assistant – VISA – Instrument drivers – Driver VI s – Serial Port Communication

UNIT IV IMAQ MACHINE VISION **9**

IMAQ Vision-Image Processing and Analysis-Particle Analysis – Machine Vision – Hardware and Software-Building a Complete Machine Vision System - Acquiring and Displaying Images With NO-IMAQ Driver Software – Image Processing tools and functions in IMAQ Vision – Motion control applications.

UNIT V CASE STUDIES **9**

PID Controller – Connect LabVIEW with PLC through OPC –Electrical Power Toolkit –Analysis Function-Power frequency-Magnitude of the supply voltage-Flicker-harmonic measurement of under-deviation and over-deviation parameters.

TOTAL HOURS: 45

(ii) LABORATORY

LIST OF EXPERIMENTS:

1. Simple program using different data types: numeric, Boolean and strings.
2. Programming using loops and Structures.
3. Programming on Arrays and clusters
4. Programming using charts and graphs.
5. Programming with SubVI and Express VI.
6. Real time voltage current, power measurement of lamp load using USB 6009 DAQ.

TOTAL HOURS: 30

SUGGESTED READINGS:

1. Jovitha Jerome, 'Virtual Instrumentation UsingLabVIEW", Prentice Hall of India, 2018.
2. Behzad Ehsani," Data Acquisition using LabVIEW", PACKT PublishingLtd, 2016.
3. Yik Yang, LabVIEW Graphical Programming Cookbook, PACKT PublishingLtd, 2014
4. Surekha P, Sumathi S,, "Virtual Instrumentation UsingLab VIEW", Acme Learning ,2016
5. Sanjay Gupta, "Virtual Instrumentation UsingLab VIEW", B S Publications,Hyderabad. ,2010

WEB RFERENCES:

1. https://www.test-and-measurement-world.com/Terminology/Difference-between-Traditional-Instrument-and-Virtual-Instrument
2. https://www.ni.com/en/support/documentation/supplemental/08/labview-for-loops-and-while-loops
3. https://www.ni.com/en/shop/compactrio/what-are-compactrio-controllers/machine-vision-and-image-processing-with-compactrio

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	2
CO2	3	3	2	1	-	-	-	-	-	-	-	1	-	2
CO3	3	3	2	1	-	-	-	-	-	-	-	1	-	2
CO4	3	3	2	1	-	-	-	-	-	-	-	2	2	2
CO5	3	3	3	2	-	-	-	-	-	-	-	2	2	2
Average	**2.8**	**2.6**	**2.3**	**1.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.4**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC542 ANALOG AND DIGITAL COMMUNICATION (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:02 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC401 ELECTROMAGNETIC FIELDS

i) THEORY

COURSE OBJECTIVES:

The Goal of this course is for students to

- Study different analog modulation techniques
- Expose various digital modulation techniques
- Provide knowledge on inter symbol interference and Nyquist criterion.

COURSE OUTCOMES:

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

- Summarize the types of analog modulation K2
- Apply the concepts of digital modulation K3
- Inspect the characteristics of base band pulse transmission techniques K3
- Analyze the bit error performance of digital modulation schemes K4
- Compare the error detection and correction codes K2

UNIT I ANALOG MODULATION SYSTEMS 9

Review of signals and systems, Frequency domain representation of signals, Principles Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

UNIT II DIGITAL MODULATION SYSTEMS 9

Sampling and Quantization process, Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation, ADPCM Delta modulation and ADM, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

UNIT III BASEBAND PULSE TRANSMISSION 9

Matched filters, Error rate due to noise, Inter symbol Interference and Nyquist criterion for distortion less baseband binary transmission, Correlative-level coding, Baseband M-ary PAM transmission, Optimum Linear receiver, Adaptive Equalization, Eye patterns.

UNIT IV PASSBAND DIGITAL MODULATION 9

Phase Shift Keying: Binary Phase Shift Keying, Differential Phase-shift keying, Quadrature Phase Shift Keying, Binary Frequency Shift Keying, Minimum shift keying, Quadrature Amplitude Modulation, Power spectrum and error probability of FSK and PSK signals.

UNIT V ERROR CONTROL CODING 9

Channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes, convolution codes, Trellis codes, Viterbi algorithm.

TOTAL HOURS:45

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Signal Sampling and its reconstruction.
2. Pulse modulation and demodulation-PAM/PWM/PCM.
3. Delta modulation and demodulation.
4. Digital modulation & demodulation– PSK, FSK.
5. Simulation of AM, FM, PM.
6. Simulation of Linear Block and Cyclic error control coding schemes.

TOTAL HOURS: 30

SUGGESTED READINGS:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2008.
2. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGrawHill,2008.
3. Barry J. R., Lee E. A. and Messerschmitt D. G., "Digital Communication", KluwerAcademic Publishers, 2004.
4. Martin S.Roden, "Analog and Digital Communication System", 3rd Edition, PHI, 2002.

WEB REFERENCES:

1. https://ngss.nsta.org/Resource.aspx?ResourceID=986
2. http://www.umsl.edu/~joshik/msis480/chapt07.htm
3. gitahttps://www.sciencebuddies.org/
4. https://www.youtube.com/watch?v=HCltbJapAf8&index=38&list=PLqGm0y RYwTgX2F kPVcY 6io003-tZd8Ru

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	1	2	1
CO2	2	1	-	-	-	-	-	-	-	1	-	1	2	1
CO3	3	2	1	-	-	-	-	-	-	1	-	1	1	1
CO4	3	3	2	1	-	-	-	-	-	1	-	1	2	1
CO5	2	1	-	-	-	-	-	-	-	1	-	1	2	1
Average	2.4	1.6	1.5	1	-	-	-	-	-	1	-	1	1.8	1

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester- V

24BEEC543 VLSI DESIGN 5H-4C

(THEORY & LABORATORY)

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3Hours

PRE-REQUISITE: 24BEEC242 DIGITAL SYSTEMS DESIGN

i) THEORY

COURSE OBJECTIVES:

The goal of this course for students is

- To impart knowledge about EDA tools with design of CMOS physical design.
- To enrich knowledge about modeling and logic circuit designing using Verilog HDL.
- To learn Verilog HDL combinational, sequential circuits and VLSI testing using system level techniques.

COURSE OUTCOMES:

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

- Identify the EDA tools for designing CMOS physical design. K3
- Analyze various characteristics and behavior of CMOS inverter with simulation. K4
- Model various logic circuits using CMOS logic gates. K3
- Construct various logic circuits with modeling using Verilog HDL. K3
- Examine different types of VLSI testing techniques with system level techniques. K4

UNIT I MOS TECHNOLOGY 9

Chip Design Hierarchy – IC Layers – Photolithography – Basic MOS Transistors – CMOS Fabrication: n-well – p-well –SOI. Latch up and prevention- Layout design rules, physical design- basic concepts, CAD tool sets, physical design of logic gates-Inverter, NAND, NOR.- MOS Parasitic & SPICE Model.

UNIT II MOS TRANSISTORS 9

Introduction to MOSFET: Symbols, Enhancement Mode-Depletion mode transistor operation– Threshold voltage derivation – Drain current derivation – non-ideal behavior of the MOS Transistor. NMOS and CMOS inverter–Determination of pull up to pull down ratio-scaling of the MOS device, Vertical MOSFET.

UNIT III CMOS LOGIC GATES & OTHER COMPLEXGATES 9

Gate delays – Logical Effort - CMOS Static Logic – Transmission Gate Logic – Tri-State Logic – Pass Transistor Logic – Dynamic CMOS Logic – Domino CMOS Logic, NORA CMOS Logic- Clocking Strategies.

UNIT IV VERILOG HDL **9**

Hierarchical modeling concepts – Basic concepts: Lexical conventions – Data types– Modules and ports. Gate level modeling–Data flow modeling–Behavioral modeling–Design examples of Combinational and Sequential circuits–Switch level modeling– Functions – UDP concepts.

UNIT V VLSI TESTING 9

Need for testing, manufacturing test principles, Design strategies for test, Chip level and system level test techniques.

TOTAL HOURS: 45

ii) LABORATORY

LIST OF EXPERIMENTS

1. Design of Combinational circuits.
2. Design and simulate a Universal Shift Register using HDL
3. Design and simulate an ALU using HDL.
4. Design and simulate Finite State Machine (Moore/Mealy) using HDL.
5. Design and simulate real time clock using HDL
6. Design and simulate a CMOS inverter using digital flow
7. Design and simulate a CMOS Inverting Amplifier.

TOTAL HOURS: 30

SUGGESTED READINGS:

1. Douglas A.Pucknell Basic VLSI Systems and Circuits3rd Edition reprint Prentice Hall of India 2008.
2. John P.Uyemura, Introduction to VLSI Circuits and Systems John Wiley & Sons, Reprint 2009.
3. Smith.M.J.S Application Specific integrated circuits Pearson Education, New York 2008.
4. Weste & Eshraghian, Principles of CMOS VLSI Design 2nd Edition Addison Wesley, 2011.
5. John PU yemura Chip Design for Submicron VLSI: CMOS layout and simulation Thomson India Edition 2010.
6. Samir Palnitkar, Verilog HDL–Guide to Digital Design and Synthesis-3rd Edition Pearson Education 2003.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee29/preview
2. https://www.digimat.in/nptel/courses/video/108107129/L01.html

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester V

24BEEC591 INTERNSHIP II/MINI PROJECT II 2H - 1C

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for students is

- To bridge the gap between academia and industry in providing an industry exposure for satisfying local industrial needs.
- To enable the students to get connected with Industry / Laboratory / Research Institute.
- Get practical knowledge on production process in the industry and develop skills to solve related problems.
- Develop skills to carry out research in the research Institutes / Laboratories.
- To learn the design methodologies and documentation process.

COURSE OUTCOMES:

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

- Apply the acquired knowledge on various tools used in industry.
- Examine technological advancement happening in industry.
- Analyze System-level design processes, verification and validation techniques, manufacturing and production processes in the firm or research facilities in the Laboratory/Research Institute.
- Analyze of industrial / research problems and their solutions.
- Make use of documentation of system specifications, design methodologies, process parameters, testing parameters and results and preparing of technical report and presentation. The students individually undergo training in reputed Firms/ Research Institutes / Laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester.

. **TOTAL HOURS :30**

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	1	1	1	-	3	-	2
CO2	3	3	2	2	-	-	-	2	1	1	-	3	-	2
CO3	3	3	2	2	-	2	1	2	2	2	-	3	-	2
CO4	3	3	2	2	-	2	1	2	2	2	-	3	-	2
CO5	3	2	1	1	-	2	1	2	2	2	-	3	-	2
Average	3	2.6	1.6	1.75	-	2.00	1.00	1.80	1.6	1.60	-	3.00	-	2.00

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-V

24BEEC511 PCB DESIGNING 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 for students is

- To create exposure about Basics of Electronics and about spice simulation.
- To inculcate knowledge about simulation of circuits using SPICE and with layout designing.
- To develop knowledge about full PCB layout for an application.

COURSE OUTCOMES:

At the end of this course students will be able to

- Explain with Basic Electronics and BOM preparation. K2
- Identify to deal with SPICE simulation tool. K3
- Build knowledge about simulation of circuits using SPICE (KiCAD). K3
- Make use of placement, routing and planning in PCB Layout. K3
- Analyze to create a PCB layout for any type of application. K4

UNIT I BASIC ELECTRONICS AND BILL OF MATERIALS PREPARATION 4

Introduction to Basic Electronic components, types of sensors, Overview about various modules of PCB circuits, Preparation of Bill of materials.

UNIT II INTRODUCTION TO SIMULATION 8

Opening new file ,creating a new schematic sheet, drawing the schematic, creating library parts, Assigning reference **Simulation of circuits using SPICE (KiCAD)**, locating components and loading libraries, placing a simulation ready components, wiring up the circuit, adding net labels, setting up a AC small signal analysis, Running the simulation

UNIT III SIMULATION OF CIRCUITS USING SPICE (KiCAD) 6

(Schematic entry of circuits using standard packages Analysis- transient, AC, DC, etc.):

Simulate and study half-wave, full-wave, and bridge-rectifier using SPICE windows, Simulate and study diode clipper and clamper circuits using SPICE windows, frequency response of Vo/Vs for CE BJT amplifier.

UNIT IV PCB LIBRARY, STACK UP PREPARATION AND PLACEMENT 6

Understanding about various package part numbers, checking for availability of footprints, Creation of footprint using KiCAD, Carrying out simulation for the given circuit. Getting confirmation for the designed Layer stack up, Placement of components in the layout using KiCAD. An understanding about the VIA concept in layout, Routing of the various nets in the circuit, Power Plane for the Layout for distribution of power, Ground plane for

the layout for distribution of Ground, Explanation about Antietch logic for power/Gndplane, Extraction of Gerber file for the designed layout.

UNIT V APPLICATIONS FOR PCB LAYOUT 6

LED blinking using 555 IC Timer, Single phase AC to DC Power supply circuit with 5volt output.

TOTAL: 30

SUGGESTED READINGS:

1. Altium Designer 14 by LI RUI.GENG LI MING(Author)
2. Circuit Design standard course for Altium Designer Summer 09 by Yong yang(Author)
3. 100 RF and microwave circuit design examples by Ali Behagi.
4. Analysis and design of transimpedance amplifiers and optical receivers by Eduard sackinger
5. PCB Designers Reference basics by Christopher Robertson
6. PCB Design guide for Engineers by Ivan Duprey

WEB REFERENCES:

1. https://www.flux.ai/p/blog/pcb-design-what-you-need-to-know-before-you-start?gad_source=1&gclid=CjwKCAjwt-OwBhBnEiwAgwzrUsCWv_yKtAmA6Ali1GgP_sLJvHIh7pBIK_VBrTjzi6iOuJxdhgpFzxoC4PQQAvD_BwE

Semester-V

24BEMC551 CRYPTOGRAPHY AND CYBER SECURITY 1H-0C

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for students is

- To know about various encryption techniques and understand the concept of public key cryptography.
- To study about message authentication and hash functions and impart knowledge on Network security.
- To learn about the introduction of cyber security and learn various malware threats and hiding files.
- To expose various ethical hacking devices.

COURSE OUTCOMES:

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

- Classify the symmetric encryption techniques and illustrate various public key cryptographic techniques. K2
- Analyse the tools and methods used in cybercrime. K4
- Identify risk management processes, risk treatment methods, organization of information security and classify cyber security solutions and information assurance. K3
- Identify structure and methods of cyber security K3
- Experiment with different cybercrimes and hacking methods K4

UNIT 1 INTRODUCTION TO CRYPTOGRAPHY 9

Computer Security Concepts – The OSI Security Architecture – Security Components, Security Attacks – Security Services, Security Mechanism – A Model for Network Security – Classical encryption techniques: Substitution, Classical Encryption techniques – Block Cipher Principles, Data Encryption Standard-Symmetric chipper Model, Substitution Techniques, Transposition techniques

UNIT II PUBLIC KEY CRYPTOGRAPHY AND RSA 9

Principle of Public Key Crypto System-Cryptography Number Theory- Public Key Cryptography, Key Establishment Protocols, Introduction, Key transport based on symmetric encryption, RSA-Key Management, Diffie-Hellman key Exchange, Quantum computers, Shor's algorithm, future demise of RSA, Quantum cryptography, Quantum key distribution and reconciliation.

UNIT III CRYPTOGRAPHIC AND DATA INTEGRITY 9

Cryptographic and Data Integrity Algorithms, Interactive protocols, Touch of complexity theory, Interactive proof systems, electronic cash, Private information retrieval, Applications of cryptographic hash functions Requirements and security, Digital Signature Standard, Digital watermarking, digital fingerprinting, Steganography.

UNIT IV INTRODUCTION TO CYBER SECURITY 9

Introduction to Cyber Security - Importance and challenges in Cyber Security - Cyberspace – Cyber threats - Cyber warfare - CIA Triad - Cyber Terrorism - Cyber Security of Critical Infrastructure– Cyber security -Organizational Implications.

UNIT V HACKERS AND CYBER CRIMES 9

Types of Hackers - Hackers and Crackers - Cyber-Attacks and Vulnerabilities - Malware threats - Sniffing - Gaining Access - Escalating Privileges - Executing Applications - Hiding Files – Covering Tracks - Worms - Trojans - Viruses – Backdoors.

TOTAL HOURS: 45

SUGGESTED READINGS:

1. William Stallings, “Cryptography and Network security Principles and Practices”, Pearson/PHI, 4th ed, 2006, ISBN-10: 0131873164 ISBN-13: 978-0131873162
2. Atul Kahate, “Cryptography and Network Security”, McGraw Hill, 3 rd Edition 2003, ISBN13: 978-1259029882
3, Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley Publisher, First Edition, 2011.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106106129
2. https://onlinecourses.swayam2.ac.in/cec20_cs15/preview

Semester VI

24BEEC601 WEARABLE DEVICES 3H-3C

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

End Semester Exam :3 Hours

PRE-REQUISITE: 24BEEC541 INDUSTRIAL AUTOMATION

COURSE OBJECTIVES:

The goal of this course for students is

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

COURSE OUTCOMES:

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

- Identify the need for development of wearable devices and its influence on various sectors. K3
- Choose a suitable sensor for a given application K3
- Examine the level of energy involvement in wearable systems K4
- Make use of signal processing for wearable systems in healthcare, smart textile and navigation K3
- Inspect wearable locomotive tools for safety and security, navigation K4

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Components of wearable Systems. Types of wearable sensors: Invasive, Non-invasive; Intelligent clothing, Industry sectors' overview – sports, healthcare, Fashion and entertainment, military, environment monitoring, mining industry, public sector and safety

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues -physical shape and placement of sensor, technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 9

Wearable ECG devices: Basics of ECG and its design, Wearable EEG devices: Principle and origin of EEG, Basic Measurement set-up, Wearable EMG devices: EMG/ SEMG Signals, EMG Measurement, Epidermal electronics system (EES), Study of Multiparametric (ECG, EEG, EMG) Epidermal Electronics Systems. Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor. Study of flexible and wearable Piezoresistive sensors for cuffless blood pressure measurement. Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring, wearable, adhesive/tattoo type. Conductive textile electrodes, Knitted Piezoresistive Fabric (KPF) sensors

UNIT IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG, respiration.

UNIT V WEARABLE CAMERAS AND MICROPHONES FOR NAVIGATION 9

Cameras in wearable devices, Applications in safety and security, navigation, Enhancing sports media, Automatic digital diary. Cameras in smart-watches; Use of Wearable Microphones: MEMS microphones, Bioacoustics, Microphones and AI for respiratory diagnostics and clinical trials. Wearable Assistive Devices for the Blind - Hearing and Touch sensation, Assistive Devices for Fingers and Hands, Assistive Devices for wrist,forearmandfeet, vests and belts, head-mounted devices.

TOTAL HOURS: 45

SUGGESTED READINGS

1. Seamless Healthcare Monitoring, Toshiyo Tamura and Wenxi Chen, Springer 2018
2. Wearable Sensors -Fundamentals, Implementation and Applications, by Edward Sazonov and Michael R. Neuman, Elsevier Inc., 2014.
3. Wearable and Autonomous Biomedical Devices and Systems for Smart Environment, by Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay, Springer 2010
4. Wearable Electronics Sensors - For Safe and Healthy Living", Subhas Chandra Mukhopadhyay, Springer 2015
5. N. Luo, W. Dai, C. Li, Z. Zhou, L. Lu, C. C. Y. Poon, et al., "Flexible Piezoresistive Sensor Patch Enabling Ultralow Power Cuffless Blood Pressure Measurement," Advanced Functional Materials, vol. 26, pp. 1178-1187, 2016.
6. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
7. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013

8. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
9. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications, Pan Stanford Publishing Pte.Ltd, Singapore, 2012
10. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
11. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

WEB REFERENCES:

1. https://www.happiestminds.com/insights/wearable-technology/
2. https://builtin.com/wearables

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester- VI

24BEEC602 ANTENNA AND WAVE PROPAGATION 4H-4C

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

End Semester Exam:3Hours

PRE-REQUISITE: 24BEEC542 ANALOG AND DIGITAL COMMUNICATION

COURSE OBJECTIVES:

The goal of this course for students is

- To learn the fundamentals of radiation, aperture and slot antennas.
- To know the antennas types, measurements and antenna arrays.
- To know the different types of radio wave propagation at different frequencies.

COURSE OUTCOMES

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

- Explain the radiation pattern and antenna parameters. K2
- Interpret the various types of aperture antennas. K2
- Identify the antenna measurements and special antennas. K3
- Outline the principles of antenna arrays. K2
- Illustrate the Radio wave propagation at different frequencies. K2

UNIT I INTRODUCTION 12

Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Matching – Baluns, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, half wave dipole. Folded dipole.

UNIT II APERTURE AND SLOT ANTENNAS 12

Radiation from rectangular apertures, Uniform and Tapered aperture, Slot Antenna, Waveguide Horn Antenna, Reflector Antennas: Flat-sheet/ Corner Reflectors, Parabolic Reflector, Lens Antennas - Dielectric Lenses, Metal-plate Lenses Travelling Wave Antenna, Yagi-Uda Arrays, Vee and Rhombic Antennas, Small Loop Antenna, Helical Antenna, Log Periodic Antenna, Micro strip Patch Antenna

UNIT III SPECIAL ANTENNAS AND ANTENNA MEASUREMENTS 12

Frequency independent antennas –Spiral antenna, Helical antenna, Log periodic. Modern antennas-Reconfigurable antenna, Active antenna, Dielectric antennas, electronic band gap structure and applications, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR

UNIT IV ARRAY ANTENNAS 12

Two element array, Uniform linear array, Side lobe level and beam width of broadside array, Beam width of end fire array, Principle of multiplication of patterns, Effect of earth on vertical patterns, Binomial array, Basic principle of Dolph- Tschebyscheff array.

UNIT V RADIO WAVE PROPAGATION 12

Ground wave Propagation, Earth constants, Space-wave Propagation, Effect of curvature of an Ideal Earth, Variations of Field strength with height in space-wave Propagation, Atmospheric effects in space-wave Propagation, Radio-Horizon, Duct Propagation, Extended-range Propagation resulting from Tropospheric Scattering, lonospheric Propagation, Gyro frequency, Refraction and reflection of Sky Waves by the Ionosphere, Critical Frequency, Skip Distance, Maximum Usable Frequency

TOTAL HOURS:45

SUGGESTED READINGS

1. John D Kraus," Antennas for all Applications", 3rd Edition, Mc Graw Hill, 2005.
2. Antenna and Wave Propagation – Harish AR and Sachidananda M, Oxford University Press, 2007.
3. Electromagnetic Waves and Radiating Systems - E.C. Jordan and K.G. Balmain. PHI, 2nd ed., 2000.
4. Robert S.Elliott "Antenna Theory and Design" Wiley Student Edition, 2006.
5. S. Drabowitch, "Modern Antennas" Second Edition, Springer Publications, 2007.
6. R.E.Collin,"Antennas and Radiowave Propagation", Mc Graw Hill 1985.
7. G.S.N.Raju, Antennas andWave Propagation, 1st Edition, Pearson Publication, Singapore.
8. Edward C.Jordan and Keith G.Balmain" Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2006.

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-VI

24BEEC603 UNIVERSAL HUMAN VALUES 2H - 2C

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

End Semester Exam:3 Hours

PRE-REQUISITE: NIL

COURSE OBJECTIVES:

The goal of this course for students is

- To help students to understand the need, basic guidelines, content and process of value education.
- To help students distinguish between values and skills
- To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
- To help students understand the meaning of happiness within their selves.
- To help students understand the meaning of happiness and prosperity for a human being

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Illustrate the significance of value inputs in a classroom, distinguish between values and skills. K2
- Interpret the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society K2
- Distinguish between the Self and the Body; understand the meaning of Harmony in the Self the Co-existence of Self and Body. K4
- Illustrate the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships. K2
- Identify their role in ensuring a harmonious society. K3

UNIT I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION 5

Understanding the need, basic guidelines, content and process for Value Education, Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential

Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING HARMONY IN MYSELF 5

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY HARMONY IN HUMAN-HUMAN RELATIONSHIP 5

Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay- tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family

TOTAL HOURS: 15

TEXT BOOKS:

1. R R Gaur, R Sangal and G P Bagaria(2009).“A Foundation Course in Human Values and Professional Ethics”
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA

3. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
6. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
7. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
8. A N Tripathy, 2003, Human Values, New Age International Publishers.

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester- VI

24BEEC641 WIRELESS COMMUNICATION (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L:3 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3Hours

PRE-REQUISITE: 24BEEC542 ANALOG AND DIGITAL COMMUNICATION

i) THEORY

COURSE OBJECTIVES

The goal of this course for students is

- To understand the design and concepts of cellular system.
- To study and understand mobile radio propagation and digital modulation Techniques.
- To study the multiple access techniques and wireless networks

COURSE OUTCOMES

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

- Illustrate the concept and design of a cellular system. K2
- Identify the mobile radio propagation models and fading effects. K3
- Utilize the concepts of digital modulation techniques, equalization and diversity. K3
- Classify the multiple access techniques and capacity of cellular system K2
- Outline wireless networks and generations, network database. K2

UNIT I INTRODUCTION TO CELLULAR ARCHITECTURE 9

Introduction- Frequency Reuse - Channel Assignment Strategies – Handoff - Interference and System Capacity - Trunking and Grade of Service - Coverage and Capacity Improving in Cellular Systems

UNIT II MOBILE RADIO PROPAGATION 9

Free Space Propagation Model - Propagation Mechanism -. Small Scale Fading - Small Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Coherence Bandwidth, Doppler Spread and Coherence Time- Fading Effects Due to Multipath Time Delay Spread, Fading Effects Due To Doppler Spread.

UNIT III DIGITAL MODULATION TECHNIQUES 9

Introduction to Digital Modulation - Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying (GMSK) - Pseudo- Noise (PN) Sequences -Direct Sequence Spread Spectrum (DS-SS) – Error Performance in Fading Channel, Equalization – Diversity Techniques

UNIT IV MULTIPLE ACCESS TECHNIQUES **9**

Frequency Division Multiple Access (FDMA)- Time Division Multiple Access (TDMA)- Spread Spectrum Multiple Access - Code Division Multiple Access (CDMA)- Space Division Multiple Access (SDMA)- Capacity of Cellular Systems.

UNIT V WIRELESS NETWORKING **9**

Introduction to Wireless and Fixed Telephone Networks, The Public Switched Telephone Network (PSTN) – Generations of Wireless Networks, - Circuit Switching, Packet Switching - Packet Reservation Multiple Access (PRMA)- Distributed Database for Mobility Management- Universal Mobile Telecommunication Systems (UMTS).

TOTAL HOURS:45

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Simulate the propagation path loss of Okumura and Hata model.
2. Modeling and simulation of Multipath fading channel.
3. Simulation of digital modulation schemes for fading channels – error performance in fading channels, error probability of MSK.
4. Spread Spectrum – DSSS Modulation
5. Modeling and simulation of TDMA, FDMA and CDMA for wireless communication

TOTAL HOURS: 30

SUGGESTED READINGS:

1. Rappaport,T.S.,-Wireless communications", Pearson Education, Second Edition, 2010.
2. Andreas. F. Molisch, "Wireless Communications", John Wiley – India, 2006.
3. Andrea Goldsmith, , "Wireless Communication", Cambridge University Press, 2011.
4. Van Nee, R. and Ramji Prasad, "OFDM for wireless multimedia communications", Artech House,2000.
5. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
6. Upena Dalal, "Wireless Communication", Oxford University Press, 2009.

Wireless Communication and Networks –William Stallings, Pearson Education, Second Edition,2002.

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-VI

24BEEC642 MICROWAVE AND OPTICAL COMMUNICATION (THEORY & LABORATORY) 5H-4C

Instruction Hours/week: L3 T:0 P:2 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC542 ANALOG AND DIGITAL COMMUNICATION

24BEEC501 TRANSMISSION LINES AND WAVEGUIDES

i)THEORY

COURSE OBJECTIVES

The goal of this course for students is:

- To perform Scattering parameter analysis of RF networks.
- To assess the impact of microwave sources and measurements.
- To analyze the role of optical fiber communication and Networks.

COURSE OUTCOMES:

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

- Apply suitable microwave components for high frequency applications. K3
- Analyze the performance characteristics of various microwave sources and solid state devices K4
- Select S parameters of microwave components for various applications. K3
- Select suitable optical sources, detectors and optical amplifiers for various applications. K3
- Examine the characteristics of optical Networks. K4

UNIT I MICROWAVE NETWORKS AND COMPONENTS 9

Introduction to microwaves and applications, advantages of microwaves, Review of Low frequency parameters, salient features of S-matrix, salient features of multiport network, and losses in microwave circuits, Waveguide corners, bends and twists. Isolator, Circulator- S-matrix of series element in the transmission line, S-matrix for E-plane Tee junction, S-matrix for H-plane Tee junction, S-matrix for magic Tee junction, S-matrix for directional coupler, Strip lines, Micro strip lines and coplanar waveguides.

UNIT II MICROWAVE SOURCES 9

Microwave Tubes: Klystron, Reflex Klystron, Magnetron - schematic, Principle of operation, performance, characteristics and application. Microwave Solid State Devices: Tunnel, Gunn,

IMPATT and TRAPATT diodes, their construction and Principle of operation. Experimental verification for mode characteristics of Reflex klystron Oscillator and Gunn diode Oscillator.

UNIT III MICROWAVE MEASUREMENTS 9

Microwave Bench general measurement set up, Measurement Devices and instrumentation: Slotted line, VSWR meter, power meter, spectrum analyzer, Network analyzer, Measurement of frequency, impedance, Attenuation, power and dielectric constant, VSWR, insertion loss, EMI / EMC basics and measurement methods. Microwave measurement setup for VSWR and Impedance of an unknown load.

UNIT IV OPTICAL COMMUNICATION SIGNAL DEGRADATION 9

Evolution of fiber optic system- Element of an Optical Fiber Transmission link– Total internal reflection-Acceptance angle – Numerical aperture – Skew rays Ray Optics-Optical Fiber Modes and Configurations -Mode theory of Circular Wave guides- Linearly Polarized Modes -Single Mode Fibers-Graded Index fiber structure. Attenuation – Absorption losses, scattering losses, Bending Losses, Core and Cladding losses, fiber splices Signal Distortion in Optical Wave Guides-Information Capacity determination -Group Delay-Material Dispersion, Wave guide Dispersion. Experimental verification of propagation and Bending Losses using Fiber Optic Analog link.

UNIT V OPTICAL SOURCES, DETECTORS AND NETWORKS 9

Requirements for an Optical source - Direct and indirect Band gap materials-Light Emitting Diodes structures --Quantum efficiency and LED power - Modulation of a LED. Laser Diodes-Modes and Threshold condition -Rate equations -External Quantum efficiency - Resonant frequencies, Temperature effects - Fiber amplifiers - Requirements for an Optical detectors – PIN Photo diode – Avalanche Photo Diode - Detector response time - WDM system - SONET/SDH, ATM, IP, Wavelength routed networks. Frequency response analysis of Fiber Optic analog and Digital links.

TOTAL HOURS: 45

(i) LABORATORY

LIST OF EXPERIMENTS:

1. Characteristics of Circulator, Directional Coupler and Magic Tee
2. Characteristics of the Reflex Klystron and Gunn Diode oscillator
3. Measurement of VSWR

4. Numerical aperture and Losses in Optical Fiber

5.Study of setting up an analog and digital link using optical fiber.

TOTAL HOURS: 30

SUGGESTED READINGS

1. Samual Y.Liao, "Microwave Devices and Circuits", PHI, 3rd Edition, Reprint 2017.
2. Collin R.E., "Foundation of Microwave Engineering", (McGraw Hill) wiley, 2nd Edition, 2009.
3. Herbert J.Reich, J.G.Skalnik, P.F.Ordung and H.L.Krauss, "Microwave Principles", CBS Publishers and Distributors, New Delhi, 2004.
4. Keiser. G, "Optical fiber communications", 4th Edition Tata McGraw Hill, New Delhi, 2008.
5. T.L. Singal "Optical Fiber Communications Principles and Applications", Cambridge University Press, 2016.
6. Agrawal. G.P, "Fiber-Optic Communication Systems" 3rd Edition John Wiley and Sons, 2002

WEB REFERENCES:

1. https://www.coursera.org/learn/microwave-antenna
2. https://microwaveeng.com/
3. https://www.nasa.gov/technology/space-comms/optical-communications-overview/

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO2	3	3	2	1	-	-	-	-	-	1	-	2	3	1
CO3	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO4	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO5	3	3	2	1	-	-	-	-	-	1	-	2	3	1
Average	**2.6**	**2**	**1.67**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2.6**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester VI

24BEEC691 MINI PROJECT III 2H - 1C

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

End Semester Exam:3 Hours

PRE-REQUISITE: NIL

COURSE OBJECTIVES:

The goal of this course for students is

- To bridge the gap between academia and industry in providing an industry exposure for satisfying local industrial needs.
- To enable the students to get connected with Industry / Laboratory / Research Institute.
- Get practical knowledge on production process in the industry and develop skills to solve related problems.
- Develop skills to carry out research in the research Institutes / Laboratories.
- To learn the design methodologies and documentation process.

COURSE OUTCOMES:

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

- Apply the acquired knowledge on various tools used in industry.
- Examine technological advancement happening in industry.
- Analyse System-level design processes, verification and validation techniques, manufacturing and production processes in the firm or research facilities in the Laboratory/Research Institute.
- Analyse of industrial / research problems and their solutions.
- Make use of documentation of system specifications, design methodologies, process parameters, testing parameters and results and preparing of technical report and presentation. The students individually undergo training in reputed Firms/ Research Institutes / Laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester.

. **TOTAL HOURS :30**

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	1	1	1	-	3	-	2
CO2	3	3	2	2	-	-	-	2	1	1	-	3	-	2
CO3	3	3	2	2	-	2	1	2	2	2	-	3	-	2
CO4	3	3	2	2	-	2	1	2	2	2	-	3	-	2
CO5	3	2	1	1	-	2	1	2	2	2	-	3	-	2
Average	**3**	**2.6**	**1.6**	**1.75**	**-**	**2**	**1**	**1.8**	**1.6**	**1.6**	**-**	**3**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester- VII

24BEEC701 PRINCIPLES OF MANAGEMENT AND ENGINEERING ETHICS 3H-3C

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

End Semester Exam:3Hours

PRE-REQUISITE: NIL

COURSE OBJECTIVES

The goal of this course for students is

- To develop a comprehensive understanding of the fundamental aspects of management
- To understand the roles and responsibilities of a manager
- To acquire knowledge in various verticals of management
- To cultivate students' awareness of engineering ethics and human values
- To instill values, foster loyalty, and promote respect for others' rights

COURSE OUTCOMES

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

- Outline the fundamental aspects of management K2
- Apply the acquired skill sets for formulating better business management processes in organizations K3
- Make use of the skills to plan, organize, direct, control and work in teams for efficient outcomes K3
- Illustrate the significance of ethics in the professional & real life K2
- Analyze situations and make unbiased decisions considering social, environmental, and technological impacts K4

UNIT I INTRODUCTION TO MANAGEMENT 9

Management – Science or Art – Manager Vs Entrepreneur – Managerial Roles, skills, and styles – Evolution of Management Thought – Types of Business Organization – Current Trends and Issues in Management.

UNIT II FUNDAMENTALS OF ORGANIZATIONAL PLANNING 9

Planning – Nature and Purpose of Planning – Planning Process – Types of Planning – Strategic Management – MBO – Decision Making Process – Organizing – Nature and Purpose of Organizing – Formal and Informal Organization – Organization Chart – Organization Structure – Line and Staff Authority – Centralization and Decentralization – HRM – Career Planning

UNIT III LEADERSHIP, COMMUNICATION, AND CONTROLLING IN MANAGEMENT 9

Directing – Nature and Purpose of Directing – Motivation – Motivation Theories – Job Satisfaction – Job Enrichment – Leadership – Communication – Process and Barrier of Communication – Controlling – System and Process of Controlling – Budgetary and Non-budgetary Control Techniques – Control Performance – Direct and Preventive Control – Reporting.

UNIT IV ETHICS AND PROFESSIONALISM 9

Scope of Engineering Ethics – Accepting and Sharing Responsibility – Resolving Ethical Dilemmas – Making Moral Choices – Rights Ethics - Duty Ethics – Virtue Ethics – Workplace Responsibilities and Rights – Teamwork – Rights of Engineers – Whistle-Blowing – Truthfulness and Trustworthiness

UNIT V ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as Responsible Experimenters – Research Ethics and Integrity - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

TOTAL HOURS:45

SUGGESTED READINGS:

1. Harold Koontz and Heinz Welhrich, “Essentials of Management - An International, Innovation and Leadership Perspective”, McGraw Hill, Tenth Edition, 2015.
2. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, New York, 2005.
3. Tripathi P C and Reddy P N, “Principles of Management”, Tata McGraw Hill, Fifth Edition, 2012.

4. Robbins S.P, Coulter M., and Vohra, N., Management, Pearson (India), Tenth Edition, 2016.
5. Christoper P Neck, Jeffery D Houghton, Emma Murray and Charles L Lattimer, "Management", Wiley, Second Edition, 2016.
6. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.
7. R. Subramanian, "Professional Ethics", Oxford University Press, 2017.

WEB REFERENCES:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	1	2	1
CO2	3	2	1	-	-	-	-	-	-	1	-	1	2	1
CO3	3	2	1	-	-	-	-	-	-	1	-	1	1	1
CO4	2	1	-	-	-	-	-	-	-	1	-	1	2	1
CO5	3	3	2	1	-	-	-	-	-	1	-	1	2	1
Average	**2.6**	**1.8**	**1.3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1.8**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester VII

24BEEC791 PROJECT WORK PHASE I AND VIVA VOCE 8H-4C

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

End Semester Exam:3 Hours

PRE-REQUISITE: NIL

COURSE OBJECTIVES:

The goal of this course for students is

- To make students to understand a problem statement.
- To enable students to design an electronic circuit useful to the society.

COURSE OUTCOMES:

At the end of this course students will be able to

- Conceive a problem statement either from rigorous literature survey or from the requirements raised from industries.
- Analyze and categorize executable project modules after considering risks.
- Design, implement and test the prototype/algorithm in order to solve the conceived problem.
- Combine all the modules through effective team work after efficient testing.
- Elaborate the completed task and compile the project report.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	1	3	-	-	-	3	3	3	3	-	-
CO2	-	3	2	3	3	-	2	-	3	3	3	3	2	-
CO3	-	-	3	3	3	3	2	-	-	3	3	3	-	3
CO4	-	-	-	-	3	3	2	-	-	3	3	3	2	3
CO5	-	-	-	-	3	3	-	-	3	3	3	3	2	3
Average	**3**	**3**	**2.5**	**2.3**	**3**	**3**	**2**	**-**	**3**	**3**	**3**	**3**	**2**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-VIII

24BEEC891 PROJECT WORK PHASE II AND VIVA VOCE 16H-8C

Instruction Hours/week: L:0 T:0 P:16 **Marks:** Internal**:120** External**:180** Total**:300**

End Semester Exam:3 Hours

PRE-REQUISITE: NIL

COURSE OBJECTIVES:

The goal of this course for students is

- To make students to understand a problem statement.
- To enable students to design an electronic circuit useful to the society.

COURSE OUTCOMES:

At the end of this course students will be able to

- Conceive a problem statement either from rigorous literature survey or from the requirements raised from industries.
- Analyze and categorize executable project modules after considering risks.
- Design, implement and test the prototype/algorithm in order to solve the conceived problem.
- Combine all the modules through effective team work after efficient testing.
- Elaborate the completed task and compile the project report.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	1	3	-	-	-	3	3	3	3	-	-
CO2	-	3	2	3	3	-	2	-	3	3	3	3	2	-
CO3	-	-	3	3	3	3	2	-	-	3	3	3	-	3
CO4	-	-	-	-	3	3	2	-	-	3	3	3	2	3
CO5	-	-	-	-	3	3	-	-	3	3	3	3	2	3
Average	**3**	**3**	**2.5**	**2.3**	**3**	**3**	**2**	**-**	**3**	**3**	**3**	**3**	**2**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC4E01 IoT PROCESSORS, PROTOCOLS AND ARCHITECTURES 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC343 MICROPROCESSORS AND MICROCONTROLLERS

COURSE OBJECTIVES:

- To impart knowledge on the infrastructure, sensor technologies and networking technologies of Internet of Things.
- To develop solutions for Internet of Things.
- To explore the real-life aspects of Internet of Things

COURSE OUTCOMES:

At the end of this course students will be able to

- Illustrate Internet of Things (IoT) characteristics, functional blocks, models for physical and logical design and services and attributes in IoT K2
- Interpret the functionalities of control units, wireless communication technologies, advanced communication protocols for IoT K3
- Construct a IoT model using embedded processors Raspberry PI and Arduino K3
- Summarize the functions of IoT communication, monitoring technologies and advanced IoT computing frameworks K2
- Explain the IoT applications for Industry, Home, urban development and specialized IoT solutions K2

UNIT I BASICS OF INTERNET OF THINGS 9

Characteristics of Internet of Things (IoT) - Challenges and Issues – Physical Design of IoT - Logical Design of IoT - IoT Functional Blocks.

UNIT II IOT COMMUNICATION ARCHITECTURES AND PROTOCOLS 9

Control Units – Communication modules – Bluetooth – Zigbee – Wi-Fi – GPS - IoT Protocols (IPv6, 6LoWPAN, RPL, CoAP) – MQTT - Wired Communication - Power Sources.

UNIT III IOT PROCESSORS **9**

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability. Embedded processors for IOT: Introduction to Python programming -Building IoT with RASPERRY PI and Arduino.

UNIT IV TECHNOLOGIES BEHIND IOT **9**

Four pillars of IoT paradigm: RFID, Wireless Sensor Networks, Supervisory Control and Data Acquisition (SCADA) - M2M - IoT Enabling Technologies: Big Data Analytics, Cloud Computing, Embedded Systems.

UNIT V CASE STUDIES **9**

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT in Defense.

TOTAL: 45

SUGGESTED READINGS:

1. Oliver Hersent , David Boswarthick and Omar Elloumi " The Internet of Things",1st Edition, Wiley,2016
2. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri,"Internet of Things: Architectures, Protocols and Standards", 1st Edition, Wiley Publications,2019.
3. Vlasios Tsiatsis, Jan Holler, Catherine Mulligan, Stamatis Karnourskos and David Boyle, "Internet of Things: Technologies and Applications for a New Age of Intelligence," 2nd Edition, Academic Press,2018.
4. ArshdeepBahga and VijaiMadisetti , "Internet of Things -A Hands-on Approach",1st Edition, Orient Blackswan Private Limited,2015.
5. David Hanes , Gonzalo salgueiro, "IoT Fundamentals Networking Technologies, Protocols and Use Cases for Internet of Things" ,1st Edition, Cisco Press, 2017.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://aws.amazon.com/what-is/iot/
3. https://www.coursera.org/in/articles/internet-of-things

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC4E02	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

PRE-REQUISITE: 24BEEC343 MICROPROCESSORS AND MICROCONTROLLERS

COURSE OBJECTIVES:

The goal of this course for students is

• To study the various generations of robots and related laws.

• To learn the various power sources used in robotics.

• To identify the sensors for different fields of robotics.

COURSE OUTCOMES:

At the end of this course students will be able to

• Explain the basic working of robot	K2
• Analyze the function of sensors in the robot	K4
• Design robots for different applications	K4
• Choose appropriate end-of-arm tool for different application	K3
• Analyze the importance of automation in various industries	K4

UNIT I BASIC CONCEPTS **9**

Definition and origin of robotics–different types of robotics–various generations of robots– degrees of freedom–Asimov's laws of robotics–dynamic stabilization of robots.

UNIT II POWER SOURCES AND SENSORS **9**

Hydraulic, pneumatic and electric drives–determination of HP of motor and gearing ratio–variable speed arrangements–path determination – micro machines in robotics– machine vision – ranging– laser–acoustic –magnetic, fiber optic and tactile sensors.

UNIT III MANIPULATORS, ACTUATORS AND GRIPPERS **9**

Construction of manipulators– manipulator dynamics and force control –electronic and pneumatic manipulator control circuits–end effectors–U various types of grippers –design considerations.

UNIT IV KINEMATICS AND PATH PLANNING **9**

Solution of inverse kinematics problem–multiple solution jacobian work envelop–hill Climbing Techniques– robot programming languages.

UNIT V AI IN ROBOTICS 9

Applications in unmanned systems, defense, medical, industries, etc.

TOTAL: 45

SUGGESTED READINGS:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 1999.
2. Bijoy K. Ghosh, T. J. Tarn, Ning X, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 2011.
3. Deb.S.R., Robotics technology and flexible Automation, John Wiley, 2010.
4. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
5. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
6. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
7. Issac Asimov I Robot, Ballantine Books, New York, 1986.

WEB REFERNCES:

1. https://doc.lagout.org/science/0_Computer%20Science/8_Electronics%20%26%20Robotics/Robotics%20and%20Automation%20Handbook.pdf
2. https://swayam.gov.in/nd1_noc20_me03/preview

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO2	3	3	2	1	-	-	-	-	-	1	-	2	3	1
CO3	3	3	2	1	-	-	-	-	-	1	-	2	3	1
CO4	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO5	3	3	2	1	-	-	-	-	-	1	-	2	3	1
Average	**2.8**	**2.4**	**1.75**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2.8**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC4E03 SENSORS AND TRANSDUCERS 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC343 MICROPROCESSORS AND MICROCONTROLLERS

COURSE OBJECTIVES:

The goal of this course for students is

- To understand the characteristics of sensors and errors occurring in it.
- To study basic concepts of mechanical sensors.
- To learn about electro mechanical sensors.

COURSE OUTCOMES:

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

- Summarize the fundamentals, characterization, performance metrics and classifications of sensors and transducers K2
- Interpret the operational principles of resistive sensors and transducers, inductive and capacitive sensors and advanced sensing technologies K3
- Elucidate the functions of thermometric, thermoelectric and semiconductor temperature sensors, photo detectors and light-sensitive devices K2
- Describe the features of magnetic and electromagnetic sensors, electroanalytical and electrochemical sensors and specialized chemical sensors. K2
- Paraphrase the role of industrial, consumer, health and environmental applications K2

UNIT I INTRODUCTION **9**

Definition, classification, static and dynamic parameters, Characterization–Electrical, mechanical,thermal, optical, biological and chemical, Classification of errors–Error analysis, Static anddynamic characteristics of transducers, Performance measures of sensors.

UNIT II MECHANICAL AND ELECTRO MECHANICAL SENSORS 9

Resistive Potentiometer, strain gauge, Inductive sensors and transducer, capacitive sensors, ultrasonic sensors.

UNIT III THERMAL AND RADIATION SENSOR 9

Thermal Sensors: Gas thermometric sensors, acoustic temperature sensors, magnetic thermometer, resistance change-type thermometric sensors, thermos emf sensors, junction semiconductor types, Thermal radiation sensors, spectroscopic thermometry Radiation Sensors: Photo detectors, photovoltaic and photo junction cells, photo sensitive cell, photo FET sand other devices.

UNIT IV MAGNETIC AND ELECTRO ANALYTICAL SENSOR 9

Magnetic Sensors: Force and displacement measurement, magneto resistive sensors, Hall Effect sensor, Inductance and eddy current sensors, Angular/rotary movement transducer, Electromagnetic flow meter, squid sensor. Electro analytical Sensors: Electro chemical cell, cell potential, sensor electrodes, electro ceramics in gas media, chem FET.

UNIT V SENSORS AND THEIR APPLICATIONS 9

Auto mobile sensor, home appliance sensor, Aero space sensors, sensors for manufacturing, medical diagnostic sensors, environmental monitoring.

TOTAL:45

SUGGESTED READINGS:

1. Patranabis D, Sensor and Actuators Prentice Hall of India (Pvt) Ltd 2006.
2. Ian Sinclair, Sensor and Transducers 3rd Edition Elsevier India Pvt Ltd, 2011.
3. A.K. Sawhney, Puneethsawhney A Course in Electrical and Electronic Measurements andInstrumentation Dhanpat Rai Publications 2012.
4. Ernest O. Doeblin, Measurement System, Application and Design 5th Edition Tata McGrawHill Publishing Company Ltd. 2008.

WEB REFERNCE:

1. https://swayam.gov.in/nd1_noc19_ee41/preview

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC4E04 INDUSTRIAL IoT AND INDUSTRY 4.0 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC343 MICROPROCESSORS AND MICROCONTROLLERS

COURSE OBJECTIVES:

The goal of this course for students is

- To understand basic concepts about Industrial IoT and Industry 4.0
- To analyze the IIOT data processing and Communication
- To know about IIOT networking and computing methods

COURSE OUTCOMES:

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

- Explain the fundamentals of Industrial Internet of Things (IIoT), IIoT architecture and it's hardware modules and communication in IIoT K2
- Interpret the operational principles of IIoT gateways and edge systems, real time data monitoring and analytics and IIoT layers K3
- Elucidate the paradigms of IIoT networking and software defined networks, big data analytics, machine learning and IIoT security K2
- Describe the features of industry 4.0, smart manufacturing, drivers, enablers, robotics and collaborative technologies K2
- Illustrate the applications and case studies of IIoT, advanced technologies and strategies in Industry 4.0 K2

UNIT I INTRODUCTION AND IMPLEMENTATION OF IIOT SYSTEMS 9

Industrial Internet of Things (IIoT)**:** Introduction, IIoT-Business Model and Reference Architecture Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems. IoT architecture, working of Actuators and Different sensors characteristics, Role of IIoT in Industry.

UNIT II IIOT DATA PROCESSING AND COMMUNICATION 9

IoT Gate way, IoT Edge Systems and Programming, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology, Industrial IoT- Layers: IIoT Sensing- IIoT Processing- IIoT Communication.

UNIT III IIOT NETWORKING AND COMPUTING 9

IIoT Networking- Big Data Analytics and Software Defined Networks: IIoT Analytics -Machine Learning and Data Science - R and Julia Programming, Data Management with Hadoop. Big Data Analytics and Software Defined Networks: Data Center Networks, Fog Computing and Cloud Computing in IIoT, Industrial IoT: Security Next Generation Sensors.

UNIT IV INDUSTRY 4.0 –OVERVIEW 9

Industry 4.0: Globalization and Emerging Issues, The Various Industrial Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Cyber Physical Systems. Cyber security in Industry 4.0, Industrial Processes, Industrial Sensing & Actuation, - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation and enabling Industry 4.0–Cyber Physical Systems - Robotic Automation and Collaborative Robots - Collaborative Platform and Product Lifecycle Management.

UNIT V APPLICATIONS AND CASE STUDIES OF IIOT AND INDUSTRY 4.0 9

Applications of IIOT: Factories and Assembly Line, Food Industry-Milk Processing and Packaging industries, Quality Control ,UAV in Industries, **Case studies of IIOT**, Industrial Internet Systems. Augmented Reality and Virtual Reality (AR & VR), Artificial Intelligence (AI), Machine Learning (ML) , Big Data and Advanced Analysis. **Applications of Industry 4.0, Case studies of Industry 4.0.** Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world – Society 5.0.

TOTAL: 45

SUGGESTED READINGS:

1. Arsheep Bahga, Internet of Things: A Hands-On Approach
2. “Industrial Internet of Things: Cyber manufacturing Systems” by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017
3. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.

4. Dr. OvidiuVermesan, Dr. Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers

5. Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress), 2017

6. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things

7. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.

WEB REFERENCES:

1. https://archive.nptel.ac.in/courses/106/105/106105195/
2. https://archive.nptel.ac.in/content/syllabus_pdf/106105195.pdf

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

Semester-IV

24BEEC4E05 HEALTHCARE SYSTEMS USING IoT 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC343 MICROPROCESSORS AND MICROCONTROLLERS

COURSE OBJECTIVES:

The goal of this course for students is

- To impart knowledge on the basics of Health Monitoring System.
- To impart knowledge on IoT for Real Time Applications.
- To give insight Smart farming detection systems.

COURSE OUTCOMES:

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

- Describe the fundamentals of Internet of Things (IIoT) architectures for medical systems, IoT based health monitoring and remote patient monitoring K2
- Explain the operation of IoT based energy monitoring and management, smart homes, grids and intelligent infrastructure K2
- Summarize the functions of IoT based farm and livestock monitoring, soil and irrigation management, greenhouse and pest control procedures K2
- Describe IoT based safety, monitoring, surveillance, robotics and renewable energy systems K2
- Illustrate the applications of IoT in healthcare, safety, environmental, weather monitoring assistive and wearable technologies. advanced technologies and strategies in Industry 4.0 K2

UNIT I IoT FOR HEALTHCARE **9**

Architecture of IoT for Healthcare, IoT based Health Monitoring System using Arduino, Smart continuous glucose monitoring (CGM) and insulin pens, Remote Patient Monitoring- IoT Heart Rate Monitoring, remote monitoring of physiological parameters, ECG, EEG, Diabetics and BP.

UNIT II IoT ENABLED SMART CITIES **9**

Energy Consumption Monitoring, Smart Energy meters to minimize power consumptions, Smart home powered by

IoT, Smart Grid and Solar Energy Harvesting, Intelligent Parking System.

UNIT III SMART FARMING **9**

Animal Intrusion detection in farms, soil moisture detection and Irrigation system, Pest monitoring and control, Livestock monitoring system, IoT based Greenhouse Environment Monitoring and controlling.

UNIT IV IoT BASED INDUSTRIAL AUTOMATION **9**

IoT based gas leakage monitoring system, Temperature and liquid level monitoring in boilers, Fire detection system, wireless video surveillance robot, Automatic Solar Tracker.

UNIT V IoT FOR SOCIETY **9**

Medical Waste Management, Weather update system with IoT, Women security system, GPS Smart Sole, Wearable glove to enable sign to speech conversation, IoT based air pollution meter

TOTAL: 45 PERIODS

SUGGESTED READINGS:

1. Millman J and Halkias C., “Integrated Electronics”, TMH, 2nd Edition, 2017. (Unit 1, 3)
2. Behzad Razavi, “Fundamentals of Microelectronics”, 1st edition, Wiley publication, 2008. (Unit 2, 5)
3. Donald. A. Neamen, “Electronic Circuits Analysis and Design”, McGraw Hill Education (India) Private Ltd., 3rd Edition, 2010. (Unit 2,3,4,5)
4. S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, “Electronic Devices and Circuits”, TMH, 2nd Edition, 2017.(Unit 1,3,5)
5. Adel S. Sedra and Kenneth C.Smith, “Microelectronic Circuits”, Oxford University Press, Sixth Edition, 2009.(Unit 1,3,4,5)
6. Robert L. Boylestad and Louis Nasheresky, ”Electronic Devices and Circuit Theory”, Pearson Education, 11th Edition, 2013. (Unit 2,4,5)
7. Floyd, “Electronic Devices”, Pearson Education, 9th Edition, 2012. (Unit 2,4,5)
8. Behzad Razavi, “Fundamentals of Microelectronics”, 1st edition, Wiley publication, 2008. (Unit 1,3,4).

WEB REFERENCES

1. https://ordr.net/article/iot-healthcare-examples
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9601552/

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-IV

24BEEC4E06 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC343 MICROPROCESSORS AND MICROCONTROLLERS

COURSE OBJECTIVES:

The goal of this course for students is

- To expose the students to the fundamentals of microprocessor architecture.
- To introduce the advanced features in microprocessors and microcontrollers.
- To enable the students to understand various microcontroller architectures

COURSE OUTCOMES:

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

- Restate the fundamentals of CPU architectures, functional units, operating modes, programming and handling K2
- Summarize the organizational features of ARM architecture, Motorola 68HC11, and PIC microcontrollers K2
- Interpret the instruction set of ARM, Motorola 68HC11, and PIC microcontroller K3
- Make use of the instruction set for ARM-based DSP application development and for Motorola 68HC11 ALP development K3
- Illustrate the interrupts and communication interfaces of Motorola 68HC11 and PIC microcontroller K2

UNIT I HIGH PERFORMANCE CISC ARCHITECTURE–PENTIUM 9

CPU Architecture-Bus Operations –Pipelining –Brach predication –floating point unit-Operating Modes –Paging –Multitasking –Exception and Interrupts –Instruction set –addressing modes –Programming the Pentium processor.

UNIT II HIGH PERFORMANCE RISC ARCHITECTURE–ARM 9

Arcon RISC Machine –Architectural Inheritance –Core & Architectures -Registers –Pipeline -Interrupts – ARM organization -ARM processor family –Co-processors-ARM instruction set-Thumb Instruction set -

Instruction cycle timings -The ARM Programmer's model –ARM Development tools –ARM Assembly Language Programming -C programming –Optimizing ARM Assembly Code –Optimized Primitives.

UNIT III ARM APPLICATION DEVELOPMENT **9**

Introduction to DSP on ARM –FIR filter –IIR filter –Discrete Fourier transform –Exception handling –Interrupts –Interrupt handling schemes-Firmware and boot loader –Embedded Operating systems –Integrated Development Environment-STDIO Libraries –Peripheral Interface –Application of ARM Processor -Caches –Memory protection Units –Memory Management units –Future ARM Technologies.

UNIT IV MOTOROLA 68HC11 MICROCONTROLLERS **9**

Instruction set addressing modes –operating modes-Interrupt system-RTC-Serial Communication Interface –A/D Converter PWM and UART.

UNIT V PIC MICROCONTROLLER **9**

CPU Architecture –Instruction set –interrupts-Timers-I2C Interfacing –UART-A/D Converter –PWM and introduction to C-Compilers.

TOTAL: 45 PERIODS

SUGGESTED READINGS:

1. Andrew N.Sloss, Dominic Symes and Chris Wright "ARM System Developer"s Guide: Designing
2. and Optimizing System Software", First edition, Morgan Kaufmann Publishers, 2004.
3. Steve Furber, "ARM System –On –Chip architecture", Addision Wesley, 2000.
4. Daniel Tabak , "Advanced Microprocessors",McGraw Hill.Inc., 1995
5. James L. Antonakos, "The Pentium Microprocessor",Pearson Education, 1997.
6. Gene .H.Miller, "Micro Computer Engineering",Pearson Education , 2003

WEB REFERENCES

1. https://elearn.nptel.ac.in/shop/nptel/microprocessors-and-microcontrollers/
2. https://cusat.ac.in/naac/criteria1/1.1.3/soe/c16.pdf

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-V

24BEEC5E01 SYSTEM ON CHIP 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC442 ANALOG INTEGRATED CIRCUITS

COURSE OBJECTIVES

The goal of this course for students is

- To understand the fundamental concepts, benefits, and challenges associated with System on Chip (SoC) integration.
- To understand of memory system design and the integration of various embedded memories
- To develop effective validation and testing strategies for ensuring the reliability and functionality of SoC designs.

COURSE OUTCOMES

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

- Illustrate the different SoC design and testing challenges K2
- Interpret the design principles and testing methodologies involved in developing SoCs K3
- Choose design methodology for memory, logic and analog cores K3
- Use the interconnect architecture and digital logics of SOC for developing Network on Chip K3
- Make use of design validation to test SoC the SoC K3

UNIT 1 INTRODUCTION TO SOC 9

System tradeoffs and evolution of ASIC Technology - System on chip concepts and methodology - benefits of System On Chip integration in terms of cost, power, and performance. Comparison of System on Board and System on Chip. Typical goals in SoC design cost reduction, power reduction, performance maximization - SoC design issues - SoC challenges and components.

UNIT II DESIGN METHODOLOGY FOR MEMORY **9**

Defining the peripherals - Memory map definition - Bus and memory system design - Embedded Memories, cache memories, flash memories, embedded DRAM.

UNIT III DESIGN METHODOLOGY FOR LOGIC AND ANALOG CORES **9**

SoC design Flow - On-chip buses - Design process for hard cores - Soft and firm cores - Designing with hard cores, soft cores – Simulation modes - Specification of analog circuits - A to D converter - D to A converter - Phase-locked loops - High speed I/O - Network on Chip.

UNIT IV INTERCONNECT ARCHITECTURES FOR SOC **9**

Bus architecture and its limitations. Network on Chip (NOC) topologies. Mesh-based NoC. Routing in an NoC - Packet switching and worm hole routing.

UNIT V DESIGN VALIDATION AND SOC TESTING **9**

Core level validation - Test benches- SoC design validation -SOC test issues - Testing of digital logic cores - Cores with boundary scan - Test methodology for design reuse - Testing of microprocessor cores - Testing of embedded memories.

Total Periods: 45

SUGGESTED READINGS

1. Rochit Rajsuman, "System-on-a-chip: Design and Test", Artech House Publishers, 2000.
2. Sudeep Pasricha and Nikil Dutt,"On-Chip Communication Architectures: System on Chip Interconnect", Morgan Kaufmann Publishers, 2008.
3. Prakash Raslinkar, Peter Paterson and Leena Singh, "System-on-a-chip verification: Methodology and Techniques", Kluwer Academic Publishers, 2001.
4. Charles Stroud, Nur Touba and Laung-terng Wang, "System on Chip Test Architectures: Nanometer Design for Testability", Morgan Kaufmann Publishers, 1st Edition, 2007.
5. Hans-peter Koepchen and Erik Larsson, "Introduction to Advanced System-On-Chip Test Design and Optimization", Springer, 2005.

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-V

24BEEC5E02 LOW POWER IC DESIGN 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC442 ANALOG INTEGRATED CIRCUITS

COURSE OBJECTIVES

The goal of this course for students is

- To understand sources and physics of power dissipation and optimization in CMOS
- To describe low power CMOS circuits, power estimation and power analysis techniques
- To build synthesis for low power, behavioral level transforms and software design strategies

COURSE OUTCOMES

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

- Identify clearly the sources of power dissipation and power optimization in CMOS circuits K3
- Summarize the various power optimization techniques in CMOS Circuits K2
- Classify the different power estimation techniques and software design for low power K2
- Explain the different low power design principles in combinational and sequential circuits K2
- Make use of computer arithmetic and software design for low power K3

UNIT 1 POWER DISSIPATION IN CMOS 9

Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS, FET devices- Basic principle of low power design.

UNIT II POWER OPTIMIZATION 9

Logical level power optimization – Circuit level low power design – Circuit techniques for reducing power consumption in adders and multipliers.

UNIT III LOW POWER CMOS CIRCUITS 9

Computer arithmetic techniques for low power systems – Reducing power consumption in memories – Low power clock, Interconnect and layout design – Advanced techniques – Special Techniques.

UNIT IV POWER ESTIMATION **9**

Power estimation techniques – Logic level power estimation – Simulation power analysis – Probabilistic Power Analysis.

UNIT V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER **9**

Synthesis for low power – Behavioral level transforms - Software design for low power.

TOTAL: 45

SUGGESTED READINGS

1. Kaushik Roy and Sharat C Prasad, "Low Power CMOS VLSI circuit design", Wiley-Interscience, 1st Edition, 2000.
2. Dimitrios Soudris, Chirstian Pignet and Costas Goutis, "Designing CMOS Circuits For Low Power", Kluwer Academic Publishers, 2002 Edition, 2002.
3. Gary Yeap, "Practical low power digital VLSI design", Kluwer Academic Publishers, Illustrated Edition, 1998.
4. James B. Kuo, Jea-hong Lou and Kuo, "Low voltage CMOS VLSI Circuits", Wiley-Interscience, Illustrated Edition, 1999.
5. Chandrakasan A. P. and Brodersen R.W., "Low power digital CMOS design", Kluwer Publishers, 5th Reprint, 2002.
6. James B. Kuo and Shin Chia Lin, "Low voltage SOI CMOS VLSI Devices and Circuits", John Wiley, 1st Edition, 2008.

WEB REFERENCE

https://www.ansys.com/en-in/blog/low-power-ic-design-techniques-best-practices

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-V

24BEEC5E03 **PHYSICAL DESIGN AND VERIFICATION** **3H-3C**

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC442 ANALOG INTEGRATED CIRCUITS

COURSE OBJECTIVES:

The goal of this course for students is

- To understand the concepts of Physical Design Process such as partitioning, Floor planning, Placement and Routing
- To acquire knowledge in TCL scripting for Physical Design verify and validate the integrated circuit layout design
- To use Physical Design and Physical Verification techniques for efficient IC design

COURSE OUTCOMES:

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

- Describe the objectives and algorithms of floor planning, power planning and timing issues K2
- Infer solutions to address the challenges of Physical Design and Physical Verification K2
- Explain efficient algorithms and scripting language for physical design K2
- Identify issues in DFM and Physical Verification K3
- Make use of different physical design concepts for efficient tape out K3

UNIT I APR FLOW BASICS **9**

Introduction to PnR flow, design setup, floorplan, Block and chip level floorplan, data required for floorplan, I/O placement, pin placement, I/O bus architecture, Power plan, Analyzing floorplan and power plan

UNIT II FLOORPLAN AND PLACEMENT **9**

App options and commands related to floorplan and power plan, STA concepts related to timing path, analyzing timing report after floorplan, Placement concepts, Analyzing timing report after placement.

UNIT III CTS CONCEPTS **9**

CTS concepts, CTS commands, CTS issues and analysis of timing reports, Tcl scripting basics.

UNIT IV ROUTING AND DFM ISSUES **9**

Tcl scripting for PnR flow, Routing concepts, DFM and antenna, antenna fix issues, Routing commands, Issues in routing stage

UNIT V PARASITIC EXTRACTION AND PHYSICAL VERIFICATION **9**

Signoff, LEC post layout and ECO flow, Parasitic Extraction, Physical verification, and tape out, Techniques to extract parasitic and fix physical verification issues, MSCTS, low power VLSI

SUGGESTED READINGS:

1. Naveed A Sherwani, "Algorithms for VLSI Physical Design Automation", Springer, 2013
2. Harry Veendrick, "Nanometre CMOS ICs: From Basics to ASICs.", Springer, 2017.
3. R Drechsler, "Evolutionary Algorithms for VLSI CAD", Kluwer Academic Publishers,2010.

WEB REFERENCE

1. https://www.maven-silicon.com/physical-design-and-verification-course/

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-V

24BEEC5E04 ASIC DESIGN 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC442 ANALOG INTEGRATED CIRCUITS

COURSE OBJECTIVES:

The goal of this course for students is

- To understand the principles of design logic cells and Programmable I/O cells.
- To study about logic synthesis and placement.
- To understand high performance algorithms for ASIC.

COURSE OUTCOMES:

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

- Outline the fundamentals of ASIC design flow and routing techniques K2
- Classify programmable logic cells ASICs, placement and routing in design perspective K2
- Explain the architecture and high-performance algorithm for ASIC K2
- Summarize the strategies for power and high performance of digital circuits K2
- Make use of logic synthesis, placement and routing for ASIC Design K3

UNIT I INTRODUCTION TO ASIC, CMOS LOGIC AND ASIC LIBRARY DESIGN 9

Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logiccell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort.

UNIT II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS 9

Anti-fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA –AlteraFLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs – Xilinx I/O blocks.

UNIT III PROGRAMMABLE ASIC ARCHITECTURE 9

Architecture and configuration of Spartan / Cyclone and Virtex / Stratix FPGAs – Micro-Blaze /Nios based embedded systems – Signal probing techniques.

UNIT IV LOGIC SYNTHESIS, PLACEMENT AND ROUTING 9

Logic synthesis - ASIC floor planning- placement and routing – power and clocking strategies.

UNIT V HIGH PERFORMANCE ALGORITHMS FOR ASIC / SOCS 9

High performance algorithms for ASICS/ SoCs as case studies – Canonic Signed Digit Arithmetic,KCM, Distributed Arithmetic, High performance digital filters for sigma-delta ADC, USB controllers, OMAP.

TOTAL: 45

SUGGESTED READINGS:

1. Douglas J. Smith, HDL Chip Design, Madison, AL, USA: Doone Publications, 1996.
2. M.J.S.Smith, " Application - Specific Integrated Circuits", Pearson,2003
3. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing ", McGraw Hill, Digitized 2007
4. Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, “FPGA-based Implementation ofSignal Processing Systems”, Wiley, 2008
5. Steve Kilts, “Advanced FPGA Design,” Wiley Inter-Science 2007

WEB REFERNCES:

1. https://www.electronics-notes.com/articles/electronic_components/programmable-logic/what- is-an-asic-application-specific-integrated-circuit.php
2. https://www.tce.edu/sites/default/files/PDF/14EC770-ASIC-DESIGN-K.Kalyani.pdf

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

Semester-V

24BEEC5E05 FPGA BASED SYSTEM DESIGN 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC442 ANALOG INTEGRATED CIRCUITS

COURSE OBJECTIVES

The goal of this course for students is

- To understand fundamentals of FPGA technology for system design
- To discuss the technology mapping and architecture of FPGA
- To apply the knowledge of various design techniques in FPGA based system design

COURSE OUTCOMES

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

- Explain the evolution of Programmable Logic Devices and FPGA Technology in system design K2
- Illustrate the features and types of various FPGA Technology in digital system design K2
- Apply the concept of Technology Mapping for FPGAs, routing and its algorithms in FPGA based system design K3
- Make use of various Technology Mapping techniques and routing algorithms for effective FPGA implementation K3
- Illustrate the block architecture fundamentals in FPGA based system design K2

UNIT 1 EVOLUTION OF PROGRAMMABLE DEVICES 9

Introduction to AND-OR structured Programmable Logic Devices PROM, PLA, PAL and MPGAs, Combinational and sequential circuit realization using PROM based Programmable Logic Element (PLE), Architecture of FPAD, FPLA, FPLS and FPID devices.

UNIT II FPGA TECHNOLOGY 9

FPGA resources - Logic Blocks and Interconnection Resources, Economics and applications of FPGAs, Implementation Process for FPGAs Programming Technologies - Static RAM Programming, Anti Fuse Programming, EPROM and EEPROM Programming Technology, commercially available FPGAs - Xilinx FPGAs, Altera FPGAs, FPGA Design Flow Example - Initial Design Entry, Translation to XNF Format,

Partitioning, Place and Route, Performance Calculation and Design Verification.

UNIT III TECHNOLOGY MAPPING FOR FPGAS **9**

Logic Synthesis - Logic Optimization and Technology Mapping, Lookup Table Technology Mapping - Chortle-CRF Technology Mapper, Chortle-d Technology, Mapper, Lookup Table Technology Mapping in MIS-PGA, Lookup Table Technology Mapping in ASYL and Hydra Technology Mapper, Multiplexer Technology Mapping - Multiplexer Technology, Mapping in MIS-PGA.

UNIT IV ROUTING FOR FPGAS **9**

Routing Terminology, Strategy for routing in FPGAs, Routing for Row Logic, Routing Algorithms

UNIT V BLOCK ARCHITECTURE **9**

Logic Block Functionality versus Area-Efficiency - Logic Block Selection, Experimental Procedure, Logic Block Area and Routing Model and Results, Based FPGAs - Segmented channel routing, 1-channel routing algorithm, K – channel routing algorithm and results.

TOTAL PERIODS: 45

SUGGESTED READINGS

1. Wayne Wolf, “FPGA Based System Design”, Prentices Hall Modern Semiconductor Design Series.
2. Clive Maxfield, “The Design Warriors’s Guide to FPGAs”, Elsevier, 2004
3. Modern VLSI Design: System-on-Chip Design (3rd Edition) Wayne Wolf, Verlag.

WEB REFERENCE

1. https://www.devicelab.com/blog/what-is-a-fpga-based-system-design/

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

Semester- V

24BEEC5E06	CMOS VLSI DESIGN	3H-3C

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

End Semester Exam: 3 Hours

PRE-REQUISITE: 24BEEC443 ANALOG INTEGRATED CIRCUITS

COURSE OBJECTIVES:

The goal of this course for students is

- To learn digital CMOS logic design.
- To nurture students with CMOS analog circuit designs.
- To realize importance of testability in logic circuit design.

COURSE OUTCOMES:

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

- Analyze the performance of CMOS Inverter circuits K3
- Illustrate the components in the logic synthesis and RTL design K2
- Identify the requirements and specifications of the subsystem design K3
- Utilize the acquire knowledge about memory design K3
- Interpret the testing techniques/algorithms to test the circuits K3

UNIT I INVERTERS **9**

Review of MOS transistor equations - Passive load inverter- CMOS inverter – Transfer Characteristics, Power dissipation- Depletion mode and enhancement mode pull ups – Pseudo nMOS Inverter - Sheet resistance - Area Capacitance - Inverter delay and Logical Effort

UNIT II LOGIC SYNTHESIS AND RTL DESIGN **9**

Logic Synthesis: Impact of logic synthesis- Verilog HDL synthesis- Synthesis design flow – Verification of gate level netlist- Modeling tips for logic synthesis- RTL design: 4-bit full adder subtractor - ALU design – Booth multiplication.

UNIT III SUBSYSTEM DESIGN **9**

Design of adders-Static adder, Mirror adder, Carry Look Ahead adder, Binary adder – Multipliers Array multiplier, Carry Save multiplier, Booths and Modified Booths multiplier - Barrel shifter, Logarithmic shifter.

UNIT IV MEMORY DESIGN **9**

CAM memory, 4x4 -OR ROM, NOR ROM, NAND ROM cell array, 6-T SRAM cell, 3-T DRAM cell, Memory peripheral circuitry - Address Decoders - Sense amplifiers - Power dissipation in memories.

UNIT V CMOS TESTING **9**

Introduction to testing- Logic verification principles- Test vectors-Manufacturing test principles - Fault models- Observability, Controllability - Fault coverage – DFT- Ad-Hoc testing - Scan design – BIST- D-algorithm and Boolean difference method.

TOTAL: 45

SUGGESTED READINGS:

1. Neil H E Weste , Kamran Eshranghian , "Principles of CMOS VLSI Design: A system Perspective", Addison Wesley, 2009.
2. Jan M Rabaey , Anantha Ch , "Digital Integrated Circuits- A Design Perspective", Prentice hall of India, 2016.
3. Palnitkar Samir, "Verilog HDL: A Guide to Digital Design and synthesis", 2nd Edition, Pearson Education, New Delhi, 2017.
4. Neil Weste & David Harris, "CMOS VLSI Design-A circuits & System Perspective", 4th Edition, Pearson education, New Delhi, 2019.
5. Douglas A Pucknell , Kamran Eshranghian , "Basic VLSI Design", Prentice Hall of India, 2011.
6. Ajay Kumar Singh , "Digital VLSI Design", PHI Learning Private Limited, 2011.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc21_ee09/preview
2. https://archive.nptel.ac.in/courses/117/101/117101105/

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	1	-	2	3	1
CO2	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO3	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO4	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO5	3	2	1	-	-	-	-	-	-	1	-	2	3	1
Average	**2.8**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2.8**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-V

24BEEC5E07	WIRELESS SENSOR NETWORKS	3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC302 SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

The goal of this course for students is

- To study about Wireless networks architecture and standards.
- To acquire knowledge on various protocols.
- To learn various sensor network platforms and tools.

COURSE OUTCOMES:

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

- Explain fundamentals and challenges of in building sensor networks K2
- Illustrate the sensor node architecture and configuration of sensor networks K2
- Interpret the deployment and routing of sensor nodes K3
- Infer the design constraints of sensor node and routing K2
- Examine the programming tools for sensor networks K4

UNIT I INTRODUCTION **9**

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks

UNIT II NETWORK ARCHITECTURE **9**

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to Tiny OS and nesC, Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.

UNIT III DEPLOYMENT AND CONFIGURATION **9**

Localization and positioning, Coverage and connectivity, Single-hop and multihop localization, self-configuring localization systems, sensor management

UNIT IV NETWORK AND ROUTING PROTOCOLS **9**

Issues in designing MAC protocol for WSNs, Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and Zig Bee, Dissemination protocol for large sensor network. Issues in designing routing protocols, Classification of routing protocols, Energy efficient routing, Unicast, Broadcast and multicast, Geographic routing.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS **9**

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS3 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

TOTAL: 45

SUGGESTED READINGS:

1. Holger Kerl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Network”, John Wiley and Sons, 2005 (ISBN: 978-0-470-09511-9)

2. Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, “Wireless Sensor Network”, Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).

3. Feng Zhao, Leonidas Guibas, “Wireless Sensor Network”,Elsevier, 1st Ed. 2004 (ISBN: 13- 978- 1-55860-914-3)

4. Kazem, Sohraby, Daniel Minoli, TaiebZanti, “Wireless Sensor Network: Technology, Protocols and Application”, John Wiley and Sons 1st Ed., 2007 (ISBN: 978-0-471-74300-2).

5. B. Krishnamachari, “Networking Wireless Sensors”, Cambridge University Press.2005

WEB REFERENCE:

1. https://nptel.ac.in/courses/106105160/

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO2	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO3	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO4	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO5	3	3	2	1	-	-	-	-	-	1	-	2	3	1
Average	**2.4**	**1.6**	**1.5**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2.4**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-V

24BEEC5E08	COGNITIVE RADIO	3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC302 SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

The goal of this course for students is

- Know the basics of the software defined radios.
- Learn the design of the wireless networks based on the cognitive radios
- Understand the concepts of wireless networks and next generation networks

COURSE OUTCOMES:

The goal of this course for students is

• Interpret the design principles on software defined radio and cognitive radio networks	K3
• Construct cognitive radio architecture for spectrum sensing	K3
• Explain the concepts behind the wireless networks and next generation networks	K2
• Develop MAC and network layer for real time wireless applications	K3
• Summarize the issues and technologies of SDR and CR	K2

UNIT I SOFTWARE DEFINED RADIOS AND COGNITIVE RADIOS **9**

Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations

UNIT II COGNITIVE RADIO ARCHITECTURE **9**

Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture

UNIT III NEXT GENERATION WIRELESS NETWORKS **9**

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design**.**

UNIT IV MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO **9**

MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques.

UNIT V COGNITIVE RADIO PLATFORMS **9**

Overview of security issues in cognitive radios, auction-based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.

TOTAL: 45 PERIODS

SUGGESTED READINGS:

1. Joseph Mitola III,"Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.
2. Thomas W.Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", ARTECH HOUSE .2009.
3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.
4. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.
5. Simon Haykin, "Cognitive Radio: Brain –Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.
6. Hasari Celebi, Huseyin Arslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications, Jan 2008.
7. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.
8. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.
9. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010.

WEB REFERENCES

1. https://www.wipro.com/engineering/cognitive-radio/#:~:text=Cognitive%20radio%20(CR)%20is%20a,interference%20to%20the%20licensed%20user.

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-V

24BEEC5E09	SATELLITE COMMUNICATION	3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC302 SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

The goal of this course for students is

- Understand the basics of satellite orbits, satellite segment and earth segment
- Analyze the various methods of satellite access and coding methods
- Understand the applications of satellites

COURSE OUTCOMES:

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

- Illustrate the principle, working and operation of various sub systems of satellite as well as the earth station K2
- Outline the satellite orbits and its trajectories with the definitions of parameters associated with it K2
- Construct the satellite link based on Space segment equipment K3
- Compute the satellite link parameters under various propagation conditions with the illustration of multiple access techniques K3
- Explain the communication satellites with the focus on national satellite system K2

UNIT I SATELLITE ORBITS **9**

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non-Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.

UNIT II SPACE SEGMENT **9**

Spacecraft Technology- Structure, Primary power, Altitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem.

UNIT III SATELLITE LINK DESIGN **9**

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV SATELLITE ACCESS AND CODING METHODS **9**

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – encryption, Coding Schemes.

UNIT V SATELLITE APPLICATIONS **9**

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).

TOTAL: 45

SUGGESTED READINGS:

1. Dennis Roddy, “Satellite Communication”, 4th Edition, Mc Graw Hill International, 2017.

2. Timothy, Pratt, Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication”,2nd Edition, Wiley Publications,2002

3. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/Pearson, 2007.

4. M.Richharia, “Satellite Communication Systems-Design Principles”, Macmillan 2003.

WEB REFERENCES

1.https://www.inmarsat.com/en/insights/corporate/2023/a-straightforward-introduction-to-satellite-communications.html

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-V

24BEEC5E10 MACHINE LEARNING TECHNIQUES 3H-3C

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

End Semester Exam:3Hours

COURSE OBJECTIVES:

The goal of this course for students is

- To familiarize with the fundamental concepts of supervised, unsupervised, and reinforcement learning
- To gain expertise in diverse regression and classification models
- To delve into the outcomes of neural network and clustering fundamental algorithms

COURSE OUTCOMES:

At the end of this course students will be able to

- Interpret the supervised, unsupervised, reinforcement learning, and pre-processing techniques' fundamental concepts
- Explore the effectiveness of different regression models.
- Examine the classification and clustering algorithms in various problem
- Implement a single layer neural network and a multilayer perceptron
- Use a ML models for solving advance data problems

UNIT I INTRODUCTION AND DATA PRE-PROCESSING 09

Machine learning – Introduction – Supervised learning – Unsupervised learning – Reinforcement learning – Machine learning lifecycle – Data Preprocessing – Importing the libraries – Importing the dataset – Handling missing data – Outlier detection and removal – Handling Imbalance class - Encoding categorical data – Splitting the dataset – Feature scaling.

UNIT II REGRESSION 09

Regression – Simple linear regression – Multiple linear regression – Polynomial regression – Support vector regression – Decision tree regression – Random Forest regression – Evaluating regression models – Regression model selection.

UNIT III CLASSIFICATION 09

Classification – Logistic regression – K-Nearest neighbor – Support vector machine – Kernel SVM – Naive Bayes – Decision tree classification – Random Forest classification – XGBoost – Classification model selection – evaluating classification models

UNIT IV CLUSTERING, ASSOCIATION, REINFORCEMENT LEARNING 09

Clustering – K-Means clustering – Hierarchical clustering. Association – Apriori – Eclat algorithm. Dimensionality reduction – PCA – LDA – Kernel PCA. Reinforcement learning – Multi armed bandit problem – Upper confidence bound – Thompson sampling. Model selection – K-fold cross validation – Grid search.

UNIT V NEURAL NETWORKS 09

Basics of Neural Networks - MP neurons - perceptron - weight - bias - activation - loss function - optimizer; Artificial Neural Networks - Single Layer Neural Network - Multilayer Perceptron.

TOTAL:45

SUGGESTED READINGS:

1. Peter Wlodarczak, "Machine Learning and its Applications", 1st Edition, John Wiley, 2020.
2. Andreas C. Muller and Sarah Guido, "Introduction to Machine Learning with Python", 1stEdition, Oreilly media, 2017.
3. Wei-Meng, "Python Machine Learning", 1st Edition, John Wiley, 2019.
4. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 3rd Edition, O'Reilly Media, 2022.
5. Pratheerth Padman, "Learn Data Science from Scratch: Mastering ML and NLP with Python in a step-by-step approach", 1st Edition, BPB Publications, 2024.

WEB REFERENCES:

1. https://www.machinelearningmastery.com/supervised-and-unsupervised-machine-learning-algorithms/
2. https://www.towardsdatascience.com

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	1	1	1
CO2	2	1	-	-	-	-	-	-	-	1	-	1	1	1
CO3	3	3	2	1	-	-	-	-	-	1	-	1	1	1
CO4	3	3	2	1	-	-	-	-	-	1	-	1	1	1
CO5	3	2	1	-	-	-	-	-	-	1	-	2	3	1
Average	**2.6**	**2**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1.2**	**1**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-V

24BEEC5E11 4G/ 5G NETWORKS 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC302 SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

The goal of this course for students is

- To familiarize the student with the basic taxonomy and terminology of the 4G/5G networking area.
- To study the processes associated with 4G/5G architecture
- To understand the concept of network management in 4G/5G

COURSE OUTCOMES:

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

- Outline the evolution of 4G/5G wireless networks K2
- Illustrate the architecture of 4G/5G network standards K2
- Compare the 4G and 5G Network design K2
- Interpret the concept of Radio Access Network (RAN) and Core Network (CN) components for both 4G and 5G networks and their roles in network functionality K3
- Make use of network management of 4G/5G for different applications K3

UNIT I INTRODUCTION TO 4G/5G WIRELESS NETWORKS 9

Evolution-2G, 3G, 4G- radio access networks- need for 5G-4G versus 5G-Next Generation core(NG-core), visualized Evolved Packet core(vEPC)-Introduction to LTE Architecture and Protocols 5G Architecture and Protocols.

UNIT II 4G NETWORK ARCHITECTURE 9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

UNIT III 5G NETWORK ARCHITECTURE **9**

Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E- UTRAN architecture - mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT IV RADIO ACCESS NETWORK FOR 5G NR **9**

5G NR requirements - 5G Core Network Architecture - Radio-Access Network (RAN)- Radio Protocol Architecture -User Plane Protocols-Radio Link Control - Medium-Access Control – Physical Layer functions -Control Plane Protocols - Network Slicing- RAN virtualization-Spectrum Management in 5G

UNIT V NETWORK MANAGEMENT IN 4G/5G **9**

Network Slicing in 4G/5G Networks Mobile Edge Computing (MEC) and 4G/5G Networks- Internet of Things (IoT) and 4G/5G Networks- Machine-to-Machine (M2M) Communications in 4G/5G Networks- Network Function Virtualization (NFV) and Software-Defined Networking (SDN) for 4G/5G Networks

TOTAL: 45

SUGGESTED READINGS:

1. From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband, 4th Edition,2021.
2. An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases, Saro Velrajan,First Edition, 2020.
3. M. Vaezi, Z. Ding, and H. V. Poor, “Multiple Access techniques for 5G Wireless Networks and Beyond”., Springer Nature, Switzerland, 2019
4. Manish, M., Devendra, G., Pattanayak, P., Ha, N., “5G and Beyond Wireless Systems PHY Layer Perspective”, Series in Wireless Technology Springer, 2021
5. Harri Holma, Antti Toskala, Takehiro Nakamura, “5G Technology 3GPP NEW RADIO”, John Wiley & Sons First Edition,2020

WEB REFERENCES:

1. https://www.koenig-solutions.com/4g-wireless-networks
2. https://www.digi.com/blog/post/what-is-lte
3. https://community.fs.com/article/what-is-radio-access-network-ran-in-5g.html

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester- V

24BEEC5E12 DATA COMMUNICATION NETWORKS 3H-3C

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

End Semester Exam:3Hours

PRE-REQUISITE: 24BEEC302 SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

The goal of this course for students is

- To learn the network models and link layer principles.
- To understand services of MAC and Network layer.
- To explore congestion control methods by transport layer
- To lean the role of application layer and its protocols
- To know the basic concepts of network security and security algorithms

COURSE OUTCOMES

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

- Explain network components, layers and its functions K2
- Apply the function of network routing protocols and addressing methods for packet transmission K3
- Outline the functions of transport layer to ensure QoS K2
- Describe the principles of application layer K2
- Categorize and classify the network security mechanisms K4

UNIT I INTRODUCTION 9

Overview of Communication networks, network applications, network software, network hardware, reference models: OSI, TCP/IP, Internet, Physical Layer - guided transmission media, overview of data and signals, Introduction to Data link layer- Addressing- Error Detection and Correction.

UNIT II MAC LAYER & INTERNETWORKING 9

Introduction to MAC layer – Multiple access protocols – Ethernet (802.3) – Wireless LAN – IEEE 802.11 protocols – Bluetooth – WiFi – 6LowPAN- Zigbee-Network layer services – Network layer design issues- IPV4 – IPV6 addressing – Internetworking.

UNIT III TRANSPORT LAYER 9

Transport layer services – Elements of transport protocols – User Datagram protocols – Transport control protocols – UDP and TCP Connection and State Transition Diagram – Error and Congestion Control – Congestion avoidance (DECbit, RED) – QoS.

UNIT IV APPLICATION LAYER 9

Introduction to application layer – Domain Name System – World Wide Web – Multimedia – Electronic Mail – application layer protocols – Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Telnet.

UNIT V NETWORK SECURITY 9

Network attacks – services- mechanisms – Firewalls – Encryption – DES & AES – Public key cryptography algorithms – RSA- Diffle-Hellman key exchange algorithm – Elliptic curve cryptography – hash functions – birthday attacks.

TOTAL: 45

SUGGESTED READINGS

1. Behrouz.A. Forouzan, Data Communication and Networking, Fifth Edition, TMH. 2017.
2. William Stallings. Cryptography and Network Security, Seventh Edition. Pearson Education 2017.
3. James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Seventh Edition, Pearson Education, 2016.
4. Doughlas. E.Comer, Computer Networks and Intermets with Internet Applications, Fourth Edition, Pcarson Education, 2008
5. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, Mc Graw Hill Publisher, 2011.

WEB REFERENCES

1. https://www.geeksforgeeks.org/data-communication-definition-components-types-channels/
2. https://www.sciencedirect.com/topics/computer-science/data-communication-network

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO2	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO3	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO4	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO5	3	3	2	1	-	-	-	-	-	1	-	2	3	1
Average	**2.4**	**1.6**	**1.5**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2.4**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-VI

24BEEC6E01	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

PRE-REQUISITE: 24BEEC441 DIGITAL SIGNAL PROCESSING

COURSE OBJECTIVES:

The goal of this course for students is

- To understand the hardware requirement of BAN
- To know the communication and security aspects in the BAN
- To implement the applications of BAN in the field of medicine

COURSE OUTCOMES:

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

- Outline the challenges, reliability and the nodes available in the network K2
- Choose a BAN for appropriate application in medicine K3
- Identify the network technologies that are widely used in this environment K3
- Interpret the various contemporary issues that are associated with the network K3
- Utilize the concepts of BAN for medical applications. K3

UNIT I INTRODUCTION **9**

Definition on Body Area Networks, Pervasive Patient Monitoring using BAN, Technical Challenges-Sensor design, biocompatibility, Energy Supply, Context Awareness, Integrated Therapeutic Systems, System security and reliability, Ideal BSN Architecture.

UNIT II HARDWARE TECHNOLOGIES FOR BAN **9**

Wireless communication - RF communication in Body, Antenna design and testing, Matching Network, Propagation, Materials, Base Station, Power considerations, Wireless communication technologies for Wearable systems, Body Area Network – Human Applications.

UNIT III NETWORK TOPOLOGIES AND WIRELESS COMMUNICATION **9**

Network Topologies - Stand –Alone BAN, Wireless personal Area Network Technologies. Standards - IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee, Healthcare system standards.

UNIT IV REGULATORY ISSUES WITH BAN **9**

Interferences – Intrinsic - Extrinsic, Effect on transmission, Regulatory Issues - Medical Device regulation in Asia, Security and Self-Protection-Bacterial attacks, Virus infection, secured protocols, Self-protection.

UNIT V VARIOUS APPLICATIONS OF BAN **9**

Monitoring patients with infected disease, Hospital patients, old age patients, Cardiac arrhymias monitoring, Multi patient caring systems, Multichannel Neural recording, Gait analysis, Smart Garments, Electronic pill with modern instruments.

TOTAL: 45 PERIODS

SUGGESTED READINGS

1. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body AreaNetworks Safety, Security, and Sustainability’’, Cambridge University Press, 2013
2. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012
3. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.
4. Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006.
5. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011

WEB REFERENCES

1. https://www.waves.intec.ugent.be/research/wireless-body-area-networks
2. https://www.geeksforgeeks.org/wireless-body-area-network/

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-VI

24BEEC6E02 DIGITAL IMAGE PROCESSING 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC441 DIGITAL SIGNAL PROCESSING

COURSE OBJECTIVES:

The goal of this course for students is

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques and restoration techniques
- To study the image segmentation and image compression techniques

COURSE OUTCOMES:

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

- Describe basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms K2
- Apply the Spatial and frequency domain techniques of an image for image enhancement K3
- Make use of restoration techniques to recover degraded images K3
- Employ image processing algorithms for extraction of region of interest K2
- Utilize appropriate techniques for compression and recognition of images K3

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters,

Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics– Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering– Inverse Filtering – Wiener filtering

UNIT IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL:45 PERIODS

SUGGESTED READINGS:

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Fourth Edition,2013.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', first edition ,Pearson, 2015.
3. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2011.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
5. D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
6. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2007

WEB REFERNCES:

1. www.homepages.inf.ed.ac.uk/rbf/CVonline/LOCAL_COPIES/TUDELFT/FIP2_3.pdf
2. www.slideshare.net/abhiabhinay/image–enhancement–techniques–24165028
3. www.owlnet.rice.edu/~elec539/Projects99/BACH/proj2/intro.html
4. www.tutorialspoint.com/dip/

CO, PO, PSO Mapping:

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CO4	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO5	3	2	1	-	-	-	-	-	-	1	-	2	3	1
Average	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2.8**	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-VI

24BEEC6E03	SPEECH PROCESSING	3H-3C

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

End Semester Exam:3 Hours

PREREQUISITE: 24BEEC441 DIGITAL SIGNAL PROCESSING

COURSE OBJECTIVES:

The goal of this course for students is

- To understand the speech production mechanism and the various speech analysis techniques
- To understand the speech recognition, speech synthesis and speaker identification techniques
- To introduce some applications of speech and audio signal processing

COURSE OUTCOMES:

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

- Describe the basic concepts of Speech processing and Speech recognition Systems K2
- Design speech compression techniques K4
- Configure speech recognition techniques K3
- Apply the knowledge of in designing different speaker recognition systems K3
- Make an effective oral presentation on different Speech recognition models and their synthesis techniques K3

UNIT I FUNDAMENTALS OF DIGITAL SPEECH PROCESSING 9

Speech production: Mechanism of speech production- Classification of Speech Sounds-Acoustic phonetics-Review of Digital Signal Processing Concepts; Short Time Fourier Transform, Pitch Detection, End Point Detection, Voiced/Unvoiced Detection, Speech Distortion Measures – Mathematical and Perceptual, Speech Quality Assessment

UNIT II LINEAR PREDICTIVE CODING (LPC) ANALYSIS 9

Basic principles of Linear Predictive Analysis-The Autocorrelation Method-The Covariance Method-Solution of the LPC Equations -Comparison between the Methods of Solution of the LPC Analysis

Equations- The Prediction Error Signal- Applications of LPC Parameters: Pitch Detection using LPC Parameters-Formant Analysis using LPC Parameters

UNIT III SPEECH RECOGNITION AND MODELLING 9

Basic pattern recognition approaches- Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n grams- context dependent sub-word units- Parametric representation of speech-Evaluating the similarity of speech patterns-Isolated digit Recognition System-Continuous digit Recognition System-Hidden Markov Model (HMM) for Speech: Hidden Markov Model (HMM) for speech recognition- Viterbi algorithm-Training and testing using HMMS.

UNIT IV SPEAKER RECOGNITION AND SPEECH SYNTHESIS 9

Speaker Recognition: Acoustic parameters for speaker verification -Recognition techniques-Features that distinguish speakers-Speaker Recognition Systems: Speaker Verification System-Text dependent speaker verification-Text independent speaker verification techniques-Speaker Identification.

Speech Synthesis: Text to speech synthesis (TTS)-Concatenative and waveform synthesis methods, sub-word units for TTS-intelligibility and naturalness-role of prosody,-Applications and present status.

UNIT V APPLICATION OF SPEECH & AUDIO SIGNAL PROCESSING 9

Algorithms: Dynamic time warping-K-means clustering and Vector quantization-Gaussian mixture modelling-Hidden Markov modelling. Automatic Speech Recognition- Feature Extraction for ASR-Deterministic sequence recognition-Statistical Sequence-Recognition-Language models-Speaker identification and verification-Voice response system-Speech synthesis-Basics of articulatory-Source-filter-Concatenative synthesis.

TOTAL :45 PERIODS

SUGGESTED READINGS:

1. Lawrence Rabiner and Biing, “Fundamentals of Speech Recognition”, Pearson Education, Reprint, 2008
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education,Reprint, 2013

3. Gerardus Blokdyk, “Speech Recognition A Complete Guide” , Kindle Edition,2020
4. Uday Kamath, John Liu, James Whitaker, “Deep Learning for NLP and Speech Recognition”, Springer International Publishing,2019
5. Ben Gold and Nelson Morgan, “Speech and Audio Signal Processing, Processing and Perception of Speech and Music”, Wiley– India Edition, Second Edition,2011.

WEB REFERENCES:

1. https://research.iaun.ac.ir/pd/mahmoodian/pdfs/UploadFile_2643.pdf
2. https://speechprocessingbook.aalto.fi,

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO2	3	3	2	1	-	-	-	-	-	1	-	2	3	1
CO3	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO4	3	2	1	-	-	-	-	-	-	1	-	2	3	1
CO5	3	2	1	-	-	-	-	-	-	1	-	2	3	1
Average	**2.8**	**2**	**1.25**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2.8**	**1**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

Semester-VI

24BEEC6E04 ADVANCED DSP 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC441 DIGITAL SIGNAL PROCESSING

COURSE OBJECTIVES:

The goal of this course for students is

- To learn and understand the concepts of stationary and non-stationary random signals and analysis & characterization of discrete-time random processes
- To enunciate the significance of estimation of power spectral density of random processes and to introduce the principles of optimum filters such as Wiener and Kalman filters
- To introduce the principles of adaptive filters and their applications to communication Engineering and concepts of multi-resolution analysis

COURSE OUTCOMES:

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

- Articulate and apply the concepts of special random processes in practical applications K3
- Choose appropriate spectrum estimation techniques for a given random process K3
- Apply optimum filters appropriately for a given communication application K3
- Apply appropriate adaptive algorithm for processing non-stationary signals K3
- Analyze wavelet transforms for signal and image processing-based applications K4

UNIT I DISCRETE-TIME RANDOM SIGNALS 9

Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Auto covariance properties and matrices, White noise, Power Spectral Density, Spectral Factorization, Innovations Representation and Process, Filtering random processes, ARMA, AR and MA processes.

UNIT II SPECTRUM ESTIMATION 9

Bias and consistency, non-parametric methods - Periodogram, modified-Periodogram -Performance

analysis. Bartlett's method, Welch's method, Blackman-Tukey method. Performance comparison. Parametric methods - autoregressive (AR) spectrum estimation – autocorrelation method, Prony's method, solution using Levinson Durbin recursion.

UNIT III OPTIMUM FILTERS 9

Wiener filters - FIR Wiener filter - Discrete Wiener Hopf equation, Applications - filtering, linear prediction. IIR Wiener filter - Causal and non-causal filters. Recursive estimators - Discrete Kalman filter.

UNIT IV ADAPTIVE FILTERS 9

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms - Steepest descent algorithm, the LMS algorithm - Convergence. Applications of adaptive filtering - Noise cancellation, Channel equalization

UNIT V MULTIRESOLUTION ANALYSIS 9

Short-time Fourier transform - Heisenberg uncertainty principle. Principles of multi-resolution analysis - Sub-band coding, the continuous and discrete wavelet transform - Properties. Applications of wavelet transform - Noise reduction, Image compression.

TOTAL: 45 PERIODS

SUGGESTED READINGS:

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.
3. John G. Proakis & Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications‖, 21 st impression -2017, Pearson Education / Prentice Hall, 2017.
4. Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000

WEB REFERNCES:

1. http://www.signal.uu.se/Courses/CourseDirs/SignalbehandlingIT/forelas08.pdf2.
2. https://www.staff.ncl.ac.uk/oliver.hinton/eee305/Chapter7.pdf
3. https://cims.nyu.edu/~cfgranda/pages/OBDA_fall17/notes/multiresolution.pdf

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester-VI

24BEEC6E05 HUMAN ASSIST DEVICES 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC441 DIGITAL SIGNAL PROCESSING

COURSE OBJECTIVES:

The goal of this course for students is

- To study the role and importance for human assist devices.
- To understand the facilitates the removal of urea from the bloodstream.
- To study about sensory exploration.

COURSE OUTCOMES:

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

- Explain the principles and construction of artificial heart K2
- Understand various mechanical techniques that improve therapeutic technology K2
- Explain the functioning of the membrane or filter that cleanses the blood K2
- Describe the measurement techniques of Respiratory responses K2
- Analyze and research on sensory perception K4

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Mock test setup for assessing its Functions. Artificial intelligence in assist devices.

UNIT II CARDIAC ASSIST DEVICES & INTERVENTIONAL TECHNIQUES 9

Principle of External counter pulsation techniques, intra-aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves. Future directions in cardiac assist device.

UNIT III HEMODIALYSIS AND ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV RESPIRATORY AND HEARING AIDS 9

Mechanism of hearing, sound conduction system - basic audiometer, pure tone audiometer - Speech audiometer, Bekesy audiometer system - Evoked response audiometry system - Hearing aids-cochlear implants - Tonometry - Measurement of basal skin response and galvanic skin response.

UNIT V SENSORY AUGMENTATION AND SUBSTITUTIONS 9

Classification of Visual Impairments, Prevention and cure of visual impairments, Visual Augmentation, Tactile vision substitution, auditory substitution and augmentation, tactile auditory substitution, Assistive devices for the visual impaired. IoT based assist devices.

SUGGESTED READINGS:

1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.
2. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd – 2004
3. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006
4. Andreas.F. Von racum, “Hand book of bio material evaluation”, Mc-Millan publishers, 1980.
5. Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004.
6. D.S. Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2010

CO, PO, PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO2	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO3	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO4	2	1	-	-	-	-	-	-	-	1	-	2	2	1
CO5	3	3	2	1	-	-	-	-	-	1	-	2	3	1
Average	**2.2**	**1.4**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2.2**	**1**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

Semester-VI

24BEEC6E06 MEDICAL IMAGING SYSTEMS 3H-3C

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

End Semester Exam:3 Hours

PRE-REQUISITE: 24BEEC441 DIGITAL SIGNAL PROCESSING

COURSE OBJECTIVES:

The goal of this course for students is

- To understand the X-ray machine and Computed Tomography.
- To know the techniques used for generation and detection of ultrasonic imaging systems.
- To learn the principles of nuclear magnetic imaging and radiation therapy techniques

COURSE OUTCOMES:

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

- Infer the working principle of the X-ray machine and its application K2
- Explain the principle and operation of computed tomography K2
- Interpret the technique used for generation and detection of ultrasonic imaging systems K3
- Outline the applications nuclear magnetic imaging K2
- Identify different imaging techniques K3

UNIT I X-RAY MACHINE AND DIGITAL RADIOGRAPHY 9

Diagnostic radiology, Nature of X-rays, Properties of X-rays, units of X-radiation, Production of X-rays; stationary anode tube, collimators and grids, exposure timing systems, automated exposure control, Visualization of X-rays Machine; X-ray films, fluorescent screens, x-ray image intensifier television system.

UNIT II COMPUTED TOMOGRAPHY 9

Principle of Computed Tomography, Contrast Scale, System components- scanning system, processing system, viewing system Image reconstruction techniques – back projection and iterative method.

UNIT III ULTRASONIC IMAGING SYSTEMS 9

Diagnostic ultrasound, Physics of ultrasonic waves-Characteristic impedance, wavelength and frequency, velocity of propagation, absorption of ultrasonic energy, beam width, resolution, generation and detection ultrasound; Medical ultrasound; Basic pulse echo apparatus; A scan- applications; B scanner- types of scan, imaging instrumentation; Biological effects of ultrasound.

UNIT IV NUCLEAR MAGNETIC IMAGING SYSTEMS 9

Radio-isotopes in medical diagnosis; Physics of radioactivity: time decay of radioactive isotopes, units of radioactivity, types and properties of particles emitted in radioactive decay; The gamma camera-basic idea and it's electronics; emission computed tomography (ECT); Single-Photon-Emission computed tomography (SPECT); Position Emission tomography (PET scanner).

UNIT V RADIATION THERAPY AND RADIATION SAFETY 9

Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles

TOTAL PERIODS:45

SUGGESTED READINGS

1. Khin Wee Lai, Dyah Ekashanti Octorina Dewi "Medical Imaging Technology", Springer Singapore, 2015.
2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis, SPIE Press 2000.
3. Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press, 2000.
4. Dougherty, Geoff (Ed.), "Medical Image Processing - Techniques and Applications ",Springer-Verlag New York, 2011
5. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi,2003.

WEB REFERENCES

1. https://link.springer.com/book/10.1007/978-3-319-96520-8
2. https://onlinecourses.nptel.ac.in/noc21_bt50/preview

CO, PO, PSO Mapping:

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

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation