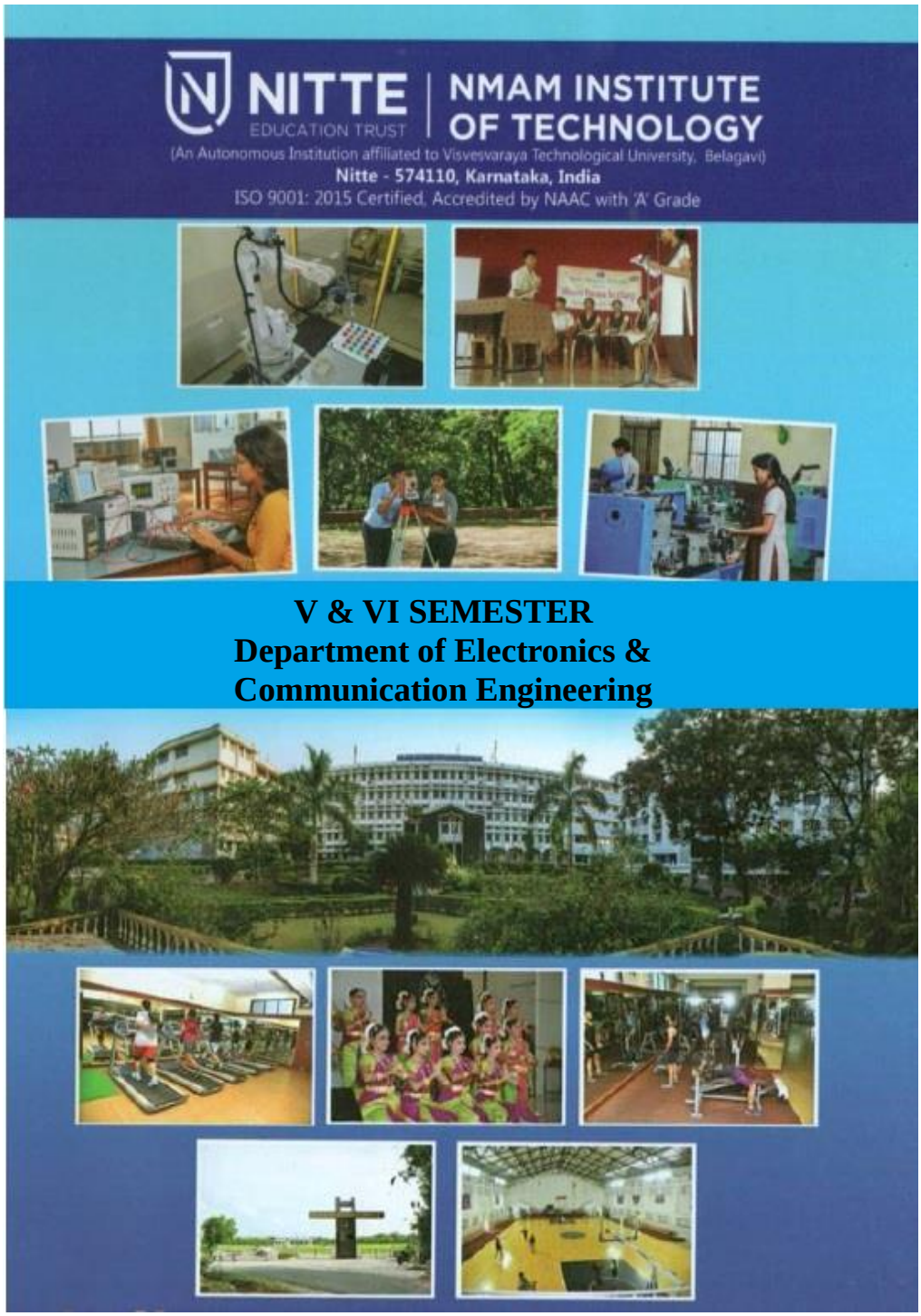
NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

College Calendar 2023-24

Department of Electronics & Communication Engineering

Syllabus of 3rd Year



College Calendar 2023-24

मातेव रक्षति पितेव हिते नियुङ्क्ते
कान्तेव चापि रमयत्यपनीय खेदम् ।
लक्ष्मीं तनोति वितनोति च दिक्षु कीर्तिं
किं किं न साधयति कल्पलतेव विद्या ॥

ಮಾತೇವ ರಕ್ಷತಿ ಪಿತೇವ ಹಿತೇ ನಿಯುಂಕ್ತೇ
ಕಾಂತೇವ ಚಾಪಿ ರಮಯತ್ಯಪನೀಯ ಖೇದಮ್ ।
ಲಕ್ಷ್ಮೀಂ ತನೋತಿ ವಿತನೋತಿ ಚ ದಿಕ್ಷು ಕೀರ್ತಿಂ
ಕಿಂ ಕಿಂ ನ ಸಾಧಯತಿ ಕಲ್ಪಲತೇವ ವಿದ್ಯಾ ॥

ತಾಯಿಯಂತೆ ರಕ್ಷಣೆಯನ್ನಿತ್ತು, ತಂದೆಯಂತೆ ಸನ್ಮಾರ್ಗದಲ್ಲಿ ತೊಡಗಿಸಿ ಪತ್ನಿಯಂತೆ ದುಃಖವನ್ನು ದೂರಮಾಡಿ ಮನಕ್ಕೆ ಮುದಕೊಡುತ್ತಾ, ಸಂಪತ್ತನ್ನು ವರ್ಧಿಸಿ ದಶದಿಕ್ಕುಗಳಲ್ಲಿ ಕೀರ್ತಿಯನ್ನು ಪಸರಿಸುವ 'ವಿದ್ಯೆ', ಕಲ್ಪಲತೆಯಂತೆ ನಾವು ಬಯಸಿದ್ದನ್ನು ಕೊಡುತ್ತಾಳೆ.

विद्या माता की तरह पालन करती है, बाप के तरह हितकर मार्ग में ही ले लेता है। पत्नी की तरह हमारा दुःख दूर करता है। मन को संतोष देता है, धन देती है, दिशाओं में कीर्ति फ़ैलाती है । कल्पवल्ली की तरह वह सब कामनाये पूरी करती है ।

Do you know in how many ways the 'Knowledge' serves his master? Like mother it protects, like father it teaches and guides, like wife, provides all kinds of happiness after destroying all sorrows, it brings wealth from every corner and spreads the fame in all direction. Like 'Kalpalatha' knowledge offers everything to human being whatever he wishes.

(An Autonomous Institution affiliated to VTU, Belgavi)
NITTE-574110, Karkala Taluk, Udupi District, Karnataka, India
ISO 9001:2015 Certified, Accredited by NAAC with "A" Grade

COLLEGE CALENDAR
2023-24
(V & VI Semester)

(An Autonomous Institution affiliated to VTU, Belgavi)
NITTE-574110, Karkala Taluk, Udupi District, Karnataka, India
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Vision Statement

Pursuing Excellence, Empowering people, Partnering in Community Development

Mission Statement

To develop N.M.A.M. Institute of Technology, Nitte, as Centre of Excellence by imparting Quality Education to generate competent,
Skilled and Humane Manpower to face emerging Scientific, Technological, Managerial and Social Challenges
with Credibility, Integrity, Ethics and Social Concern.

In Memorium

Late Nitte Mahalinga Adyanthaya

Our Founder

Late Justice K. S. Hegde

1909-1990

SRI N. VINAYA HEGDE

President, Nitte Education Trust
Chancellor, Nitte (Deemed to be University), Mangaluru

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

Sl.No.	Name of the Faculty	Designation
1.	Dr. N. Niranjan Chiplunkar	Principal
2.	Mr. Yogeesh Hegde	Director(CM&D)
3.	Dr. Shrinivasa Rao B. R.	Vice Principal/Controller of Examinations/Professor
4.	Dr. I. Ramesh Mithanthaya	Vice Principal / Dean (Academic)/Professor
5.	Dr. Sudesh Bekal	Dean (R&D)/Professor
6.	Dr. Rajesh Shetty K.	Dean (Admissions)/Professor
7.	Dr. Rekha Bhandarkar	Deputy Registrar of Nitte Off-campus Centre, Nitte (DU)
8.	Dr. Subrahmanya Bhat K	Deputy COE of Nitte Off-campus Centre, Nitte (DU)
9.	Dr. Nagesh Prabhu	Director(Curriculum Development) Nitte (DU)
10.	Dr. Srinath Shetty K.	Resident Engineer/Professor
11.	Dr. Narasimha Bailkeri	Dean(Student Welfare)/Professor
12.	Dr. Rajalakshmi Samaga BL	PG Coordinator/Professor

HEADS OF DEPARTMENTS

1.	Dr. Arun Kumar Bhat	HoD, Civil Engg.
2.	Dr. Jyothi Shetty	HoD, Comp. Science & Engg
3.	Dr. Ashwini B	HoD, Information Science & Engg
4.	Dr. Ujwal P	HoD, Biotechnology
5.	Dr. KVSSSS Sairam	HoD, E&C Engg.
6.	Dr. Suryanarayana K	HoD, E&E Engg.
7.	Dr. Muralidhara	HoD, Robotics & Artificial Intelligence
8.	Dr. Kumudakshi	HoD, Mathematics
9.	Dr. Shobha R. Prabhu	HoD, Physics
10.	Dr. Shivaprasad Shetty M.	HoD, Chemistry
11.	Dr. Mamatha Balipa	HoD, MCA
12.	Dr. Vishwanatha	HoD, Humanities

13.	Dr. Udaya Kumar K Shenoy	HoD, Computer & Communication Engg
14.	Dr. Sharada Uday Shenoy	HoD, Artificial Intelligence & Machine Learning
15.	Dr. Srinivas Pai P	HoD, Mechanical Engg
16.	Dr. Venugopala PS	HoD, Artificial Intelligence & Data Science
17.	Mr. Bharath G Kumar	Head, Training & Placement Cell

INCHARGE OF INSTITUTION'S RESPONSIBILITIES

1.	Dr. Shashikanth Karinka	Co-ordinator MoUs
2.	Dr. Gururaj Upadhyaya	Workshop Suptd
3.	Dr. Joy Elvine Martis	1st year Coordinator
4.	Dr. Jnaneshwar Pai Maroor	Co-ordinator Alumni
5.	Dr. Venkatesh Kamath	Assistant CoE
6.	Dr. Janardhan Nayak	Co-ordinator – Red Cross Unit
7.	Mr. Srinivas Nekkar	NCC Officer
8.	Mr. Krishnaraja Joisa	Public Relation Officer
9.	Mr. K. Sathish Nayak	Digital Media Executive
10.	Sri. Shekar Poojari	Student Welfare Officer

ENTREPRENEURSHIP DEVELOPMENT CELL

1.	Dr. Ramakrishna B	Professor/EDC- Incharge
2.	Mrs. Geetha Poojarthi	Co-ordinator

DEPARTMENT OF TRAINING & PLACEMENT

1.	Mr. Ankith S Kumar	Counsellor

DEPARTMENT OF MATHEMATICS

1.	Dr. Shashirekha B. Rai	Professor
2.	Dr. Kumudakshi	Asso. Professor/ HoD
3.	Dr. Sharad M. Hegde	Asst. Professor Gd III
4.	Dr. Vasanth K.R	Asst. Professor Gd III
5.	Dr. Ashwini Kumari	Asst. Professor Gd III
6.	Dr. Chaithra K.	Asst. Professor Gd III
7.	Dr. Prashanthi K S	Asst. Professor Gd III

8.	Dr. Girija K P	Asst. Professor Gd III
9.	Dr. Ganesh Kumar K	Asst. Professor Gd III
10.	Mrs. Ambika N.	Asst. Professor Gd I
11.	Mrs. Vinaya Acharya	Asst. Professor Gd I
12.	Mrs. Anitha D. Bayar	Asst. Professor
13.	Mrs. Bhavya K.	Asst. Professor
14.	Mrs. Bhavya. D.	Asst. Professor
15.	Mrs. Sharmila	Asst. Professor
16.	Mrs. Anjana Pai K	Asst. Professor
17.	Mrs. Soumya	Asst. Professor
18.	Mrs. Smitha G. V.	Asst. Professor

DEPARTMENT OF PHYSICS

1.	Dr. Manjunath K. B.	Professor
2.	Dr. Shobha R. Prabhu	Asso. Professor / HoD
3.	Dr. Sathyajith	Asso. Professor
4.	Dr. Raghavendra Bairy	Asso. Professor
5.	Dr. Nagaraja B.S.	Asst. Professor Gd III
6.	Dr. Shyam Prasad . K.	Asst. Professor Gd III
7.	Dr. Saritha Suvarna	Asst. Professor Gd III

DEPARTMENT OF CHEMISTRY

1.	Dr. Janardhana Nayak	Professor
2.	Dr. Ramesh Bhat	Asso. Professor
3.	Dr. Shivaprasad Shetty M.	Asso. Prof/HoD
4.	Dr. Aarti S. Bhat	Asst. Professor Gd III
5.	Dr. Subrahmanya Ishwar Bhat	Asst. Professor Gd III
6.	Dr. Sarvajith MS	Asst. Professor Gd III
7.	Dr. Ranjitha	Asst. Professor Gd III

DEPARTMENT OF HUMANITIES

1.	Dr. Ramakrishna B.	Professor
2.	Mrs. Rashmi D. Hegde	Asso. Professor

3.	Dr. Vishwanatha	Asso. Professor /HoD
4.	Dr. Jnaneshwar Pai Maroor	Asst. Professor Gd III
5.	Dr. Joy Elvine Martis	Asst. Professor Gd III
6.	Mrs. Shyla D Mendonca	Asst. Professor Gd II
7.	Ms. Sonia Lobo	Asst. Professor Gd I
8.	Ms. Akshatha Kumari J Shetty	Asst. Professor Gd I
9.	Mr. Srinivas Nekkar	Asst. Professor
10.	Mrs. Sudeeksha S. Pai	Asst. Professor
11.	Mrs. Shwetha	Asst. Professor

OFFICE SECTION HEADS

1.	Mr. Keshava Mugeraya	Sr. Suptd, Academic Section/ Purchase In -Charge
2.	Mrs. Suneetha R. Shetty	Sr. Suptd, Administrative Section
3.	Mr. Suresh Achar	Sr. Suptd, Stores
4.	Mrs. Jayashree	Sr. Programmer, Office Automation Cell
5.	Mrs. Shailaja V. Shetty	Suptd, Accounts Section
6.	Dr. Preetham Shetty KV	Librarian

SECURITY DEPARTMENT

1.	Mr. Hirianna Suvarna S	Security Supervisor

SPORTS DEPARTMENT

1.	Sri. Shyam Sundar M.	P.E.D
2.	Sri. Ganesh Poojary	P.E.D
3.	Ms. Sowjanya M.	P.E.I
4.	Mr. Ravi Prakash C. Anpur	Basket Ball Coach
5.	Mr. Clive Nolan Mascarenhas	Football Coach
6.	Mr. Rajesh Acharya	Cricket Coach

HOSTEL WARDENS

1.	Dr. Veena Devi S.V	Chief Warden, NET Ladies Hostels, Nitte
2.	Dr. Vishwanatha	Chief Warden, NET Gents Hostels, Nitte

HOSTEL SUPERINTENDENT / MANAGER

1.	Mr. John D'Souza	Sr. Manager, Gents Main Hostel
2.	Mr. Manjunatha Suvarna	Hostel Manager, Gents Main Hostel
3.	Mr. Rajesh Ballal	Manager, Gents PG Hostel
4.	Mrs. Gayathri Kamath	Manager, Ladies PG Hostel
5.	Mrs. Chethana Sharma	Manager, Ladies Main Hostel
6.	Mrs. Hema S. Hegde	Superintendent, Hostel Office

REGULATIONS

2023-24

(Applicable for admission batch 2021-22 onwards)

NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

CONTENTS

REGULATIONS

REGULATIONS COMMON TO ALL B.E. (CREDIT SYSTEM) DEGREE PROGRAMMES OF NMAM INSTITUTE OF TECHNOLOGY, NITTE

Karkala, Udupi Dist., Karnataka

1. INTRODUCTION

1.1 The general regulations are common to all B.E. (Credit System) Degree Programmes conducted at the NMAMIT, Nitte Campus and shall be called "NMAMIT Regulations".

1.2 The provisions contained in this set of regulations govern the policies and procedures on the Registration of students, imparting Instructions of course, conduct of the examination and evaluation and certification of student's performance and all amendments related to the said Degree programme(s).

1.3 This set of Regulations, on approval by the Academic Council and Governing Council, shall supersede all the corresponding earlier sets of regulations of the BE Degree program (of VTU) along with all the amendments thereto, and shall be binding on all students undergoing the Graduate Degree Programme(s) (Credit System) conducted at the NMAMIT, Nitte with effect from its date of approval. **This set of Regulations, may evolve and get modified or changed through appropriate approvals from the Academic Council / Governing Council from time to time, and shall be binding on all stake holders (The Students, Faculty, Staff of Departments of NMAMIT, Nitte). The decision of the Academic Council/ Governing Council shall be final and binding.**

1.4 In order to guarantee fairness and justice to the parties concerned in view of the periodic evolutionary refinements, any specific issues or matters of concern shall be addressed separately, by the appropriate authorities, as and when found necessary.

1.5 The Academic Council may consider any issues or matters of Concern relating to any or all the academic activities of NMAMIT courses for appropriate action, irrespective of whether a reference is made here in

this set of Regulations or otherwise.

1.6 The course shall be called **Bachelor of Engineering** course abbreviated as B.E. (Subject of specialization) – Credit System.

1.7 **DURATION OF THE COURSE**

(a) The course shall extend over a period of total duration of 4 years.

(b) Each year shall have the following schedule with **5** ½ days a week.
Suggested Break down of Academic Year into Semesters

1. No. of Semesters / Year	Three; Two being Main semesters (odd, even) and one being a supplementary semester; after 2 main semesters. (Note: Supplementary semester is primarily to assist weak and / or failed students through make up courses. However, Autonomous Colleges may use this semester to arrange Add-On courses for other students and / or for deputing them for practical training elsewhere.)
2. Semester Duration	Main semester (odd, even) each 19 Weeks; Supplementary Semester 8 Weeks
3. Academic Activities	Main Semester
(Weeks):	Registration of Courses & Course Work (16.0) Examination Preparation and Examination (3.0) Total (19) Supplementary Semester Registration of Courses & Course Work (5.0)

	Examination Preparation and Examination (3.0) Total (8) Declaration of results: 2 weeks from the date of last examination Inter- Semester Recess: After each Main Semester (2) Total Vacation: 10 weeks (for those who do not register for supplementary semester) and 4 weeks (for those who register for supplementary semester)

(Note: In each semester, there will be provision for students for Registration of courses at the beginning, dropping of courses in the middle and withdrawal from courses towards the end, under the advice of faculty member. These facilities are expected to enhance the learning capabilities of students, minimizing their chances of failure in courses registered and also ensure their better monitoring by Faculty Advisors).

A candidate shall be allowed a maximum duration of eight years from the first semester of admission to become eligible for the award of Bachelor Degree.

The calendar of events in respect of the course shall be fixed by the Senate from time to time, but preferably in line with the academic calendar of the VTU.

2. DEGREE PROGRAMMES

2.1 Undergraduate B.E. Degree Programmes are offered in the following disciplines by the respective programme hosting departments listed below:

i)	**Biotechnology Engineering**	**(BT)**
ii)	**Civil Engineering**	**(CV)**
iii)	**Computer Science & Engineering**	**(CS)**
iv)	**Electronics & Communications Engineering**	**(EC)**
v)	**Electrical & Electronics Engineering**	**(EE)**
vi)	**Information Science & Engineering**	**(IS)**
vii)	**Mechanical Engineering**	**(ME)**
viii)	**Artificial Intelligence and Machine Learning Engg.**	**(AM)**
ix)	**Computer and communication Engineering**	**(CC)**
x)	**Robotics and Artificial Intelligence Engineering**	**(RA)**

Other teaching departments are –

i)	**Mathematics**	**(MA)**
ii)	**Physics**	**(PH)**
iii)	**Chemistry**	**(CY)**
iv)	**Humanities, Social Sciences and Management**	**(HU)**

2.2 The provisions of these Regulations shall be applicable to any new discipline* that may be introduced from time to time and appended to the above list.

3. REGISTRATION

3.1 Every student after consulting his Faculty Advisor in parent department shall register approved courses (core and elective) to earn credits for meeting the requirements of degree program at the commencement of each Semester on the days fixed for such registration and notified in the academic calendar. Students who fail to register on or before the specified date will have to pay a late fee. Such courses together with their grade and credits earned will be included in the grade card issued by the college at the end of each semester, like odd, even, supplementary and it forms the basis for determining the student's performance in that semester.

3.2 **Lower and Upper Limits for Course Credits Registered in a Semester**
Course Credit Assignment

All courses comprise of specific Lecture/Tutorial/Practical (L-T-P) schedule. The course credits are fixed based on the following norms.

Lecture / Tutorials / Practical:

i) One hour Lecture per week is assigned one Credit.

ii) 2-hour Tutorial session per week is assigned 1.0 Credit.

iii) 2-hour Lab. session per week is assigned 1.0 credit.

For example, a theory course with L-T-P schedule of 3-2-0 hours will be assigned 4.0 credits.

A laboratory practical course with L-T-P schedule of 0-0-2 hours will be assigned 1.0 credit.

Calculation of Contact Hours / Week – A Typical Example

A student must register, as advised by Faculty Advisor, between a

minimum of 15 credits and up to a Maximum of 25 credits.

3.3 Mandatory Pre-Registration for higher semester

In order to facilitate proper planning of the academic activities of the Semester, it is necessary for the students to declare their intention to register for courses of higher semesters (3^{rd} and above) at least two weeks before the end of the current semester choosing the courses offered by each department in the next higher semester which is displayed on the Department Notice Board at least 4 weeks prior to the last working day of the semester.

Registration to a higher semester is allowed only if the student fulfills the following conditions -

i) satisfied all the academic requirements to continue with the programme of studies without termination

ii) cleared all Institute, hostel and library dues and fines, if any, of the previous semester

iii) paid all required advance payments of the Institute and the hostel for the current semester

iv) has not been debarred from registering on any specific grounds by the Institute.

4. ADD / DROP / AUDIT options

4.1 Registration of courses

Each student shall have to register for course work at the beginning of a semester within 2 to 3 days of commencement after discussing with subject teacher and under faculty advice. The permissible course load to be either average credits (=20) or to be within the limits of minimum (=15) and maximum (=25) credits.

4.2 DROP-option

During a specified period at the middle of a semester student's performance in CIE is reviewed by the faculty advisor. Following poor performance by a student he/she can be facilitated to drop identified course(s) (up to the minimum credits specified for the semester). Such course(s) will not be mentioned in the Grade card. Such courses to be re-registered by these students and taken up for study at a later time.

4.3 Withdrawal from courses

During a specific period specified towards the end of the semester, student's performance in CIE is reviewed by the Faculty advisors. Following poor

performance by a student in identified course (s) he/she is advised to withdraw from such course(s) (up to the minimum credits specified for the semester) with mention in the Grade card (Grade 'W'). Such courses to be re-registered by these students and taken up for study at a later time.

4.4 AUDIT-option

A student can register for courses for audit only, with a view to supplement his/her knowledge and/or skills. The student's grades in such course(s) will have to be reflected in the grade card. However, CORE courses shall not be made available for audit. But these shall not be taken into account in determining the student's academic performance in the semester. 'U" grade is awarded to such courses on satisfying the attendance requirements and CIE requirements. The candidate need not appear for SEE in such courses.

5. COURSE STRUCTURE:

5.1 Typical Breakdown for the B.E. Degree Curriculum:

No.	Course Category	Credit Range
1.	Basic Science Courses	20-25
2.	Engineering Science Courses	18-22
3.	Humanity, Social Science and Management	8-12
4.	Ability Enhancement Courses	10-14
5.	Professional Core Courses (PCC)	40-45
6.	Professional Elective Courses (PEC)	8-12
7.	Open Elective Courses (OE)	8-12
8.	Skill Courses (Project Work / Internship / Seminar)	28-36
9.	Mandatory courses	2
Note:	**Student can register between 15 to 25 credits per semester** **Total Credits to be earned : 160**	

5.2 The Department Undergraduate Committee (DUGC) will discuss and recommend the exact credits offered for the programme for the above

components, the semester wise distribution among them, as well as the syllabi of all undergraduate courses offered by the department from time to time before sending the same to the Board of Studies(BOS). The BOS will consider the proposals from the departments and make recommendations to the senate for consideration and approval.

5.3 **The earned Credit Requirement for the B.E. Degree is 160.**

Degree is awarded by prescribing the total number of credits to be earned, rather than by using the program duration, giving flexibility to student to plan their career.

5.4 **Mandatory Learning Courses**

These are courses that must be completed by the student at appropriate time or at his convenience. The 'PP' grade is awarded for a Pass in the course and 'NP' grade is awarded for a Fail in the course. In case 'NP' grade is awarded, the student has to re- register for the same course wherein he has no alternative options. However, he/she can opt for other courses if he/she has been provided with multiple options.

The 'PP' and 'NP' grades do not carry grade points and hence not included in the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) computations. However such non-credit mandatory courses are required to be included in the students' performance record (transcript) with Pass or Fail (PP or NP).

Courses that come under this category are the following.

Moral and Ethical Values, Communication skills, Entrepreneurship Development Programme, Environmental issues, Proficiency in a Language etc.

Such courses will not carry any credits for the award of degree, but a pass in each of such course during the programme shall be a necessary requirement for the student to qualify for degree award.

5.5 **PROJECT**

i) Project work at 7^{th} semester shall be completed batch wise. The batch shall consist of a maximum of 4 students.

ii) Project viva-voce examination shall be conducted individually.

5.6 **ELECTIVES**

i) A candidate shall take electives in each semester from groups of electives, commencing from 6^{th} semester.

ii) The minimum number of students to be registered for any Elective offered shall not be less than ten.

iii) A candidate shall opt for his/her choice of electives and register for the same if pre-registration is not done, at the beginning of each of 6^{th} & 7^{th} semesters. The candidate is permitted to opt for change of elective within 15 days from the date of commencement of the semester as per the academic calendar of the college.

6. ATTENDANCE REQUIREMENT:

6.1 Each semester is considered as a unit and the candidate has to put in a minimum attendance of 85% in each subject with a provision of condoning 10% of the attendance by Principal for reasons such as medical grounds, participation in University level sports, cultural activities, seminars, workshops and paper presentation.

6.2 The basis for the calculation of the attendance shall be the period of term prescribed by the College by its calendar of events. For the first semester students, the same is reckoned from the date of admission to the course (as per CET/COMED-K or Management allotment).

6.3 The students shall be informed about their attendance position in the first week of every month by the College so that the students shall be cautioned to make up the shortage.

6.4 A candidate having shortage of attendance (<75%) in any course(s) registered shall not be allowed to appear for SEE of such course(s).Such students will be awarded 'N' grade in these courses.

He/she shall have to repeat those course(s). Such students shall re-register for the same course(s) core or elective, as the case may be when the particular course is offered next either in a main (odd/even) or supplementary semester.

6.5 **Attendance in CIE and SEE:** Attendance at all examinations both CIE and SEE of each course registered shall be compulsory and there shall not be any provision for re-examinations. Any student against whom any disciplinary action is pending shall not be permitted to attend any SEE in that semester.

7. WITHDRAWAL FROM THE PROGRAMME

7.1 Temporary Withdrawal

a) A student who has been admitted to a degree programme of the college may be permitted once during the course to withdraw temporarily, for a period of one semester, on the grounds of prolonged illness or grave calamity in the family etc., provided –

i) The student applies to the College within 6 weeks of the commencement of the college stating fully the reasons for withdrawal together with supporting documents and endorsement from his parent/guardian.

ii) The College is satisfied about the genuineness of the case and that even by taking into account the expected period of withdrawal, the student has the possibility to complete the programme requirements (160 credits) within the time limits specified by the university.

iii) The student does not have any dues or demands at the College / University including tuition and other fees as well as library material.

iv) A student availing of temporary withdrawal shall be required to pay such fees and/or charges as may be fixed by the college until such time as his/her name appears on the Student's roll list. The fees/charges once paid shall not be refunded.

v) A student will be entitled to avail the temporary withdrawal facility only once during his/her studentship. However, any other concession for the concerned student shall have to be approved by the academic council.

7.2 Permanent Withdrawal

Any student who withdraws admission before the closing date of admission for the Academic Session is eligible for the refund of the deposits only. Fees once paid will not be refunded on any account.

Once the admission for the year is closed, the following conditions govern withdrawal of admissions.

(a) A student who wants to leave the College for good, will be permitted to do so (and take Transfer Certificate from the College, if needed), only after remitting the Tuition fees as applicable for all the remaining semesters

and clearing all other dues if any.

(b) Those students who have received any scholarship, stipend or other forms of assistance from the College shall repay all such amounts.

(c) The decision of the Principal of the College regarding withdrawal of a student is final and binding.

8. EVALUATION SYSTEM

8.1 The Academic Performance Evaluation of a student shall be according to a Letter Grading System, based on the Class Performance Distribution.

8.2 The Letter grades S, A, B, C, D, E, F indicate the level of academic achievement, assessed on a decimal (0-10) scale.

8.3 The Letter grade awarded to a student in a course, for which he has registered shall be based on his performance in quizzes, tutorials, assignments etc., as applicable, in addition to two mid- semester examinations and one semester end examination. The distribution of weightage among these components may be as follows.

Semester End Examination (SEE)	:	50% (50 marks)
Continuous Internal Evaluation (CIE)	:	50% (50 marks)
i) Quizzes, Tutorials, Assignments, Seminars, mini projects, tutorials etc.	:	10 marks
ii) Mid-semester Examination	:	40 marks

Any variation, other than the above distribution, requires the approval of the pertinent DUGC and Academic Council.

8.4 The letter grade awarded to a student in a 0-0-P (Practical) course, is based on an appropriate continuous evaluation scheme that the course instructor shall evolve, with the approval of the pertinent DUGC and the performance in SEE held on specified period in a semester.

8.5 The course Instructor shall announce in the class and/or display at the Faculty door/website the details of the Evaluation Scheme, including the distribution of the weightage for each of the components and method of conversion from the raw scores to the letter-grades within the first week of the semester in which the course is offered, so that there are no ambiguities in communicating the same to all the students concerned.

8.6 Passing standards

Evaluation Method	Passing Standard
Sessional (CIE)	Score: ≥40% (≥20 marks)
Terminal (SEE)	Score: ≥40% (≥20 marks)

i) Project work evaluation: The evaluation of CIE of the project work shall be based on the progress of the student in the work assigned by the project supervisor, periodically evaluated by him/her together with a Department committee constituted for this purpose. Seminar presentation, project report and final oral examination conducted by project evaluation committee at the department level shall form the SEE of the project work.

ii) In the case of other requirements, such as, seminar, industrial internship, field work, comprehensive viva voce, if any, the assessment shall be made as laid down by the Academic council.

iii) **There shall be no re-examination for any course in the credit system.**

However, students

- who have abstained from attending CIE or SEE without valid reasons ('N' grade), or
- who have failed ('F' grade) to meet the minimum passing standards prescribed for CIE and/or SEE, or
- who have been detained for want of attendance, or
- who have withdrawn ('W' grade),
- who have dropped any course

shall be required to re-register for such course(s) and go through CIE and SEE again and obtain a grade equal to or better than E in each case. While such students should re-register for same course(s) if core, they can re-register for alternative course(s) from among the elective courses, as the case may be. The re- registration shall be possible when the particular course is offered again either in a main (Odd/Even) or a supplementary semester.

8.7

i) Grade point scale for absolute grading

Level	Out Standing	Excellent	Very Good	Good	Average	Poor	Fail
Grade	S	A	B	C	D	E	F
Grade Points	10	09	08	07	06	04	00
Score (Marks) Range(%)	≥ 90	< 90 - ≥80	< 80- ≥70	< 70- ≥60	< 60 - ≥50	< 50 - ≥40	< 40

ii) The grade points given above help in the evaluation of credit points earned by the student in a course as the credit points are equal to the number of credits assigned to the course multiplied by the grade points awarded to the student in that course. This shall be used in arriving at the credit index of the student for that semester, as it is the sum total of all the credit points earned by the student for all the courses registered in that semester.

8.8 **Earning of Credits**

A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range S-E. Letter grade 'F' in any course implies failure of the student in that course and no credits earned.

8.9 The Transitional Grades 'I', 'W' and 'X' would be awarded by the teachers in the following cases. These would be converted into one or the other of the letter grades (S-F) after the student completes the course requirements.

- Grade 'I': To a student having satisfactory attendance at classes and meeting the passing standard at CIE, but remained absent from SEE for valid & convincing reasons acceptable to the College, like:

i) Illness or accident, which disabled him/her from attending SEE;
ii) A calamity in the family at the time of SEE, which required the student to be away from the College;

- Students who remain absent for Semester End Examinations due to valid reasons and those who are absent due to health reasons are required to

submit the necessary documents along with their request to the Controller of Examinations to write Make up Examinations within 2 working days of that particular examination for which he or she is absent, failing which they will not be given permission. This is admissible only for students who have more than 45 CIE marks.

- Grade 'W': To a student having satisfactory attendance at classes, but withdrawing from that course before the prescribed date in a semester under Faculty Advice
- Grade 'X': To a student having attendance ≥85% and CIE rating (90%), in a course but SEE performance observed to be poor, which could result in a F grade in the course. **(No 'F' grade awarded in this case but student's performance record maintained separately).**

8.10 Grade Card

Each student shall be issued a Grade Card at the end of each semester. This will have a list of all the courses registered by a student in the semester, together with their credits, the letter grades with grade points awarded. Only those courses registered for credit and having grade points shall be included in the computation of the students performance like SGPA and CGPA and the courses taken for audit will not form part of this computation. The results of mandatory courses, which are of the non-credit type shall also be reflected in the Grade card as PP (for Passed) or NP (for not passed). **Each UG student shall have to obtain the grade PP in each mandatory course to qualify for the Degree awarded by the university.**

8.11 The Make Up Examination

The Make Up Examination facility would be available to students who may have missed to attend the SEE of one or more course(s) in a semester for valid reasons and given the 'I' grade; Also, students having the 'X' grade shall be eligible to take advantage of this facility. The makeup examination would be held as per dates notified in the Academic Calendar. However, it would be possible to hold a makeup examination at any other time in the semester with the permission of the Academic Council of the College. In all these cases, the standard of makeup examinations shall be same as the regular SEE for the course(s).

a) All the 'I' and 'X' grades awarded to the students would be converted

to appropriate letter grades after the make-up examinations. Any outstanding 'I' and 'X' grades after the last scheduled make-up examinations shall be automatically converted to 'F' grade.

b) All the 'W' grades awarded to the students would be eligible for conversion to the appropriate letter grades only after the concerned students re-register for these courses in a main/ supplementary semester and fulfill the passing standards for their CIE and (CIE+SEE).

9. EVALUATION OF PERFORMANCE

The overall performance of a student will be indicated by two indices: SGPA; which is the Semester Grade Point Average, and CGPA which is the Cumulative Grade Point Average.

SGPA for a semester is computed as follows.

$$\text{SGPA} = \frac{\sum [\textit{(course credit) X (Grade point)}] \textit{ (for all courses in that semester)}}{\sum [\textit{(course credits)}]}$$

CGPA is computed as follows:

$$\text{CGPA} = \frac{\sum [\textit{(course credits)X (Grade points)}] \textit{ (for all courses excluding those with F grades until that semester)}}{\sum \textit{(course credits)}] \textit{ (for all courses excluding those with F grades until that semester)}}$$

10. COMMUNICATION OF GRADES

The SGPA and CGPA respectively, facilitate the declaration of academic performance of a student at the end of a semester and at the end of successive semesters. Both of them would be normally calculated to the second decimal position.

11. VERTICAL PROGRESSION (PROMOTION / ELIGIBILITY TO HIGHER SEMESTERS)

11.1 There shall be no restriction for promotion from an odd semester to the next even semester, provided the student has fulfilled the attendance requirement.

11.2 **A Student shall be declared fail if he / she**

(i) Has not satisfied the CIE requirements of any Course/s.

(ii) Has not registered for the SEE even after satisfying the attendance and CIE requirements.

11.3 **(A) Vertical Progression in case of students admitted to First year:**

(a) Students having not more than four F grades in the two semesters of first year of the Programme shall be eligible to move to second year.

(a.1) Students having not more than four F grades in the four semesters of I and II year shall be eligible to move to III year.

(a.2) Students who have earned all the prescribed credits of I year, and having not more than four grades in the four semesters of II and III year shall be eligible to move to IV year.

(B) Vertical Progression in case of Diploma students admitted to Second year (lateral entry):

(a) Students having not more than four F grades (excluding the Fail or pass status of Additional Mathematics I and II) in the two semesters of II year of the Programme shall be eligible to move to III Year.

(a.1) Students having not more than four F grades (excluding the Fail or pass status of Additional Mathematics I and II, if any) in the four semesters of II and III year shall be eligible to move to IV year.

(b) The mandatory non-credit Courses Additional Mathematics I and II prescribed at III and IV semesters respectively, to lateral entry Diploma holders admitted to III semester of B.E/B.Tech. Programmes shall attend the classes during the respective semesters to satisfy attendance and CIE requirements and to appear for the University examinations.

(b.1) In case, any student fails to satisfy the attendance requirement of the Courses Additional Mathematics I and II, he/she shall not be eligible to appear for the Semester End Examinations of that semester and shall not be permitted to take admission to next higher semester. The candidate shall be required to repeat that semester during the subsequent year.

(b.2) Students who have satisfied the attendance requirement but not the CIE requirements of the Courses Additional Mathematics I and II shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements in the same Course/s (with or without satisfying the attendance requirement) when offered during subsequent semester/s.

(c) Completion of Additional Mathematics I and II shall be mandatory for the award of degree.

(C) Vertical Progression in case of B.Sc students admitted to Second year (Lateral entry):

(a) Students having not more than four F grades (excluding the Fail or pass status of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme) in the two semesters of II year of the Programme shall be eligible to move to III year.

(a.1) Students having not more than four F grades (excluding the Fail or pass status of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme, if any) in the four semesters of II and III year shall be eligible to move to IV year.

(b) The prescribed mandatory non-credit Courses Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme to lateral entry B. Sc holders admitted to III semester of B.E/B. Tech Programmes, shall attend the classes during the respective semesters to complete CIE and attendance requirements and to appear for the University examinations.

(b.1) In case, any student fails to satisfy the attendance requirement of the above said Courses; he/she shall not be eligible to appear for the Semester End Examinations of that semester and shall not be permitted to take admission to next higher semester. The candidate shall be required to repeat that semester during the subsequent year.

(b.2) Students who have satisfied the attendance requirement but not the CIE requirements of the above said Courses, shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements in the same Course/s (with or without satisfying the attendance requirement) when offered during subsequent semester/s.

(c) Completion of Engineering Graphics and Elements of Civil Engineering and Mechanics shall be mandatory for the award of degree.

The Principal of each college shall make suitable arrangements in the timetable to facilitate the B. Sc students to attend the above mentioned courses to satisfy the CIE and attendance requirements and to appear for the University examinations.

11.4 Termination from the programme

A student shall be required to withdraw (discontinue) from the programme and leave the college on the following grounds.

i) **Failure to secure a CGPA = 5.0 on three consecutive occasions.**
ii) **Failure to earn a credit of 160 (120 for lateral entry students) in 8 years (6 years for lateral entry students) of duration from the year of admission including the duration of temporary withdrawal (leave of absence).**
iii) Absence from classes for more than **six weeks at a time** in a semester without leave of absence being granted by competent authorities.
iv) Failure to meet the standards of discipline as prescribed by the college from time to time.

12. AWARD OF CLASS

Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or Class awarded as in the conventional system of declaring the results of University examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class and Second Class. This can be seen from the following Table.

Percentage Equivalence of Grade Points (For a 10-Point Scale)

Grade Point	Percentage of Marks	Class
≥ 7.75	≥ 70%	Distinction
≥ 6.75	≥ 60%	First Class
< 6.75	< 60%	Second Class

Percentage = (GPA - 0.75) x 10

13. APPEAL FOR REVIEW OF GRADES

a. The entire process of evaluation shall be made transparent and the course instructor shall explain to a student why he/she gets whatever grade he/she is awarded, if and when required. A mechanism for review of grade is incorporated in the evaluation system. However, before appealing for such review, a student shall first approach the concerned course Instructor and then the concerned DUGC, with the request to do the needful; and only in situations where satisfactory remedial measures have not been taken, the student may then appeal to the Department Academic Appeals Boards (DAAB) before the date specified in Academic Calendar, by paying the prescribed fees.

b. The fee for such an appeal will be decided by the Senate from time to time. If the appeal is upheld by DAAB, then the fee amount will be

refunded to the student.

14. AWARD OF DEGREE

14.1 (1) B.E. Degree

a) Students shall be declared to have completed the Programme of B.E./B.Tech. degree and is eligible for the award of degree, provided the students have undergone the stipulated Course work of all the semesters under the Scheme of Teaching and Examinations and has earned the prescribed number of credits (160 credits for regular students registered for 4 year degree programmes & 120 for lateral entry students).

b) For the award of degree, a CGPA≥5.00 at the end of Programme shall be mandatory.

c) Completion of Additional Mathematics I and II, shall be mandatory for the award of degree to lateral entry diploma students.

d) Completion of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme shall be mandatory for the award of degree to lateral entry B.Sc. graduates.

e) (i) Over and above the academic credits, every Day College regular student admitted to the 4 years Degree Programme and every student entering 4 years Degree Programme through lateral entry, shall earn 100 and 75 Activity Points respectively through AICTE Activity Point Programme for the award of degree. Students transferred from other Universities/Autonomous colleges under VTU to fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student's eight semester Grade Card.

(ii) Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.

In case students fail to earn the prescribed activity Points before the commencement of 8th semester examinations, eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

(2) B.E. (Honors) Degree

VTU, Belagavi has framed the guidelines for applying for the award of Bachelor of Engineering (Honors) degree.

These Regulations are applicable for the following students:

1. Admitted to **I semester** / I year from the academic year **2018-19** (i.e. USN XXX18XXXXX)
2. Admitted to **III semester** / II year from the academic year **2019-20** (i.e. USN XXX19XX4XX)
3. These Regulations are uniformly applicable to Affiliated, Autonomous and Constituent Colleges under VTU.

Eligibility criterion

(i) Students have to earn 18 or more additional credits through MOOCs.

(ii) Students shall register for this course from fifth semester onwards.

(iii) Students shall obtain a grade $\geq$ D in all the courses in first attempt only in all the semesters till 5th.

(iv) Students shall obtain CGPA of 8.5 and above at the end of fourth semester.

(v) For Diploma students, they shall complete Additional Mathematics I and II during 3rd and 4th semesters in first attempt only.

Requirements:

(i) Students shall maintain a grade $\geq$D in all courses from 5thto 8thsemester in 'first attempt' only.

(ii) Students not having CGPA greater than or equal to 8.5 at the end of the B.E. programme shall not be eligible for the award of Honors degree, even if they have satisfied the requirement of additional credits.

(iii) Students shall take up additional course work, other than the regular courses prescribed by the University from 5thto 8thsemester from NPTEL and other platforms notified by the University and complete the same in any number of attempts with a final score (online assignments: 25 % + Proctored examination: 75 %) leading to the following certificates – ELITE (60 to 75 %) or ELITE + SILVER (76 to 89 %) or ELITE + GOLD (≥ 90 %) before closure of eighth semester as per the academic calendar.

(iv) Students shall be permitted to drop the registered course work (s) and select alternative course work (s) in case they cannot give proctored examination.

(v) Students have to take courses from the list of MOOCs approved by the University, which can be from NPTEL / SWAYAM / other platforms.

(vi) Students shall select courses in consultation with their Class Advisor, such that the content / syllabus of them are not similar to that of the core courses, professional electives or open electives, which the students may chose in the program.

(vii) Students shall earn the additional credits for these courses through MOOCs, by only appearing in person to the proctored examinations conducted by NPTEL / SWAYAM / other platform. The method of assessment shall be as per NPTEL online platform.

(viii) The Credit equivalence shall be as follows - 4 weeks of online course duration – 1 credit, 8 weeks of online course duration – 2 credits and 12 weeks of online course duration – 3 credits.

Registration:

(i) Any student meeting the eligibility criteria and interested to register for Honors degree qualification shall apply to the University through the Principal in the prescribed form along with the prescribed application fees within 15 working days after notification by the University.

(ii) The Registrar shall notify the registration of the student and it will be notified to the student and the student shall pay a one-time, non-refundable registration fees as prescribed by the University to confirm the registration.

Award of Honors Qualification:

(i) Students who successfully complete the MOOCs prescribed by the University and submit their E-certificates to the University through the Principal against the notification issued by the Registrar in time before the closure of eighth semester, as per the academic calendar shall be eligible for B.E. (Honors) degree. If a student does not submit the certificates in time on or before the last date, their request shall not be considered, even if they have earned the requisite number of credits.

(ii) The Honors degree shall be awarded only if the CGPA at the end of the B.E. programme is equal to or greater than 8.5.

(iii) A student who has earned the requisite number of credits and who has submitted the certificates in time and has been accepted by the University will get B.E. degree with Honors suffixed indicating recognition of higher achievement by the student concerned.

(iv) Further students fulfilling all the above requirements shall be entitled to receive their transcripts indicating both the achievement of the student concerned.

(v) The award of the Honors degree shall be recommended by the Academic Senate and approved by the Executive Council of the University.

14.2 (1) Noncompliance of CGPA ≥ 5.00 at the end of the Programme

(a) Students, who have completed all the courses of the Programme but not having a CGPA ≥ 5.00 at the end of the Programme, shall not be eligible for the award of the degree.

(b) In the cases of 14.2 (1) a, students shall be permitted to appear again for SEE in course/s (other than Internship, Technical seminar, Project (Mini and Main), and Laboratories) of any Semester/s without the rejection of CIE marks for any number of times, subject to the provision of maximum duration of the Programme to make up the CGPA equal to or greater than 5.00 for the award of the Degree.

(c) In case, the students earn improved grade/s in all the reappeared course/s, the CGPA shall be calculated considering the improved grade/s. If it is ≥5.00, the students shall become eligible for the award of the degree. If CGPA <5.00, the students shall follow the procedure laid in 14.2 (1) b

(d) In case, the students earn improved grade/s in some course/s and the same or lesser than the previously earned pass grade/s in the other reappeared course/s, the CGPA shall be calculated considering the improved grade/s and the pass grades earned before the reappearance. If it is ≥5.00, the students shall become eligible for the award of the degree. If CGPA<5.00, the students shall follow the procedure laid in 14.2 (1) b

(e) In case, the students earn improved grade/s in some courses and fail in the other reappeared course/s, the CGPA shall be calculated by considering the improved grade/s and the previously earned pass grade/s of the reappeared course/s in which the students have failed. If it is≥5.00, the students shall become eligible for the award of the degree. If CGPA <5.00, the students shall follow the procedure laid in 14.2 (1) b

(f) In case, the students fail (i.e., earns F grade) in all the reappeared course/s, pass grade/s of the course/s earned by the students before reappearance shall be retained. In such cases, the students shall follow the procedure laid in 14.2 (1) b

(g) Students shall obtain written permission from the Registrar (Evaluation) to reappear in SEE to make up the CGPA equal to or greater than 5.00.

(2) Noncompliance of Mini-project

(a) The mini-project shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the mini-project shall be declared fail in that course and shall have to complete the same during subsequent University examinations after satisfying the Mini-project requirements. Also, mini-project shall be considered for eligibility to VII semester.

(3) Noncompliance of Internship

(a) All the students of B.E/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation. A University examination shall be conducted during VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail in that Course and shall have to complete the same during subsequent University examinations after satisfy the internship requirements.

14.3 The maximum duration for a student for complying to the Degree requirements is 16 – semesters from the date of first registration for his first semester (8 years from the date of admission to first year, (12 semesters / 6 years from the date of admission for lateral entry student)).

15 GRADUATION REQUIREMENTS AND CONVOCATION

15.1 **A student shall be declared to be eligible for the award of the degree if he/she has**

a) **Fulfilled "Award of Degree" Requirements**
b) **No Dues to the College, Departments, Hostels, Library, Central Computer Centre and any other centres**
c) **No disciplinary action pending against him/her.**

15.2 **The award of the degree must be recommended by the Senate**

15.3 **Convocation**

Degree will be awarded for the students who have graduated during the

preceding academic year. Students are required to apply for the Convocation along with the prescribed fees, after having satisfactorily completed all the degree requirements (refer 'Award of Degree') within the specified date in order to arrange for the award of the degree during convocation.

16 AWARD OF PRIZES, MEDALS, CLASS & RANKS

For the award of Prizes and Medals, the conditions stipulated by the Donor may be considered as per the statutes framed by the College for such awards.

Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or Class awarded as in the conventional system of declaring the results of University examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class and Second Class as described in 12.

17 CONDUCT AND DISCIPLINE

17.1 Students shall conduct themselves within and outside the premises of the College in a manner befitting the students of an Institution of National Importance.

17.2 **As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.**

17.3 The following acts of omission/ or commission shall constitute gross violation of the Code of Conduct and are liable to invoke disciplinary measures:

a) Ragging.
b) Lack of courtesy and decorum; indecent behaviour anywhere within or outside the campus.
c) Willful damage or stealthy removal of any property/belongings of the College/Hostel or of fellow students/citizens.
d) Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs.
e) Mutilation or unauthorized possession of Library books.
f) Noisy and unseemly behaviour, disturbing studies of fellow students.
g) Hacking in computer systems (such as entering into other Person's area without prior permission, manipulation and/or Damage of

computer hardware and software or any other Cyber crime etc.).

h) Plagiarism of any nature.

i) Any other act of gross indiscipline as decided by the Senate from time to time.

j) Use of Mobile in the college Academic area.

k) Smoking in College Campus and supari chewing.

l) Unauthorized fund raising and promoting sales.

Commensurate with the gravity of offence the punishment may be: reprimand, expulsion from the hostel, debarring from an examination, disallowing the use of certain facilities of the College, rustication for a specified period or even outright expulsion from the College, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.

17.4 For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the Chief Warden, the Head of the Department and the Dean (Academics), respectively, shall have the authority to reprimand or impose fine.

17.5 All cases involving punishment other than reprimand shall be reported to the Principal.

17.6 Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Controller of Examinations for taking appropriate action.

18. EARNING OF ACTIVITY POINTS FOR THE AWARD OF DEGREE

18.1 As per VTU guidelines, every students entering 4 year degree programme should earn 100 activity points & every students entering 4 year degree programme through Lateral Entry should earn 75 activity points for the award of the Engineering Degree.

18.2 The Activity Points earned will be reflected on the student's eighth semester Grade Card.

18.3 The activities can be spread over the years (duration of the programme) any time during the semester weekends and holidays, as per the interest & convenience of the students from the year of entry to the programme.

18.4 Activity Points (non-credit) have no effect on SGPA/CGPA point.

18.5 In case students fail to earn the prescribed Activity Points, Eighth semester Grade Card shall be issued only after earning the required Activity Points.

Note: Students are required to be inside the examination hall 20 minutes before the commencement of examination. This is applicable for all examinations (Semester end/Supplementary/makeup) henceforth. Students will not be allowed inside the examination hall after the commencement, under any circumstances.

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LIST OF MAJOR SCHOLARSHIPS

Applicable to	*Types of scholarship*	*Method*	*Website*
For SC/ST Students	*Income : Below Rs.2,50,000/-*	*Online application*	**SSP**
	Income : Above Rs.2,50,000/- to Rs.10,00,000/-		
For Others	*Category I : Income Below Rs.2,50,000/-*	*Online application*	
	Category 2A, 3A, 3B Income Below Rs.1,00,000/-	*Online application*	
	GSB & Brahmins EWS Certificate upto Rs.8,00,000/-	*Online application*	
	Minority students Income Below Rs.2,50,000/-	*Online application*	*NSP & SSP*
Parents must have Beedi Id. Card	*Beedi Scholarship*	*Online application*	**scholarships.gov.in or nsp.gov.in**

1. **Scholarship details will be published in the notice board near College Academic Section. Students must see the notice board and submit the application before due dates.**

2. **All SC/ST and Category I students who have not paid any fee in CET must apply for Fee concession or Scholarship. Otherwise they must pay the tuition fee and college fee.**

3. **The students, who are applying for any of the above scholarship through online, must submit the hardcopy with supporting documents (with attestation) to the academic section in time.**

B. E. SYLLABUS

ELECTRONICS & COMMUNICATION ENGINEERING

V & VI SEMESTER

With

Scheme of Teaching

& Examination

DEPARTMENT: ELECTRONICS & COMMUNICATION ENGINEERING

1.	Dr. K. Rajesh Shetty	Ph.D.	Professor/Dean (Admissions)
2.	Dr. Rekha Bhandarkar	Ph.D.	Professor & Deputy Registrar
3.	Dr. K. V. S. S. S. S. Sairam	Ph.D.	Professor & Head
4.	Dr. Veena Devi Shastrimath V.	Ph.D.	Professor & Chief Warden
5.	Dr. Prabha Niranjan	Ph.D.	Professor
6.	Dr. K. S. Shivaprakasha	Ph.D.	Professor
7.	Dr. Krishnananda Shet	Ph.D.	Assoc. Professor
8.	Dr. Subramanya Bhat	Ph.D.	Assoc. Professor
9.	Dr. Shankar B. B.	Ph.D.	Assoc. Professor
10.	Dr. Vidya Kudva	Ph.D.	Assoc. Professor
11.	Dr. Durga Prasad	Ph.D.	Assoc. Professor
12.	Dr. Roopa B. Hegde	Ph.D.	Assoc. Professor
13.	Dr. Sukesh Rao M.	Ph.D.	Assoc. Professor
14.	Dr. Mamatha Girish	Ph.D.	Assoc. Professor
15.	Dr. Shrividya G.	Ph.D.	Assoc. Professor
16.	Dr. Padmavathi K.	Ph.D.	Assoc. Professor
17.	Mrs. Sushma P. S.	M.Tech. (Ph.D.)	Assoc. Professor
18.	Mr. Mahaveera K.	M.Tech. (Ph.D.)	Asst. Prof Gd III
19.	Mrs. Sunitha Lasrado	M.Tech. (Ph.D.)	Asst. Prof Gd III
20.	Mr. Satheesh Rao	M.Tech. (Ph.D.)	Asst. Prof Gd III
21.	Dr. Narendra K. C.	Ph.D.	Asst. Prof Gd III
22.	Dr. Shivakumar B. R.	Ph.D.	Asst. Prof Gd III
23.	Dr. Anusha R. Sharath	Ph.D.	Asst. Prof Gd III
24.	Dr. Bommegowda K. B.	Ph.D.	Asst. Prof Gd III
25.	Dr. Kavitha S.	Ph.D.	Asst. Prof Gd III
26.	Mrs. Charishma	M.Tech. (Ph.D.)	Asst. Prof Gd III

27.	Mrs. Shubha B.	M.Tech. (Ph.D.)	Asst. Prof Gd III
28.	Mr. Ravindra K. S.	M.Tech. (Ph.D.)	Asst. Prof Gd II
29.	Mr. Pradyumna G. R.	M.Tech. (Ph.D.)	Asst. Prof Gd II
30.	Mrs. Niju Rajan	M.Tech. (Ph.D.)	Asst. Prof Gd II
31.	Mr. Anil Kumar Bhat	M.Tech. (Ph.D.)	Asst. Prof Gd II
32.	Mr. Dileep Kumar M. J.	M.Tech. (Ph.D.)	Asst. Prof Gd II
33.	Mr. Sudharshana	M.Tech. (Ph.D.)	Asst. Prof Gd II
34.	Mrs. Nagapriya Kamath K.	M.Tech.	Asst. Prof Gd II
35.	Mr. Karthik	M.Tech. (Ph.D.)	Asst. Prof Gd II
36.	Mrs. Lavanya B. L.	M.Tech. (Ph.D.)	Asst. Prof Gd II
37.	Mrs. Ramya Shetty	M.Tech. (Ph.D.)	Asst. Prof Gd II
38.	Mrs. Deepa K.	M.Tech. (Ph.D.)	Asst. Prof Gd I
39.	Mrs. Anupama B.	M.Tech. (Ph.D.)	Asst. Prof Gd I
40.	Mrs. Ashwini K.	M.Tech. (Ph.D.)	Asst. Prof Gd I
41.	Mrs. Shankari N.	M.Tech. (Ph.D.)	Asst. Prof Gd I
42.	Mrs. Harshitha Bhat	M.Tech. (Ph.D.)	Asst. Prof Gd I

DEPARTMENT: ELECTRONICS & COMMUNICATION ENGINEERING

Vision:

Empowering people, Partnering in Community Development by achieving expertise requiring the knowledge of state of the art technology in the field of Electronics and Communication.

Mission:

To impart specialized education in the field of Electronics & Communication that contributes to the socio-economic development of the region and to generate technical manpower with high degree of credibility, integrity and ethical standards by providing vibrant learning environment.

Program Educational Objectives (PEOs):

PEO1: The graduate should have effective foundation in mathematics, science as well as other relevant disciplines and a strong foundation in Electronics and Communication Engineering.

PEO2: The graduate will inculcate effective communication skills, teamwork, lifelong learning and leadership in preparation for a successful career in industry and academia with credibility, integrity and ethics.

PEO3: The graduate will be able to design and develop innovative systems that contribute to socio-economic development.

Program Specific Outcomes (PSOs):

PSO1: Understand the concepts and applications in the field of communication, signal processing, VLSI, embedded systems, power electronics and control systems.

PSO2: Effectively apply the domain knowledge to arrive at optimum solutions to real time applications.

PSO3: Apply acquired skills in project management and execution to Electronics and Communication systems.

Program Outcomes (POs):

Engineering Graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and

design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Graduate Attributes :

Sl. No.	Graduate Attributes
A	Engineering Knowledge
B	Problem Analysis
C	Design / development of solutions
D	Conduct investigations of complex problems
E	Modern tool usage
F	The engineer and society
G	Environment and sustainability
H	Ethics
I	Individual and team work
J	Communication
K	Project management and finance
L	Life-long learning

N. M. A. M. Institute of Technology, Nitte

B.E. in Electronics and Communication Engineering (ECE)

Scheme of Teaching and Examinations 2021

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2021-22)

V Semester

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Teaching Hours/ Week				Examination				Credits
					Theory / Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration Hours	CIE	SEE	Total	
					L	T	P	S					
1	PCC	21EC501	Information Theory and Error Control Coding	EC	3	0	0		3	50	50	100	3
2	IPCC	21EC502	Microprocessor and Microcontroller	EC	3	0	2		3	50	50	100	4
3	PCC	21EC503	Digital Communication	EC	3	0	0		3	50	50	100	3
4	PCC	21EC504	VLSI Design	EC	3	0	0		3	50	50	100	3
5	PCC	21EC505	VLSI Lab	EC	0	0	2		3	50	50	100	1
6	AEC	21HU511	Research Methodology and Intellectual Property Rights	CV/ ME	2	0	0		3	50	50	100	2
7	AEC	21ECA51	Employability Skill Development	EC	1	0	0		1	50	50	100	1
8	HSMC	21CV512	Environmental Studies	CV	1	0	0		1	50	50	100	1
			TOTAL						**20**	**400**	**400**	**800**	**18**
9	NCMC		**Physical Education (Sport & Athletics)/ YOGA & NSS**	PE/ NSS	-	-	2			50	50	100	0

BSC: Basic Science Course, **PCC**: Professional Core Course, **HSMC**: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **INT** –Internship, **IPCC**: Integrated Professional Core Course

L –Lecture**, T –** Tutorial, **P-** Practical/ Drawing, **S –** Self Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

N. M. A. M. Institute of Technology, Nitte

B.E. in Electronics and Communication Engineering (ECE)

Scheme of Teaching and Examinations 2021

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2021-22)

VI Semester

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Teaching Hours/ Week				Examination				Credits
					Theory/ Lecture	Tutorial	Practical / Drawing	Self-Study	Duration Hours	CIE	SEE	Total	
					L	T	P	S					
1	HSMC	21EC601	Operations Research and Project Management	EC	3	0	0		3	50	50	100	3
2	IPCC	21EC602	Computer Networks	EC	3	0	2		3	50	50	100	4
3	PCC	21EC603	Antenna and Microwave Systems	EC	3	0	0		3	50	50	100	3
4	PEC	21ECEXXX	Professional Elective Course I	EC	3	0	0		3	50	50	100	3
5	OEC	21XXXXX	Open Elective Course I		3	0	0		3	50	50	100	3
6	PCC	21EC604	Communication Lab	EC	0	0	2		3	50	50	100	1
7	MP	21EC605	Mini Project	-	0	0	4		-	100	-	100	2
8	INT	21INT61	Innovation/ Entrepreneurship/ Social based Internship	-	Completed during the vacation of IV and V semesters				3	100	-	100	3
			TOTAL						**21**	**500**	**300**	**800**	**22**
9	NCMC		**Physical Education (Sport & Athletics)/ YOGA & NSS**	PE/ NSS	-	-	2			50	50	100	0

BSC: Basic Science Course, **PCC**: Professional Core Course, **HSMC**: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **INT** –Internship, **IPCC**: Integrated Professional Core Course

L –Lecture, **T –** Tutorial, **P-** Practical/ Drawing, **S –** Self Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

PROGRAM ELECTIVE COURSES

ELECTIVE I		ELECTIVE II	
STREAM 1: COMMUNICATION AND NETWORKING			
21ECE101	Adhoc & Sensor Networks	21ECE201	Cognitive Radio
21ECE102	Modern Radar & Navigational Aids	21ECE202	Fiber Optics
21ECE103	Multimedia Communications	21ECE203	Detection and Estimation
21ECE104	Optical Communication & Networks	21ECE204	High Performance Communication Networks
21ECE105	Spread Spectrum Communication	21ECE205	RF Circuit Design
21ECE106	Wireless Communication	21ECE206	Satellite Communication Systems
STREAM 2: VLSI/ EMBEDDED SYSTEMS			
21ECE111	Automation using Scripting Language	21ECE211	Advanced Digital Logic Verification
21ECE112	Automotive Electronics	21ECE212	Analog and Mixed Mode VLSI Design
21ECE113	Biomedical Instrumentation	21ECE213	Digital IC Design using Verilog HDL
21ECE114	Embedded Linux	21ECE214	Embedded Systems
21ECE115	Low Power VLSI	21ECE215	Internet of Things
21ECE116	Nanoelectronics	21ECE216	Introduction to Sensors and Actuators
21ECE117	IoT Device Security	21ECE217	Embedded Secure Element
STREAM 3: SIGNAL PROCESSING			
21ECE121	Artificial Intelligence	21ECE221	Advanced Signal Processing
21ECE122	Biomedical Signal Processing	21ECE222	Fuzzy Logic
21ECE123	DSP Processors & Architecture	21ECE223	Linear Algebra for Signal Processing
21ECE124	Image Processing	21ECE224	Optical Computing
21ECE125	Machine Learning and its Applications	21ECE225	Pattern Recognition
21ECE126	Wavelets	21ECE226	Speech Processing
STREAM 4: IT AND MANAGEMENT			
21ECE131	Big Data Analytics	21ECE231	Computer Architecture
21ECE132	Computer Operating Systems	21ECE232	Data Base Management System
21ECE133	Cryptography	21ECE233	Finance Management
21ECE134	Data Structures using C++	21ECE234	Object Oriented Programming with C++
21ECE135	Object Oriented Programming in Java	21ECE235	Project Management
21ECE136	Real Time Operating Systems	21ECE236	Python Programming

INFORMATION THEORY AND ERROR CONTOL CODING

Course Code	**21EC501**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Understand how information is measured and explain the concepts of entropy as applicable to zero memory sources.
2. Illustrate the properties of codes, to identify the instantaneous codes, devise source codes using various coding techniques and to determine its efficiency.
3. Explain with examples the concepts of Groups, Fields, Rings and Vector Spaces.
4. Describe a linear block code in matrix form, understand binary cyclic code and to design an encoder and syndrome calculation circuit for linear block codes and binary cyclic codes.
5. Determine error detection and correction capabilities of linear block codes.
6. Understand the encoding and decoding processes of convolution codes.

UNIT – I

Introduction to Information Theory

Measure of information, Entropy of zero memory sources, Source coding, Prefix codes, Source coding theorem, Huffman coding, Dictionary based coding: LZ algorithm.

9 Hours

Algebra for Error Control Coding

Groups, Rings, Fields, Galois Fields, Quotient rings, Vector spaces.

7 Hours

UNIT - II

Linear Block Codes

Types of errors, Examples, Methods of controlling errors, Types of codes, Linear block codes- Matrix description, Encoding circuit, Syndrome computation and error detection, Syndrome calculation circuit, Hamming weight, Hamming distance, Minimum distance of a block code, Error detection and correction capabilities of a linear block code, Single error-correcting Hamming codes, Table lookup decoding using standard array.

9 Hours

Binary Cyclic Codes

Algebraic structures of cyclic codes, Non-systematic cyclic codes, Systematic cyclic codes, Encoding using (n-k) bit shift register, Syndrome calculation.

5 Hours

UNIT – III

Convolution Codes

Introduction, Encoding using time domain approach, Encoding using transform domain approach, State diagram, Code tree, Trellis diagram, Sequential decoding, Viterbi decoding algorithm, Principle of Turbo coding.

09 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Calculate the information content of a message, entropy of a zero-memory source for the given source statistics. Determine the codewords and calculate coding efficiency using Huffman algorithm for memoryless sources given the source statistics and LZ algorithm for sources with memory.
2. Discuss the concepts of Groups, Rings, Fields, Galois Fields, Quotient rings and Vector Spaces as applied to Error Control Coding.
3. For the given (n, k) linear block codes determine the codewords, syndrome, error detecting and correcting capability of the code; Design a single error correcting linear block code for the given message length.
4. For the given generator polynomial for an (n, k) binary cyclic codes, determine the codewords in non-systematic and systematic forms; Determine the syndrome for the given received vector.
5. Evaluate the codewords for a given (n, k, m) convolution encoder and use sequential search and Viterbi algorithm to decode the information from the given received vector and discuss Turbo codes.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO5	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Shu Lin, Daniel J. Costello, **"Error Control Coding",** Pearson / Prentice Hall, 2nd Edition, 2004.
2. Muralidhar Kulkarni and K. S. Shivaprakasha, **"Information Theory and Coding",** Wiley (India), 2015.

REFERENCE BOOKS:

1. Todd K. Moon, **"Error Correction Coding",** John Wiley Publications, 2005.
2. K. Sam Shanmugham, **"Digital and Analog Communication Systems"**, John Wiley Publications, 1996.
3. Simon Haykin, **"Digital Communications"**, John Wiley Publications, 2003.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/117101053/

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MICROPROCESSOR AND MICROCONTROLLERS			
Course Code	**21EC502**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:2**	**SEE Marks**	**50**
Total Hours	**39+26**	**Credits**	**04**

Course Learning Objectives:

This course will enable the students to

1. Identify the architecture of 8 bit Microcontroller.
2. Develop application using 8051 Interrupts, Timers/Counters and IO port.
3. Understand ARM architecture.

UNIT – I

Introduction to 8 bit Microcontroller:

8051 Architecture, Memory organization, addressing modes, Basic instructions format, Instruction set - Data transfer group, Arithmetic group, logical group, control transfer group, 8051 Assembly Language programs, Machine Cycles, Delay programs

15 Hours

UNIT – II

Microcontroller Peripheral Modules:

Programming 8051 I/O port, I/O interfacing examples using C programs (LED, Switch and Seven segment LED using multiplexing technique), 8051 Timers/Counters in Mode1 & Mode 2, Timer Programming examples using C, Serial Communication, Example C

programs on serial communication and External Interrupts, timer interrupts and serial communication interrupts with example programs.
I2C and SPI communication protocols

15 Hours

UNIT – III

Introduction to ARM processor: ARM architecture, Application specific classification of ARM family, Pipeline, programming model, memory organization, processor modes, Instruction encoding format, data processing and arithmetic and branch instructions, call or exceptions in ARM

9 Hours

Course Outcomes:

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

1. Describe the architecture and write the assembly language program with relevant instruction set for 8051 microcontroller.
2. Develop applications using embedded C program with IO Ports, Timers, Serial communication and Interrupts of microcontroller.
3. Interface different sensors and actuator modules and develop API using embedded C program for any microcontroller
4. Describe the architecture of ARM processor and instruction formats.
5. Analyze the working of instruction execution in ARM processor.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-			
CO2	2	3	-	-	-	-	-	-	-	-	-	-			
CO3	3	-	-	-	-	-	-	-	-	-	-	-			
CO4	3	-	-	-	-	-	-	-	-	-	-	-			
CO5	3	-	-	-	-	-	-	-	-	-	-	-			

3 – High **2 – Medium** **1 - Low**

Suggested List of Experiments

1. Interfacing LED and Switches with 8051 Microcontroller
2. Interfacing seven segment LED with 8051 Microcontroller
3. Writing embedded C program to interface matrix keypad with 8051 microcontroller
4. Writing embedded C program to interface I2C based temperature sensor with LPC176x ARM Processor
5. Interfacing stepper motor using LPC176x ARM processor
6. Interfacing analog sensors (pressure, light or strain) with LPC176x ARM processor and writing embedded C program for ADC.
7. Interfacing LCD to 8051/LPC176x Microcontroller

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student must obtain minimum of 20 marks out of 50 in CIE and 20 marks out of 50 in SEE and 40% in total to obtain a pass grade. Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

Methods recommended: Two Tests (80%), Written Quiz (16%) and module assignments (4%). Course coordinator will announce the evaluation procedure at the beginning of the semester and will be recorded in the course plan.

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

TEXTBOOKS:

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay, **"The 8051 Microcontroller and Embedded Systems – using assembly and C"**, PHI, 2006 / Pearson, 2006.
2. Steve Furber, **"ARM System Architecture"**, Edison Wesley Longman 1996

REFERENCE BOOKS:

1. Kenneth J. Ayala, **"The 8051 Microcontroller"**, 3rd Edition, Thomson/Cengage Learning.
2. William Hohl, **"ARM Assembly Language – Fundamentals and Techniques"**, CRC Press, 2009

E Books/NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/106108100/
2. http://nptel.ac.in/courses/108107029/

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DIGITAL COMMUNICATION			
Course Code	**21EC503**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Understand the basic Nyquist's sampling theorem and generation of samples.
2. Understand the techniques used in geometric interpretation of signals, designing a correlation receiver and matched filter receiver.
3. Understand the different types of waveform coding techniques- PCM, DPCM, DM.
4. Understand the concept of ISI in the transmission of binary data through a bandlimited channel, and solutions to overcome the degradation of waveform.
5. Understand the design of different coherent and non-coherent digital modulation techniques, and estimate their probability of error.

UNIT – I

Sampling Process

Sampling theorem, Generation and Reconstruction of a message signal from its samples, Quadrature sampling of band-pass signal, Effect of Aliasing, Practical aspects of sampling and signal recovery: Natural and Flat top samples.

Detection and Estimation

Gram-Schmidt Orthogonalization procedure, Geometric interpretation of signals, Response of bank correlators to noisy input, Correlation receiver, Matched Filter: Matched filter receiver, Maximization of SNR at the output of Matched filter and Properties of matched filter. Estimation: concept and criteria, Maximum likelihood estimation of phase.

14 Hours

UNIT- II

Waveform Coding Techniques

PCM, Channel noise and error probability, Quantization noise and SNR, Robust quantization, DPCM and Delta Modulation.

Base-Band Shaping for Data Transmission

Discrete PAM signal, Waveform formats, Power spectra of discrete PAM signals, Intersymbol Interference, Nyquist's criterion for distortion less base-band binary transmission, Correlative coding techniques, Eye pattern.

14 Hours

UNIT – III

Digital Modulation Techniques

Digital modulation formats, Coherent binary modulation techniques, Coherent quadrature modulation techniques, Non-coherent binary modulation techniques, Comparison of binary and quaternary modulation techniques, M-ary modulation techniques: M-ary PSK, M-ary QAM.

11 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Apply the concepts of sampling and reconstruction to baseband and bandpass signals.
2. Apply the concepts of signal space dimensionality in the analysis of optimum receiver.
3. Understand the concepts of quantization and apply it to analyze the performance of various waveform coding techniques.
4. Realize line codes and their power spectral densities; describe the principle of ISI. Analyze the methods for minimizing ISI.
5. Analyze digital modulation techniques and determine their error performance.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Simon Haykin, "**Digital Communication**", John Wiley and sons, 1988.
2. Proakis and Salehi, "**Fundamentals of Communication Systems**", Pearson Education, First Edition, 2007.

REFERENCE BOOKS:

1. Simon Haykin, "**Communication Systems**", Third Edition. John Wiley & sons, 1998.
2. H. Taub and D. L. Schilling, "**Principles of communication systems**", Tata McGraw-Hill, 2008.

NPTEL/ MOOC Link:

1. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ee10/
2. https://archive.nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee27/
3. https://archive.nptel.ac.in/noc/courses/noc17/SEM2/noc17-ec12/
4. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ee05/

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VLSI DESIGN			
Course Code	**21EC504**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. To know about VLSI Design flow.
2. Understand the concepts of physical design.
3. Analyse CMOS inverters and compute the delay in combinational circuits.
4. To know the principle of dynamic CMOS logic and to know the concepts of CMOS testing.

UNIT – I

Introduction: Overview of VLSI design methodology, VLSI Design Flow, Design hierarchy, regularity, modularity, locality, VLSI design styles (T2: 1.1-1.8, T1: 1.6.2-1.6.3) CMOS logic (T1: 1.4.1 to 1.4.8)

Physical Design: CMOS Fabrication and layouts (T1: 1.5, 3.3).

MOSFET Scaling: Constant field scaling, constant voltage scaling (T2: 3.5, T1: 7.4.3).

15 Hours

UNIT - II

Power dissipation in CMOS inverters (T2: 6.7)

DC and Transient Response: CMOS inverter DC characteristic (T1:2.5.1to 2.5.3), RC Delay Model (T1:4.3.1 to 4.3.3), Transient response (T1:4.3.4 to 4.3.6), Linear Delay Model, Logical Efforts of Paths (T1: 4.4 , 4.5).

Combinational Circuit Design: Pseudo-NMOS, CVSL (T1: 9.2.2, 9.2.3).
Sequential Circuit Design: Latches and Flip-Flops, (T1: 10.3.1, 10.3.2, 10.3.4).

15 Hours

UNIT – III

Dynamic Logic Circuits: Introduction, Dynamic CMOS Circuit Techniques: CMOS Transmission gate logic, dynamic CMOS logic, Domino CMOS logic, NORA CMOS logic, (T2: 9.1, 9.5,9.6)
Testing and Verification: Introduction to DFT, fault types and models, controllability and observability, adhoc testable design techniques, scan based techniques, BIST techniques (T2: 15.1 to 5.6).

09 Hours

Scheme of SEE Question Paper
There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:
At the end of the course the student will be able to

1. Explain the VLSI design flow and construct logic circuits using CMOS logic.
2. Explain CMOS fabrication flow and MOSFET scaling; design stick diagram and area optimised layout for the given combinational logic circuit.
3. Analyse the sources of power dissipation in CMOS inverter, analyse CMOS inverter DC and transient response. Estimate the delay through logical cascade and optimize using Logical Effort Technique.
4. Analyse pseudo-NMOS, CVSL logic families, lathes and flip-flops.
5. Explain the concept of dynamic logic circuits, explain the need for testing and testability issues in VLSI Design.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Neil H. E. Weste and David Money Harris**, "CMOS VLSI Design- A Circuits and Systems Perspective",** 4th Edition, Pearson Education India, 2011.
2. Sung-Mo Kang, Yosuf Leblebici, **"CMOS Digital Integrated Circuits: Analysis and Design",** Third Edition, Tata McGraw-Hill, 2003.

REFERENCE BOOKS:

1. Neil H. E. Weste and Kamaran Eshraghian, **"Principles of CMOS VLSI Design",** Addison- Wesley, 2nd Edition, 2004.
2. John P. Uyemura, **"Introduction to VLSI Circuits and Systems"**, Wiley, 2002.

NPTEL/ MOOC Link:

1. https://nptel.ac.in/courses/122106025/2
2. https://nptel.ac.in/courses/117106091

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VLSI LAB			
Course Code	**21EC505**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**0:0:3**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**1**

Course Learning Objectives:

This course will enable the students to

1. Develop Verilog codes for digital CMOS circuits, adder and counters.
2. Develop Verilog testbench and perform simulation using available EDA tool.
3. Synthesize the Verilog code using the available technological library, given the constraints.
4. Design CMOS schematic circuits, perform AC & DC analysis of an Inverter, MOS amplifiers and DAC.
5. Draw layout, perform DRC and simulation of Inverter, MOS amplifiers and DAC.

PART – A: ASIC DIGITAL DESIGN

Write Verilog code for the following and Perform simulation for functional verification using testbench.

Observe the waveform. Synthesize the code using available technological library, given the constraints*.

1. Inverter – Gate level Verilog Model.
2. 4-bit Parallel Adder.
3. Synchronous counters for given MOD-N, with reset control.

4. Asynchronous counters.
5. Demonstration of ASIC Design flow from RTL to GDS II.
*An appropriate constraint should be given

PART - B: ANALOG DESIGN

1. Design an Inverter for the given specifications*.
    a. Draw the schematic circuit and perform the following
        i) DC Analysis
        ii) Transient Analysis
    b. Draw the Layout, perform DRC and perform simulation.

2. For the following circuits, draw the schematic circuit and perform DC Analysis, AC Analysis and Transient Analysis. Also draw the Layout, perform DRC and perform simulation.
    a) Common source amplifier. b) Common Drain amplifier

3. For a single stage differential amplifier, draw the schematic circuit and perform DC Analysis, AC Analysis and Transient Analysis.

4.Design a 4 bit R-2R based DAC using given op-amp in the library**. Draw the schematic and perform simulation.

* Appropriate specification should be given.

** Applicable Library should be added & information should be given to the designer.

Course Outcomes:

After studying this lab course, the student will be able to:

1) Develop Verilog code and testbench for a 4-bit parallel adder, 4-bit synchronous and asynchronous counters and perform simulation using available EDA tool.
2) Design and perform schematic simulation of CMOS Inverter, Common source amplifier, common drain amplifier and differential amplifier, for the given specifications and layout simulation of CMOS Inverter, Common source amplifier and common drain amplifier using available EDA tool.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	2	-	-	-	-	-	-	-	3	1	-
CO2	3	-	-	-	2	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

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RESEARCH METHODOLOGY AND IPR			
Course Code	**21HU511**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:0:0**	**SEE Marks**	**50**
Total Hours	**25**	**Credits**	**02**

Course Learning Objectives:

This course will enable the students to

1. To explain the significance of carrying out research work,
2. To explain the Research Problem, Review the literature.
3. To understand Research Design, methodological way of execution.
4. To understand Data Collection, and Interpretation and Report Writing.
5. To appreciate the importance of Intellectual property rights protection.

UNIT – I

Research Methodology:

Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method.

Defining the Research Problem:

Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Reviewing the literature:

Place of the literature review in research, Bringing clarity and focus to your research problem, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

09 Hours

UNIT - II

Research Design:

Need for Research Design, Features of a Good Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Design of Sample Surveys:

Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Data Collection:
Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Interpretation and Report Writing:
Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout.

Interpretation and Report Writing (continued):
Types of Reports, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

09 Hours

UNIT – III

Introduction to Intellectual Property
Intellectual Property (IP) – Importance, Jurisprudential definition and concept of property, rights, duties and their correlation; evolution of IPR – Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications.

Agreements and Treaties
TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; Indian Patent Act 1970 & recent amendments – Patent (Amendment) Rules, 2017.

Basics of Patents and Concept of Prior Art
Introduction to Patents; Types of patent applications, Specifications: Provisional and complete; Forms and fees Invention in the context of "prior art". Patent databases.

Patent filing procedures
National & PCT filing procedure; Status of the patent applications filed; Structure of Patent document, Precautions while patenting – disclosure/non-disclosure; Patent licensing and agreement; Patent infringement- meaning, scope, litigation.

07 Hours

Scheme of SEE Question Paper
There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain the significance of carrying out research work and identifying a research problem and perform e literature review.
2. Explain the Research Design, methodological way of execution, Data Collection, and Interpretation and Report Writing.
3. Explain the importance of Intellectual property rights and patents.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	3	-	-	-	-	1
CO2	3	3	2	-	-	1	1	-	-	-	-	-	-	-	1
CO3	1	1	-	-	-	3	2	2	-	3	-	-	-	-	1

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. C. R. Kothari, Gaurav Garg, **"Research Methodology: Methods and Techniques"**, New Age International, 4th Edition, 2018.
2. Ranjit Kumar, **"Research Methodology a step-by step guide for beginners",** SAGE Publications Ltd, 3rd Edition, 2011.
3. Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

REFERENCE BOOKS:

1. Trochim, **"Research Methods: the concise knowledge base",** Atomic Dog Publishing, 2005.
2. Fink A, **"Conducting Research Literature Reviews: From the Internet to Paper",** Sage Publications, 2009.

NPTEL/ MOOC Link:

1. NPTEL course material related to operations management, operations research and entrepreneurship.

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EMPLOYABILITY SKILL DEVELOPMENT			
Course Code	**21ECA51**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**1:0:0**	**SEE Marks**	**50**
Total Hours	**12**	**Credits**	**1**

UNIT – I

Quantitative- Numbers (Odd, even, H.C.F & L.C.M, Square roots & cube roots, Average, Percentage)
Analytical/logical- Numerical logic (next number in series, odd man out)
Verbal- Vocabulary (root words, prefix, suffix)

UNIT – II

Quantitative-Ratios & Proportions, Partnership
Analytical/logical- Coded language
Verbal- Vocabulary (synonyms)

UNIT – III

Quantitative- Time & work
Analytical/logical- Syllogism
Verbal- Vocabulary (antonyms)

UNIT – IV

Quantitative- Pipes & Cistern
Analytical/logical- Direction (N-E-W-S)
Verbal- One word substitution

UNIT – V

Quantitative- Speed
Analytical/ Logical- Seating arrangement
Verbal- Idiom/phrases

UNIT – VI

Quantitative- Problems on trains
Analytical /logical- Blood relations
Verbal- Sentence completion

UNIT – VII

Quantitative- Problems on boats & streams

Analytical/logical- Blood relations
Verbal- Active & Passive voice

UNIT – VIII

Quantitative- Allegation & Mixtures
Analytical/logical- Statement & Conclusion
Verbal- Direct & indirect speech

REFERENCE BOOKS:

1. Aggarwal R.S, **"Quantitative Aptitude for Competitive Examinations"**, S Chand Publishing.
2. Aggarwal R.S, **"A modern approach to verbal and non-verbal reasoning"**, S Chand Publishing.
3. Bharath Patodi and Aditya Choudhary, **"Verbal Ability & Comprehension"**, Disha Publication, Second edition, 2015.
4. Shakuntala Devi, **"Joy of numbers"**, Orient Black Swan.
5. Shakuntala Devi, **"More puzzles to puzzle you"**, Orient Black Swan.

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ENVIRONMENTAL STUDIES			
Course Code	**21CV512**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**1:0:0**	**SEE Marks**	**50**
Total Hours	**15**	**Credits**	**01**

Course Learning Objectives :

Upon Completing this course, the students will be able to

1. To raise consciousness about environmental conditions and to imbibe environmentally appropriate behaviour.
2. To equip the engineering undergraduates to identify the significance of environmental practice in their daily life and in the engineering practices.
3. To make them conscious of understanding the environment where we live and act up on.

UNIT – I

Environment

Definition, significance of environmental studies- current scenario, local, regional, national and global problems

Components of environment: atmosphere, hydrosphere, lithosphere, and biosphere. Layers of atmosphere and its role.

Parts of Earth- lithosphere and its role; hydrological cycle

Eco system

Definition, ecology and environment, ecosystem components: biotic and abiotic components; ecological balance; elements of ecosystem: biotic, abiotic; producers, consumers and decomposers.

Habitat, range of life, Biome, balanced eco- system, food chain, food web and ecological pyramids

Human activities

The Anthropogenic System- human activities like growing food, building shelter and other activities for economy and social security. Soil erosion, water logging -definition. Organic farming- definition.

03 Hours

Natural Resources

Resources - Natural resources, water, minerals, Fossil fuels and energy

Water resources - Global water resources: distribution, uses of water for irrigation, domestic and industrial purposes in India.

Quality aspects - Water quality parameters, drinking water standards for turbidity, pH value, total hardness, iron, fluoride, lead, arsenic, nitrate

Mineral resources- Metallic minerals, non-metallic minerals Fossil fuels - Coal and petroleum

Forest Wealth - Components of the forest, key benefits of forests. Deforestation- environmental effects of deforestation and remedies Sustainable development- definition, objectives

Material cycles - Carbon, Nitrogen, and Sulphur cycles.

03 Hours

UNIT – II

Environmental pollution: Definition, harmful effects related to public health

Water pollution:

Definition, types, and sources – agriculture (pesticides and fertilizers), industry, domestic and mining, harmful effects, water borne and water induced diseases- definition, common diseases and their causatives, Fluoride problem in drinking water

Land pollution:

Definition, sources_ agriculture, housing, industry, mining, transportation. Types of municipal Solid waste Disposal (Sanitary landfills, composting, incineration (in brief) and effects

Air Pollution:

Definition, types, and sources: industry, mining, agriculture, transportation, and effects

Noise pollution:

Definition, sources, mining, industries, rail-roads, aviation, effects and control measures

03 Hours

Energy

Different types of energy-

Non-renewable energy; fossil fuels- coal, oil, and natural gas- brief description only.

Nuclear energy- nuclear power plants,

Renewable energy: solar energy- Photovoltaic systems for street and domestic lighting, solar water heating-brief description only

Wind energy- definition, merits and demerits, Hydro power- definition, merits, and demerits.

Biomass energy- definition, sources of bioenergy, biogas, biofuels, India's position in renewable energy

Hydrogen as an alternative future source of energy- brief scope, fuel cells.

02 Hours

UNIT – III

Current environmental issues of importance

Population growth- Definition, growth rate, effects, remedies Urbanization - Definition, environmental impacts and remedies Global warming and climate change- Concept of greenhouse effect, sources of greenhouse gases, effects, and remedial measures of greenhouse gases

Acid rain: Definition, causes and effects, control measures.

Ozone Depletion: Definition, causes, effects, and control measures.

Environmental Impact Assessment- EIA definition, objectives, and benefits of EIA.

04 Hours

Course Outcomes:

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

1. Identify the significance of environmental practice in their daily life and in the Engineering practices.
2. Create awareness about environmental conditions.
3. Follow environmentally appropriate behaviour.
4. Understand the importance of their surroundings.
5. Understand Current environmental issues of importance.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	-	-	-	-	2	-	-	-	-	1	-	-
CO2	-	-	-	1	-	-	-	-	-	1	-	-	1	-	-
CO3	1	-	-		1	-	-	-	-	-	-	-	1	-	-
CO4	1	-	-	1	-	-	-	-	-	-	-	-	1	-	-
CO5	-	-	3	-	-	-	-	-	-	-	3	-	1	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Benny Joseph, **"Environmental Studies"**, Tata McGraw Hill Publ. Co., New Delhi, 2005.
2. Rajagopalan R., **"Environmental Studies: From Crisis to Cure"**, Oxford University Press, London, 2005.

REFERENCE BOOKS:

1. Balasubramanya, N and Chatwal, Gurdeep R., **"Environmental Studies"**, Himalaya Publishing House, Mumbai, 2007.
2. Barucha, E., **"Environmental Studies"**, University Grants Commission, New Delhi, 2004.
3. Bhatia, S. C., **"Environmental Chemistry"**, CBS Publishers, New Delhi, 2005.
4. De, A.K. and De, A. K., **"Environmental Studies"**, 2006.
5. Keller, Edward A., **"Environmental Geology"**, CBS Publishers and Distributors, Delhi, 1985.

NPTEL/ MOOC Link:

1. https://nptel.ac.in/courses/110/106/110106062/
2. https://nptel.ac.in/courses/110/106/110106059/

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OPERATIONS RESEARCH AND PROJECT MANAGEMENT			
Course Code	**21EC601**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

Upon Completing this course, the students will be able to

1. Define Operations Research.
2. Understand to formulate a Linear Programming Problem.
3. Solve a Linear Programming Problem using Simplex method.
4. Understand the concept of duality.
5. Solve balanced and unbalanced Transportation Problem.
6. Formulate Assignment Problem.
7. Estimate the project completion time using CPM.

UNIT – I

Introduction, Linear Programming: Introduction, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study, Models used in OR.

Introduction to Linear Programming Problem (LPP): Generalized LPP- Formulation of problems as LPP. Solutions to LPP by graphical method (Two Variables).

Simplex Method - 1: Introduction to simplex method, Setting up the simplex method, Algebra of the simplex method.

15 Hours

UNIT – II

Simplex Method - 2: The simplex method in tabular form, Slack, Surplus and Artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP.

Duality Theory - Concept of Duality, Writing Dual of given LPP, Solutions to LPP by Dual Simplex Method.

Transportation Problem: Formulation of Transportation Problem (TP), Solution, Initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in TP by Modified Distribution (MODI) method. Unbalanced TP. Maximization TP. Degeneracy in TP, Applications of TP.

16 Hours

UNIT – III

Assignment Problem: Formulation, Hungarian method for optimal solution, Unbalanced assignment problems, Travelling Salesman Problem (TSP).

Network Model -Critical Path Method: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, Critical path method to find the expected completion time of a project.

08 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. List the applications, phases and models in Operations research; Formulate Linear Programming models for the optimum utilization of productive resources in service and manufacturing systems.
2. Apply graphical method to find optimum solution for a given two variable Linear Programming Problem.
3. Determine the optimum solution and Compute Maxima or Minima for a given Linear Programming Problem using Simplex method, Big M method and Two phase simplex method; Discuss the concept of duality in Simplex problems; Formulate and Solve dual Simplex problem for a given Linear Programming Problem.
4. Formulate balanced and unbalanced transportation problem; Compute initial basic feasible solution for a given transportation problem using North-West Corner rule and Vogel's Approximation method and optimal solution using Modified Distribution method; Explain degeneracy in transportation problem and List the applications.
5. Formulate assignment model and Obtain optimal solution using Hungarian method; Explain Travelling Salesman Problem. Model an optimal replacement policy for individual and group replacement problems for a given real time scenario.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	1	1	1	-	1	1	3	-
CO2	3	-	-	-	-	-	-	1	1	1	-	1	1	3	-
CO3	3	-	-	-	-	-	-	1	1	1	-	1	1	3	-
CO4	2	3	-	-	-	-	-	1	1	1	-	1	1	3	-
CO5	2	3	-	-	-	-	-	1	1	1	-	1	1	3	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Ramamurthy P, **"Operations Research"**, 2nd Edition, New Age International (P) Ltd., Publishers, 2007.
2. S. D. Sharma, **"Operations Research"**, Kedar Nath Ram Nath Publishers, 2015.

REFERENCE BOOKS:

1. Taha, H.A., **"Operations Research: An Introduction"**, 8th Edition, Pearson Prentice Hall, 2007.
2. Winston, Wayne L., and Jeffrey B. Goldberg, **"Operations Research: Applications and Algorithms"**, Belmont: Thomson Brooks/Cole, 2004.

NPTEL/ MOOC Link:

3. https://nptel.ac.in/courses/110/106/110106062/
4. https://nptel.ac.in/courses/110/106/110106059/

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COMPUTER NETWORKS			
Course Code	**21EC602**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:2**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**04**

Course Learning Objectives:

This course will enable the students to

1. Appreciate the use of computer networking in various walks of life, describe the types of networks, network configurations and network topologies. Write the OSI and TCP/IP reference models for networking.
2. Explain responsibilities of data link layer, its implementation and associated protocols, algorithms/pseudo codes and various techniques used to access a shared channel in the network.
3. List types of networking devices, backbone networks and Internet Protocol (IP) addressing.
4. Explain the responsibilities of network, transport and application layers.
5. Discuss selected issues that are often encountered when dealing with communications and networking problems and to show how network security and cryptography can be used in three upper layers of the Internet model.

UNIT – I

Introduction: Uses of computer networks, physical topology Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Wireless Networks, protocols and

standards.

Network Models: Layered tasks, The OSI Reference Model, The TCP/IP Reference Model, Comparison of the OSI and TCP/IP Reference Models, addressing.

Data Link Layer: Framing, Error Control, Flow Control, Error-Detection and correction: Introduction, Error detection using CRC.

Data Link Protocols: Simplest Protocol, Stop-and-Wait Protocol, Stop-and-Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ, HDLC.

Multiple Accesses. Random Access: ALOHA, Carrier Sense Multiple Access (CSMA) Protocols, CSMA with Collision Detection, CSMA with Collision Avoidance.

Controlled Access: Reservation, Polling and Token Passing.

Channelization: FDMA, TDMA, CDMA.

15 Hours

UNIT – II

Connecting LANs, Backbone and Virtual LANs: Connecting devices, Back bone Networks, Virtual LANs.

Network Layer: Need for network layer, Logical addressing, IPv4 addresses, IPv6 addresses, IPv4 and IPv6 datagrams, Transition from IPv4 to IPv6.

Network Layer: Delivery, Forwarding, Types of Routing protocols, Unicast Routing Protocols.

The Transport Layer: Process to process Delivery, User Datagram Protocol (UDP) and Transmission Control Protocol (TCP).

Application layer: Domain name space, Distribution of name space, Resolution.

14 Hours

UNIT – III

Introduction to Cryptography – Symmetric-key Cryptography, Asymmetric-key Cryptography.

Introduction to Network Security - Security Services, Message Confidentiality, Message Integrity, Message Authentication, Digital Signature, Entity Authentication, Key Management.

Security in the Internet: IP Security (IPSec), Secure Socket Layer/ Transport Layer Security, (SSL/TLS), Pretty Good Privacy (PGP), Virtual private network (VPN) and Firewalls.

Introduction to Cyber Security: Classification of cybercrimes, planning of attacks, social engineering: Human-based, Computer-based: Cyberstalking, Cybercafe and Cybercrimes, Phishing, Password cracking, Keyloggers and Spywares, DoS and DDoS attacks, SQL Injection, Identity Theft (ID): Types of identity theft, Techniques of ID theft.

10 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain the different aspects of computer networks, protocols, discuss network models.
2. Apply framing techniques for variable size data, Use CRC for error detection using the given generator polynomial, analyse data link layer protocols for unidirectional data transfer.
3. Analyse and compare multiple access methods, evaluate throughput for random access method, system capacity in controlled access and channelization methods for the given network scenario.
4. Identify the network connecting devices, explain addressing schemes used at the network layer and configure a block of IPv4 addresses among the given number of organizations and end users. Explain the use of unicast routing protocols, UDP/TCP and DNS for global communication for the given network Dijkstra's algorithm.
5. Describe the Basic concepts of Cryptography in Computer Network Security, identify the possible attacks on computer networks, describe the Internet Security Protocols, identify and explore the authentication mechanisms over internet.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	1	-	-	2	1	-	-	1	3	1	1
CO2	3	1	2	2	3	-	-	-	-	2	-	1	3	1	1
CO3	3	1	2	2	3	-	-	2	1	2	-	1	3	1	1
CO4	3	1	2	2	3	-	-	-	-	2	-	1	3	1	1
CO5	3	1	-	-	1	2	1	2	1	-	-	1	3	1	1

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Behrouz A Forouzan, **"Data Communications and Networking"**, McGrawHill, 3rd Edition, 2004.
2. Nina Godbole, Sunit Belapure, "**Cyber Security, Understanding cybercrimes, computer forensics and legal perspectives**", Wiley Publications, 2016.

REFERENCE BOOKS:

1. Andrew S. Tenenbaum, **"Computer Networks"**, Pearson Education/PHI, 4th Edition, 2003.
2. William Stallings, **"Data and Computer Communication"**, Pearson Education Asia, 6th Edition.
3. Kurose and Ross, **"Computer Networking"**, Pearson Education, 2002.
4. Brian Underdahl, **"Cybersecurity for Dummies"**, Wiley, 2011.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/106105081/
2. http://nptel.ac.in/courses/106105082/
3. https://www.mooc-list.com/course/networking-introduction-computer-networking-stanford-university

List of Experiments:

Part A: Implementation using C/C++

1. Write a program for a HDLC frame to perform the following,
    i. Bit stuffing
    ii. Character stuffing
2. Write a program for distance vector algorithm to find suitable path for transmission.
3. Implement Dijkstra's algorithm to compute the shortest routing path.
4. For the given data, use CRC-CCITT polynomial to obtain CRC code. Verify the program for the cases.
    i. Without error
    ii. With error.
5. Implementation of stop-and-wait protocol and sliding window protocol.
6. Write a program for congestion control using Leaky Bucket algorithm.
7. Write a program to perform encryption and decryption.

Part B: using NS2/NS3/OPNET/NCTUNS/NetSim/QualNet/Packet Tracer/Python or any other equivalent tool.

1. Implement a point-to-point network with four nodes and duplex links between them. Analyse the network performance by setting the queue size and vary the bandwidth and find the number of packets dropped.
2. Implement a four-node point-to-point network with the links connected as follows: n0–n2, n1–n2 and n2–n3. Apply TCP agent between n0–n3 and UDP between n1–n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP.
3. Implement Ethernet LAN using n nodes (6-10), compare the throughput by changing the error rate and data rate.

4. Implement ESS with transmitting nodes in wireless LAN and obtain the performance parameters.
5. Implementation of Link State Routing Algorithm.

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ANTENNA AND MICROWAVE SYSTEMS			
Course Code	**21EC603**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Distinguish the features of a strip and microstrip line.
2. Learn the application of Smith chart to solve impedance matching problems in transmission lines and study the micro-strip lines.
3. Possess the basic concepts of radiation of electromagnetic energy from a radiator.
4. Analyze the radiation pattern in terms of power, radiation intensity or electric field and basic antenna types.
5. Describe the construction and design features of commercial antennas.

UNIT – I

Introduction, Planar transmission lines: strip lines, Losses in strip lines, excitation of strip lines, Microstrip lines, effective dielectric constant, losses, excitation,
Problems on micro strip lines, advantages and disadvantages of planar transmission lines.
Impedance matching transformers: Introduction, General condition for impedance matching, Quarter wave impedance transformer, Smith chart as an admittance chart.
Stub matching, Single stub matching on a line, Double stub matching networks, Problems.
Microwave devices: S – Parameters, S-matrices of a multiport network. E-plane Tee, H-plane Tee and Hybrid Microwave devices: S – Parameters, S-matrices of a multiport network, Properties (i) and (ii) (iii) and (iv) Tee, Directional Couplers.
E-plane Tee, Construction, derivation of S matrix, H-plane Tee, Construction, derivation of S matrix. Hybrid Tee, Construction, derivation of S matrix, Ring resonator, power divider with parameters.
Microwave oscillator: High frequency limitations of conventional microwave devices, Reflex Klystrons oscillators: Velocity modulation, expression for power output and efficiency.

16 Hours

UNIT – II

Basic antenna parameters: Directivity, gain, effective aperture, effective height,
Problems, Point sources and various patterns, Power theorem and applications, Radiation Intensity. Problems.
Field and phase patterns, Array of two isotropic point sources Case (i), (ii), (iii), (iv) and (v).

Pattern multiplication, Problems on field patterns. Arrays of n isotropic sources of equal amplitude and spacing Arrays of two driven λ/2 elements.

Null directions, basic equation, null direction for broadside, end fire and extended end fire array system.

Retarded vector potential and scalar potential for short dipole, Radiation resistances (Qualitative analysis),

Loop Antenna: Square loop, derivation of E and H fields, radiation resistance.

14 Hours

UNIT – III

Antenna Types: Helical antenna, Monofilar axial-mode helical antenna, Dipole arrays with parasitic elements, Yagi-Uda array, Basic construction of Slot antenna, types, Babinet's principle and Complementary antenna. Horn antenna and Reflector antenna. Frequency independent antenna- Basics and Rumsey's principle. Log- periodic antennas - principle and design.

09 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Apply the Smith chart to solve impedance matching problems and study the parameters of strip and micro-strip lines.
2. Discuss the concepts of scattering parameters, apply them to microwave components and elaborate on microwave oscillator & solid state microwave devices.
3. Discuss the fundamental parameters of antenna and determine the null directions.
4. Analyze the pattern using null direction concept and derive the field parameters of basic antenna systems.
5. Contrast the construction, design and principle of operation of fundamental antennas.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	1	1	1	-	1	3	1	-
CO2	3	2	1	1	-	-	-	1	1	1	-	1	3	1	-
CO3	3	2	1	-	-	-	-	1	1	1	-	1	3	1	-
CO4	3	2	1	-	-	-	-	1	1	1	-	1	3	1	-
CO5	3	1	1	-	-	-	-	1	1	1	-	1	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Annapurna Das & Sisir K. Das, **"Microwave Engineering",** Tata McGraw-Hill 2000.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, **"Antennas and Wave Propagation",** Tata McGraw Hill Publication, 4th Edition, 2012.

REFERENCE BOOKS:

1. Liao S., "**Microwave Devices and Circuits",** Prentice Hall India Ltd., 2004.
2. John D Kraus, "**Antennas for all applications**", McGraw Hill, 3rd Edition, 2002.
3. K.D. Prasad, "**Antennas and wave Propagation**", Sathya Prakashan, 2009.

NPTEL/ MOOC Link:

1. https://nptel.ac.in/courses/108/103/108103141/
2. https://nptel.ac.in/courses/108/101/108101112/
3. https://nptel.ac.in/courses/108/101/108101092/

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COMMUNICATION LAB			
Course Code	**21EC604**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**0:0:2**	**SEE Marks**	**50**
Total Hours	**26**	**Credits**	**1**

Course Learning Objectives:

This laboratory course enables students to:

1. Realize the concepts of sampling and signal reconstruction.
2. Realize the different types of digital modulation and demodulation schemes.
3. Realize the concepts of power divider, ring resonator using appropriate microwave setup
4. Measurement of antenna parameter for Yagi antenna and Dipole antenna.

LIST OF EXPERIMENTS:

1. Verification of sampling theorem
2. Binary ASK generation and detection
3. Binary FSK generation and detection
4. Binary PSK generation and detection
5. DPSK modulation and demodulation
6. QPSK modulation and demodulation
7. Measurement of guide wavelength (λg), frequency and VSWR with using microwave test bench Reflex Klystron as source
8. Study of optical fibers: measure losses in the analog link and numerical aperture
9. Determination of coupling coefficient and isolation characteristics of microstrip line Directional coupler.
10. Measurement of antenna parameters for Dipole and Yagi antenna.
11. Measurement of resonant characteristics of microstrip Ring Resonator
12. Measurement of power division; Isolation characteristics of microstrip 3dB power divider.
13. Design of microstrip antennas for 5G/6G applications.

Course Outcomes:

1. Set up experiments to demonstrate the concepts of digital communication and microwave communication schemes using suitable circuits.
2. Simulate the concepts of digital communication using appropriate Simulation tools.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	2	-	-	-	-	1	1	-	-	3	-	-
CO2	2	-	-	-	3	-	-	-	1	1	-	-	3	-	-

3 – High 2 – Medium 1 – Low

REFERENCE BOOKS:

1. Simon Haykin, **"An Introduction to Analog & Digital Communication",** John Wiley, 2006.
2. Ramakanth Gayakwad, "**Opamps and Linear integrated circuits**", Pearson, 4Th edition, 2017.
3. S.Liao, **"Microwave devices and circuits",** PH , 2004.
4. John D Kraus**, "Antennas for all applications"**, McGraw Hill, 3rd Edition, 2002.

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MINI PROJECT			
Course Code	**21EC605**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**0:0:4**	**SEE Marks**	**-**
Total Hours	**52**	**Credits**	**02**

Student will carry out a project using the knowledge gathered from the courses successfully completed to arrive at some useful conclusions using any of the methods listed below:

i) Designing and testing a circuit for a new concept.
ii) Conceptual development of a new idea in the field of electronics.
iii) Literature survey of any topic of importance in electronics.

Course Outcomes:

After completion of this Project Phase the student will be able to

1. Source, comprehend and Analyze technical literature and other credible sources of information to formulate an engineering problem.
2. Form a team with clearly defined roles for each member.
3. Identify the societal, health or environmental need that is addressed through the solution to the identified engineering problem.
4. Create a project proposal document detailing the problem, its objective, methodology and expected outcomes.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	2	-	-	-	-	-	-	2	3	1	2
CO2	-	-	-	-	-	-	-	-	2	-	-	-	1	1	2
CO3	-	-	-	3	-	2	1	-	-	-	-	-	1	1	2
CO4	-	-	-	-	-	-	-	-	2	3	1	-	3	1	2

3 – High **2 – Medium** **1 - Low**

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ELECTIVES

ADHOC AND SENSOR NETWORKS			
Course Code	**21ECE101**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Establish the concept of forming a network with sensor nodes with radio frequency (RF) link.
2. Analyze the architecture, performance of the wireless and adhoc networks with protocols of Physical, MAC and network layer.
3. Describe the time synchronization and localizations of the adhoc and wireless sensor networks.
4. Observe the characteristics of various layers of wireless sensor networks using simulation tools.
5. Construct a layout of wireless/body sensor networks with the help of development platforms.

UNIT - I

Introduction to sensors:

Sensor basics, Sensor types, Characteristics, Applications **4 Hours**

Introduction to Wireless Sensor Networks (WSN):

Factors influencing the WSN design, hardware constraints, Power consumption, Communication, Simplified energy model **4 Hours**

WSN Architecture, Hardware components, Physical layer, Radio Frequency(RF), UWB, Modulation, Path loss.

Transceiver tasks and characteristics, Physical layer transceiver design

Medium access control layer: Energy consumption.

Network layer functionalities. **4 Hours**

Protocol stack, embedded operating systems, Tiny OS, Contiki OS**.** **3 Hours**

UNIT - II

MAC Protocols:

Fundamentals, Classes of MAC protocols, MAC protocols for WSN, Low duty cycle protocols, Wake up radio concepts, Contention and Schedule based protocols, IEEE 802.15.4 MAC protocol.

Time synchronization:

Properties, Light weight time synchronization protocols (LTS) **8 Hours**

Localisation and Positioning:
Procedures, Possible approaches, Combining hierarchical topologies, and power control. Pilot based power control, Adhoc Network design algorithm (ANDA), Energy efficiency unicast routing protocol. **8 Hours**

UNIT - III

Wireless Body Area Networks,
Network topologies, Scenarios, WPAN technology, Inertial energy scavenging technique, Wireless sensor network development platforms. **8 Hours**

Scheme of SEE Question Paper
There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:
At the end of the course the student will be able to

1. Explain the fundamental knowledge in Wireless sensor node; Determine the performance parameters of modules of Sensor node.
2. Explain physical, media access control & network layer parameters of wireless sensor network architecture; Determine the path loss for the given Wireless Sensor network scenario.
3. Discuss the concepts of Medium access control protocols; Associate time-synchronisation schemes in the protocols with the conventional MAC protocol concepts.
4. Apply basic techniques of localisation and positioning to control power of the wireless sensor network.
5. Create Wireless Body sensor network basics in terms of different network topology scenarios, involving the present IEEE standard and the energy scavenging techniques to generate power for the voltage sources of the sensor nodes using the inertial technique.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
CO5	2	3	-	-	-	-	-	-	-	-	-	-	3	2	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Ian F. Akyildiz, Mehmet Can Vuran, **"Wireless Sensor Networks"**, John Wiley & Sons Ltd., 2010
2. Holger Karl and Andreas Willig, **"Protocols and Architectures for Wireless Sensor Networks"**, John Wiley & Sons, Ltd.. 2005
3. Guang-Zhong Yang (Ed.), **"Body Sensor Networks"**, Springer-Verlag London Limited, 2006.

REFERENCE BOOKS:

1. Waltenegus Dargie and Christian Poellabauer, **"Fundamentals of Wireless Sensor Networks"**, John Wiley & Sons Ltd., 2010.
2. Kazem Sohraaby,Daniel Minoli and Taieb Znati, **"Wireless Sensor Networks Technology, Protocols and Applications"**, John Wiley & Sons Ltd., 2007.

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MODERN RADAR AND NAVIGATIONAL AIDS			
Course Code	**21ECE102**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to

1. Work with different radar range equations and calculate the effect of various external / internal factors on radar accuracies.
2. Learn border view of radar subsystems , Radar measurement and Navigation.
3. Apply the knowledge to obtain signal levels in simple direction finders for Navigational instruments.
4. Study radar measurement processes, evaluate Doppler shifts and blind speeds.
5. Learn the elements of electronic navigation and integrate with emerging technologies.

UNIT – I

Elementary Modern radar: Radar overview, Radar range equation, Radar search and detection, Radar Cross section, Transmitted power, Pulse Repetition frequency and Radar Clutter. **15 Hours**

UNIT – II

MTI & Pulse Doppler Radar: Introduction to MTI & Pulse Doppler Radar, Delay line cancellers, MTD, CW & FMCW Radar.

Influencing factors: Propagation effects, Target reflectivity, Target fluctuations, Detection criteria, Detection theory, Signal processing, Pulse compression.
Radar Measurements: Parameter Measurements, Doppler phenomenology, Doppler processing.

16 Hours

UNIT – III

Navigation: Introduction to four methods of Navigation. Radio direction finding, VOR, Hyperbolic systems of navigation- LORAN, DECCA, GPS.
Aids to approach and Landing: ILS, MLS, DME & TECAN. **8 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Analyze Radar range equations and Estimate radar range, transmitted power, Pulse repetition frequency, cross section, clutter for different target and Integrate for developing Radar range equation.
2. Evaluate the performance of different radar systems for stationary and moving targets and Design different receiver systems for specific radar applications.
3. Apply the propagation effects on radar signal to estimate target reflectivity, fluctuations and Deduce appropriate detection criteria, signal processing and pulse compression schemes.
4. Use parametric measurements to Develop Doppler phenomenology and Doppler processing.
5. Classify different methods of navigation radio detection and VOR techniques, Compare the performance with other hyperbolic systems. Extend the concepts of navigation systems to Evaluate the performance of advances Instrument landing systems.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	1	1	-	1	3	-	-
CO2	3	-	-	-	-	-	1	-	1	1	-	1	3	-	-
CO3	3	-	-	-	-	-	-	-	1	1	-	1	3	-	-
CO4	3	-	-	-	-	-	-	-	1	1	-	1	3	-	-
CO5	2	3	-	-	-	-	1	-	1	1	-	1	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Mark A Richards, et al**. "Principles of Modern Radar-Vol. I",** Yes Dee Publishers, 2012.
2. N. S. Nagaraja, **"Elements of Electronic Navigation",** McGraw-Hill Publications,2nd Edition.
3. A. K. Sen et al., **"Radar Systems and Radio Aids to Navigation",** Khanna Publishers, 2010.

REFERENCE BOOKS:

1. Merrill Skolnik, **"Introduction to Radar Systems",** McGraw-Hill Publications.
2. Merrill Skolnik, **"Radar Handbook"**, McGraw-Hill Publications.
3. Simon Kingsley et al., **"Understanding Radar Systems",** McGraw-Hill Publications.
4. Myron Kayton et al., **"Avionics Navigation Systems"** John Wiley Publications, 2nd Edition.

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MULTIMEDIA COMMUNICATIONS			
Course Code	**21ECE103**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

The course presents basics of Multimedia Communication that aims to

1. Introduce basics of Multimedia Communication.
2. Introduce the students with knowledge of Audio Video Compression and Multimedia information Networks.
3. Introduce Multimedia transport and management protocols.
4. Introduce the multimedia information representation techniques.
5. Introduce the networks significance in multimedia.

UNIT – I

Multimedia Communications: Introduction, Multimedia information representation, Multimedia networks, Multimedia applications, Media types, Communication modes, Network types, Multipoint conferencing, Network QoS application QoS. **15 Hours**

UNIT – II

Audio and Video Compression: Introduction, Audio compression, DPCM, ADPCM, APC, LPC, Video compression, Video compression principles, H.261, H.263, MPEG, MPEG-1, MPEG-2, and MPEG-4.

Multimedia Information Networks: Introduction, Network performance parameters, Throughput, Networking delay, Delay variance, Error rate, Quality of service. QoS perspectives, QoS Processing, Multimedia transmission, Requirements, transmission over WANs, Multimedia Transmission over LANs, ATM Networks, Wireless LANs.

16 Hours

UNIT – III

Multimedia transport and management protocols

Multimedia transport**:** RTP and RTCP

Multimedia management protocols: H.323, SIP, SDP, SAP. **8 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

A student who successfully fulfils the course requirements will have demonstrated:

1. Discuss the importance of multimedia networks and information representation techniques namely text, image, audio and video for efficient transfer of information.
2. Analyse the interpersonal, interactive and entertainment applications of multimedia communication networks. Determine the QoS parameters associated with a constant bit rate channel of communication network.
3. Demonstrate the audio codec systems DPCM, ADPCM, LPC and video codec systems H.261, H.263, MPEG-1, MPEG-2, and MPEG-4using SIMULINK tool.
4. Calculate the multimedia network performance parameters throughput, network delay, delay variance, error rate and predict the multimedia transmission over LAN, WAN and MAN.
5. Examine the capabilities of multimedia transport protocols RTP and RTCP and multimedia management protocols H323, SIP, SDP, SAP for the best Voice over IP service.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	1	1	1	-	1	3	-	-
CO2	2	3	-	-	2	-	-	1	1	1	-	1	3	2	2
CO3	3	-	-	-	2	-	-	1	1	1	-	1	3	2	2
CO4	3	-	-	-	-	-	-	1	1	1	-	1	3	-	-
CO5	3	-	-	-	-	-	-	1	1	1	-	1	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Fred Halsall, **"Multimedia Communications: Applications, Networks, Protocols, and Standards"**, Pearson Education, Asia, 2nd Edition Indian reprint 2002.
2. Nalin K. Sharda, **"Multimedia Information Networking",** PHI, 2003.
3. Ralf Steinmetz, Klara Narstedt, **"Multimedia Fundamentals: Vol. 1-Media Coding and Content Processing",** Pearson Education, 2004.

REFERENCE BOOK:

1. Andy Sloane, "**Multimedia Communications**", McGraw Hill,1996.

NPTEL/MOOC Link:

1. http://nptel.ac.in/courses/117105083/

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OPTICAL COMMUNICATION & NETWORKS			
Course Code	**21ECE104**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Appreciate the use of Optical Communication and Networks in various walks of life, describe the types of networks, and network Services and Applications.
2. Explain responsibilities of Optical Transmitters, Optical receiver its implementation and its function.
3. Explain the various techniques used in fiber coupler and connectors.
4. List types of optical networks and its significance in optical domain.
5. Explain the operation of WDM concept and its applications.

UNIT – I

Overview of Optical Fiber Communication: Introduction, Historical development, General system, Advantages, Disadvantages and applications of optical fiber communication, Optical fiber waveguides, Ray theory, Cylindrical, Single mode fiber, Cutoff wave length, Mode filed diameter. Optical Fibers: Fiber materials, Photonic crystal, Fiber optic cables specialty fibers.

Introduction, Attenuation, Absorption, Scattering losses, Bending loss, Dispersion, Intra model dispersion, Inter model dispersion. **12 Hours**

UNIT – II

Optical Sources and Detectors: Introduction, LED's, LASER diodes, Photo detectors, Photo detector noise, Response time, Double hetero junction structure, Photo diodes, Comparison of photo detectors. **6 Hours**

Fiber Couplers and Connectors: Introduction, Fiber alignment and joint loss, Single mode fiber joints, Fiber splices, Fiber connectors and fiber couplers. **6 Hours**

Optical Receiver: Introduction, Optical Receiver Operation, Receiver sensitivity, Quantum limit, Eye diagrams, Coherent detection, Burst mode receiver, Operation, and Analog receivers. **6 Hours**

UNIT – III

Optical Amplifiers and Networks: Optical amplifiers, Basic applications and types, Semiconductor optical amplifiers, EDFA.

Optical Networks: Introduction, SONET / SDH, Optical Interfaces, SONET/SDH rings, High – speed light – waveguides.

WDM Concepts and Components: WDM concepts, Overview of WDM operation principles, WDM standards. **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain the propagation of optical signals for single mode and multimode in different fiber structures.
2. Estimate the fiber losses and quantum efficiency due to attenuation factor, dispersion and total carrier recombination life time.
3. Explain the concept of fiber couplers, connectors and fiber alignment mechanism.
4. Discuss the concepts of optical receiver characteristics to estimate the receiver sensitivity, quantum limit.
5. Explain the concept of SONET/SDH and WDM network models for wavelength connectivity and multiplexing techniques.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. M. N. Bandyopadhyay, **"Optical Communication and Networks"**, PHI, 2014.

REFERENCE BOOKS:

1. John M. Senior, **"Optical Fiber Communications"**, Pearson edition, 2000.
2. Rajiv Ramswami, N. Sivaranjan, **"Optical Networks"**, M. Kauffman Publishers,2000.
3. Gerd Keiser, **"Optical Fiber Communication"**, MGH, 1991.
4. G. P. Agarawal, **"Fiber Optics Communication Systems"**, John Wiley New York, 1997.
5. P.E. Green, **"Optical Networks"**, Prentice Hall, 1994.

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SPREAD SPECTRUM COMMUNICATION

Course Code	**21ECE105**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Get a notion about spread spectrum communication system and how it is used for secure communication.
2. Understand the concept of synchronization.
3. Understand the multiple access technique used in spread spectrum communication system.

UNIT – I

Introduction to Spread Spectrum Systems: Two communication problems, Direct sequence spread spectrum, BPSK, QPSK, MSK direct sequence spread spectrum Frequency –Hop spread spectrum, Hybrid direct sequence/ frequency –Hop spread spectrum, Complex envelope representation of Spread – spectrum systems.

Binary Shift Register sequences for Spread – spectrum Systems: Introduction, Definitions, Mathematical background and sequence generator fundamentals, Maximal length sequences, Gold Codes, Non linear code generators. **16 Hours**

UNIT – II

Code tracking Loops: Introduction, Optimum tracking of Wide band signals, Base band Delay lock tracking loop, Non-coherent Delay lock tracking loop, Tau-Dither non-coherent tracking loop, Double Dither non coherent tracking loop, Non coherent Delay lock tracking loop with arbitrary data and spreading modulation, Code tracking loops for frequency – Hop systems**.**

Initial synchronization of the receiver spreading code: Introduction, Problem definition and the optimum synchronizer, Serial search synchronization techniques, Generalized analysis of average synchronization time, Synchronization using a matched filter, Synchronization by estimating the received spreading code, Tracking loop pull in.

17 Hours

UNIT – III

Code Division Multiple Access : Introduction, Cellular radio concept, Fundamentals of cellular radio system, Co-channel interference protection prediction, and cellular concept revisited, CDMA digital cellular systems, Detection of spread spectrum signal.

6 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Generate various types of spreading codes like PN sequence and Gold sequence using appropriate polynomials.
2. Demonstrate the understanding and functioning of different types of spread spectrum systems and evaluate the system using the parameters – processing gain and jamming margin.
3. Realize the need of synchronization and also how to achieve synchronization and maintain synchronization by using code tracking loops.
4. Analyze and evaluate the techniques of initial synchronization in spread spectrum systems.
5. Realize the fundamental concepts of CDMA and Determine the radio channel capacity of CDMA system.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	2	1
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	2	1
CO4	2	3	-	-	-	-	-	-	-	-	-	-	3	2	1
CO5	2	3	-	-	-	-	-	-	-	-	-	-	3	2	1

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Peterson, Ziemer and Borth, **"Introduction to Spread Spectrum Communication",** Pearson Education Publication, 1995.
2. Valeri Ipatov,**"Spread Spectrum and CDMA Application",** John Wiley Publication, 2005.

REFERENCE BOOK:

1. Simon, Omura, Scholtz, Levitt, **" Spread Spectrum Communications Handbook",** McGraw Hill Publication, 1994.

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WIRELESS COMMUNICATION			
Course Code	**21ECE106**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

7. Have an idea about the cellular design fundaments and realize the wireless propagation models.
8. Understand the concept of fading channels and need of diversity.
9. Appreciate the bandwidth efficient techniques like CDMA and OFDM..

UNIT – I

Cellular Concept Fundamentals & Radio Wave Propagation

Introduction, Frequency reuse, Cellular geometry, Channel assignment strategies, Handoff strategies, Interference and System capacity, Trunking and GOS, Improving coverage and capacity of cellular systems.

Introduction to Radio wave propagation, Free space propagation model, Relating power to electric field, Basic propagation mechanism – Reflection, Diffraction and Scattering (Suitable models to be covered), Practical link budget design using path loss models, Outdoor and Indoor propagation.

14 Hours

UNIT - II

Fading & Diversity Techniques

Fading, Factors influencing small scale fading, Small scale multipath propagation, Impulse response model of multipath propagation, Small scale multipath measurements, Parameters of mobile multipath channels, Types of small scale fading.

Concepts of Diversity, Combining and Switching methods, Selection Diversity, Feedback Diversity, Maximal Ratio Diversity, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity.

13 Hours

UNIT – III

Broadband Techniques

CDMA: Features of CDMA, DS CDMA, FH CDMA, Radio channel capacity of DS CDMA and FH CDMA.

OFDM: Principle of OFDM, OFDM transceivers, Cyclic Extension, Channel Estimation, Peak to average power ratio, Intercarrier Interference, Adaptive Modulation and Capacity.

12 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

6. Demonstrate the understanding of the cellular concept and apply it to evaluate the system capacity with Quality of Service as well as to improve the capacity.
7. Apply the Radio Propagation Models based on the fundamental attributes of propagation and Determine the path loss and percentage coverage area.
8. Interpret and Apply the concept of fading; determine the impulse response of the channel as well as the parameters of mobile multipath channels and classify the fading channels.
9. Apply the diversity techniques and switching & combining methods to combat fading in wireless channels.
10. Explain the concepts of Multi user and Multi carrier systems with respect to Broadband communication systems.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. T. S. Rappaport, **"Wireless Communications – Principles & Practice"**, Second Edition, PHI, 2010.
2. Bernard Sklar, **"Digital Communications – Fundamentals and Applications"**, Pearson Education, Second Edition, 2001.

REFERENCE BOOKS:

1. Ye(Geoffrey) Li & Gordon L Stuber, "**OFDM for Wireless Communication**", Springer 2006.
2. Kamil Sh.Zigangirov, "**Theory of Code Division Multiple Access Communication**", John Wiley & Sons, Second Edition, 2004.
3. Simon Haykin**, "Modern Wireless Communication",** Pearson Education Inc., 2005.

NPTEL/ MOOC Link:

2. http://nptel.ac.in/courses/117104099/2
3. http://nptel.ac.in/courses/117104099/5
4. http://nptel.ac.in/courses/117104099/10

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COGNITIVE RADIO			
Course Code	**21ECE201**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Understand the principle of software defined radio.
2. Appreciate the concept of cognitive radio.
3. Explain the next generation wireless networks.

UNIT – I

Introduction To Software Defined Radio & Architecture: Essential functions of the software radio, Basic SDR, Hardware architecture, Computational Definitions and potential benefits, Software radio architecture evolution, Technology tradeoffs and architecture implications. Processing resources, Software architecture, Top level component interfaces, Interface topologies among plug and play modules. **15 Hours**

UNIT – II

Introduction to Cognitive Radios and Cognitive Radio Architecture: Marking radio self-aware, Cognitive techniques – position awareness, Environment awareness in cognitive radios, Optimization of radio resources, Artificial Intelligence Techniques. 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. **15 Hours**

UNIT – III

Next Generation Wireless Networks: The XG Network architecture, Spectrum sensing, Spectrum management, Spectrum mobility, Spectrum sharing, Upper layer issues, Cross – layer design. **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Discuss software radio on hardware & Software radio architecture, potential benefits, trade-offs and architecture implications of Software Defined Radio.
2. Explain Processing resources, top level component interfaces, interface topologies among plug and play modules of Software Defined Radio.
3. Discuss Making radio self-aware, cognitive techniques for position& environment awareness, optimization of radio resources, Artificial Intelligence Techniques in cognitive radio.
4. Apply Cognitive Radio functions, design rules, Inference Hierarchy, Architecture maps for Cognitive Radio & Software defined Radio Architecture.
5. Discuss the concepts of Wireless Networks and Apply them on The XG Network architecture, spectrum sensing, management, mobility, sharing, upper and cross layer issuesin Next Generation Wireless Networks.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Joseph Mitola, **"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, ShantidevMohanty, "**Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey**" Elsevier Computer Networks, May 2006.

REFERENCE BOOKS:

1. Simon Haykin, "**Cognitive Radio: Brain –Empowered Wireless Communications**", IEEE Journal on selected areas in communications, Feb 2005.
2. Hasari Celebi, Huseyin Arslan, "**Enabling Location and Environment Awareness in Cognitive Radios**", Elsevier Computer Communications, Jan 2008.
3. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "**Software Defined Radio**", John Wiley, 2003.
4. Huseyin Arslan, "**Cognitive Radio, SDR and Adaptive System**", Springer, 2007.
5. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "**Cognitive Radio Communication and Networks**", Elsevier, 2010.

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FIBER OPTICS			
Course Code	**21ECE202**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

This course will enable students to:

1. Competing the different light propagation mechanisms with fundamentals.
2. Justifying the impact of LED and LASER services and their applications.
3. Formulating the different scenarios of fiber optics measurement through industry and medical applications.
4. Elaborating the fiber optics connectivity modes by means of physical components.
5. Minimize the different fiber optic losses by improving the transmission characteristics.

UNIT – I

Optical Fibers and Their Properties: Principles of light propagation through a fiber, Different types of fibers and their properties, Transmission characteristics of optical fiber, Absorption losses, Scattering losses, Dispersion, Optical fiber measurement, Optical sources, Optical detectors – LED-LD-PIN and APD.

Laser Fundamentals: Fundamental characteristics of Lasers, Three level and four level lasers, Laser modes, Resonator configuration, Q-switching and mode locking, Cavity dumping, Types of lasers -Gas lasers, Solid lasers and liquid lasers and semiconductor lasers (Basic working principle only).

15 Hours

UNIT – II

Industrial Application of Optical Fibers and Lasers: Fiber optic sensors, Interferometric method of measurement of length, Measurement of pressure, Temperature, Current, Voltage, Liquid level and strain, Fiber optic gyroscope, Polarization maintaining fibers.
Laser for measurement of distance, Velocity, Acceleration, Material processing, Laser heating, Welding melting and trimming of materials, Removal and vaporization.

16 Hours

UNIT – III

Laser In Holography and Medical Application: Holography – basic principle; Methods; Holographic interferometry and applications, Holography for non-destructive testing,- Medical applications of lasers; Laser and tissue interaction, Laser instruments for surgery, Removal of tumours, Brain surgery, Plastic surgery.

8 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

At the end of the course student will be able to

1. Estimate the fiber losses and quantum efficiency due to attenuation factor, dispersion, photodetector noise and response time.
2. Apply the laser fundamentals concept to construct the different laser levels, resonator, Q switching and mode locking and applications.
3. Determine the industrial application for optical fibers to choose the measurement of pressure, voltage, current and liquid level in fiber optic gyroscope – polarization maintaining fibers.
4. Identify the different laser measurement techniques using the distance, velocity, acceleration and material processing concepts.
5. Discuss the laser applications in holography and interferometry, removal of tumors and brain surgery.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. John F. Read**, "Industrial Applications of Lasers",** Academic Press, 1978.
2. Senior J. M., **"Optical Fiber Communication Principles and Practice",** Prentice Hall, 1985.
3. Eric Udd,**"Fiber Optic Sensors An Introduction for Engineers and Scientists",** A John Wiley & Sons, Inc., Publication.

REFERENCE BOOKS:

1. John and Harry, **"Industrial Lasers and their Applications",** McGraw Hill, 1974.
2. Monte Ross, **"Laser applications"**, McGraw Hill, 1968.
3. Keiser G., **"Optical Fiber Communication",** McGraw Hill, 1991.
4. Markolf H. Niemz, **"Laser-Tissue Interactions, Fundamentals and Applications"**, Springer, 2007.

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DETECTION AND ESTIMATION			
Course Code	**21ECE203**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to:

1. Understand the basics of binary hypothesis testing leading to signal detection theory with Neyman-Pearson approaches.
2. Understand the basics of binary hypothesis testing leading to signal detection theory with Bayesian approaches.
3. Understand the fundamentals of single parameter estimation theory with deterministic and Bayesian philosophies.
4. Understand the fundamentals of multi-parameter estimation theory with deterministic and Bayesian philosophies.
5. Develop a simple application by using Kalman or Wiener filters.

UNIT – I

Detection Theory: Introduction, Hypothesis testing, Likelihood ratio test, Neyman-Pearson theorem, Bayes risk. Detection of deterministic signals in Gaussian noise, Matched filters. Detection of random signals in Gaussian noise. Composite hypothesis testing: Bayesian approach, Generalized likelihood ratio test. Detection of signals with unknown parameters. Signal detection in non-Gaussian noise.

15 Hours

UNIT – II

Classical Estimation : Minimum variance unbiased estimation of scalar and vector parameters. Cramer-Rao lower bound, Efficient estimator. Linear model. Best linear unbiased estimator (BLUE). Maximum likelihood estimation (MLE), Properties of MLE, Numerical determination of the MLE.

16 Hours

UNIT – III

Bayesian Estimation: Introduction, Maximum a Posteriori (MAP) and minimum mean square error (MMSE) estimation. Signal waveform estimation: Wiener filtering. Kalman filters.

08 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Apply hypotheses test for random signals to compute likelihood between them.
2. Develop test and metrics for detection of signals in presence of Gaussian and non-Gaussian noises.
3. Develop representation and bounds of estimation for random signals using estimators.
4. Design estimators for noisy signals.
5. Design of Kalman filters or Wiener filters for signal deconvolution or noise suppression.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO5	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. S. M. Kay, **"Fundamentals of Statistical Signal Processing. Volume I: Estimation Theory",** Dorling Kindersley (India), New Delhi, 2010.
2. S. M. Kay, **"Fundamentals of Statistical Signal Processing. Volume II: Detection Theory",** Prentice-Hall, Upper Saddle River, New Jersey, USA, 1998.

REFERENCE BOOK:

1. H. L. Van Trees, **"Detection, Estimation and Modulation Theory, Part I"**, John Wiley, USA, 2001.

NPTEL/ MOOC Link:

1. https://nptel.ac.in/courses/117103018/

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HIGH PERFORMANCE COMMUNICATION NETWORKS			
Course Code	**21ECE204**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

This course will enable the students to

1. Build the connectivity between different types of communication networks.
2. Maximizing the high performance estimation through physical and logical layer connectivities.
3. Compiling the different network control management techniques , various services and applications etc.,
4. Importance between optical connectivity and wireless connectivity through network evaluation criterion approach.
5. Evaluating the different networks qualitative analysis by enhancing through intelligent networks and Derived demand for network services.

UNIT – I

Introduction: Networking principles, Future networks Internet, Pure ATM Network, Cable Network and Wireless. Network services and Layered Architecture, Applications, Traffic characterization and quality of services, Network services, High performance networks, Network Elements., Layered applications, Open data network model, Network architectures, Network bottlenecks.

Internet and TCP/IP Networks: IPV4 Reliable multicast ,Multicast IP, Mobile IP, TCP and UDP, Applications, FTP,SMTP. Internet success and limitations, Performance of TCP/IP Networks, Performance of circuit switched Networks. **14 Hours**

UNIT – II

ATM And Wireless Network: ATM: Main features of ATM, Addressing, signalling and Routing, ATM header structure, ATM AAL, Internetworking with ATM

Wireless Networks: Link level design, Channel Access, Network design, Wireless networks today, Future networks, Ad hoc networks, High speed Digital cellular, Home RF and Bluetooth.

Network controls: Control of networks, Objectives and methods of control, Circuit switched networks, Datagram Networks, Network economics, Derived demand for network services, ISPs, Subscriber demand model. **18 Hours**

UNIT – III

Optical Networks: Optical Links, WDM systems, Optical cross connects, Optical LANs, Optical paths and Networks. SONET, DWDM, Optical Network Survivability, Physical Layer Implementation Techniques.

7 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Utilize different network model architectures, pure ATM, Open data layer, internet and calculate the network latency using Traffic Characterization.
2. Explain the use of multicasting routing protocols, TCP/IP and circuit switching performance.
3. Discuss the concepts of ATM and wireless networks , internetworking, channel access, Home RF and Bluetooth and applications.
4. Make use of network control to design subscriber demand model for Internet Service Provider (ISP).
5. Build the optical network connectivity using SONET, WDM and survivability integration techniques using, fiber demand distribution, fiber protection ratio, fiber demand bundling techniques.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-	2	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Warland and Varaiya, **"High Performance Communication Networks",** Morgan Kauffman, Elsevier, 2nd Edition 2000.
2. William Stallings, **"High-Speed Networks and Internet: Performance and Quality of Service",** Pearson Edu., 2001.
3. Dr. K.V. S. S. S. S. Sairam, and Chandra Singh, **"Survivability Techniques in Optical Networks "**, Studium Press (India) Pvt. Ltd, 2019.

REFERENCE BOOKS:

1. Rajiv Ramaswamy, Ramaswami Kumar and Sivarajan Galen Sasaki, **"Optical Networks A Practical Perspective",** 3rd Edition,Morgan Kaufmann, 2010.

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RF CIRCUIT DESIGN			
Course Code	**21ECE205**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. To study the radio frequency and medium wave concepts and the circuit representations of RF and MW networks.
2. To learn the application of Smith chart in lumped and distributed element circuit applications.
3. To design the matching networks.
4. To learn the design of small signal and large signal RF/MW Amplifiers considering the gain.
5. To design an RF/MW oscillator considering the stability.
6. To design an RF/MW frequency converters, rectifiers, detectors, mixers etc.

UNIT – I

Wave Propagation in Networks: Introduction to RF/MW concepts and applications; RF electronic concepts Fundamental concepts in wave propagation, Circuit representation of two port RF/MW networks.

Passive Circuit Design: Smith Chart, Applications of smith chart in distributed and lumped element circuit applications, Design of matching networks. **16 Hours**

UNIT – II

Basic considerations in Active networks: Stability consideration in active networks, Gain considerations in Amplifiers.

Active Networks: Linear and Nonlinear Design: RF/MW Amplifiers small signal design, Large signal design, RF/MW oscillator design. **16 Hours**

UNIT – III

RF/MW frequency converters, Rectifier and detector design, Mixer design, RF/MW control circuit design. **7 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

After studying this subject student will be able to understand:

1. Discuss the concept of RF/Microwave electronics from the component to wave nature level and Determine the circuit parameters for a two port RF/MW junction.
2. Determine the transmission line parameters using Smith chart; Determine the frequency response of a passive circuit using analytical methods /procedure.
3. Examine the stability and gain of an active device using stability criterion/transistor design procedures.
4. Design a small/large signal amplifier and Oscillator to operate at RF band using the transistor design procedures.
5. Summarize the design procedures, performance and parameters of detector, mixer & control circuits that operate in RF band.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Mathew M. Radmanesh, **"Radio Frequency & Microwave Electronics Illustrated",** PE (Asia) Pte. Ltd 2004.

REFERENCE BOOK:

2. Reinhold Ludwig and Pavel Bretchko, **"RF Circuit Design Theory and Applications"**, PE (Asia) Pte. Ltd 2004.

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SATELLITE COMMUNICATION SYSTEMS			
Course Code	**21ECE206**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Learn general laws governing Satellite orbits & its parameters also discuss overall design of satellites.
2. Learn the propagation impairments of the Electromagnetic wave and consider losses for link power calculations and implementation of various controls.
3. Learn applications of Satellite and different communication systems used for access.

UNIT – I

Over view of Satellite Systems: Introduction, Frequency allocation, Communication Satellites, INTELSAT.

Orbits: Introduction, Kepler's laws, Definitions, Satellite period and orbits, Orbital element, Apogee and Perigee heights, Orbit perturbations, Inclined orbits, Calendars, Universal time, Sidereal time, Orbital plane, Local mean time and LEO,MEO, GEO and MOLNIYA and Sun Synchronous orbits.

Geostationary orbit: Introduction, Antenna, Look angles, Polar mount antenna, Limits of visibility, Earth eclipse of satellite, Sun transit outage, Launching orbits.

Propagation Impairments: Introduction, Atmospheric loss, Ionospheric effects, Rain attenuation, Other impairments.

Space link: Introduction, EIRP, Transmission losses, Link power budget, System noise, CNR, Uplink, Down link, Effects of rain, Combined CNR **16 Hours**

UNIT – II

Space Segment: Introduction, Power supply units, Attitude control, Station keeping, Thermal control, TT&C, Transponders, Antenna subsystem.

Earth Segment: Introduction, Receive only home TV system, Out-door unit, Indoor unit, MATV, CATV, Tx.–Rx. Earth station.

Interference: Introduction , Types of Interference between satellite circuits, Remedies

Satellite access: Single access, Pre-assigned FDMA, DAMA, SCPC (spade system), TDMA, Pre-assigned TDMA, Demand assigned TDMA. CDMA. **15 Hours**

UNIT – III

DBS: Introduction, Orbital spacing, Power rating and number of transponders, Frequency and polarization, Transponder capacity, Bit rates for digital TV.
Other Satellite services: Satellite mobile; VSAT, VSAT, LANDSAT, RADARSAT, GPS, Space Station, Indian Satellites, IRS, INSAT, Space missions, CHANDRAYAN and MOM Orbiter

8 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Analyze different satellite orbits for various applications , Identify services provided by communication satellites at GEO orbit and Apply necessary corrections to the satellite to keep the satellite in GEO orbit.
2. Compute satellite link power budget and carrier to noise ratio for both uplink and down link signals and Estimate transmission losses and losses due to propagation impairments.
3. Device different satellite subsystems for operational requirements and Distinguish between different satellite receiver systems.
4. Deduce combined of multiple satellite access system using different multiplexing and multiple access techniques and Evaluate the multiple access system for providing different satellite services.
5. Apply satellite communication concepts to DBS system and Extend the same to other satellites services and Indian space missions to Compare the performances.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	1	1	-	1	3	-	-
CO2	2	3	-	-	-	-	-	-	1	1	-	1	3	-	-
CO3	3	-	-	-	-	-	-	-	1	1	-	1	3	-	-
CO4	2	3	-	-	-	-	-	-	1	1	-	1	3	-	-
CO5	3	-	-	-	-	1	1	-	1	1	-	1	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Dennis Roddy, "**Satellite Communications**", 4th Edition, McGraw-Hill International edition, 2006
2. Chartrand M R, "**Satellite Communications**", Cengage learning

REFERENCE BOOKS:

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, "**Satellite Communications**", 2nd Edition, John Wiley & Sons, 2003
2. W.L. Pritchard, H.L. Suyderhoud, R.A. Nelson, "**Satellite Communication Systems Engineering**", 2nd Edition, Pearson Education, 2007
3. Manjit Mitra, "**Satellite Communications**", PHI,2007
4. Agarwal, "**Satellite Communications**", Khanna Publs,2013

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AUTOMATION USING SCRIPTING LANGUAGES			
Course Code	**21ECE111**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

This course will enable students to

1. Get Introduced to various verification techniques.
2. Write a script to automate a tool.

UNIT – I

PERL:

History and Concepts of PERL, Scalar Data, Arrays and List Data, Control structures, Hashes, Basics I/O, Regular Expressions, Functions

Automatic code generation, Report Filtering, Netlist patching, Test Vector Generation, Controlling Tools. **15 Hours**

UNIT – II

Tool Command Language:

An Overview of TCL and Tk, TCL Language syntax, Variables, Expressions, Lists, Control flow, Procedures, Errors and exceptions, String manipulation, Accessing files **15 Hours**

UNIT – III

Verification:

Introduction to Verification, Verification Process-Specification Design Decomposition, Functional Test Strategies, Transformation Test Strategies, Coverage **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Illustrate the role of server side scripting using PERL Programming.
2. Apply the concepts of PERL scripting for test vector generation and VHDL testbench.
3. Analyze the salient features of TCL over PERL and write programs using fundamental concepts.
4. Discuss the knowledge of TCL and TK to show TCL/TK structures and substitution rules.
5. Make use of orthogonal verification principle within a design flow for RTL verification.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	2	-	-	2	1	-
CO2	3	-	-	-	2	-	-	-	-	-	-	-	3	2	-
CO3	2	3	-	-	-	-	-	-	-	-	-	1	2	1	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-	3	2	-
CO5	3	-	-	-	2	-	-	-	-	-	-	-	3	2	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Larry Wall, Tom Christiansen, John Orwant, "**Programming PERL**", Oreilly Publications, 3rd Edn., 2000.
2. John K. Ousterhout, **"Tcl and the Tk Toolkit"**, Addison-Wesley Publishing Company, Inc., 2011.

REFERENCE BOOKS:

1. Brent B. Welch and Ken Jones, **"Practical Programming in Tcl and TK"**, Pearson Education, 2003.
2. Lionel Bening and Harry Foster, **"Principles of Verifiable RTL Design"**, Kluwer Academic Publishers, 2001.
3. Randal L, Schwartz Tom Phoenix, **"Learning PERL"**, Oreilly Publications, 3rd Edn., 2000.

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AUTOMOTIVE ELECTRONICS			
Course Code	**21ECE112**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

After studying this Course, the student should be able to:

1. Understand the overall Electrical and Electronic architecture of a vehicle.
2. Understand the working of sensors and actuators used in Automotive applications.
3. Understand the use of different communication protocols used in Automotive systems.
4. Know about the AUTOSAR in the open-source platform for Automotive development.
5. Know about the Automotive Control Systems.

UNIT – I

Electrical And Electronic Systems in the Vehicle: Overview, Motronic-engine management system, Electronic diesel control, Lighting technology, Electronic stability program, Adaptive cruise control, Infotainment System.

Automotive Sensors & Measuring Principle: Air Flow Rate Sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall-Effect Position Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor, Temperature Sensors, Exhaust Gas Oxygen Sensor, Knock Sensors, Automotive Engine Control Actuators.

15 Hours

UNIT – II

In Vehicle Networking: Need for In-vehicle Networking, Vehicle buses. Overview of CAN, LIN, Flex Ray, MOST protocols. **Vehicular ad hoc networks (VANETs).**

AUTOSAR Concepts: Architecture, Methodology and Application Interfaces. ECU SW Architecture, Virtual Function Bus, Abstraction Layer, BSW, RTE, ECU Communication.

15 Hours

UNIT - III

Architecture of Electronic Systems & Control Units: Basics and Overview, Vehicle system architecture. Control units, Operating conditions, Design and data processing. Digital modules in the control unit. Automotive Applications. **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Describethe function and operation of automotive Electrical and Electronic subsystems.
2. Discussthe principle and operation of sensors and actuators used in automotive applications.
3. Analyse the use of CAN, LIN, MOST and Flexray protocols in automotive applications.
4. Explainthe architecture & Methodology of AUTOSAR.
5. DescribeAutomotive data processing and memory systems.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	1	-	1	3	-	-
CO2	2	1	1	-	-	-	-	-	3	3	1	1	3	2	-
CO3	1	1	1	-	-	-	-	-	3	3	1	1	3	2	-
CO4	1	-	-	-	-	-	-	-	-	1	-	1	3	-	-
CO5	2	-	1	-	-	-	-	-	3	3	1	1	3	2	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Robert Bosch GmbH, **"Bosch Automotive Electrics and Automotive Electronics",** 5th Edition. John Wiley & Sons Ltd, 2007.
2. William B. Ribbens, **"Understanding Automotive Electronics"**, 6th Edition, Elsevier, 2003.
3. Tom Denton: **"Automobile Electrical and Electronic Systems**", 3rd Edition, Elsevier Butterworth-Heinemann Publication, 2004.
4. KPIT Technologies Ltd. **"KPIT-AUTOSAR Handbook**", https://www.kpit.com/resources/downloads/kpit-autosar-handbook.pdf

REFERENCE BOOKS:

1. William B.Ribbens, **"Understanding Automotive Electronics**", 6th Edition, Elsevier, 2003.
2. Tom Denton, **"Automobile Electrical and Electronic Systems",** 3rd Edition**,** Elsevier Butterworth-Heinemann Publication, 2004.

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BIOMEDICAL INSTRUMENTATION			
Course Code	**21ECE113**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

After studying this Course, the student should be able to:

1. With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.
2. It attempts to render a broad and modern account of biomedical instruments.
3. It gives the introductory idea about human physiology system which is very important.
4. Demonstrate a basic understanding of disease, medical conditions or physiological conditions.
5. Explain the functional components of various instruments.
6. Demonstrate a critical appreciation of various biomedical instruments.
7. Explore new developments for better management or assessment of conditions.

UNIT – I

Fundamentals of medical instrumentation: Anatomy and Physiology, Physiological Systems of the body, Sources of Biomedical Signals, Basic medical instrumentation system, Intelligent medical instrumentation system, General constraints in design of medical instrumentation system.

Bioelectric signals and electrodes: Origin of Bioelectric Signals, Recording Electrodes, Ag-AgCl Electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes for EMG, Electrical conductivity of Electrode Jellies and Creams, Microelectrodes**.** **15 Hours**

UNIT – II

Physiological transducers and recording systems: Classification of transducers, Pressure Transducers, Transducers for body temperature measurement, Pulse sensors, Respiration sensors, Preamplifiers, Signal processing techniques, Recording system.

Biomedical recorders: ECG, VCG, PCG, EEG, EMG, Other biomedical recorders. **15 Hours**

UNIT - III

Modern imaging systems: X-ray Machine and Digital Radiography, X-ray Computed Tomography, MRI System, Ultrasonic Imaging System, Cardiac imaging-echocardiography-echoencephalography . **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Discuss the block diagram of basic medical instrumentation system and intelligent instrumentation system and describe the constraints of medical instrumentation system.
2. Describe the electrodes used for the measurement of ECG, EEG and EMG.
3. Discuss the characteristics and principle of pressure transducers, body temperature transducers, pulse transducers and respiration transducers.
4. Describe the biomedical recording systems for ECG, EMG, EEG, PCG and other biomedical recorders.
5. Illustrate the principle and working of X-ray machine, Computed Tomography, MRI scanning system, Cardiac imaging system and ultrasonic imaging system.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	2	2	-	-	3	1	-
CO4	3	-	-	-	2	-	-	-	2	2	-	-	3	1	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

- R.S.Khandpur, "**Handbook of Bio-Medical Instrumentation",** Tata McGraw Hill Publishing Co. Ltd., 2003.

REFERENCE BOOKS:

1. John W. Clark, John G. Webster, **"Medical Instrumentation",** John Wiley and Sons, 1998.
2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, **"Bio-Medical Instrumentation and Measurements",** Pearson Education, 2002/PHI. 2nd edition,
3. L. A. Geddes and L. E. Baker, "**Principles of Applied Bio-Medical Instrumentation",** John Wiley & Sons, 1975.

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EMBEDDED LINUX			
Course Code	**21ECE114**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:0:2**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

NOTE:

1. CIE Evaluation:MSE-1 + MSE-2 + Mini project : 15Marks + 15 Marks +20 Marks
2. No. of Hours allotted for Lab: **11 Hours**

Course Learning Objectives :

1. Working of basic Linux operating system and usage of basic Linux commands are introduced.
2. Able to understand basic Linux character driver modules and use of its development tools.
3. Covers the basic design framework of an embedded system.

UNIT – I

Overview of Unix/Linux: Introduction to Linux, Unix Commands, Understanding of some basic commands such as echo, pwd, ls, who, date, passwd, cal, cat, grep, cp, rm, chmod ,date and combining commands using pipes and redirection. Shell Programming using Loops, Conditional statements and Command line arguments.

12 Hours

UNIT – II

Introduction to Linux Device Drivers: Kernel Architecture and Functional Overview, File System, System Calls, Process management, Device Drivers, Char Drivers.
Development Tools: Embedded IDE, Cross Compilers. **10 Hours**

UNIT – III

Embedded Linux system Development – System Design and Development, Life Cycle Models, Problem Solving – Five Steps to Design, Design Process, Identifying and formulating the requirements, System Specification Vs System Requirement. **6 Hours**

Project based Lab:

Class 1 to 4

1. Introduction to Raspberry Pi and ARM development board
2. Python Programming
3. Interfacing IO devices
4. Feature finalization of project work

Class 5 to 11

Project work

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Illustrate Linux operating system and identify the usage of Unix commands.
2. Develop and write shell scripts using relevant unix commands.
3. Identify the building blocks of Linux device drivers. Use basic device drivers to work with hardware.
4. Demonstrate applications to use device drivers using system calls.
5. Design a frame work for the embedded system on generic or Linux platform.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO5	2	2	3	2	2	-	-	-	1	1	-	-	3	2	2

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. M. G. Venkateshmurthy **"Introduction to Unix and Shell Programming"** , Pearson Education.
2. K.V. K. K Prasad, **"Embedded /Real-Time Systems: Concept, Design & Programming"**, Dreamtech, 1st Edition, 2005.
3. James K. Peckol, Wiley, **"Embedded Systems –A contemporary Design Tool"**.

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LOW POWER VLSI			
Course Code	**21ECE115**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Get a clear understanding of the physics and different sources of power dissipation in CMOS circuits.
2. Be able to appreciate the need for low power design.
3. Gain knowledge about the different power analysis techniques.
4. Get a firm understanding on the different low power techniques used in circuit level and logic level.
5. Gain knowledge on the different special low power approaches in clock distribution.
6. Get a firm understanding on the different low power techniques used in circuit level and logic level.

UNIT – I

Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Basic Principles of Low Power Design.

Physics of power dissipation in CMOS devices – The MIS structure, Long channel MOSFET, Submicron MOSFET, Gate induced drain leakage.

Power dissipation in CMOS – Short circuit dissipation, Dynamic dissipation, Load capacitance. **10 Hours**

UNIT – II

Simulation Power analysis: SPICE circuit simulation, Gate Level Logic Simulation- Architecture Level Analysis, Data Correlation Analysis in DSP Systems, Monte Carlo simulation.

Probabilistic Power Analysis: Random Logic Signals, Probability and Frequency, Probabilistic Power Analysis Techniques, Signal Entropy.

Low Power Design at Circuit Level: Transistor and Gate Sizing- Sizing an Inverter chain, Transistor and Gate sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction. Network Restructuring and Reorganization, Special Latches and Flip flops **15 Hours**

UNIT – III

Low Power Design at Logic level: Gate reorganization, Signal Gating, Logic Encoding, State Machine Encoding, Pre-Computation Logic.

Low power Clock Distribution: Power dissipation in clock distribution, Single driver Vs distributed buffers, Zero skew Vs tolerable skew.

Special Techniques: Power reduction in clock networks, CMOS Floating Node, Low Power Bus, Delay Balancing, Low Power Techniques for SRAM.

Low Power Design at Architecture and System Level: Power and Performance Management, Switching Activity Reduction, Parallel Architecture with Voltage Reduction, Flow Graph Transformation.

14 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain the need for low power design in VLSI chips, sources of power dissipation in CMOS circuits and analyse the basic and emerging low power design approaches.
2. Explain the physics of power dissipation in CMOS devices; Explain the simulation based power analysis techniques to determine the power dissipation in VLSI circuits.
3. Determine the power dissipation in VLSI circuits using probabilistic power analysis techniques.
4. Explain power reduction techniques at the circuit level and logic level for VLSI circuits.
5. Explain the approaches of low power design in clock distribution, architectural and system levels.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-	3	1	-
CO5	3	-	-	-	2	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Gary K. Yeap, "**Practical Low Power Digital VLSI Design**", KAP, 2002.

REFERENCE BOOKS:

1. Kaushik Roy, Sharat Prasad, "**Low-Power CMOS VLSI Circuit Design**", Wiley, 2000.
2. Rabaey, Pedram, "**Low Power Design Methodologies**", Springer, 2009.

NPTEL/MOOC Link:

1. https://nptel.ac.in/courses/106105034/
2. https://nptel.ac.in/courses/106105161/58

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NANOELECTRONICS			
Course Code	**21ECE116**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to:

1. Explain semiconductor device physics and materials technology to enable the Nanoelectronics.
2. Know fundamentals of CMOS technology in sub nanometer regime.
3. Know transistors with new structure and nano materials.
4. Know materials characterization techniques.

UNIT – I

Overview, Nano devices, Nano materials, Nano characterization, Technology node, Basic CMOS Process flow. MOS Scaling theory, Issues in scaling MOS transistors : Short channel effects.

MOS capacitor, Gate oxide thickness scaling, SiO2 vs High-k gate dielectrics and Integration issues of high-k, CV and IV techniques.

12 Hours

UNIT – II

Metal gate transistor, Transport in Nano MOSFET, Silicon on Insulator, Ultrathin body SOI - double gate transistors, FinFET and Surround gate FET.

Metal source/drain junctions: Properties of schottkey junctions on Silicon, Germanium and compound semiconductors.

Germanium Nano MOSFETs : Advantages of Germanium over Silicon, PMOS versus NMOS. Compound semiconductors: material properties, MESFETs, Compound semiconductors, Hetero structure MOSFETs.

15 Hours

UNIT – III

Synthesis of Nanomaterials : CVD, Nucleation and Growth, ALD, Epitaxy, MBE.

Compound semiconductor, hetero-structure growth and characterization : Quantum wells, Thickness measurement techniques, Characterization techniques for nanomaterials.

Emerging nano materials : Nanotubes, nanorods and other nano structures.

12 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain technology node of CMOS technology and illustrate the application of scaling theory to MOS transistors in sub nanometer regime.
2. Describe MOS capacitor with oxide and high-K gate dielectrics and analyse the integration issues.
3. Discuss the properties of materials and device, develop various nanostructures for transistors.
4. Explain and select the synthesis and characterization techniques of nanomaterial.
5. Describe some emerging nanoelectronic materials analyse them for nanoelectronics applications.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	2	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Y. Taur and T. Ning, **"Fundamentals of Modern VLSI Devices"**, Cambridge University Press, 2009.
2. Plummer, Deal, Griffin, **"Silicon VLSI Technology"**, Pearson Education India, 2009.
3. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, **"Nanoscale Science and Technology"**, John Wiley, 2007.

REFERENCE BOOKS:

1. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A., **"Introduction to Nanoelectronics"**, Cambridge University Press, 2007.
2. Hanson, **"Fundamentals of Nanoelectronics"**, Pearson Education India, 2009.

NPTEL Link:

https://nptel.ac.in/courses/117108047

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IOT DEVICE SECURITY			
Course Code	**21ECE117**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:0:2**	**SEE Marks**	**50**
Total Hours	**26+0+13**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Understand IoT Architecture and potential security vulnerabilities
2. Learn cryptography fundamentals required for IoT Security
3. Understand attacks on IoT devices and commonly used security mechanisms
4. Learn about enhancing security of IoT devices by integrating secure element.

UNIT – I

Introduction to IoT Systems:

IoT Systems: Introduction to IoT, IoT Architecture, IoT threats / Security Vulnerabilities

Corner stone of Security: Authentication, confidentiality, Integrity, Non-repudiation and Availability. Authentication Mechanisms (Password, Bio, Single/multiple layer)

Cryptography: Data encryption techniques, Data encryption standards (AES, DES, ECB, CBC), Public Key Cryptography, RSA, ECC, Key Management - Public key certificate and key exchange, Message Digest (MD5, SHA256, HMAC, RIPEMD160), Digital Signature (ECDSA), Random number

9 Hours

UNIT - II

Security by Design:

Attacks on IoT devices: TVR (Threat, Vulnerability, Risks), Attack technologies, Logical Attack, Invasive, Semi-Invasive and Non-Invasive Attacks

Threat modelling: Asset identification, Identify threats, threat mitigation/measures, Secure Software Development Life Cycle

IoT Security functions/defenses: Device Authentication, Key Provisioning, Secure Communication (TLS), Stored Data Protection, Secure boot, Secure SW/FW update

Security Concepts: Software Security concepts - Integrity of program flow, data integrity, function parameter integrity, randomization, data masking, full comparison pattern, redundant decision making, Hardware Security concepts - Memory and register encryption/masking, random number generator, Isolation, Secured Architecture (ROSI)

12 Hours

UNIT – III

Device Security:

Platform Security: TEE Overview, TrustZone, ARM PSA, Trusted FM

Secured MCUs: Overview, Security features

Secure Elements: Overview (Different form factor), Security features, Introduction to Optiga Trustx, Feature Set.

05 Hours

Lab exercises:

1. Performing symmetric cryptographic operations on a 32 bit MCU
2. Performing RSA cryptographic operations on a 32 bit MCU
3. Performing ECC cryptographic operations on a 32 bit MCU
4. Performing Message Digest operation on a 32 bit MCU
5. Performing fault attack on code running on a 32 bit MCU

6. Performing side channel attack on code running on a 32 bit MCU
7. Secure communication with cloud using cryptographic libraries running on a 32 bit MCU
8. Performing symmetric cryptographic operations using a Secure Element connected to a 32 bit MCU
9. Performing asymmetric cryptographic operations using a Secure Element connected to a 32 bit MCU
10. Performing Certificate and Message Digest operations using a Secure Element connected to a 32 bit MCU
11. Secure communication with cloud using a Secure Element connected to a 32 bit MCU
12. Project work
13. Project work

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Describe the IoT architecture and identify the security threats for IoT Devices
2. Classify different cryptographic mechanisms relevant for IoT Device security
3. Describe threat modelling and Identification of defensive mechanisms
4. Discuss the importance of hardware based security
5. Explain concepts in designing Secure edge devices

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	-	2	-	-	-	2	1	2	1	3	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	2	2	-	2	-	-	-	2	1	2	1	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. V K Pachgare, **"Cryptography and Information Security"**, PHI Publication, 3rd Edition, 2019.
2. Brian Russell, Drew Van Duren, **"Practical Internet of Things Security",** Packt Publishing, 2016.

REFERENCE BOOK:

1. Catherine H. Gebotys, **"Security in Embedded Devices",** Springer, 2010.

EBOOKS / ARTICLES:

1. http://ethesis.nitrkl.ac.in/4170/1/Buffer_Overflow_Attacks_%26_Countermeasures.pdf
2. https://trustedconnectivityalliance.org/wp-content/uploads/2020/01/NFC_Secure_Element_Stepping_Stones_v1.0.pdf
3. https://www.cl.cam.ac.uk/techreports/UCAM-CL-TR-630.pdf
4. https://www.dsci.in/sites/default/files/documents/resource_centre/IoT%20Security%20Guide.pdf

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ADVANCED DIGITAL LOGIC VERIFICATION			
Course Code	**21ECE211**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Understand the significance of testing and verification.
2. Understand the different verification methodologies.
3. Understand basic of System Verilog.
4. Understand the concept of randomization in system Verilog.
5. Gain knowledge about UVM.

UNIT – I

Verification Concepts: Concepts of verification, Importance of verification, Stimulus v/s Verification, Functional verification, Verification challenges, Typical verification flow, Functional verification approaches, Direct testing, Coverage: Code and Functional coverage, coverage plan, Types of code coverage. **8 Hours**

Language Constructs System Verilog constructs: Data types: Two-state data, Strings, arrays: Queues, Dynamic and associative arrays, Structs, Enumerated types. Program blocks, Module, Interfaces, Clocking blocks, Modports. **7Hours**

UNIT – II

Classes & Randomization SV Classes: Language evolution, Oop terminology, Classes and objects, Class Variables and Methods, Class Instantiation, Inheritance, Polymorphism and encapsulation, Class members: Types. Randomization: Directed Vs Random testing. Randomization: Constraint Driven Randomization. **8 Hours**

Assertions & Coverage Assertions: Introduction to Assertion based verification, Immediate and concurrent assertions. Functional coverage, Cover Group, Cover Point, Cross Coverage, Concepts of Binning and event sampling. **7 Hours**

UNIT – III

Building Testbench: Layered test bench architecture, Introduction to Universal Verification Methodology, Overview of UVM Base Classes and simulation phases in UVM and UVM macros. Unified messaging in UVM, UVM environment structure, Connecting DUT- Virtual Interface, UVM tb-top memory model. **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain the concept of verification process and model the typical verification flow; compare the white, black and grey box verification approach used in verification environment.
2. Develop the system verilog code by choosing suitable language constructs.
3. Explain the classes and object and describe the concept of inheritance, polymorphism, encapsulation and randomization.
4. Explain the concept of assertion based verification and describe the concept of cover group, cover point, binning and event sampling.
5. Explain UVM methodology; Construct UVM test bench architecture and identify the simulation phases and bases classes used in UVM.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Venessa R. Cooper, **"Getting started with UVM, A beginner's guide"**, Verilab Publishing, 2013.
2. Chris Spear, Gregory J Tumbush, **"System Verilog for verification - a guide to learning the testbench language features**", Springer, 2012.
3. Sasan Iman Si, **"Step-by-Step Functional Verification with System Verilog and OVM"**, CA Spring 2008.

REFERENCE BOOKS:

1. Janick Bergeron Synopsys, Inc., **"Writing Testbenches using System Verilog",** Springer,2006.

NPTEL/ MOOC Link:

1. http://www.nptel.ac.in/courses/106103016/#

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ANALOG AND MIXED MODE VLSI DESIGN			
Course Code	**21ECE212**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

This course will enable the students to

1. Learn different types of MOS device models, single stage amplifiers, current mirrors & differential amplifiers.
2. Understand Op-Amp design, fundamentals and architecture of different data converters.
3. Understand the design of capacitors, resistors, MOSFET Switch, Delay and Adder elements etc. in sub-micron CMOS technology.

UNIT – I

Review of MOS device physics, MOS device models.

Single stage amplifiers: Basic concepts, Common source, Source follower, Common gate stage, Cascode stage amplifiers.

Current mirrors (basics), Differential amplifiers: Single-ended and differential operation, Basic differential pair (qualitative analysis only), Common mode response.

Op-Amp design: General considerations, One-stage Op-Amp, Two Stage Op-Amp.

14 Hours

UNIT – II

Data Converter fundamentals: Analog versus Digital Discrete Time Signals, Sample & Hold Circuits, DAC Specifications, ADC Specifications, Mixed –Signal Layout Issues.

Data Converter Architectures: DAC Architectures: Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DAC, Cyclic DAC, Pipeline DAC, ADC Architectures: Flash, 2-step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC. **17 Hours**

UNIT – III

Sub-Micron CMOS circuit design: Process flow, Capacitors and resistors, MOSFET Switch, Delay and Adder elements. **8 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain the working of Single-Stage MOS Amplifier topologies; Identify MOS amplifier topology and compute its gain and impedance parameters.
2. Explain the working of Current Mirrors, One and two-stage Op-Amps; Compute the value of output current for a given current mirror circuit; Demonstrate the use of Current mirror circuit for a given specification.
3. Compute the performance parameters for a given DAC; Select between Resistor String, R-2R, Current Steering, Charge Scaling, Cyclic, Pipeline DAC architectures for the given application & specification.
4. Compute the performance parameters for a given ADC; Select between Flash, 2-Step Flash, Pipeline, Dual Slope, Single Slope and SAR ADC for the given application & specification.
5. Discuss the process flow for construction of transistors, Resistors and Capacitors in sub-micron technology; Describe the operation of CMOS Delay and Adder elements.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	1	1	-	-	1	2	3	-	-	3	2	-
CO2	3	2	1	-	1	-	-	1	2	3	-	-	3	2	-
CO3	3	1	1	-	-	-	-	1	2	3	-	1	3	2	-
CO4	3	1	1	-	-	-	-	1	2	3	-	1	3	2	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Behzad Razavi, **"Design of Analog CMOS Integrated Circuits",** Tata McGraw Hill, 2002.
2. R. Jacaob Baker, Harry W Li, David E Boyce, **"CMOS Circuit Design, Layout, Simulation",** PHI Edn, 2005.
3. R. Jacob Baker, **"Mixed Signal Circuit Design (Vol II of CMOS: Circuit Design, Layout and Simulation)",** CMOS –IEEE Press and Wiley Interscience, 2002.

REFERENCE BOOK:

1. P.E. Allen and D.R. Holberg, **"CMOS Analog Circuit Design"**, Oxford University Press, 2nd Edition, 2002.

NPTEL/ MOOC Link:

1. Analog Circuits: http://www.nptel.ac.in/courses/117101106/ [NPTEL]
2. VLSI Circuits: http://nptel.ac.in/courses/117106092/ [NPTEL]
3. Circuits and Electronics 2: https://www.edx.org/course/circuits-electronics-2-amplification-mitx-6-002-2x-0[MOOC]

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DIGITAL IC DESIGN USING VERILOG HDL			
Course Code	**21ECE213**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:0:2**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

NOTE:

1. CIE Evaluation:MSE-1 + MSE-2 + Verilog programming Lab : 15Marks + 15 Marks +20 Marks
2. No. of Hours allotted for Lab: 11 Hours
3. Tool to be used: Xilinx

Course Learning Objectives:

This course will enable students to

1. Understand the basics of design methodologies involved in digital system design.
2. Develop Verilog code in behavioral modeling for digital circuits.
3. Verification of Combinational and Sequential circuits using Testbench.
4. Describe a design at Register transfer level for Algorithmic state machines.

UNIT – I

Design Methodology: Design flow (T1_10.1), Design Optimization (T1_10.2), Design for Test (T1_10.3), Synthesizable HDL Models of Sequential Circuits (T2_5.6), Design Procedure (T2_5.8), HDL for Registers and Counters (T2_6.6).

Verilog for Synthesis: Data Types and Operations (T1_C.1), Combinational Functions (T1_C.2), Sequential Circuits (T1_C.3), Memories (T1_C.4), Programming examples in behavioral modeling.

12 Hours

UNIT – II

Verification: Verification of Combinational Circuits (T1_2.4), Verification of Sequential Circuits (T1_4.4.2), Verilog Testbench for Combinational and Sequential Circuits (T1)

10 Hours

UNIT – III

Register Transfer Level: Introduction, Register Transfer Level notation, Register Transfer Level in HDL, Algorithmic State Machines (ASMs), Design Example (T2_8.1-8.5)

6 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain the design methodology of modern digital systems.
2. Implement a Verilog code in behavioral modeling for a given a state diagram/digital circuit.
3. Develop Verilog Testbenches to verify combinational logic circuits.
4. Develop Verilog Testbenches to verify sequential logic circuits.
5. Explain the fundamentals of representing a digital system at the Register Transfer Level for Algorithmic State Machines.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	1	1	-	2	-	-	-	1	2	1	1	3	-	-
CO3	3	2	2	-	2	-	-	-	1	2	1	1	3	-	-
CO4	3	2	2	-	2	-	-	-	1	2	1	1	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Peter J. Ashenden, **"Digital Design An Embedded Systems Approach using Verilog"**, Morgan Kaufmann Publishers.
2. M. Morris Mano, Michael D. Ciletti, **"Digital Design with an Introduction to the Verilog HDL"**, 5th Edition, Pearson.

REFERENCE BOOKS:

1.
2. Stephen Brown, ZvonkoVranesic, **"Fundamentals of Digital Logic with Verilog Design"**, McGraw Hill Education.

NPTEL/MOOC Link:

1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ee05/
2. https://www.coursera.org/courses?query=verilog

VERILOG PROGRAMMING LAB

Lab	List of Programs
1-3	Implementation of Combinational Circuits using FPGA
4-6	Implementation of Sequential Circuits using FPGA
7-9	Verification of Combinational and Sequential circuits using Testbench
10-11	Task/Evaluation

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EMBEDDED SYSTEMS			
Course Code	**21ECE214**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to:

1. Understand the technological aspects of embedded systems and recognize design challenges in embedded system design processes.
2. Illustrate the domain and application specific aspects of embedded systems and understand different computational models.
3. Acquire knowledge about different entities of Embedded System Development Environment

UNIT – I

Introduction to embedded systems, Embedded system versus general computing systems, Classification of embedded systems, Major application areas of embedded systems, Purpose of embedded systems, Embedded system design challenges, Common design metrics and optimizing them. Survey of different embedded system design technologies, Trade-offs, Custom single purpose processors, Design of custom single purpose processors, General purpose processors, General-purpose processor design, Core of the embedded system, Memory, Sensors and actuators, Communication interface and other system components.

16 Hours

UNIT – II

Embedded systems- Application and domain specific, Fundamental issues in hardware software co-design, Computational models in embedded design, Introduction to Unified

Modelling Language (UML), Embedded firmware design approaches, Embedded firmware development languages, Programming in embedded C.

15 Hours

UNIT – III

The Integrated Development Environment (IDE), Types of files generated on cross compilation, Disassembler/ decompiler, Simulators, Emulators and debugging, Target hardware debugging, Boundary scan.

08 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. List and explain the basic concepts and applications of embedded system, Discuss the design metrics, design challenges and design technologies of embedded system, Design custom single purpose processor.
2. Discuss the memory, sensors and actuators, communication interface and system components.
3. Discuss the fundamental issues in hardware software co-design and interpret the computational models.
4. Discuss the embedded firmware design approaches and development languages.
5. Discuss the Integrated Development Environments for embedded firmware.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	1	1	-	-	3	1	-
CO2	3	-	-	-	-	-	-	-	1	1	-	-	3	1	-
CO3	3	-	-	-	-	-	-	-	1	1	-	-	3	1	-
CO4	3	-	-	-	-	-	-	-	1	1	-	-	3	1	-
CO5	3	-	-	-	-	-	-	-	1	1	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. K.V. Shibu, **"Introduction to Embedded Systems"**, Tata McGraw, 2009.
2. Frank Vahid and Tony Givargis, **"Embedded System Design: A Unified Hardware/Software Approach"**, John Wiley & Sons

REFERENCE BOOKS:

1. J.W. Valvano, **"Embedded Microcomputer System: Real Time Interfacing"**, Brooks/Cole, 2000.
2. David E. Simon,**"An Embedded Software Primer"**, Addison Wesley, 2000.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/108102045/
2. http://nptel.ac.in/courses/108105057/
3. http://nptel.ac.in/courses/106105159/

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INTERNET OF THINGS			
Course Code	**21ECE215**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:0:2**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

NOTE:

1. CIE Evaluation:MSE-1 + MSE-2 + IoTLab : 15Marks + 15 Marks +20 Marks
2. No. of Hours allotted for Lab: 11 Hours
3. Tool to be used: Energia

Course Learning Objectives:

This course will enable students to:

1. Understand the basic concepts of IoT and its architecture.
2. Understand the cloud and fog computing in IoT.
3. Understand the design of IoT system.

UNIT – I

Introduction to the Internet of Things: Internet of Things Concepts (T1_1.2), IoT Framework (T1_1.4), Information and Communication Technology Infrastructure (T1_1.5), Standards (T2_2.1).

5 Hours

Enabling Technologies for the Internet of Things: IP Based IoT (T2_2.2.2), Physical/ Link Layer (T2_2.2.2), Network Layer (T2_2.2.3), Transport Layer (T2_2.2.4), Application layer (T2_2.2.5).

6 Hours

UNIT – II

Interoperability and Discoverability: The Verticals: Cloud-Based Solutions (T2_3.2), Messaging Queues and Publish/ Subscribe Communications (T2_3.5) Service and

Resource Discovery (T2_4.1), Local and Large-Scale Service Discovery (T2_4.2), Scalable and Self-Configuring Architecture for Service Discovery in the IoT (T2_4.3).

5 Hours

Cloud and Fog Computing in the Internet of Things: IoT System Requirements (T1_4.2), Cloud Computing in IoT (T1_4.3), Big Data Processing Pattern (T2_6.2), Big Stream (T2_6.2), Big Stream and Security (T2_6.3), Fog Computing in IoT (T1_4.4), The Role of IoT Hub (T2_6.6).

6 Hours

UNIT – III

A Tutorial Introduction to IoT Design and Prototyping with Examples: Hardware for IoT (T2_7.1), Main Features of IoT Hardware Development Platforms (T1_6.2), Software for IoT (T2_7.2), Design and Prototyping of IoT Applications (T1_6.3), Projects on IoT Applications (T1_6.4).

6 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain IoT; Describe the IoT framework, Information and Communication Technology Infrastructure and Standards.
2. Describe IP based IoT and explain the enabling technologies of IoT.
3. Explain the interoperability and discoverability of IoT systems.
4. Describe the Cloud and Fog computing techniques in IoT.
5. Design and develop prototype of an IoT system.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	2	2	1	2	-	-	-	1	2	1	1	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Qusay F. Hassan, **"Internet of Things A to Z, Technologies and Applications"**, John Wiley Publications, 2018 (T1).
2. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, **"Internet of Things, Architectures, Protocols and Standards"**, John Wiley Publications, 2019 (T2).

REFERENCE BOOK:

1. Donald Norris, **"Internet of Things: Do-it-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black"**, McGraw-Hill Education Publications, 2015 (R1).

NPTEL/ MOOC Link:

1. https://nptel.ac.in/courses/106/105/106105166/
2. https://nptel.ac.in/courses/108/108/108108098/

IoT Lab

Lab	List of Programs
1.	Introduction to IoT Lab
2.	Browsing HTML pages using HTTP Server and Controlling GPIO and Reading Sensor Connected to the interfacing Hardware Kit
3.	Creation of own Web Server and Web page
4.	Working with ThingSpeak Cloud Server for IoT
5.	Application of Message Queue Telemetry Transport(MQTT) in IoT
6.	Working with Eclipse Cloud Server using MQTT Dash
7-11	Projects

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INTRODUCTION TO SENSORS AND ACTUATORS			
Course Code	**21ECE216**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:0:2**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

NOTE:

1. CIE Evaluation:MSE-1 + MSE-2 + Mini project : 15Marks + 15 Marks +20 Marks
2. No. of Hours allotted for Lab: **11 Hours**

Course Learning Objectives:

This Course will enable students to

1. Provide an introduction to Mechatronics system Design.
2. Provide an introduction to sensors and actuator technology.
3. Discuss the basic principles of Signal Processing needed for sensors.

UNIT – I

Sensors: Introduction, Position and Speed Measurements, Stress and Strain Measurement, Temperature Measurement, Vibrational and Acceleration Measurement, Pressure and Flow measurement, Semiconductor Sensors and Micro-electro-mechanical devices **11 Hours**

UNIT – II

Actuators: Introduction, Solenoids and Relays, DC Motors, Stepper Motors, Hydraulics, Pneumatics **10 Hours**

UNIT – III

Signal Conditioning: Amplification, Filtering, Protection, Linearization, error compensation **7 Hours**

LIST OF EXPERIMENTS:

1. To study the characteristics of IR sensor and Ultrasonic Sensor.
2. To determine the value of unknown resistance using Wheatstone bridge.
3. To study the characteristics of temperature sensor.
4. To study the characteristics of K-type Thermocouple.
5. To determine the direction control of stepper motor .

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

A student who successfully fulfills the course requirements will be able to:

1. Explain the performance parameters of sensors.
2. Describe the principle of operation and characteristics of proximity sensors, switches, potentiometers, LVDT, optical encoders, strain gages, load cells, thermocouples, and accelerometers and design simple application circuits using the same.
3. Discuss the construction and working of stepper motor, DC motor, Solenoid and Relay. Determine the specification of motor required for a given application.
4. Discuss the components of hydraulic and pneumatic systems.
5. Describe the need for Signal conditioning and Design the basic Signal Conditioning circuits.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	3	-	-	-	-	1	1	-	-	3	2	-
CO2	2	2	3	-	-	-	-	-	1	1	-	-	3	2	2
CO3	2	3	-	-	-	-	-	-	1	1	-	-	3	2	2
CO4	3	-	-	-	-	-	-	-	1	1	-	-	3	2	-
CO5	3	2	-	-	-	-	-	-	1	1	-	-	3	2	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. David G. Alciatore, Michael B. Histand, **"Introduction to Mechatronics and Measurement Systems"**, McGraw Hill, 4th Edition.
2. Bolton. W, **"Mechatronics-Electronic Control Systemsin Mechanical &Electrical Engineering"**, Pearson Education, 3rdEdition.
3. Clarence W. de Silva , **"Sensors and Actuators: Engineering System Instrumentation",** CRC Press, 2nd edition, 2015.

REFERENCE BOOKS:

1. Helfrick, **"Modern Electronic Instrumentation and Measurement Techniques",** Prentice Hall India Learning Private Limited, 1st edition, 1992.
2. Analog Devices Technical Reference Books, **"Practical Design Techniques for Sensor Signal Conditioning"**, Analog Devices, 1999.

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EMBEDDED SECURE ELEMENT			
Course Code	**21ECE217**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:0:2**	**SEE Marks**	**50**
Total Hours	**26+0+13**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Understand the architecture of secure elements
2. Learn Java Card applet programming
3. Learn about industry standards and domain specifications in the context of secure elements
4. Understand Global Platform and card content management

UNIT – I

Architecture of Secure Elements:

Hardware architecture: I/O System, CPU, Memory (RAM, EEPROM, FLASH), Co-Processors

Packaging: Surface Mount Devices (VQFN, XQFN, USON8)

Software architecture (OS Layers): I/O interface, Hardware Abstraction Layer, Application Layer, Crypto Library

Industry standards and certification schemes: Connectivity standard alliance, Cybersecurity, Labelling Scheme, ARM PSA, Payment Wearables, Digital Identity Tokens, FIPS Certification.

Java Card architecture: Comparison of Java Card Architecture - Java, why JCRE and JCVM; JCVM, JCRE, JC API, JC Applets, JC Library packages; Approach to Applet development (tools, build flow, cap..); Data Objects, File Structure and command APDUs

12 Hours

UNIT - II

Java Card applet programming:

Applet architecture: Java Card Objects, Atomicity and Transactions, Exception Handling, Handling Command APDUs Design & Develop your Applet.

09 Hours

UNIT – III

Global Platform for Secure Element content management:
Architecture, Security Domains, Secure Element and Application Management, Secure Communications, Command References.

05 Hours

Lab Exercises

1. Setting up the Java Card Development environment
2. APDU command construction to perform file system operations
3. Design file system access management for confidentiality and integrity protection.
4. APDU command construction to perform an authentication operation
5. Development of basic Java Card Applet – Command handling and data types
6. Development of Java Card Applet - Symmetric Crypto and Random number generation
7. Develop a demonstrative Java Card Applet supporting ISO 7816 Record file system
8. Development of a closed-loop payment system
9. Development of Java Card Applet for Hash
10. Development of Java Card Applet for Asymmetric Crypto operation
11. Project work
12. Project work
13. Project work

Scheme of SEE Question Paper
There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:
At the end of the course the student will be able to

1. Discuss usage of Secure element (SE) as per Industry specific standards for applications such as payments, IoT security solutions
2. Describe Java Card architecture - typically used Operating system for secure elements
3. Design and development of Java card applets
4. Demonstrate crypto operations on Embedded secure element.
5. Understand purpose of Global platform specifications, SE content management.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	1	-	-	-	-	-	-	-	3	-	-
CO3	3	2	2	-	2	-	-	-	2	1	2	1	3	-	-
CO4	3	2	2	-	2	-	-	-	2	1	2	1	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Chen, Zhiqun, "Java card technology for smart cards: architecture and programmer's guide", Addison-Wesley Professional, 2000.
2. Rankl, Wolfgang, and Wolfgang Effing, "Smart Card Handbook", John Wiley & Sons, 2010.

REFERENCE BOOKS:

1. Mayes, Keith, and Konstantinos Markantonakis, "Smart Cards, Tokens, Security and Applications", Springer, 2017.

EBOOKS / ARTICLES:

1. https://www.oracle.com/java/java-card/
2. https://globalplatform.org/specs-library/card-specification-v2-3-1/

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ARTIFICIAL INTELLIGENCE			
Course Code	**21ECE121**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

The course presents basics of Artificial Intelligence that aims to

1. Introduce AI, propositional calculus, graph theory and Heuristic approach.
2. Arm the students with the basics of issues involved with knowledge presentation and history of Al representational systems.
3. Introduce Role of knowledge in language understanding.

UNIT - I

Introduction to Artificial Intelligence (AI): The History of Artificial Intelligence and the State of the Art. Components of AI.

Problems, Problem Spaces, and Search: Defining the Problem as a State Space Search, Production Systems, Problem Characteristics, Production System Characteristics and Issues in Design of Search Problems. Additional Problems:

Water Jug Problem, Missionaries and Carnivals Problem, Chess Problem, 8-Puzzle Problem, Tower of Hanoi Problem, Cryptarithmetic Problem (5 Hrs-SS).

Heuristic Search Techniques: Hill Climbing, Best First Search-A* SEARCH, AO* Search, Problem Reduction and Constraint Satisfaction. **15 Hours**

UNIT - II

Knowledge Based Systems (KBS): Type of Knowledge, Knowledge Acquisition, Knowledge Representation-Logic, Semantic Network, Frame, Conceptual

Graphs Conceptual Dependency and Script (5 H-SS).

Natural Language Processing (NLP): Applications of NLP, Examples of NLP Systems, Chomsky Hierarchy of Grammars, Transformational Grammar, Case Grammars (FILLMORE's) & Context Free Grammar (CFG).

Parsing Process: Introduction to Parsing-Top-Down and Bottom-Up Process. Types of Parsing-Deterministic Parsing and Non-Deterministic Parsing. **15 Hours**

UNIT – III

Game Playing: MiniMax Search and Alpha- Beta (α-β) Pruning.

Planning and Understanding: An Example Domain: The Blocks World, Components of a Planning System, Goal Stack Planning, Nonlinear Planning using Constraint Posting and Hierarchical Planning. Understanding as Constraint Satisfaction.

Learning: Rote Learning, Learning by Taking Advise, Learning in Problem Solving, Neural Net Learning-Single Layer Network, Multilayer Network, Feed Forward and Back Propagation

Neural Network (3 Hrs-SS) **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

A student who successfully fulfills the course requirements will have demonstrated:

1. Apply AI production rules to solve the state space problems namely Water Jug Problem, Missionaries and Carnivals Problem, Chess Problem, 8-Puzzle Problem and Cryptarithmetic Problem.
2. Analyze AI problem using Hill Climbing and Heuristic Search algorithms for best path finding and decision making functions.
3. Apply Knowledge Based System (KBS) representation technique in solving problems to support human decision making.
4. Determine Natural Language Processing (NLP) in understanding human language using NLP grammars and parsing techniques.
5. Apply Alpha–Beta search and artificial neural network feed forward and back propagation neural network learning for AI applications.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	1	1	1	1	1	3	1	-
CO2	3	-	-	-	2	-	-	1	1	1	1	1	3	2	1
CO3	3	-	-	-	-	-	-	1	1	1	1	1	3	1	-
CO4	3	-	-	-	-	-	-	1	1	1	1	1	3	1	-
CO5	3	-	-	-	2	-	-	1	1	1	1	1	3	2	1

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Elaine Rich, Kevin Knight, Shivashankar B. Nair **"Artificial Intelligence",** Tata McGraw Hills, 3rd Edition, 2009.
2. Charniak and Mc Dermott, **"Introduction to Artificial Intelligence",** Pearson Education, 1999.

REFERENCE BOOKS:

1. George F Luger, **"Artificial Intelligence",** Pearson Education, 4th Edition, 2002.
2. Simon Haykin, **"Neural Networks"**, Prentice-Hall of India, 3rd Edition, 2009.

NPTEL/ MOOC Link:

1. nptel.ac.in/courses/106105077/
2. nptel.ac.in/courses/106106126/

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BIOMEDICAL SIGNAL PROCESSING			
Course Code	**21ECE122**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives (CLOs):

This course will enable the students to

1. Understand the general characteristics of medical data.
2. Identify different techniques to record ECG.
3. Analyze digital & integer filters in biomedical applications.
4. Learn application of adaptive filters in biomedical signal processing.
5. Learn importance of signal averaging in signal processing.
6. Understand different data reduction techniques.
7. Analyze an ECG signal using different techniques.

UNIT – I

Overview of Biomedical Signals: Sources and nature of biomedical signals, Types of biomedical signals: Deterministic, Stochastic, Fractal and chaotic. Characteristics of medical data, Objectives of biomedical signal analysis.Introduction to ECG, EEG, EMG, PCGand their signal characteristics.

Artifacts in Biomedical Signals: Baseline wander, Power-line noise and High frequency noise sources.

Digital and Integer Filters: Digital filters pole-zero plot, Integer filters: Basic design concept, Low-pass, High-pass, Band-pass and Band-reject integer filters. **14 Hours**

UNIT – II

Adaptive Filters and Signal Averaging: Principal noise canceller model, 60-Hz adaptive canceling using a sine wave model, Applications of adaptive filtering, Basics of signal averaging.

Data Reduction Techniques: Overview of data reduction techniques, Turning point algorithm, Huffman coding.

Characterization of Nonstationary Signals: Mean, Variance, Measures of activity, Higher-order statistics.

Advanced Biomedical Signal Analysis techniques: Power spectrum estimation, Discrete Cosine Transform (DCT) and Short-time Fourier Transform (STFT), Discrete Wavelet Transform (DWT). **14 Hours**

UNIT – III

ECG QRS Detection: Differentiation techniques, Template matching techniques, Pan-Tompkins QRS detection algorithm.

Computer-Aided Biomedical Signal Interpretation: Overview of computer-aided diagnosis, ECG interpretation, Computer-assisted classification, Portable arrhythmia monitor.

Instructions to access the biomedical data: Demo to open source database PhysioNet, Acquisition of signal from database, Simulation of signals using MATLAB. **11 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes (COs):

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

1. Discuss the sources, objectives and characteristics of biomedical signals and describe the artefacts affecting the physiological signals.
2. Design and implement digital and integer filters using Lynn Transfer function for biomedical applications.
3. Apply LMS algorithm for adaptive filtering and calculate SNR using signal averaging technique in biomedical signal analysis.
4. Apply Huffman and turning point algorithm for efficient data reduction and Analyze DCT, STFT and DWT for biomedical signal analysis.
5. Apply the differentiation, template-matching technique, Pan-Tompkin's algorithm and use computer aided techniques for biomedical signal feature extraction and classification.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	2	-	-	-	2	2	-	-	3	1	-
CO4	3	-	-	-	2	-	-	-	2	2	-	-	3	1	-
CO5	3	-	-	-	2	-	-	-	2	2	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Willis J. Tompkins, **"Biomedical Digital Signal Processing: C-language Examples and Laboratory Experiments for the IBM PC",** Prentice Hall, 1993.
2. Rangaraj M. Rangayyan, **"Biomedical Signal Analysis: A Case-Study Approach,"** Wiley-IEEE Press, 2001.
3. Eugene N. Bruce, **"Biomedical Signal Processing and Signal Modeling,"** Wiley-Interscience, 2001.

REFERENCE BOOKS:

1. Arnon Cohen, **"Biomedical Signal Processing,"** 2nd Ed., CRC Press, 2002.
2. MetinAkay, **"Biomedical Signal Processing,"** Academic Press, 1994.
3. MetinAkay, **"Time Frequency and Wavelets in Biomedical Signal Processing,"** Wiley-IEEE Press, 1997.

NPTEL/MOOC Link:

1. http://onlinecources.nptel.ac.in/noc18_ec02/preview

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DSP PROCESSORS AND ARCHITECTURE			
Course Code	**21ECE123**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to

1. Learn to represent real-time signals in digital format and understand transform-domain representations of the signals.
2. Understand the architectural features for the programmable DSP device.
3. Study the linear systems approach to signal processing problems using high-level programming language.
4. Demonstrate the linear filters on real-time DSP chips.
5. Present the applications of linear filters and their real-time implementation challenges.

UNIT – I

Introduction to Digital Signal Processing: Introduction, Digital Signal-Processing System, Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.

Architectures for Programmable Digital Signal-Processors: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External Interfacing. **15 Hours**

UNIT – II

Programmable Digital Signal Processors: Introduction, Commercial Digital Signal Processing Devices, Data Addressing Modes of TMS32OC54xx, Memory Space of TMS320C54xxProcessors, Program Control. Detail Study of TMS320C54X & 54xx, Instructions and Programming, On-Chip peripherals. Interrupts of TMS320C54XXProcessors, Pipeline Operation of TMS320C54xx Processor.

Implementation of Basic DSP Algorithms: Introduction, the Q-notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). **15 Hours**

UNIT – III

Implementation of FFT Algorithms: Introduction, FFT Algorithm for DFT Computation, Overflow and Scaling, Bit- Reversed Index Generation & Implementation on the TMS32OC54xx.

Interfacing Memory and Parallel I/O Peripherals to DSP Devices: Introduction, Memory Space Organization, Memory interface. Introduction to TMS320C6748 Processor (Architecture). **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

At the end of the course student will be able to

1. Apply the knowledge of digital signal processing algorithmsfor developing representation of signals.
2. Identify the basic architectural features of fixed point digital signal processors that are useful for programming.
3. Identify and listthe relevant features and instruction set for programming TMS320C54XX processor.
4. Develop algorithms and plan the implementation of FIR and IIR filters in TMS320C54xx processors.
5. Develop and plan the implementation of DFT and FFT algorithms in TMS320C54XX processor along with interfacing memory and peripherals.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO5	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Avatar Singh and S. Srinivasan, **"Digital Signal Processing",** Thomson Learning, 2004.

REFERENCE BOOKS:

1) Ifeachor E. C., Jervis B. W.**, "Digital Signal Processing : A Practical Approach"**, Pearson- Education, 2002
2) B. Venkataramani, M. Bhaskar, **"Digital Signal Processors",** TMH, 2002
3) Kuo S. M., Gan W-S.S., **" Digital Signal Processors: Architectures, Implementations and Applications"**, Prentice Hall, 2005.

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IMAGE PROCESSING			
Course Code	**21ECE124**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Recall the mathematical & signal principles, forming the basis for methods for image processing.
2. Understand image representation, enhancement, filtering, restoration, analysis &reconstruction.
3. Know the processing techniques including various image transformations, image reconstruction, segmentation & recognition.
4. Design & conduct imaging experiments using MATLAB.
5. Convert image from RGB to gray, black & white, remove blurring effects, noisereduction, edge detection, compression and segmentation.

UNIT – I

Definition of Digital Image Processing: Origins and examples of DIP, Fundamental steps in DIP, Elements of visual perception, A simple image formation model, Concepts of sampling & quantization, Representation of digital images, Spatial and Gray level resolution, Zooming& Shrinking of digital images, Basic relationships between pixels.Understanding of Satellite image & Concept of False Color Composite.

Image Enhancement in Spatial domain: Concept & Importance of Histogram Some basic gray level transformations, Histogram processing, Basics of spatial filtering, smoothing spatial filters, sharpening filters.

Image Enhancement in Frequency domain: Introduction to Fourier Transform & Frequency Domain Basics of filtering in frequency domain, Designing the filter in for smoothening and sharpening the images. **15 Hours**

UNIT – II

Image Restoration: A model of image degradation & Restoration process, Noise models, Restoration in the presence of Noise only-spatial filtering, Periodic noise reduction by frequency domain filtering, Inverse filtering, Minimum Mean Square (Wiener) filtering.

Color Fundamentals: Color models, Pseudocolor Image processing, Basics of Full color image processing, Color transformations, Smoothing & Sharpening, Noise in color images, Color image compression.

Image Compression: Fundamentals, Image compression models, Some basic compression methods: Huffman coding, Arithmetic coding, Run length coding, JPEG, MPEG. **15 Hours**

UNIT – III

Morphological Image Processing: Introduction, Dilation & Erosion, Opening & Closing operations, Some basic morphological algorithms.

Image Segmentation: Fundamentals, Point, Line & edge detection, Thresholding, Region-based segmentation.

9 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Apply the image fundamentals and mathematical transforms: zooming (nearest neighbor, bilinear and bilateral) and shrinking necessary for improving resolution of image.
2. Apply spatial & frequency domain techniques to enhance the image.
3. Explain the image restoration technique in presence & absence of noise and explain noise models: Gaussian, Raleigh, exponential, impulse, gamma and impulse.
4. Explain the color models (RGB, CMYK, HSI and YCbCr), pseudocolor image processing, image compression and video compression techniques.
5. Apply morphological operations and segmentation techniques for detection region of interest.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	1	-	1	-	-	1	-	-
CO2	3	-	-	-	1	-	-	1	-	1	-	-	1	-	-
CO3	3	-	-	-	1	-	-	-	-	1	-	-	1	-	-
CO4	3	-	-	-	1	-	-	-	-	1	-	-	1	-	-
CO5	3	-	-	-	1	-	-	1	-	1	-	-	1	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. R. C. Gonzalez and R. E Woods, **"Digital Image Processing"**, Pearson education (Asia)/Prentice Hall of India, 2nd Edition, 2004.

REFERENCE BOOK:

1. S. Jayaraman, S. Esakkirajan and T Veerakumar, **"Digital Image Processing",** Tata McGraw- Hill Education Pvt. Ltd, New Delhi, 3rd Edition, 2010.

NPTEL/MOOC Link:

1. https://nptel.ac.in/courses/117105135/
2. https://nptel.ac.in/courses/117105079/#

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MACHINE LEARNING AND ITS APPLICATIONS			
Course Code	**21ECE125**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to:

1. Understand aspects of pattern recognition and its importance in machine learning.
2. Critical understanding of basic statistical significance tests.
3. Practice machine learning algorithms for solving healthcare and biomedical problems.
4. Identify potential applications of machine learning in practice and execution of machine learning tools such as WEKA.

UNIT – I

Introduction to Machine Perception: Feature Extraction, Bio Markers, Feature Selection, Learning and Adaptation-Supervised, Unsupervised and Reinforcement Learning.
Statistical Pattern Recognition: Standard Deviation, Variance, Covariance, Eigenvalue and Eigenvectors, Dimensionality Reduction, Principal Component Analysis, Independent Component Analysis. **15 Hours**

UNIT – II

Statistical Significance Test: Multivariate Data Analysis, Methods in Analysis of Two-Class Problem and Multi-Class Problem.
Classification System: Class Labeling, Training and Testing a Classifier, *k*-fold Cross Validation, Confusion Matrices, Statistical Data Interpretation and Visual Tools, Performance Measure Techniques. **15 Hours**

UNIT – III

Classifiers: Decision Tree, *k*-Nearest Neighbor (*k*-NN)classifier and Support Vector Machine (SVM) classifier, Advances in Machine-Learning systems, Introduction to WEKA.
9 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

At the end of the course student will be able to:

1. Identify the characteristics of pattern recognition that make it useful to real-world problems.
2. Make use of statistical techniques in machine learning for discrimination of patterns.
3. Formulate two class and multiclass problems and analyse multivariate data to real-world problems.
4. Identify and utilize performance metrics for machine learning algorithms.
5. Identify pattern classifiers and propose solutions for machine learning problems.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	3	-	-	-	2	-	-	-	1	1	-	-	3	1	-
CO5	3	2	-	-	2	-	-	-	1	1	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. R.O. Duda, P.E. Hart, D.G. Stork, **"Pattern Classification"**, John Wiley & Sons, New York, 2012.
2. C. M. Bishop, **"Pattern Recognition and Machine Learning"**, vol. 4, no. 4. NewYork: Springer, 2006.

REFERENCE BOOK:

1. Ethem Alpaydin, **"Introduction to Machine Learning"**, 2nd Edition, PHI Learning Pvt. Ltd., 2013.

NPTEL/MOOC Link:

1. https://nptel.ac.in/courses/117105135/

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WAVELETS			
Course Code	**21ECE126**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

Upon Completing this course, the students will be able to

1. Understand Continuous and Discrete Wavelet Transform
2. Explain Orthogonal Wavelet Decomposition
3. Explain Orthonormal Wavelets and their relationships to filter banks
4. Understand Orthonormal basis generating wavelets
5. Construct simple Wavelets
6. Explain applications of Wavelet Transforms

UNIT - I

Continuous Wavelet Transform: Introduction, C-T wavelets, Definition of CWT, The CWT as a correlation. Constant Q-Factor Filtering Interpolation and time frequency resolution, the CWT as an operator, inverse CWT.

Introduction to Discrete Wavelet Transform and Orthogonal Wavelet Decomposition: Introduction. Approximation of vectors in nested linear vector spaces, (i) example of approximating vectors in nested subspaces of a finite dimensional liner vector space, (ii) Example of approximating vectors in nested subspaces of an infinite dimensional linear vector space. Example MRA. (i) Bases for the approximations subspaces and Harr scaling function, (ii) Bases for detail subspaces and Haar wavelet.

15 Hours

UNIT – II

MRA, Ortho normal Wavelets and Their Relationship to Filter Banks: Introduction, Formal definition of an MRA. Construction of a general orthonormal MRA, (i) scaling function and subspaces, (ii) Implication of dilation equation and orthogonality, a wavelet basis for MRA. (i) Two scale relations for (t), (ii) Basis for the detail subspace (iii) Direct sum decomposition, Digital filtering interpolation (i) Decomposition filters, (ii) reconstruction, the signal.

Examples of Wavelets: Examples of orthogonal basis generating wavelets, (i) Daubechies D4 scaling function and wavelet. (ii) band limited wavelets, Interpreting orthonormal MRAs for Discrete time MRA, (iii) Basis functions for DTWT.

15 Hours

UNIT – III

Construction of Simple Wavelets: Construction of simple wavelets like Harr and DB1. Other Applications of Wavelet Transforms: Introduction, wavelet de-noising, speckle removal, edge detection and object isolation, Image fusions, Object detection by wavelet transforms of projections. Embedded tree image coding, compression with JPEG audio compression, Audio masking and Wavelet based audio coding.

9 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain and Apply the concept of Continuous and Discrete Wavelet Transforms.
2. Apply the concepts of approximating Vectors in Nested Subspaces of Finite-Dimensional Linear Vector Space and Infinite –Dimensional Vector Space. Use Haar Wavelet decomposition for digital filter implementation.
3. Apply Wavelet basis two scale relation, basis for the detail subspaces and direct sum decomposition in MRA. Explain digital filtering interpretation with decomposition filters and reconstructing the signal.
4. Explain Orthonormal basis generating wavelets. Analyse orthonormal MRAs for discrete time signals.
5. Apply wavelet transforms to signal and image compression.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	2	-	-	-	1	1	-	-	1	1	-
CO2	3	2	-	-	2	-	-	-	1	1	-	-	1	1	-
CO3	3	2	-	-	2	-	-	-	1	1	-	-	1	1	-
CO4	3	2	-	-	2	-	-	-	1	1	-	-	1	1	-
CO5	3	2	-	-	2	-	-	-	1	1	3	-	1	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Raghuveer M. Rao and Ajit S. Bapardikar, **"Wavelet transforms- Introduction to Theory and Applications"**, Person Education, 2000.

REFERENCE BOOKS:

1. Prasad and Iyengar, **"Wavelet Transform"**, John Wiley India Pvt. Ltd, 2007.
2. Gilbert Strang and Nguyen Wellesley, **"Wavelet and Filter Banks"**, Cambridge press, 1996.
3. K. P. Soman and K.L. Ramchandran, **"Insight into Wavelets from Theory to Practice"**, Eastern Economy Edition, 2008.

NPTEL/ MOOC Link:

1. https://nptel.ac.in/courses/117/101/117101123/
2. https://nptel.ac.in/courses/108/101/108101093/

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ADVANCED SIGNAL PROCESSING			
Course Code	**21ECE221**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

This course will enable the students to

1. Homomorphic signals and systems are discussed with cepstral analysis.
2. Different types of adaptive filters with its application are elaborated.
3. Introduces multirate digital signal processing along with different forms of filter bank applications.

UNIT – I

Review of prerequisites for advanced digital signal processing: Signals, Fourier representations, DFT & FFT, IIR and FIR filters.

Homomorphism signal processing: Homomorphic system, Complex Cepstrum, Properties of complex cepstrum, Complex cepstrum of exponential signals, Real Cepstrum, Implementation of cepstrum using DFT, Hilbert transform relations in cepstral analysis.

Homomorphic systems: Convolution and Deconvolution, Examples of Homomorphic signal processing, Communication signal processing and speech processing. **16 Hours**

UNIT – II

Adaptive filtering: Principle of Adaptive filters, Tapped delay Line and Weiner filters, Steepest Descent Algorithm, Least Mean Square (LMS) Algorithm, Direct Least Square and Recursive Least Square (RLS) Algorithms.

Application of Adaptive filters: Noise canceller, Echo canceller, Side Lobe Canceller, Adaptive Line Enhancer.

Multi-rate Signal Processing: Multi-rate Systems, Decimation and Interpolation (integer and fractional), Decimation Filters, Interpolation File **15 Hours**

UNIT – III

Interpolated FIR filters for decimation and interpolation filters. Uniform DFT filter banks, QMF banks Perfect Reconstruction, Poly Phase Filter structure, Poly Phase Filter structure for Decimation and Interpolation, Filter Banks, Half band and Multiband filters, PR systems. **8 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

At the end of the course student will be able to

1. Apply the concepts of DSP to find the DFT for a signal of length 8 or less; Design digital IIR filters using Butterworth/ Chebyshev approximation and digital FIR filter using windows for the given frequency specifications; Determine the cepstrum for the given first or second order system.
2. Discuss the properties of the Complex Cepstrum. Explain and Use the concept of homomorphic signal processing to Design a system for real time applications namely communication signal processing and speech processing.
3. Discuss Weiner Filter, Steepest Descent, LMS, Direct Least Square and RLS algorithms; Design first and/ or second order filters using Weiner Hopf equations and Steepest Descent Algorithm for the given signal conditions.
4. Discuss and Build systems for Adaptive filters in Noise canceller, Echo canceller, Side lobe canceller, Adaptive line enhancer. Apply the principle of decimation and interpolation to obtain the rate transformed signals for the given decimation/ interpolation factor.
5. Analyse uniform DFT filter banks, QMF banks perfect reconstruction, Poly Phase filter structure for Decimation and Interpolation, Half band and Multiband filters.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	2	2	2	2	3	-	-	1	2	2	1	1	3	2	2
CO4	2	2	2	2	3	-	-	1	2	2	1	1	3	2	2
CO5	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1 Proakis & Manolakis, **"Digital Signal Processing Principles Algorithms & Applications",** PHI, 4th Edition, New Delhi, 2007.
2 Vaidyanathan P.P, **"Multirate Systems and Filter Banks",** Prentice Hall, India, 1992.
3 Haykin, **"Adaptive Filter Theory",** Prentice Hall, India, 1986.
4 DSP Handbook.
5 Elliot et al Hayes M H, **"Statistical Signal Processing and Modeling",** John Wiley Sons, Inc, 2002.
6 Manolakis D.G., Vinay Ingle K. and Kogan S. M., **"Statistical and Adaptive Signal Processing",** McGraw Hill 2000.

REFERENCE BOOKS:

1 Oppenheim A. V. and Schafer R. W., **"Digital Signal Processing",** Prentice Hall, 1992
2 Orfaneds S. J., **"Optimum Signal Processing",** McGraw Hill, NJ, 1989.

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FUZZY LOGIC			
Course Code	**21ECE222**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

The course presents basics of Fuzzy Logic that aims to:

1. Introduce concept of Fuzzy logic, Classical and Fuzzy relations, Member functions and Fuzzy arithmetic.
2. Arm the students with the basics of Fuzzy rule based system.
3. Introduce Fuzzy classification.

UNIT – I

Introduction: Brief history of fuzzy theory and applications.

Classical sets: Operations on Classical Sets, Properties of classical sets, Mapping of classical sets to functions.

Fuzzy sets and basic operations on fuzzy sets: From classical set to fuzzy sets, Basic concepts associated with fuzzy set, Operations on fuzzy sets. Further operations on Fuzzy sets: Fuzzy complement, Fuzzy Union- The S-Norms, Fuzzy Intersection- The T-Norms, Averaging Operators.

Classical and fuzzy relations: Cartesian Product, Crisp Relations, Operations on Crisp Relations, Properties of Crisp Relations, Composition. From classical relations to fuzzy relations.

Projections and Cylindric Extensions, The Extension Principle.

Composition of Fuzzy Relations**.**

Tolerance and Equivalence Relations: Crisp Equivalence Relation, Crisp Tolerance Relation, Fuzzy Tolerance and Equivalence Relations. **14 Hours**

UNIT – II

Fuzzy Arithmetic: Fuzzy Numbers and Decomposition Theorem, Addition and Subtraction of Fuzzy Numbers, Multiplication and Division of Fuzzy Numbers, Fuzzy Equations, Fuzzy Ranking.

Linguistic Variables and Fuzzy IF-THEN Rules: From Numerical variables to Linguistic Variables, Linguistic Hedges, Fuzzy IF-THEN Rules.

Classical logic and fuzzy logic: Classical predicate logic-tautologies, Contradictions, Equivalence, Logical proofs, Deductive Inferences, Fuzzy logic, Fuzzy tautologies, contradictions, Equivalence and logical proofs, Other forms of the implication operation.

Fuzzifiers and Defuzzifiers: Fuzzifiers- different types, Defuzzifiers- different types, comparison of defuzzifiers. **14 Hours**

UNIT – III

Fuzzy classification: Classification by equivalence relations-crisp relations, Fuzzy relations cluster analysis, Cluster validity, c-Means clustering-hard c-Means (HCM), Fuzzy c-Means (FCM), classification metric, Hardening the fuzzy c-Partition, Similarity relations from clustering**.** **11 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

A student who successfully fulfills the course requirements will be able to

1. Analyse classical sets and fuzzy sets based on membership function, characteristic function and basic operations.
2. Illustrate the properties of classical relation and fuzzy relation; determine the relation matrices for the given relationship between two sets; determine projections and cylindrical extensions and composition for the given fuzzy sets.
3. Explain Fuzzy numbers and decomposition theorem ; Evaluate fuzzy numbers by performing addition, subtraction , multiplication and division on given fuzzy sets.
4. Discuss on Fuzzy inference rules based on Modus Ponens, Modus Tollens and Hypothetical Syllogism; Evaluate the fuzzy linguistic terms based on the hedges; Explain Fuzzifiers and Defuzzifiers.
5. Explain clustering based on equivalence relations, C-means clustering, Hard C-means and Fuzzy C-means; Illustrate the construction of fuzzy relation based on fuzzy partition matrix.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Timothy J. Ross, **"Fuzzy Logic with Engineering Applications",** McGraw-Hill, 1997.

REFERENCE BOOKS:

1. Li-Xin Wang**, "A course in Fuzzy Systems and Control",** Prentice- Hall International, 1997.
2. B. Kosko, **"Neural Networks and Fuzzy Systems A Dynamical System Approach"**, Pearson Education, 1991.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/108104049/16

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LINEAR ALGEBRA FOR SIGNAL PROCESSING			
Course Code	**21ECE223**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

Upon Completing this course, the students will be able to

1. Understand the concept of linear equations.
2. Explain vector spaces.
3. Define linear transformation.
4. Understand the concept of orthogonality.
5. Determine Eigenvalues and Eigenvectors for a given data.
6. Explain how linear algebra can be applied in real time applications.

UNIT - I

Linear Equations: Introduction. Systems of Linear Equations, Matrices and Elementary Row Operations, Solution Sets of Linear Systems.

Vector Spaces: Subspaces, Null Spaces, Column Spaces, Basis, Dimension, Rank.

Linear Transformations: Linear Transformations, Representation of Transformations by Matrices, Null Space and Range space of Linear Transformation. Basis and dimension calculation of Null Spaces and Range Spaces of Linear Transformation.

15 Hours

UNIT – II

Orthogonality: Inner Product, Length and Orthogonality, Orthogonal Projections, The Gram–Schmidt Process, Orthonormalisation, Unitary Transformation.

Eigenvalues and Eigenvectors: Eigenvalues and Eigenvectors, The Characteristic Equation, Diagonalization, Four Fundamental Subspaces associated with Linear Transformation.
Singular Value Decomposition (SVD).

15 Hours

UNIT – III

Applications in Signal Processing: Least Square Problems, Least Square Estimation, Curve Fitting, QR Factorisation, Fourier Series and Projection, Data Compression using Orthonormal Transformations like DFT, DCT and SVD.

9 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Solve a given set of Linear equations, Determine the rank, Null Spaces, Column Spaces for a given m · n matrix.
2. Illustrate the representation of linear transformations using matrices; Calculate basis and dimension of null spaces and range spaces of linear transformation.
3. Apply the concepts of Orthogonality, Orthogonal Projections, Gram–Schmidt Process, Orthonormalisation for the given set of vectors and Explain Unitary Transformation.
4. Determine Eigenvalues and Eigenvectors for a given matrix; Explain four fundamental subspaces associated with linear transformation. Apply Singular Value Decomposition (SVD) for a given m · n matrix.
5. Analyse the applications of Linear Algebra towards Least Square Estimation, Curve Fitting, QR Factorization, Fourier Series and Projection, Data Compression using DFT, DCT and SVD

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	1	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-	1	1	-
CO5	3	2	-	-	2	-	-	-	2	2	-	-	1	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Gilbert Strang, **"Introduction to Linear Algebra"**, 4th Edition, Wellesley-Cambridge Press, MA, 2009.
2. David C. Lay, Steven R. Lay and J. J. McDonald: **"Linear Algebra and its Applications"**, 5th Edition, Pearson Education Ltd., 2015

REFERENCE BOOKS:

1. Li Z. N., Drew M. S., Liu J., **"Fundamentals of Multimedia"**, Upper Saddle River (NJ), Pearson Prentice Hall, 2004.
2. Jayant Nuggehally S. and Peter Noll, **"Digital Coding of Waveforms: Principles and Applications to Speech and Video"**, Englewood Cliffs, NJ, 1984.

NPTEL/ MOOC Link:

1. https://www.coursera.org/programs/nmam-institute-of-technology-on-coursera-e9clx?collectionId=&productId=ARf5_jvZEeeYEBLbuVGJ2g&productType=course&showMiniModal=true
2. https://nptel.ac.in/courses/111/108/111108066/

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OPTICAL COMPUTING			
Course Code	**21ECE224**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Understand the concept of optical processing.
2. Understand the concept of optical arithmetic.
3. Know about the optical devices.
4. Understand the concept of shadow casting and symbolic substitution.

UNIT – I

Linear Optical Processing: Introduction, Photographic film, Spatial filtering using binary filters, Holography, Inverse filtering, De-blurring

Optical Arithmetic: Introduction, Half-tone processing, Non-linear optical processing, Arithmetic operation

16 Hours

UNIT – II

Recognition using analog optical systems: Introduction, Matched filter, Joint transform correlation, Phase only filter, AM recognition filters, Generalized correlation filter, Mellin transform based correlation

Devices: Non-linear devices, Integrated objects, Threshold devices **13 Hours**

UNIT – III

Shadow casting and symbolic substitution: Shadow casting system and design algorithm, POSC logic operation, POSC multiprocessor, Parallel ALU using POSC, Sequential ALU using POSC, Symbolic substitution

10 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Illustrate the optical properties of a photographic film and discuss the various spatial filtering operations that can be realized using a linear optical processor. Discuss holography as a means of synthesizing complex filters. Explain inverse and Weiner filters.
2. Illustrate the computing applications of coherent optical processors in the areas of spatial filtering, non linear operations and arithmetic.
3. Illustrate the working of Character Recognition filters such as Matched filter, Joint Fourier Transform filter, Phase-only filter and Amplitude Modulated Phase-only filter. Use the properties of Mellin transforms and establish the interrelationship between Mellin and Fourier Transform.
4. Illustrate the working of devices that are used to realize digital optical computing schemes.
5. Illustrate Shadow casting setup and POSC Design Algorithm. Design a parallel and sequential ALU. Implement the optical symbolic substitution schemes.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Karim and Awwal, **"Optical Computing: An Introduction",** John Wiley, 2003.

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PATTERN RECOGNITION			
Course Code	**21ECE225**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

3. Make use of Probability& Statics and Image Processing to understand the basic concepts of Pattern Recognition.
4. Learn various parameters used in Pattern Recognition by choosing appropriate decision making technique.
5. Perform clustering and apply linear regression concepts for Pattern Recognition.
6. Apply the knowledge of linear models for classification on various pattern recognition studies.

UNIT – I

Introduction: Pattern recognition systems, the design cycle, learning and adaptation.

Mathematical preliminaries: Probability of events, Random variables, joint distributions and densities, Moments of random variables, estimation of parameters from samples, minimum risk estimators.

Bayesian Decision Theory: Introduction, Continuous features, Minimum error rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features

Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case; Bayesian estimation: Gaussian case **15 Hours**

UNIT – II

Non Parametric techniques: Introduction, density estimation, parzen Windows, k-Nearest neighbor estimation, Fuzzy classification

Linear discriminant functions: Introduction, linear discriminant functions and decision surfaces, generalized linear discriminant functions, Gradient descent procedures;

Clustering: Introduction, Hierarchical clustering, partitional clustering.

Dimensionality reduction: Principal component analysis, Fisher discriminant analysis.

15 Hours

UNIT - III

Introduction to Artificial Neural Networks: Biological Neuron – Artificial Neural Model - Types of activation functions, Architecture: Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks. Learning: Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron Convergence Theorem. L1, L2 **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1) Estimate mean and variance of a probability density function from given samples of size not more than 20 using parameter estimation methods; The method of moments, maximum likelihood method, unbiased estimator.
2) Apply Bayes theorem for classification of continuous and discrete features with minimum error.
3) Apply window based technique to determine the probability density function of given samples of size not more than 6 using rectangular/triangular/Gaussian windows and K-NN, Fuzzy methods for classification of samples of size not more than 10. Determine the coefficients discriminant function in the next iteration given the coefficients of current iteration.
4) Apply clustering methods; single-linkage/complete-linkage/Average-linkage/k-means/Ward's method/Forgy's method for pattern classification and PCA, Fisher discriminant analysis for dimensionality reduction of features.
5) Make use of single layer and two-layer feed forward neural networks and Gradient descent algorithm to implement truth table with binary inputs not more than three.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	2	-	-	-	2	-	-	-	3	-	-
CO4	3	-	-	-	2	-	-	-	2	-	-	-	3	-	-
CO5	3	-	-	-	2	-	-	-	2	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

7. Richard O. Duda, Peter E. Hart and David G. Stork, **"Pattern Classification"**, John Wiley & Sons, 2012.
8. Earl Gose, Richard Johnsonburg & Steve Joust, **"Pattern Recognition"**, Prentice-Hall of India-2003.
9. J.M. Zurada, **"Introduction to Artificial Neural Systems"**, Jaico Publications 1994.

REFERENCE BOOKS:

10. Christopher M. Bishop, **"Pattern Recognition and Machine Learning",** Springer, 2006.
11. Robert J Schalkoff, **"Pattern Recognition Statistical, Structural and Neural Approaches",** John Wiley, 1992.

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SPEECH PROCESSING			
Course Code	**21ECE226**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to

1. Obtain knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
2. Describe signal processing techniques for real-time processing of speech signals.
3. Discover practical aspects of speech processing and relate experimental methodology into practice.

UNIT – I

Production and classification of speech sounds: Introduction, Mechanism of speech production. Acoustic phonetics: Vowels, Diphthongs, Semivowels, Nasals, Fricatives, Stops and affricates.

Time-domain methods for speech processing: Time dependent processing of speech, Short time energy and average magnitude, Short-time average zero crossing rates**.**

16 Hours

UNIT – II

Analysis and Synthesis: Brief Applications of temporal processing of speech signals in synthesis, Enhancement, Hearing applications and clear speech.

Frequency domain methods for speech processing: Introduction, Definitions and properties: Fourier transforms interpretation and linear filter interpretation, Sampling rates in time and frequency**.**

15 Hours

UNIT – III

Filter bank summation and overlap add methods: Short-time synthesis of speech, Sinusoidal and harmonic plus noise method of analysis/synthesis.

Homomorphic speech processing: Introduction, Homomorphic system for convolution, Complex cepstrum of speech, Homomorphic vocader. **8 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Identify and model basic characteristics of human speech production and hearing mechanisms.
2. Develop time domain methods to design applications involving short time analysis of speech signals.
3. Develop algorithms for analysis and synthesis of digital speech signals in time and frequency domains.
4. Develop algorithms using filter bank methods for synthesis and analysis of speech signals.
5. Create a plan to develop end to end subsystems using homomorphic signal processing for speech signals.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO5	2	2	3	-	-	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. L. R. Rabiner and R. W. Schafer, **"Digital Processing of Speech Signals"**, Pearson Education Asia, 2004.

REFERENCE BOOKS:

1. T. F. Quatieri, "**Discrete Time Speech Signal Processing"**, Pearson Education Asia, 2004.
2. B. Gold and N. Morgan, "**Speech and Audio Signal Processing**: **Processing and Perceptionof Speech and Music",** John Wiley, 2004.

NPTEL/MOOC Link:

1. http://nptel.ac.in/courses/117105145/
2. http://nptel.ac.in/courses/126104006/23

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BIG DATA ANALYTICS			
Course Code	**21ECE131**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Understanding of the statistical procedures most often used by practicing engineers.
2. Understand Forecasting methods and apply for business applications.
3. Learn tips and tricks for Big Data use cases and solutions.
4. Able to apply fundamental algorithmic ideas to process data.
5. Learn to apply hypotheses and data into actionable predictions.
6. Constructing a real world application with data storage and retrieval.

UNIT – I

Introduction to Big Data Analytics: Definition, Overview and Big data in Industry.
Overview of Data Analytics Lifecycle: Phases of typical analytics lifecycle-discovery, Data preparation, Model planning, Model building.
Introduction to R programming: Using R programming for Initial Analysis of the Data, Basic visualization using R. **16 Hours**

UNIT – II

Advanced Analytics and Statistical Modeling for Big Data - Theory and Methods: Core methods used by data scientist, Candidate selection using Naïve Bayesian Classifier, Categorization using K-means clustering algorithm and association rules, Predictive modelling using decision trees, Linear and logistic regression and time series analysis and text analysis. **13 Hours**

UNIT – III

Advanced Analytics and Statistical Modeling for Big Data – Technology and Tools: Analytic tools for unstructured data, MapReduce and the Hadoop ecosystem. In-database analytics with SQL extensions and other advanced SQL techniques and MADlib functions for in-database analytics.

10 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

At the end of the course the student should be able to

1. Explain the phases of data analytics.
2. Use R programming to Discuss the data analysis phase.
3. Explain the classifiers used for data selection by data scientist; Apply Baye's theorem to solve problems on Classifiers.
4. Describe the predictive statistical models available for data analytics.
5. Explain the basics of database techniques to identify and classify the types of data.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Sartaj Sahni, **"Data Structures, Algorithms, and Applications in C++",** McGraw Hill, 2000.

REFERENCE BOOKS:

1. Michael Minnelli, Michele Chambers, Ambiga Dhiraj, **"Big Data Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses**", Wiley India Pvt. Ltd., 2013.
2. Arvind Sathi, **"Big Data Analytics"**, MC Press, LLC, 2012.
3. Vignesh Prajapathi, **"Big Data Analytics with R and Hadoop"**, PACKT, 2013.R4. Emmanuel Paradis, R for Beginners (Open Source).

NPTEL/ MOOC Link:

1. https://onlinecourses.nptel.ac.in/noc16_mg06

COMPUTER OPERATING SYSTEMS

Course Code	21ECE132	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Hours	39	Credits	03

Course Learning Objectives :

This course will enable students to

1. Define and Describe operating systems, Resource allocation, Operating System structure, Operating System operations and services.
2. Explain Process concept, Operations on processes, Inter process communication, Multi-Threaded Programming and Process management.
3. Explain memory management concepts as applicable to kernel and programs in an Operating System.
4. Define and Describe Virtual memory, Paging policies and Scheduling of processes in an Operating System.

UNIT – I

Introduction And Overview Of Operating Systems : Introduction to Operating system, Goals of an O.S, Operation of an O.S, Functions performed by an OS, Computational structures and OS responsibilities, O.S and the computer system, Efficiency and user convenience, Classes of operating systems, Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems, Distributed operating systems.

Structure of the Operating Systems: Structure of an Operating system,, Configuring and installing of the Kernel, Operating system with monolithic structure, Layered design, Virtual machine operating systems, Kernel based operating systems, and Microkernel based operating systems. **15 Hours**

UNIT – II

Process Management: Concept of Processes and Programs, Programmer view of processes, OS view of processes, Interacting processes, Threads, Processes in UNIX, Threads in Solaris.

Memory Management: Managing the memory hierarchy, Memory allocation preliminaries, Memory allocation to process, Reuse of memory, Contiguous and noncontiguous allocation to programs, Paging, Segmentation, Segmentation with paging, Kernel memory allocation. **15 Hours**

UNIT – III

Virtual Memory: Virtual memory basics, Demand paging, Address translation and page fault generation, Address translation in multi programming systems, Operation of a virtual memory handler, Page replacement policies, Shared pages, UNIX virtual memory.
Scheduling: Scheduling preliminaries, Non- Preemptive scheduling algorithms-FCFS,SRN,HRN, Preemptive scheduling algorithms-RR,LCN,STG, Scheduling in Practice-Long-term scheduling, Medium and short term scheduling.

9 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Describe Computational structure, operations and services of Operating System.
2. Explain fundamental classes and structures of Operating System.
3. Describe how processes and threads are used in operating system context.
4. Illustrate how memory is managed in operating system and compare memory management techniques.
5. Describe Virtual memory, paging policies, Scheduling of processes in an Operating System and apply the concepts of page replacement policies and scheduling to achieve effective resource utilization.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. D. M. Dhamdhare**,"Operating Systems A Concept Based Approach"** TMH, 2nd Ed, 2006.

REFERENCE BOOK:

1. Silberschatz and Galvin, "**Operating Systems Concepts",** John Wiley, 5th Edition, 2001.

CRYPTOGRAPHY			
Course Code	**21ECE133**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objective:

The course presents the basics of Cryptography that aims to:

1. Introduce OSI model, different types of encryption and decryption techniques.
2. Introduce basic mathematical functions required to solve most of the Cryptographic algorithms.
3. Arm the students with ability to select appropriate cryptographic algorithm based on the requirement.
4. Introduce various Private and Public key cryptographic algorithms.
5. Introduce basics of Digital Signature, Hash and MAC algorithms.

UNIT – I

Overview: Services, Mechanisms and attacks, OSI security architecture, Model for network security.

Introduction to finite fields: Groups, Rings and Fields, modular arithmetic, Euclid algorithm, Finite fields of the form GF(p), polynomial arithmetic, Finite fields of the form $GF(2^n)$.

Introduction to number theory: Prime numbers, Fermat's and Euler's theorem, Chinese Remainder Theorem, Discrete logarithm.

Classical encryption techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Rotor machine, Steganography. **16 Hours**

UNIT – II

Block ciphers and DES: Fiestel ciphers, Simplified DES, Block cipher principles, DES, Strength of DES, Block cipher design principles, Block cipher modes of operation, Problems , IDEA , Double DES, Triple DES, Blow–Fish, RC4, RC5.

Public Key Cryptography and RSA: Principles of Public Key Cryptosystems, RSA algorithm, Problems, Knapsack problem, ElGamal cryptosystem.

Other public key cryptosystems and key management: Key management, Diffie Hellman key exchange, Man in the middle attack, Elliptic curve arithmetic, Elliptic curve cryptography, Problems. Analog of Diffie-Hellman on ECC, Analog of ElGamal on ECC.

16 Hours

UNIT – III

Message authentication and hash functions: Authentication requirements, Authentication functions, Message authentication codes, Hash functions, Security of Hash functions, and MAC, SHA-1 and MD5.

Digital signature and authentication protocol: Digital signature and authentication protocol, Digital signature standard.

Introduction to quantum cryptography, Introduction to Block chain technology. **7 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain the security mechanism and attacks on a Network; Describe the OSI architecture for Network Security; Perform encryption and decryption using Symmetrical cipher models.
2. Explain the properties of Group, Rings and Fields; Apply the mathematical techniques Euclid algorithm, CRT and Fermat Theorem to solve the problems of finite field (GF (p)).
3. Explain the modes of operation of Block Ciphers, RC4 and Blow-Fish; Describe the working of Data Encryption Standard (DES); Determine the cipher using S-DES (8-Bit data).
4. Explain the working of Public key ciphers; perform the encryption and decryption using Public key ciphers.
5. Explain the message authentication and Hash function; describe digital authentication protocol and standards.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. William Stallings, **"Cryptography and Network Security Principles and Practices",** 3rd Edition, Pearson Education /PHI 2003.

REFERENCE BOOKS:

1. Neal Koeblitz, **"A Course in Number Theory and Cryptography",** 2nd Ed., Springer verlag, 2006.
2. Behrouz A.Forouzan, Debdeeep Mukhopadhyay, "**Cryptography and Network Security",** 2nd Ed, Mc Graw Hill.
3. Bruce Schneier, "**Applied Cryptography",** 2nd Ed., John Wiley and Sons, 2001.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/106105031/
2. http://nptel.ac.in/courses/106103015/

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DATA STRUCTURES USING C++			
Course Code	**21ECE134**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Outline the concepts of data structures, types and overview of data structures.
2. Make use of linear data structures like stack, queue and their applications.
3. Make use of nonlinear data structures like binary tree and their usage.

UNIT – I

Introduction: Functions and parameters, Dynamic memory allocation classis, Testing and debugging. Data Representation, Introduction, Linear lists, Formula-based representation linked representation, Indirect addressing simulating pointers.
Arrays And Matrices: Arrays, Matrices, Special matrices sparse matrices. **15 Hours**

UNIT – II

Stacks: The abstract data types, Derived classes and inheritance, Formula-based Representation, Linked representation, Applications.
Queues: The abstract data types, Derived classes and inheritance, Formula-based representation, Linked representation, Applications.

Skip Lists and Hashing: Dictionaries, Linear representation, Skip list representation, Hash table representation. **15 Hours**

UNIT – III

Binary And Other Trees: Trees, Binary trees, Properties and representation of binary trees, Common binary tree operations, Binary tree traversal the ADT binary tree, ADT and class extensions.

Search Trees: Binary search trees, B-trees, Applications. **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

After studying this Course, the student should be able to:

1. Describe the concepts of Data Representation, Functions and Dynamic memory allocation in data structures.
2. Describe the concepts of Linear Lists, Arrays and Matrices in data structures.
3. Explain the data types, inheritance classes and representation of stacks & queues.
4. Explain the concepts of data redundancy and data integrity using skip listing & hashing.
5. Explain the concepts of finding the solution by Tree search algorithm.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	2	1	-	-	1	-	-
CO2	3	1	-	-	-	-	-	-	2	1	-	-	1	-	-
CO3	3	2	-	-	-	-	-	-	2	1	-	-	1	-	-
CO4	3	-	-	-	-	-	-	-	2	1	-	-	1	-	-
CO5	3	-	-	-	-	-	-	-	2	1	-	-	1	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Sartaj Sahni, **"Data Structures, Algorithms, and Applications in C++",** McGraw Hill, 2000.

REFERENCE BOOKS:

1. Balaguruswamy,**"Object Oriented Programming in C++"**, TMH, 1995.
2. Balaguruswamy, **"Programming in C++",** TMH, 1995 Litivin, Vikas Publication, 2003.

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OBJECT ORIENTED PROGRAMMING IN JAVA			
Course Code	**21ECE135**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

The course presents basic Object Oriented Programming in Java programming that aims to

1. Introduce Java Operators, Arrays and Data Structures.
2. Arm the students with the basic object oriented programming concepts.
3. Introduce different techniques like Inheritance, Multithreaded Programming and HTML.

UNIT – I

Introduction to Java: Java history. Connection between Java and Internet, JVM –The heart of Java, Java's Magic Bytecode, Servlets: Java on the Server Side and Java Buzzwords, Overview of Java: Two Paradigms, Three OOP Principles – Encapsulation, Inheritance, Polymorphism, Lexical issues. **3 Hours**

Data Types, Variables and Arrays in Java: Primitive data types, Integers, Floating-Point Types, Characters, Booleans, Variables, Type Conversion and Casting, Java Operators- Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, The ? Operator, Operator Precedence, Control Statements- Selection Statements, Iteration Statements, Jump Statements, and Arrays- One-Dimensional Arrays, Multidimensional Arrays. **7 Hours**

Methods and Classes: Overloading Methods, Argument Passing, Returning Objects, Recursion, Access Specifiers, Static member, Final variable, String Class. **4 Hours**

UNIT – II

Inheritance: Inheritance basics, superclass, Multilevel Inheritance, Method Overriding, Final and abstract keyword, Basics of Packages and Interfaces. **6 Hours**

Exception Handling: Exception Types, Try and catch, Multiple catch Clauses, Nested try Statements, Throw, Java's Built-in Exceptions. **2 Hours**

Multithreaded programming: Main Thread, Creating threads, Extending the thread class, Thread priority, Synchronization, Stopping and blocking a thread, Basics of Enumerations.

3Hours

Java Servlets: Benefits, A simple Java Servlet, Anatomy of a Java Servlet, Reading data from a client, Reading HTTP Request Headers, Sending data to a client and writing the HTTP Response Header, Working with Cookies, Tracking Sessions. **4 Hours**

UNIT – III

Java Server pages (JSP), JavaScript & HTML: Basics of JSP Tags, Attributes, URLs, Links, Applet, The APPLET Element, Naming Applets JAR Archives, The OBJECT Element and Passing Parameters to Applets. Introduction to JavaScript(JS),HTML DOM,JS Data Type, Loops in JS, functions in JS, Embedding JS in HTML. **10 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

A student who successfully fulfills the course requirements will have demonstrated:

1. Explain the various data types and variables of Java Programming.
2. Explain the various principles of the object oriented programming; Develop simple Object oriented programs using the concept of Methods & Classes.
3. Apply the concept of Inheritance, Exception handling, multithreaded programming to write a program using JAVA.
4. Develop simple HTML codes using Java servlets.
5. Explain the front-end development of webpage using applets and Java Server page.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	2	1	-	-	1	-	-
CO2	3	1	-	-	-	-	-	-	2	1	-	-	1	-	-
CO3	3	2	-	-	-	-	-	-	2	1	-	-	1	-	-
CO4	3	-	-	-	-	-	-	-	2	1	-	-	1	-	-
CO5	3	-	-	-	-	-	-	-	2	1	-	-	1	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Herbert Scheldt, **"The Complete reference JAVA"**, 7th Edition, Tata McGraw – Hill, ISBN: 0-07-063677.
2. Cay Horstmann , **"Computing Concepts with Java 2 Essentials"**, 2nd Edition, WILEY INDIA, ISBN: 81-265-0931-9.

REFERENCE BOOKS:

1. Cay Horstmann , **"Big java"**, 2nd Edition, WILEY INDIA, ISBN: 81-265-0879-5.
2. E Balagurusamy , **"Programming with JAVA Primer"**, 3rd Edition, Tata McGraw –Hill, ISBN: 0-07-061713-9.

NPTEL/ MOOC Link:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-092-introduction-to-programming-in-java-january-iap-2010/index.htm
2. https://www.udacity.com/course/intro-to-java-programming--cs046

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REAL-TIME OPERATING SYSTEMS			
Course Code	**21ECE136**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Understand the difference between a Real Time System and General computing system and calculate performability and program runtime in a Real Time System.
2. Be familiar with various task scheduling methods and their intended usage.
3. Learn various multiple access protocols used in Real Time Communication.
4. Know the services offered issues involved in Real Time Operating Systems.
5. Analyze and design the architecture of a Real Time Systems.

UNIT – I

Introduction: Issues in Real Time Computing, Task classes. Characterizing Real Time Systems and Tasks: Performance measures for Real Time Systems, Estimating Program runtimes**.**

Task Assignment & Scheduling: Classical Uniprocessor scheduling algorithms: Rate Monotonic and Earliest Deadline First; Multiprocessor scheduling: Utilization-Balancing Algorithm, Next-Fit Algorithm, Bin-Packing Assignment. **16 Hours**

UNIT – II

Real Time Communication: Network topologies, Network architecture issues; Protocols: Contention-based protocol (VTCSMA only) and Token-based protocols: Timed Token Protocol**.**

Real Time Operating Systems (RTOS): OS Services, Real Time & Embedded System OS, RTOS Task scheduling models, OS security issues. **16 Hours**

UNIT – III

RTOS Tools with case studies: Use of MUCOS/OS-II, Use of Vx Works, Case studies of Automatic Chocolate Vending machines, Coding for sending application layer byte streams on a TCP/IP network. (Excluding programming). **7 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Describe the structure, types and issues in the real time systems, illustrate the performability of a given real-time system and estimate source code run time.
2. Illustrate RM and EDF uniprocessor scheduling algorithm and Utilization-Balancing, Next-Fit and Bin-Packing Assignment multiprocessor scheduling algorithms.
3. Describe the network architectural issues and VT-CSMA, Timed token and Token ring real time protocols for real-time communication.
4. Explain RTOS services, Kernel services, Scheduling algorithms and OS security issues.
5. Describe the features of MUCOS and Vx-Works along with ACVM and Sending application layer bytes on a TCP/IP protocol.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. C M Krishna & Kang G Shin, **"Real Time Systems",** MGH, 1997.
2. Raj Kamal, **"Embedded System Architecture, Programming & Design",** TMH 2003.

REFERENCE BOOK:

1. Liu, "Real Time Systems", Integre Technical Publishing Co. Inc., January 2000.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/downloads/106105086/
2. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Embedded%20systems/Pdf/Lesson-28.pdf
3. http://nptel.ac.in/courses/108105063/pdf/L-37(SM)%20(IA&C)%20((EE)NPTEL).Pdf
4. https://www.coursera.org/lecture/real-time-systems/the-concepts-of-real-time-systems-tJncu
5. https://www.coursera.org/lecture/real-time-systems/the-concept-of-real-timetasks-j9CYf

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COMPUTER ARCHITECTURE			
Course Code	**21ECE231**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

Upon Completing this course, the students will be able to

1. Outline the basic structure and operation of a digital computer.
2. Learn about arithmetic unit and perform fixed point and floating point addition, subtraction, multiplication and division in binary 2's complement number system.
3. Appreciate the fine grain details of basic processing unit in terms of control unit, arithmetic and logical unit, memory unit and I/O unit.
4. Remember and comprehend the hierarchical memory system including cache memories and virtual memory.
5. Tell how different ways of communication with I/O devices and standard I/O interfaces.

UNIT – I

Basic Computer Organization: Basic structure of computer and its components, Memory Location and Addresses, Memory operations, Instructions and instruction sequencing, Comparison of RISC and CISC architectures.

Arithmetic Operations: Multiplication of positive numbers, Signed operand multiplication, Fast multiplication, Integer division, Floating-point numbers and operations on numbers in IEEE format.

15 Hours

UNIT – II

Memory Systems: Memory system: Basic concepts, Semiconductor RAM memories, Read only memories, Speed, Size and cost, Cache memories – Mapping functions, FIFO and LRU replacement policies, Performance considerations, Virtual memories, Secondary storage.

Pipelining: Introduction to pipelining, Instruction level pipelining (ILP), Pipeline hazard-Structural, Data, and control hazards .

15 Hours

UNIT – III

Input/ Output Organization: Input / Output organization: Accessing I/O Devices, Interrupts –interrupt hardware, Enabling and disabling interrupts, Exceptions, Handling multiple devices, Controlling device requests, Buses, Direct memory access, Interface circuits (parallel, Serial), Standard I/O Interfaces – PCI bus, SCSI bus, USB *(Basics only)*

09 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Describe the organization of computer, its component parts, structural design and connectivity.
2. Carry out the multiplication & division operations performed on numbers in IEEE format.
3. Comprehend the basic structure of processors, and modern trends in processor technology.
4. Explain the structure of memory systems in cache memories and virtual memory.
5. Explain the design of basic and standard I/O interfaces.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky**, "Computer Organization"**, 5th Edition, TMH, 2002.
2. John L. Hennessey and David A. Patterson**, "Computer Architecture, A Quantitative Approach"**, 4th Edition, Elsevier, 2007.
3. Shameem Akhter and Jason Roberts, **"Multicore Programming- Increasing Performance Through Software Multithreading",** Intel press, 2006.

REFERENCE BOOKS:

1. William Stallings, **"Computer Organization & Architecture"**, 7th Edition, PHI, 2006.
2. Vincent P. Heuring & Harry F. Jordan, **"Computer Systems Design and Architecture"**, 2nd Edition, Pearson Education, 2004.
3. David A. Patterson, John L. Hennessy, **"Computer Organization and Design"**, 4th Edition Elsevier, 2012.
4. John P. Hayes, **"Computer Architecture"**, 2nd edition, McGraw Hill, 1988.

E-Books / Online Resources:

1. https://dcs.abu.edu.ng/staff/sani-ahmad-hassan/course materials/COSC303_LEC.pdf
2. http://www.cse.iitm.ac.in/~vplab/courses/comp_org/
3. http://www.ddegjust.ac.in/studymaterial/msc-cs/ms-07.pdf
4. http://nsec.sjtu.edu.cn/data/MK.Computer.Organization.and.Design.4th.Edition.Oct.2011.pdf

MOOC:

1. http://nptel.ac.in/courses/106103068/

DATA BASE MANAGEMENT SYSTEM			
Course Code	**21ECE232**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

This course will enable students to

1. Describe databases and database management systems.
2. Understand database structures and their working principles.
3. Design simple database models using Entity-Relationship Modeling.
4. Learn how to relate tables together in a database.
5. Recognize structured query language (SQL) statements and write queries using SQL.
6. Construct the stages of database project design-query processing and optimizing database, concurrency control using locking techniques.
7. Understand the issues associated with Transaction Processing and Recovery.

UNIT – I

Introduction: DBMS Administrators, Designers, Users, Developers & maintenance users of DBMS.

DBMS: Architecture, Schemes & Interfaces. Entity-Relationship model, Record storage & primary file organization: Hashing techniques, Index structures, Multilevel indexes using B-trees.

Relational data model & Relational algebra: Queries in relational algebra. **16 Hours**

UNIT – II

SQL- A Relational Database language, Different clauses & example queries.

Database Design: I, II, III Normal forms, BCNF, Join dependencies, IV & V Normal forms.
14 Hours

UNIT – III

Query processing & Optimization, Transactions, Recovery & Concurrency control. Security & Integrity constraints. **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

At the end of the course student will be able to

1. Explain the working principle of a database structure.
2. Construct a simple database model using Entity- Relationship Modeling.
3. Develop the queries using SQL to retrieve data from database.
4. Describe the stages of database project design considering the normal forms of database design.
5. Explain the issues associated with Query Processing& Optimization related to data retrieval from database.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	1	-	-	1	-	-
CO2	3	1	-	-	-	-	-	-	2	1	-	-	1	-	-
CO3	3	2	-	-	-	-	-	-	2	1	-	-	1	-	-
CO4	3	-	-	-	-	-	-	-	2	1	-	-	1	-	-
CO5	3	-	-	-	-	-	-	-	2	1	-	-	1	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Ramez Elmasri, Shamkant B. Navathe, **"Fundamentals of Database Systems",** The Benzamin/Cummings, Addison-Wesley, VI Edition, 2011.

NPTEL/ MOOC Link:

1. https://onlinecourses.nptel.ac.in/noc15_cs14

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FINANCE MANAGEMENT			
Course Code	**21ECE233**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Develop basic financial management knowledge essential to make a managerial career in professional life.
2. Impart some of the crucial and basic skills required to work in the area of budgeting, investment and financial decision making.
3. Enable in making a right decisions on selection of projects for investment.
4. Understand the basics of finance and financial markets, project evaluation and selection.

UNIT – I

Financial Management: Concepts and Meaning – Introduction to Finance; Objectives of Financial Management; Profit Maximization; EVA; Changing Role of Financial Managers.
Time Value of Money: Techniques and Applications of Compounding and Discounting.
13 Hours

UNIT – II

Cost of Capital: Sources of various Types of Capital; Cost of Debenture Capital; Cost of Preferential Capital; Cost of Term Loans; Cost of Equity Capital.
Working Capital : Factors influencing Working Capital Requirements.
Inventory Management: Techniques of Inventory Management and Control – EOQ, ABC Analysis, Just-in-Time (JIT) System. **13 Hours**

UNIT – III

Capital Budgeting (Investment Evaluation Techniques): Payback Period Method; Present Worth Method; Annual Worth Method; Future Worth Method; Estimation of IRR.
BreakEven Analysis: Estimation of Break-Even Point and Values. **13 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Describe the basic financial management skills required for a professional.
2. Explain techniques and applications of compounding and discounting and calculate compounded/discounted amount for the given proposal.
3. Evaluate the given investment option by capital budgeting techniques.
4. Describe the basics of cost of capital and working capital. Determine the cost of capital for the given investment option.
5. Describe the basics of inventory management and calculate the economic order quantity and reorder point for the given conditions. Calculate breakeven point for the given manufacturing setup.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		-	-	-	-	-	-	1	1	-	1	-	-	-
CO2	1	3	-	-	-	-	-	-	1	1	-	1	-	-	-
CO3	2	3	-	-	-	-	-	-	1	1	-	1	-	-	-
CO4	2	3	-	-	-	-	-	-	1	1	-	1	-	-	-
CO5	1	3	-	-	-	-	-	-	1	1	-	1	-	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. M Y Khan, P K Jain , **"Financial Management – Text, Problems & Cases"**,7th Edition, 2015; McGraw Hill Education (India) Pvt. Ltd, New Delhi.
2. I M Pandey, **"Financial Management"**, 11th Edition, 2015; Vikas Publishing House Pvt. Ltd. (UP) India.
3. James L. Riggs, David D. Bedworth and Sabah U. Randhawa, **"Engineering Economics"**, 4th Edition, Tata McGraw Hill Edition.

REFERENCE BOOKS :

1. Prasanna Chandra, **"Financial Management"**, 6th Edition, 2004; Tata McGraw Hill Publishing Company Ltd, New Delhi.
2. S. D. Sharma, **"Operation Research"**.

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OBJECT ORIENTED PROGRAMMING WITH C++			
Course Code	**21ECE234**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

The course presents basic Object Oriented Programming using C++ programming that aims to:

1. Arm the students with the basic object oriented programming concepts.
2. Introduce different techniques like Inheritance, Polymorphism, Virtual Functions and Constructors.
3. Arm the students with the necessary constructs of OOP C++ programming.
4. Introduce concepts like template classes and STL libraries.

UNIT – I

Principles of OOP: OOP paradigm, Procedural Vs. Object Oriented Programming, Benefits and applications of OOP.
C++ Features: Program structure, Namespace, Identifiers, Variables, Constants, Enum, Operators, Ttypecasting, Control structures.
C++ Functions: Call and Return by reference, Inline functions, Overloading of functions, Default arguments.
Objects and classes : Basics of object and class in C++, Private and public members, Static data and function members, Constructors and their types, Destructors, Operator overloading, Type conversion, Friend functions. **16 Hours**

UNIT – II

Inheritance : Concept of Inheritance, Types of inheritance: Single, Multiple, Multilevel, Hierarchical, Hybrid, Protected members, Overriding, Virtual base class.
Polymorphism : Pointers in C++. Pointes and Objects, This pointer, Virtual and pure virtual functions, Implementing polymorphism.
I/O and File management : Concept of streams, cin and cout objects, C++ stream classes, Unformatted and formatted I/O, Manipulators, File stream, C++ File stream classes, File management functions, File modes, Binary and random files.

16 Hours

UNIT – III

Templates, Exceptions and STL: What is template? function templates and class templates, Introduction to exception, Try-catch-throw, Multiple catch, Catch all,

Rethrowing exception, Implementing user defined exceptions, Overview and use of Standard Template. **7 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2**full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

A student who successfully fulfills the course requirements will be able to

1. Explain the basic principles and features of object-oriented programming using C++ and hence analyse the given program.
2. Illustrate the concepts of functions, classes and objects using object-oriented programming with C++.
3. Illustrate the concepts of inheritance and polymorphism to write a program using C++.
4. Illustrate I/O and File management techniques using the concepts of stream classes in C++.
5. Apply the concepts of exception handling and templates to write a program using C++.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	1	1	-	-	3	1	-
CO2	2	3	-	-	-	-	-	-	1	1	-	-	3	1	-
CO3	2	3	-	-	-	-	-	-	1	1	-	-	3	1	-
CO4	2	3	-	-	-	-	-	-	1	1	-	-	3	1	-
CO5	3	-	-	-	-	-	-	-	1	1	-	-	3	1	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. E Balagurusamy, **"Object Oriented Programming With C++"**, TMH, 3rd Edition.

REFERENCE BOOKS:

1. Robert Lafore, **"Object Oriented Programming in Turbo C++"**, Galgotia publishers.
2. Bjarne Stroustrup , **"Programming Principles and Practice Using C++"**, Addison-Wesley.

NPTEL/ MOOC Link:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-096-introduction-to-c-january-iap-2011/
2. https://www.coursera.org/learn/c-plus-plus-a
3. https://www.coursera.org/learn/c-plus-plus-b

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PROJECT MANAGEMENT			
Course Code	**21ECE235**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to

1. Understand key concepts of project management and project lifecycle.
2. Practice the key stages of managing projects.
3. Develop increased awareness of available resources to further develop project management skills.
4. Understand how to apply new knowledge to their own projects and set realistic goals for moving forwards.

UNIT – I

Introduction: Characteristics of project, Neat types and forms. Systems approach: Concepts project as a system, design algorithm.

Project organization: Formal and informal organization, Forms of organization of structures, Project organization, Matrix organization, Pure project organization, Selection of structures. **15 Hours**

UNIT – II

Work definition: Planning, work break down, Responsibility integration with organizational structure detailed project plan.

Project scheduling: Activities, Events Gantt charts network scheduling pert, CPM resource constraints.

Project costing: Estimation and budgeting, Project cost, account systems cost, Schedules, Forecasting, Financial evaluation of a project, Social costs. **15 Hours**

UNIT – III

Project control and management: Phases types, Variance analysis problems, Role of project manager, Team work and leader ship.

Project termination: Varieties of project termination processes, Final report.

Computers in project management: Monitoring information, System software packages, Utility and limitations. **9 Hours**

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

At the end of the course student will be able to:

1. Explain project management and its concepts.
2. Describe project oraganizations and its structure.
3. Describe effective project execution and control techniques that result in successful projects.
4. Demonstrate a strong working knowledge of ethics and professional responsibility.
5. Describe effective organizational leadership and change skills for managing projects and project teams.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	1	1	3	-	-	-	-
CO2	3	-	-	-	-	-	-	-	1	1	3	-	-	-	-
CO3	3	-	-	-	-	-	-	-	1	1	3	-	-	-	-
CO4	3	-	-	-	-	-	-	1	-	1	3	-	-	-	-
CO5	3	-	-	-	-	-	-	1	-	1	3	-	-	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Parameshwar Iyer, "**Engineering Project Management",** Apex publication, 2001

REFERENCE BOOKS:

1. Robert Wysockietal, **"Effective Project Management",** John Wiley, 2001
2. Rory Burke, **"Project Management Planning and Control Techniques",** John Wiley, 3rd Edition, 2001
3. Jack Meredith, **"Project Management: A Managerial Approach"**, John Wiley, 5th edition 2005

PYTHON PROGRAMMING			
Course Code	**21ECE236**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives :

Upon Completing this course, the students will be able to

1. Demonstrate basic understanding of python programming language.
2. Illustrate and relate the advanced python concepts with reference to OOP concepts.
3. Build python programs for real world applications.

UNIT – I

Introduction: Getting Started with Python Programming, Running Code in the Interactive Shell, Input, Processing and Output, Editing, Saving and Running a Script, Behind the Scenes: How Python Works.

Data Types and Expressions: Data Types, String Literals, Escape Sequences, String Concatenation, Variables and the Assignment Statement, Program Comments and Docstrings, Numeric Data Types and Character Sets, Arithmetic Expressions.

Loops and Selection Statements: Definite Iteration: The for Loop, Selection: if and if-else Statements, Logical Operators and Compound Boolean Expressions, Short-Circuit Evaluation, Conditional Iteration: The while Loop, Loop Logic, Errors, and Testing.

14 Hours

UNIT – II

Strings and Text Files: The Structure of Strings, The Subscript Operator, Slicing for Substrings, Strings and Number Systems conversion from one form to another, Text files(reading and writing text/numbers from/to a file).

Lists and Dictionaries: Lists literals and basic operators, Search, Replace, Insert element from List, Tuples, Defining simple functions, Dictionary literals, adding/accessing/removing keys, Traversing dictionaries.

Design with Functions: Functions as Abstraction Mechanisms, Functions Eliminate Redundancy, Functions Hide Complexity, Design with Recursive Functions.

14 Hours

UNIT – III

Design with Classes: Getting Inside Objects and Classes, Structuring Classes with Inheritance and Polymorphism, operator overloading (_eq_,_str_, etc); abstract classes; exception handling, try block.

Introduction GUI and CGI: creating simple GUI; buttons, labels, entry fields, dialogs and fonts, Multithreading: Threads and Processes, Basics of CGI interface and its applications.

11 Hours

Scheme of SEE Question Paper

There will be **8** questions of **20** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III**.

Course Outcomes:

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

1. Explain the fundamentals of python programming. Explain and use the data types and expressions to write python programs using PyCharm.
2. Use the concepts of loops: for, if, else if and while loops for implementation of logical and mathematical expressions using PyCharm.
3. Explain strings, conversion of strings to numbers, lists, tuples and dictionaries for writing python programs using PyCharm.
4. Apply the concepts of functions using PyCharm.
5. Determine the attributes and behaviour of classes required by a python program; Design a Graphical User Interface using Tkinter.

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	1	-	-	3	-	-
CO2	3	-	-	-	1	-	-	1	-	1	-	-	3	-	-
CO3	3	-	-	-	1	-	-	1	-	1	-	-	3	-	-
CO4	3	-	-	-	1	-	-	1	-	1	-	-	3	-	-
CO5	3	-	-	-	1	-	-	1	-	1	-	-	3	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOK:

1. Kenneth A. Lambert, **"The Fundamentals of Python: First Programs",** 2012, Cengage Learning.

REFERENCE BOOKS:

1. Mark Lutz, **"Learning Python",** 5th Edition, O'Reilly 2013.
2. Paul Barry, **"Head First Python"**, 2nd Edition, O'Reilly 2016..
3. Zed A. Shaw, **"Learn Python the Hard Way"**, 3rd Edition, Addison Wesley 2013.

NPTEL/ MOOC Link:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016
2. https://www.coursera.org/learn/python
3. https://nptel.ac.in/courses/106/106/106106182/ (Joy of Computing with Python, IIT Ropar)

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OPEN ELECTIVE (VI Semester) - 2023-2024

Sl. No.	Code	Name
1.	21MA8X02	Linear Algebra (for all except CS, IS, EC, CCE & AIML)
2.	21HU8X03	Intellectual property rights (for all)
3.	21CV8X07	Environment Impact Assessment (for all except Civil)
4.	21ME8X08	Industrial Pollution Control (for all except Mechanical)
5.	21HU8X24	Professional and Cognitive Communique (for all)
6.	21ME8X28	Operations Management and Entrepreneurship (for all except Mechanical)
7.	21IS8X38	Introduction to Python Programming (for all except CS & IS)
8.	21BT8X40	Bio Fuel Engineering (for all except BT)
9.	21BT8X42	Solid Waste Management (for all except BT & Civil)
10.	21EC8X59	PCB Design (For all except E&C)
11.	21ME8X63	Innovation & Entrepreneurship (for all)
12.	21HU8X68	Introduction to Yoga (The classes will be conducted from 7.00 a.m. to 8.00 a.m. Those who are willing to come at 7.00 a.m. should only register)
13.	21HU8X70	Overview of Indian Culture and Arts (for all)
14.	21HU8X71	Principles to Physical Education (The classes will be conducted from 5.30 p.m. to 6.30 p.m. Those who are willing to come at 5.30 p.m. should only register)
15.	21HU8X72	Introduction to Japanese language (Students with no backlogs, CGPA should be above 7.0 & who opt to get placed in Japanese companies in Japan/India are eligible to register)
16.	21HU8X74	Introduction to German Language (for all)
17.	21ME8X75	Sustainable Development Goals (for all)
18.	21IS8X76	Web Technologies (for all except CS & IS)
19.	21CS8X77	Programming in Java (for all except EC,CS & IS)
21.	21CS8X78	Data Structures & Algorithms (for all except EC,CS & IS)
21.	21EE8X79	Electric Vehicle Technology (for all except EE)
22.	21HU8X81	National Cadet Corps: Organization, Functions & Capabilities (for only NCC Cadet Students)
23.	21EC8X82	Fundamentals of Image Processing – a practical approach (Only for CV, ME & BT)
24.	21HU8X86	Introduction to Yakshagana (for all - who are familiar with kannada Language)
25.	21ME8X88	Marketing Management (for all except Mechanical)

LINEAR ALGEBRA			
Course Code	**21MA8X02**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Understand the concepts of vectors, bases.
2. Determine the kernel, range, rank, and nullity of a linear transformation and apply them suitably in their field of study.
3. Find the canonical forms and appraise its importance in various fields.
4. Make use of Gram-Schmidt process to produce an orthonormal basis.
5. Learn the concepts of singular value decomposition and PCA.

UNIT - I

Vector spaces

Vector spaces, subspaces, bases and dimensions, coordinate vecotrs, null spaces and column spaces of the matrices.

Linear Transformations

15 Hours

UNIT - II

Canonical Forms

Review of characteristic values, similarity of matrices, Cayley Hamilton theorem, annihilating polynomials, invariant subspaces, Jordan and rational canonical forms.

Inner Product Spaces

Inner products; inner product spaces, orthogonal sets and projections, Gram-Schmidt process, QR-factorization, Least-squares problems.

15 Hours

UNIT - III

Symmetric Matrices and Quadratic Forms:

Diagonalization, quadratic forms, constrained optimization, singular value decomposition and principal component analysis. Applications to linear recurrence relations.

09 Hours

Course Outcomes: At the end of the course student will be able to

1.	Interpret vectors in two and three-dimensional spaces both algebraically and geometrically.
2.	Analyze the concept of a linear transformation as a mapping from one vector space to another and be able to calculate its matrix representation with respect to standard and nonstandard bases.
3.	Understand the concepts of Jordan and rational canonical forms.
4.	Make use of Gram-Schmidt process to produce an orthonormal basis and also able to use least square approximation method to obtain the solution of ill conditioned system.
5.	**Apply techniques of constrained optimization singular value decomposition and PCA for problems arising in various engineering fields.**

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2										
CO2	2	2										
CO3	3	1										
CO4	3	2										
CO5	3	2										

1: Low 2: Medium 3: High

Mode of Teaching and Learning:
Class room teaching. Use of mathematical softwares (such as MATLAB, MATHEMATICA, SAGE, ETC.) as teaching aid.

Assessment Details (both CIE and SEE)	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student must obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.	
Continuous Internal Evaluation:	
1.	Methods recommended: Two Tests (80%), Written Quiz (10%) and module assignments (10%).
2.	The class teacher must decide the topic for closed book test and Written Quiz. In the beginning only teacher must announce the methods of CIE for the subject.
Semester End Examination:	
	There will be **8** questions of **21** marks each in the question paper categorized into **3 Units** as per the syllabi & contact hours. The student will have to answer **5** full questions, selecting **2** full questions each from **Unit - I** & **Unit – II** and **1** full question from **Unit – III**.

TEXTBOOKS:	
1.	**Kenneth Hoffman and Ray Kunze, "Linear Algebra," 2nd edition, Pearson Education (Asia) Pte. Ltd, 2104.**
2.	David C.Lay, "Linear Algebra and its Applications",3rd edition, Pearson Education (Asia) Pte. Ltd, 2105.
REFERENCE BOOKS:	
1.	M. Artin , Algebra Prentice Hall of India.2104.
2.	Gilbert Strang, "Linear Algebra and its Applications", 4th edition, Thomson Learning Asia, 2103.
3.	Bernard Kolman and David R. Hill, "Introductory Linear Algebra with Applications", Pearson Education (Asia) Pte.Ltd 7th edition ,2103.
4.	Sheldon Axler, "Linear Algebra Done Right", Springer International Publication, Third Edition,2115.

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INTELLECTUAL PROPERTY RIGHTS

Course Code	**21HU8X03**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Learning Objectives:

1.	Understand the creativity component in intellectual property, different types of legal protection of intellectual properties and other basic concepts of Intellectual property.
2.	Analyze different types of protection for inventions, different types of agreements and treaties for Intellectual properties with an ability to examine patent types, specifications and patent search and database for 'prior art'.
3.	Understand the basic procedure of drafting claims, apply for patents, other legal forms of intellectual property rights and also to examine the protocol involved in protection of inventions like patents.

UNIT - I	
Introduction to Intellectual Property Invention and Creativity - Intellectual Property (IP) – Importance, Jurisprudential definition and concept of property, rights, duties and their correlation; History and evaluation of IPR – like Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications.	8
Agreements and Treaties History - General Agreement on Trade and Tariff (GATT). Indian Position vis-a-vis WTO and Strategies; TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities – Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments – Patent (Amendment) Rules, 2117	8
UNIT - II	
Basics of Patents and Concept of Prior Art Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in the context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, WIPO, IPO, etc.)	8
Patent filing procedures National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Structure of Patent document, Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies	8
UNIT - III	
Case Studies: Patents: Biological Cases - i) Basmati rice ii) Turmeric iii) Neem; Non-biological cases – (i) TVS V/S Hero, (ii) Samsung V/S Nokia – Copyright and related rights – Trade Marks – Trade secrets - Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition; Technology transfer and license agreements (US anti-HIV drug license to Africa)	7

Course Outcomes: At the end of the course student will be able to

1.	Have a General understanding of the Intellectual Property Rights.
2.	Have awareness of different forms of intellectual property rights, national and international IPR related legislations.
3.	Have a general understanding about the provisions, privileges and limitations of intellectual property right holders with an understanding of the legal aspects (civil or criminal) of the use of intellectual property rights.
4.	Acquire Knowledge of National and International Trade Agreements and Agencies functioning in relation to intellectual property rights
5.	Be aware and have a general understanding of patenting procedures and licensing.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
CO1		3	3	2		3			2	2		3		
CO2	2	2	3			3		3	1	1	2	2		
CO3	2			2		3			2	2	2	3		
CO4			1	1		3			1	2		3		
CO5	3	2	1			3			3	1		2		

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2107
2.	Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2107
3.	Subbaram N.R. "Handbook of Indian Patent Law and Practice", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
4.	Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1794.
5.	Intellectual Property Today: Volume 8, No. 5, May 2101,
6.	WTO and International Trade by M B Rao. Vikas Publishing House Pvt. Ltd.
7.	Correa, Carlos M. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and

	policy options, Zed Books, New York 2100
8.	Wadehra, B. L. Law relating to patents, trademarks, copyright designs & geographical indications 2 ed. Universal Law Publishing 2100
9.	Sinha, Prabhas Chandra Encyclopedia of Intellectual Property Rights, 3 Vols. Eastern Book Corporation, 2106.
10.	"Practical Approach to Intellectual Property Rights"; Rachna Singh Puri and Arvind Vishwanathan, I. K. International Publishing House Pvt. Ltd.
E-RESOURCES:	
1.	http://www.w3.org/IPR/
2.	http://www.wipo.int/portal/index.html.en
3.	http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
4.	www.patentoffice.nic.in
5.	www.iprlawindia.org/

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ENVIRONMENTAL IMPACT ASSESSMENT			
Course Code	**21CV8X07**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Identify the need to assess and evaluate the impact of projects on environment.
2. Explain major principles of environmental impact assessment.
3. Understand the different steps within environmental impact assessment.
4. Appreciate the importance of EIA for sustainable development and a healthy environment.

UNIT – I

Evolution of EIA: Concepts of EIA, EIA methodologies (Adhoc, Network Analysis, Checklists, Map overlays, Matrix method), Screening and scoping, Rapid EIA and Comprehensive EIA, General Framework for Environmental Impact Assessment, EIA Specialized areas like environmental health impact assessment, Environmental risk analysis.

16 Hours

UNIT - II

Baseline data study, Prediction, and assessment of impacts on physical, biological, and socio-economic environment, Legislative and environmental clearance procedures in India, Public participation, Resettlement, and rehabilitation.

10 Hours

UNIT – III

Fault free analysis, Consequence Analysis, Introduction to Environmental Management Systems, Environmental management plan-Post project monitoring Environmental Audit: Cost Benefit Analysis, Life cycle Assessment. Case studies on project, regional and sectoral EIA.

13 Hours

Course Outcomes:

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

1. Understand phenomena of impacts and know the impact quantification of various projects in the environment.
2. Liaise with and list the importance of stakeholders in the EIA process.
3. Know the role of public in EIA studies.
4. Overview and assess risks posing threats to the environment.
5. Assess different case studies/examples of EIA in practice.

Course Articulation Matrix :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1				2	3	2					2	3	
CO2	1	1				2	3	2					2	3	
CO3	1	1				2	3	2					2	3	
CO4	1	1				2	3	2		3			2	3	
CO5	1	1		3		2	3	2				3	2	3	

Note:- 1:Low 2:Medium 3: High

TEXTBOOKS:

1. Noble, L. 2110. Introduction to environmental impact assessment. A Guide to Principles and Practice. 2nd edition. Oxford University Press, Don Mills, Ontario.
2. Larry W. Canter, Environmental Impact Assessment, McGraw Hill Inc. Singapore, 1996

ADDITIONAL REFERENCE MATERIALS

1. Morris and Therivel, 2109. Methods of Environmental Impact Assessment, 3rd edition. New York, NY: Routledge.
2. Hanna, K.S. 2109. Environmental impact assessment. Practice and Participation. 2nd edition. Oxford, University Press, Don Mills, Ontario.

NPTEL SOURCES

http://nptel.ac.in/courses/121108004/
http://nptel.ac.in/courses/121108004/module3/lecture3.pdf

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INDUSTRIAL POLLUTION CONTROL			
Course Code	**21ME8X08**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives: This Course will enable students to,	
1	Know the Consequences of pollution, relationship between man and environment over the last few decades, necessity of modern awareness on pollution and how carbon audit can help in developing a carbon strategy.
2	Identify the Importance of Meteorology in pollution control and global warming, various types of plume dispersions and its effect; analyze various levels of plume height for different pollutants.
3	Distinguish Particulates and fly ash separation techniques such as cyclone separator, electrostatic precipitator efficiency calculations etc.
4	Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants.
5	Summarize the Effects of water, soil, plastics and odor pollution their control techniques, Different Pollution Control Acts, Legal aspects of pollution control and how these acts can help in bringing down the pollution rate.

UNIT - I

Introduction to Pollution

Man and the environment, types of pollution and its consequences, Changing environmental management concept, sustainable industrial growth, carbon audit, Ill effects of various pollutants, permissible concentration levels & AQI.

Meteorology

Meteorology, Wind rose, Lapse rate, plume dispersion studies & Numerical problems

15 Hours

UNIT - II

Separation techniques

Different types of Particulates, Need for Separation techniques, Sources of Particulates Matter Fly Ash Electrostatic precipitator (Problems) Theory of settling processes (Design Problems), Bag House fabric filter Cyclone separator Spray Tower Scrubbers & Venturi Scrubber

Smoke and gaseous pollutants

Smoke- White, blue and black smoke, Sources of smoke, T,T,T-O Principle of smoke Measurement of stack smoke intensity using Ringlemann Chart and Smokescope &
Bosch Smoke meter, Domestic and Industrial Incinerators-Design factors, Pollutant gaseous So2, Co, UBHC, Nox their ill effects and & control methods..

15 Hours

UNIT - III

Water, soil, noise, and odor pollution, their control methods, problems associated with nuclear reactors, Legal aspects of pollution control in India, brief details of Euro and BS standards. **9 Hours**

Course Outcomes:

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

CO 1	Identify the various types of pollutants and distinguish between them with regards to Particulate matters and AQI.
CO 2	Outline the instruments for Meteorological measurements, distinguish types of plume dispersions and its effect; analyze the concentration of various gaseous pollutants from T-Z diagrams.
CO 3	Explain the Particulates and fly ash separation techniques, compare and Interpret their efficiency.
CO 4	Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants
CO 5	Identify Effects of water, soil, plastics and odor pollution on environmental Pollution and explain the Legal aspects of pollution control.

TEXTBOOKS:

1. "Environmental Pollution Control Engineering, *Wiley Eastern Ltd.*,
2. "Introduction to Environmental Engineering & Science", Gilbert M Masters, PHI,1995
3. "Environmental Pollution Control Engineering, *C. S RAO New Age Int.*

REFERENCE BOOKS:

1. *"Air Pollution"*, Henry C. Perkins, Mc-Graw Hill, 1974.
2. *"Air Pollution control"*, W. L. Faith, *John Wiley*

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/105106119/36

Course Articulation Matrix

Course Code / Name : 21ME8X08/ Industrial Pollution Control														
Course Outcomes (CO)	**Program Outcomes (PO)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-21ME8X08.1	2								1	1		1		
C-21ME8X08.2	2								1	1		1		
C-21ME8X08.3	2								1	1		1		
C-21ME8X08.4	2								1	1		1		
C-21ME8X08.5	2								1	1		1		

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **8** questions of **21** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I** & **Unit – II** and **1** full question from **Unit – III**.

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PROFESSIONAL & COGNITIVE COMMUNIQUÉ

Course Code	**21HU8X24**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Learning Objectives:

1.	To Problematize Commonsense & Apply Critical thinking skills
2.	Comprehend etiquettes and manners in different situations
3.	Be gender sensitive in both offline and online behavior
4.	Exhibit better comprehension of the social implications of human body
5.	Understand the importance of reading and writing skills

UNIT - I

Common sense and Emotional Intelligence Common sense, Commonsensical Consensus, Critical thinking, Unsettling commonsensical Consensus, Role of language in Common sense and Critical Thinking; Nature & Functions of Emotional Intelligence, Emotions, Intelligence and Creativity, Growth of Emotional Intelligence	15
Etiquettes & Workplace Etiquette, Workplace Etiquettes, Workplace Readiness Skills, Significance of Cross-Cultural Understanding; Cultural Sensitivity, Impact of social media in Workplace	

UNIT - II

Social Networking Sites and its Impacts Emergence of social media, Impact on Gender and Self Representation, Regulatory and Liberatory aspects of social media, Offline Norms & Online Behaviour	15
Gender and Body Gender & Sex, Genderization, Homogeneity and Heterosexuality, Gender Expressions, Gender Schooling, Representations of Body, Objectification, Gender Perspectives of Body, Different Ways of Seeing the Body, Discipline & Coercion, ISA & RSA	

UNIT - III

Writing Types of Writing, Note Taking Methods, Plagiarism **Reading** Styles of Reading, Types of Reading,Scanning, Skimming	9

Course Outcomes: At the end of the course student will be able to

1.	Problematize Commonsense & Apply Critical thinking skills
2.	Comprehend etiquettes and manners in different situations
3.	Be gender sensitive in both offline and online behavior
4.	Exhibit better comprehension of the social implications of human body
5.	Understand the importance of reading and writing skills

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
CO1		3							3	3		3		
CO2		2						3	2	3		2		
CO3		3							2	2		3		
CO4		3							2	2		3		
CO5		2							3	3		2		

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Geetha.V. Gender. Kolkatta: Web Impressions, 2109.
2.	Bailey, Jane, et al. "Negotiating with Gender Stereotypes On Social Networking Sites: From "Bicycle Face" to Facebook." Journal of Communication Enquiry 37.2 (2113): 91-112.
3.	Barry, Peter. Beginning Theory. New Delhi: Viva Books, 2110.
4.	Berger, John. Ways of Seeing. London: Penguin Books, 1977.
5.	Cranny-Francis, Anny, et al. Gender Studies: Terms and Debates. New York: Palgrave Macmillan, 2103.
6.	Gauntlett, David. Media, Gender and Identity: An Introduction. London: Routledge, 2108
7.	Pilcher, Jane, and Imelda Whelehan. 50 Key Concepts in Gender Studies. London: Sage, 2104. Print.
8.	Jeanne, Haraway Donna. Simians, Cyborgs, and Women. London: Free Association Books, 1991. Web.
9.	Koskela, Hille. "Webcams, TV Shows and Mobile Phones: Empowering Exhibitionism." Surveillance & Society 2.3 (2104): 199-215.Web.

E-RESOURCES:

1.	http://www.cyberpsychology.eu/view.php?cisloclanku=2109061501/ >.
2.	http://www.surveillance-and-society.org/articles2(2)/webcams.pdf
3.	http://eprints.rclis.org/19790/>.

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OPERATIONS MANAGEMENT & ENTREPRENEURSHIP

Course code	**21ME8X28**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**(3:0:0)**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives: This Course will enable students to,

1	Define production/operations management, Classify Production and service system and different type of production systems, Understand the importance of CRM and ERP
2	Appreciate the importance of Quality tools and methods in operations management
3	Analyze the data draw variable process control charts and determine process capability; Understand salient issues concerning reliability
4	Understand the issues related to entrepreneurship, characteristics of an entrepreneur and different studies carried out during project appraisal.
5	Identify and differentiate the different national and state level funding agencies.

UNIT – I

Introduction to Production/ Operations Management: Concept of production, Classification of production systems, Production Management, Concept of operations, Distinction between Manufacturing Operations and Service Operations, Objectives of Operations Management (Customer Service and Resource utilization/ Competitive advantage through Quality-Delivery-Cost), Scope of Operations Management. Introduction to

Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP).

7 Hours

Introduction to Quality Concepts: The Meaning of Quality and Quality Improvement, Key dimensions of Quality, Concept of cost of quality. Customers' perception of quality.

TOTAL Quality Management: Definition, Principles of TQM, Gurus of TQM, Benefits of TQM.

Managing Quality: Quality circles, Continuous Improvement- Juran's Trilogy, PDSA cycle, Kaizen, 7 QC tools,

Philosophy of statistical process control and modeling process quality: Normal distribution tables, Finding the Z score, Central limit theorem, Chance and assignable causes of variation, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, warning limits)

9 Hours

UNIT – II

Control charts for variables: Control Charts for X-Bar and R- Charts, Type I and Type II errors, Simple Numerical Problems,

Process capability: The foundation of process capability, Natural Tolerance limits, c_p – process capability index, c_{pk}, p_p – process performance index, summary of process measures. Numerical problems. Concept of Six sigma.

Introduction to reliability, Mean time to failure, Mean time between failures, Bath tub curve, Reliability of series and parallel systems, Numerical problems on the above topics.

8 Hours

Entrepreneurship: Concept of Entrepreneurship, Stages in entrepreneurial process, Role of entrepreneurs in Economic Development, Barriers to Entrepreneurship, Meaning of Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneur - an emerging Class.

Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

Application of Operations Management concepts in Facility/ Business Location: General procedure for making locations decisions, Numerical Problems on application of Breakeven analysis and Transportation method to make location decisions.

8 Hours

UNIT – III

Small scale industries: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI, Government policy towards SSI; Different Policies of SSI, Impact of Liberalization, Privatization, Globalization on SSI. Effect of WTO/GATT on SSI, Supporting Agencies of Government for SSI, Ancillary Industry and Tiny Industry (Definition Only)

Institutional Support: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.

7 Hours

Course Outcomes (CO)

CO 1	Differentiate production and service systems. Discuss continuous and intermittent production systems with their advantages and disadvantages. Discuss CRM and ERP systems.
CO 2	Discuss Total Quality Management tools and methods. Solve problems on fundamentals of statistics and normal distribution.
CO 3	Draw and Analyze variable process control charts and determine process capability. Calculate reliability of series and parallel systems using the information on failure rate and time.
CO 4	Discuss entrepreneurship, characteristics of an entrepreneur and barriers to entrepreneurship. Discuss the elements of a project report and feasibility studies conducted in the project appraisal.
CO 5	Identify and differentiate the national and state level funding agencies. Discuss the effect of GATT and WTO on Indian economy.

TEXTBOOKS:

1. **Production / Operations Management**, Joseph G Monks, McGraw Hill Books
2. **Production and Operations Management**, William J Stevenson, Tata McGraw Hill, 8th Edition.
3. **Statistical Quality Control**: RC Gupta, Khanna Publishers, New Delhi, 2105.
4. **Total Quality Management**: Dale H. Besterfield, Pearson Education, 2103.
5. **Dynamics of Entrepreneurial Development & Management** – Vasant Desai – Himalaya Publishing House
6. **Entrepreneurship Development** – Poornima.M.Charantimath – Small Business Enterprises – Pearson Education – 2106 (2 & 4).

REFERENCE BOOKS:

1. **Statistical Quality Control:** E.L. Grant and R.S. Leavenworth, 7th edition, McGraw- Hill publisher.
2. **Statistical Process Control and Quality Improvement:** Gerald M. Smith, Pearson Prentice Hall. ISBN 0 – 13-049036-9.
3. **Statistical Quality Control for Manufacturing Managers:** W S Messina, Wiley & Sons, Inc. New York, 1987
4. **Statistical Quality Control:** Montgomery, Douglas, 5th Edition, John Wiley & Sons, Inc. 2105, Hoboken, NJ (ISBN 0-471-65631-3).
5. **Principles of Quality Control:** Jerry Banks, Wiley & Sons, Inc. New York.
6. **Entrepreneurship Development** – S.S.Khanka – S.Chand & Co.

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/110105067/
2. https://www.edx.org/course/operations-management-iimbx-om101-1x

Course Articulation Matrix

Course Code / Name: 18ME8X28/ Operations Management & Entrepreneurship															
Course Outcomes (CO)	**Program Outcomes (PO)**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C-21ME8X28.1	3	1	0					1	1	1	1				
C-21ME8X28.2	1	2	0						1	1	3				
C-21ME8X28.3	2	2	0				1	0	1	1	3				
C-21ME8X28.4	3	1	0			1	0	1	1		2				
C-21ME8X28.5	1	1	0			1	1	1	1		3				

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **8** questions of **21** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I** & **Unit – II** and **1** full question from **Unit – III**.

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INTRODUCTION TO PYTHON PROGRAMMING			
Course Code	**21IS8X38**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Prerequisites:

Student must have fundamental knowledge of procedure-oriented programming.

Course Learning Objectives (CLOs):

At the end of the course student should be able to:

- Construct Python programs using data types and looping.
- Design object-oriented Python programs using classes and objects.
- Design useful stand-alone and CGI applications in Python.

UNIT - I

INTRODUCTION: Introduction to python, Installing Python; basic syntax, interactive shell, editing, saving, and running a script. The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages. Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation.

STRING MANIPULATIONS: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa, Binary, octal, hexadecimal numbers

LISTS, TUPLES, AND DICTIONARIES: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

15 Hours

UNIT – II

FUNCTIONS: Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions

CLASSES AND OOP: Classes, objects, attributes and methods; defining classes; design with classes, data modelling; persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block

15 Hours

UNIT – III

FILE HANDLING: Manipulating files and directories, Reading from Text Files, Writing to Text Files, Reading from Binary Files, Writing to Binary Files, Seeking Within Files, Creating and Reading a formatted file (csv or tab-separated).

GRAPHICAL USER INTERFACES: event-driven programming paradigm; creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames Simple CGI form

9 Hours

Course Outcomes:

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C8X38.1	Demonstrate the basics of Python programming like data types and looping	L2
C8X38.2	Apply the basic data structures in solving the problems	L3
C8X38.3	Experiment with usage of functions in a given problem	L3
C8X38.4	Develop Objects by creating classes and apply object-oriented features	L3
C8X38.5	Develop applications in Python using File Programming &User Interface	L3

Table: Mapping of COs to PIs, POs and BTL

Course Outcomes (COs)	Program Outcomes (POs) Addressed	Performance Indicators (PI)	Bloom's Taxonomy Level (BTL)
CO1	1,2,3	1.4.1,1.3.1,2.1.1,2.1.2,2.2.4,3.1.1	L2
CO2	1,2,3	1.4.1,1.3.1,2.3.1,3.1.1,3.2.2	L3
CO3	1,2,3	1.4.1,1.3.1,2.1.1,2.1.2,2.2.4,3.1.1,3.1.6,3.2.1,3.2.2	L3
CO4	1,2,3	1.4.1,1.3.1,2.1.1,2.1.2,2.2.4,3.1.1,3.1.6,3.2.1,3.2.2	L3
CO4	1,2,3	1.4.1,1.3.1,2.1.1,2.1.2,2.2.4,3.1.1,3.1.6,3.2.1,3.2.2	L3

Mapping Course Outcomes with Programme Outcomes:

POs COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C8X38.1	1	2	1											
C8X38.2	1	2	1										2	2
C8X38.3	1	2	2										2	3
C8X38.4	1	2	2										2	3
C8X38.5	1	2	2										2	3

(L/1=Low30%-49%,M/2=Medium50%-69%,H/3=High>70%)

TEXTBOOK:

1) Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2111, Cengage Learning, ISBN: 978-1111822705

ADDITIONAL RESOURCES:
1. Think Python. PDF is free.

SEE Question Paper Pattern:

There will be **8** questions of **21** marks each in the question paper divided into**3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I &Unit – II** and **1** full question from **Unit – III.**

BIOFUEL ENGINEERING			
Course Code	**21BT8X40**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

***Prerequisites*:** Nil
***Co-requisites*:** Nil

Course Learning Objectives:
The objective of this course is
- To learn the fundamental concepts of biofuels, types of biofuels, their production technologies.
- To learn the concepts of feedstock utilization and energy conversion technologies.

UNIT – I

LIQUID BIOFUELS
Description and classification of Biofuels; Primary biomass: Plant materials-Woody biomass, Lignocellulosic and agroindustrial by-products, starchy and sugary crops. Secondary biomass: Waste residues and co-products-wood residues, animal waste, municipal solid waste. Biomass production for fuel – algal cultures, yeasts (Lipid and carbohydrate).
Production of biodiesel: Sources of Oils – edible and non edible; Esterification and Transesterification. Free fatty acids; saponification; Single step and two step biodiesel production. Catalysts for biodiesel production – homogeneous (alkali/acidic) and heterogeneous; Lipase mediated process. General procedure of biodiesel production and purification Quality Control Aspects: GC analysis of biodiesel, fuel property measurements, ASTM (D-6751) and Indian standards (IS15607).Algal Biodiesel production.
Production of Bioethanol: Bioethanol production using Sugar; Starch and Lignocellulosic feedstocks; Pretreatment of lignocellulosic feed stock

15 Hours

UNIT – II

BIOHYDROGEN AND MICROBIAL FUEL CELLS
Enzymes involved in H_2 Production; Photobiological H_2 Production: Biophotolysis and Photofermentation; H_2 Production by Fermentation: Biochemical Pathway, Batch Fermentation, Factors affecting H_2 production, Carbon sources, Detection and Quantification of H_2. Reactors for biohydrogen production.
Microbial Fuel cells: Biochemical Basis; Fuel Cell Design: Anode & Cathode Compartment, Microbial Cultures, Redox Mediators, Exchange Membrane, Power Density; MFC Performance Methods: Substrate & Biomass Measurements, Basic Power Calculations, MFC Performance: Power Density, Single vs Two-Chamber Designs, Wastewater Treatment Effectiveness; Advances in MFC.

15 Hours

UNIT – III

RECOVERY OF BIOLOGICAL CONVERSION PRODUCTS

Biogasification of municipal solid waste: Anaerobic processing; Types of digesters, Biogas plant in India.

Thermochemical processing: Planning an incineration facility, Incineration technologies: Mass burning system; Refuse derived fuel (RDF) system; modular incineration; Fluidized bed incineration; energy recovery; Fuel production through biomass incineration, Pyrolysis and gasification, hydrothermal processing.

9 Hours

Course Outcomes:
At the end of this course, student should be able to:

1. Mark the significance of biofuels and raw materials and Identify suitable feedstock for production of biofuels.
2. Illustrate the production of liquid biofuels from various feed stocks.
3. Demonstrate production of biohydrogen using microbial sources.
4. Extend the concepts of microbial fuel cells towards development of specific application.
5. Understand and apply the concepts of biochemical processing to harvest energy from waste products/streams.

Mapping of POs &COs:

	PO											
CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1		M							L			
CO2		M							L			
CO3		M							L			
CO4		M							L			
CO5		M							L			

REFERENCE BOOKS:

1. Drapcho, C. M., Nhuan, N. P. and Walker, T. H. *Biofuels Engineering Process Technology*, Mc Graw Hill Publishers, New York, 2108.
2. Jonathan R.M, *Biofuels – Methods and Protocols (Methods in Molecular Biology Series),* Humana Press, New York, 2109.
3. Olsson L. (Ed.), *Biofuels (Advances in Biochemical Engineering/Biotechnology Series*, Springer-Verlag Publishers, Berlin, 2107.
4. Glazer, A. and Nikaido, H. *Microbial Biotechnology – Fundamentals of Applied Microbiology*, 2 Ed., Cambridge University Press, 2107.
5. Godfrey Boyle (Ed). *Renewable Energy- Power for sustainable future*, 3rd Ed. Oxford. 2112.
6. Ramachandran, T. V. *Management of municipal solid waste*. Environmental Engineering Series. Teri Press, 2116.

SEE QUESTION PAPER PATTERN:

Unit No.	I	II	III
Questions to ask (21 marks/Qn)	3	3	2
Questions to answer	2	2	1

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SOLID WASTE MANAGEMENT			
Course Code	**21BT8X42**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

***Prerequisites*:** Nil
***Co-requisites*:** Nil

Course Learning Objectives:
The objective of this course is

1. To learn types of solid wastes, collection, treatment and disposal methods.
2. To understand various processing techniques and regulations of treatment and disposal.

UNIT – I

INTRODUCTION TO SOLID WASTES AND ITS SEGREGATION & TRANSPORTATION

Solid waste – Definition, Sources of waste, Classification of Solid waste, Characteristics of Solid Waste (Physical, Chemical, Biological), Solid waste problems – impact on environment and health. Concept of waste reduction, recycling and reuse.

Waste collection and segregation: Solid waste generation, Onsite handling and segregation of wastes at source, Collection and storage of municipal solid wastes, Equipment used and manpower required in collection, Collection systems and routes.

Transportation: Transfer stations: types, location, maintenance, Methods and means of transportation.

15 Hours

UNIT – II

PROCESSING TECHNIQUES, RECOVERY OF RESOURCES AND WASTE DISPOSAL

Processing Techniques: Unit operations for separations and processing, mechanical and thermal volume reduction, Incineration of solid wastes – process and types of incinerators (liquid injection, rotary kiln and fluid bed), Biological processing – composting, vermicomposting, biomethanation, fermentation, Drying and dewatering of wastes.

Recovery of Resources: Heat recovery in incineration process, energy recovery and conversion of products from biological processes.

Dumping of solid wastes, Landfills – Types, site selection, preliminary design, operation, case study, Advantages and disadvantages of landfills, Leachate and landfill gases: Collection and treatment, Landfill disposal for hazardous wastes, biomedical waste.

16 Hours

UNIT – III

SOLID WASTE MANAGEMENT RULES AND PLANNING ISSUES

Legislative trends and impacts: Major legislations, Government agencies. Municipal Solid Waste Management Act (1999), Hazardous Wastes (Handling and Management) Rules, Biomedical Waste (Handling and Management) Rule (1998), e-Waste (Management and Handling) Rule 2111.

Planning and developing a site for solid waste management, Site Remediation: Assessment and Inspection, Remedial techniques, Siting guidelines.

8 Hours

Course Outcomes:

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

1. Identify the sources, classification and characteristics of solid wastes
2. Develop insight into the collection, transfer, and transport of solid waste.
3. Apply waste processing techniques and recovery of resources from the waste.
4. Select the alternatives of solid waste disposals and its impacts.
5. Acquire knowledge about solid and hazardous waste management legislative rules.

Mapping of POs & COs:

	PO											
CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1	L								L			
CO2	L	L				L	L		L			
CO3		M							L			
CO4		M				L	L		L			
CO5	L								L			L

REFERENCE BOOKS:

1. Tchobanaglous, G., Theisen, H. and Vigil, S. A. *Integrated Solid Waste Management,* McGraw – Hill. 1993.
2. Tchobanoglous, G., Thiesen, H., Ellasen, *Solid Waste Engineering Principles and Management*, McGraw – Hill, 1997.
3. Landrefh, R. E. And Rebers, P. A. Lewis, *Municipal Solid Wastes-Problems & Solutions*, 1997.
4. Bhide, A. D. and Sundaresan, B. B. *Solid Waste Management in Developing Countries*, Indian National Scientific Documentation Centre. New Delhi, 2100.

SEE QUESTION PAPER PATTERN:

Unit No.	I	II	III
Questions to ask (21 marks/Qn)	3	3	2
Questions to answer	2	2	1

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PCB DESIGN			
Course Code	**21EC8X59**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Pre-requisites:

Basic electrical and electronics engineering.

Course Learning Objectives:

1. To enable students to gain knowledge of Schematic Design techniques & PCB design techniques
2. To expose students to complete PCB Design & manufacturing process

List of Experiments

- Introduction to PCB design tool: building a schematic circuit and layout
- Exploring the PCB design tool by creating new components, using existing components and footprint, simulation features, Active & Passive Components
- Drawing a PCB layout in a single layer with constraints such as board area, track width, packages, via etc
- Creating a double layer PCB for a given schematic circuit
- Creating and using different component package types
- Fabrication of single and double layer PCB on a copper clad board using hatching/engraving technique.
- Handling PCB prototype machine using Mach3 CNC tool for the PCB prototype.

Detailed Course Plan

Lab 1
Introduction to PCB design tool : building a schematic circuit.

Lab 2
Creating Library & Components, using existing components and footprint, simulation features, Active & Passive Components.

Lab 3
Designing a single layer PCB for given schematic circuit diagram, Gerber file generation.

Lab 4
Designing a double layer PCB for given schematic circuit diagram, Gerber file generation.

Lab 5
Simulating digital and analog circuits for given test cases.

Lab 6
Handling programmable microcontroller circuit in the simulation environment of schematic editor .

Lab 7
Defining a footprint for a component in the PCB layout.

Lab 8
Fabrication of single layer PCB using PCB prototype machine – Generating bit filein Copper Cam tool.

Lab 9
Fabrication of single layer PCB using PCB prototype machine – Setting up Mach3 CNC tool.

Lab 10
Fabrication of double layer PCB using PCB prototype machine – Generating bit file in Copper Cam tool.

Lab 11
Fabrication of double layer PCB using PCB prototype machine -Setting up Mach3 CNC tool.

Lab 12
Component placement and soldering.

Lab 13
Desoldering and testing.

Scheme of SEE Examination
It is a 3-Hour exam at the end of the semester where the student is to demonstrate the PCB designing process.

Sl.No	Activity	Max. Marks
1	Creating schematic for a given circuit diagram	15
2	PCB Layout design	21
3	Setting up fabrication	15
Total		**50**

Course Outcomes:
At the end of the course the student will be able to
1. Draw schematic circuit and create PCB layout for single or multilayer PCB
2. Fabricate single and double-layer PCB using Mach3Mill operated CNC machine.

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INNOVATION AND ENTREPRENEURSHIP			
Course Code	**21ME8X63**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Prerequisites:
The student must have learnt basics of Engineering concepts, applications and business as a whole.

Course Learning Objectives: This Course will enable students to,

1	Understand Technological Innovation
2	Understand Innovation management and the difference between Invention and Innovation.
3	Appreciate the importance of Innovation as management process and Innovation management techniques.
4	Define Innovation system and Understand the importance of Technology management and Transfer.
5	Identify Technological Entrepreneurship and its types and Understand the Institutional support provided for Entrepreneurs

UNIT – I

INTRODUCTION TO TECHNOLOGICAL INNOVATION **14 Hours**

Basic Concepts and Definitions: Technology - Technology Management – Invention – Creativity – Innovation - The Concept of Technological Innovation - Innovation Posture, Propensity and Performance - Innovation Measurement - Key factors linking creativity and innovation – Classifications of Innovations – Innovation Process.

INTRODUCTION TO INNOVATION MANAGEMENT

Innovation Management Through Management of Knowledge and Education – Types of Learning - Difference Between Innovation and Invention - Types and Characteristics of Innovation.

INNOVATION AND COMPETITIVENESS

Case Study – Barriers for Innovation and Competitiveness.

UNIT – II	
INNOVATION AS A MANAGEMENT PROCESS	**14 Hours**
Activities to enhance companies capacity for innovation – Management of Technological Innovation: Corporate Perspective, National Perspective, Theoretical Perspective and Individual Perspective - Challenges in Technological Innovation Management - Case Study in Technological Innovation Management - Innovation Management Techniques (IMTs).	
INNOVATION SYSTEMS	
The Concept of Innovation Systems - Innovation Systems: Sectoral, Regional, National.	
TECHNOLOGY MANAGEMENT AND TRANSFER	
Technology Transfer - Impacts of MNCs in technology transfer -	
UNIT – III	
INTRODUCTION TO TECHNOLOGICAL ENTREPRENEURSHIP	**11 Hours**
Types of Entrepreneurship: Mixed Entrepreneurship, Pure Entrepreneurship, Social Entrepreneurship, Collaborative Entrepreneurship, Internal Entrepreneurship, External Entrepreneurship - Sustainable Entrepreneurship -	
INSTITUTIONAL SUPPORT	
Business Incubator (Bi) - Determination of the Five Incubator Services - Incubation Centres in India – Atal Incubation Centre – Startup India - NSIC, KIADB, KSFC.	

Course Outcomes (CO):

At the end of the course the student will be able to,	
CO 1	Describe technological innovation and its key features for business.
CO 2	Describe innovation management and difference between invention and innovation.
CO 3	Explain innovation as a management process, its management and perspectives. Understand Innovation management techniques.
CO 4	Explain innovation system, technology management and transfer.
CO 5	Explain technological entrepreneurship and institutional support.

TEXTBOOK:

1	Carayannis, Elias G., Samara, Elpida T., Bakouros, Yannis L., "Innovation and Entrepreneurship Theory, Policy and Practice", Springer, 2115.

REFERENCE BOOKS:

1	Dick Whittington, "Digital Innovation and Entrepreneurship", Cambridge University Press, 2118.

Course Articulation Matrix:

Course Code / Name : 21ME8X63/ INNOVATION AND ENTREPRENEURSHIP														
Course Outcomes (CO)	**Program Outcomes (PO)**												**PSO**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C-21ME8X63.1	3	2				1	1		1			1	3	1
C-21ME8X63.2	3	2				1	1		1			1	3	1
C-21ME8X63.3	2	2				1	1		1			1	3	1
C-21ME8X63.4	2	2				1	1		1			1	3	1
C-21ME8X63.5	3	2				1	1		1			1	3	1

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **8** questions of **21** marks each in the question paper divided into **3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I** & **Unit – II** and **1** full question from **Unit – III**.

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INTRODUCTION TO YOGA

Course Code:	**21HU8X68**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Learning Objectives:

1.	To give a brief history of the development of Yoga
2.	Identify names of different classical texts on Yoga
3.	To illustrate how Yoga is important for healthy living
4.	To explain the Asanas and other Yogic practices
5.	To explain, how Yoga practices can be applied for overall improvement

UNIT – I

Yoga: Meaning and initiation, definitions and basis of yoga, History and development, Astanga yoga, Streams of yoga.Yogic practices for healthy living. General guidelines for Yoga practices for the beginners: Asanas, Pranayama.	**09 Hours**
Classification of Yoga and Yogic texts:Yogasutra of Patanjali, Hatha yogic practices- Asanas, Pranayama, Dharana, Mudras and bandhas.	**07 Hours**

UNIT – II

Yoga and Health: Concept of health and Diseases-Yogic concept of body – pancakosaviveka, Concept of disease according to Yoga Vasistha.	**06 Hours**
Yogic concept of healthy living- rules & regulations, yogic diet, ahara, vihara. Yogic concept of holistic health.	**04 Hours**
Applied Yoga for elementary education:Personality development- physical level,mental level,emotional level. Specific guidelines and Yoga practices f**or** - Concentration development,Memory development	**04 Hours**

UNIT - III

Yoga and physical development: Mind-body, Meditation, Yogasanas and their types. Different Yoga practices and Benefits.	**05 Hours**
Specific guidelines and Yoga practices for **–** Flexibility, Stamina, Endurance (Surya Namaskara)	**04 Hours**

Course Outcomes: At the end of the course student will be able to

1.	Understand a brief history of the development of Yoga
2.	Know important practices and principles of Yoga
3.	Explain how Yoga is important for healthy living
4.	Practice meditation to improvement of concentration etc.
5.	Have knowledge about specific guidelines of yoga practices

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
CO1						1			1			1		
CO2						1			1			3		
CO3						2			1			3		
CO4						3			2			3		
CO5						2			2			3		

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	B.K.S. Iyengar, "Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority", Thorsons publisher 2116.
2.	MakarandMadhukar Gore, "Anatomy and Physiology of Yogic Practices: Understanding of the Yogic Concepts and Physiological Mechanism of the Yogic Practices", MotilalBanarsidass Publishers; 6 edition (2116).
3.	Swami SatyanandaSaraswati, "Asana, Pranayama, Mudra and Bandha: 1", Yoga Publications Trust.
REFERENCE BOOKS:	
1.	Science of Yoga: Understand the Anatomy and Physiology to Perfect Your Practice by Ann Swanson
2.	Yoga for Everyone : 50 Poses For Every Type of Body by Dianne Bondy
E Books / MOOCs/ NPTEL	
1.	https://onlinecourses.swayam2.ac.in/aic19_ed29/preview
2.	https://youtu.be/FMf3bPS5wDs

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OVERVIEW OF INDIAN CULTURE AND ART

Course Code	**21HU8X70**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Learning Objectives:

1.	To understand the relevance of Culture in Human Life, dynamism of Indian Culture and Arts through ages.
2.	To understand the local culture and its vibrancies.
3.	To develop awareness about Indian Society, Culture and Arts under Western rule.
4.	To comprehend different dimension and aspects of the Indian culture and arts.
5.	To appreciate cultural performances in India.

UNIT - I

Knowing Culture What is Culture, Different aspects of Culture, Cultural expression, Importance of Culture	7
Influence of Culture Relationship of Culture with: Language, Religion and History, Gender	7

UNIT - II

Media and Culture Role of News Papers, Indian Cinema, Music, Advertisements	7
Languages, Literature and Culture Role of Sanskrit, Vedas, Upanishads, Ramayana and Mahabharata, Puranas, other Sanskrit Literature, Buddhist and Jain Literature, Dravidian Languages and Literature, North Indian Languages and Literature, Subaltern Literature	7

UNIT - III	
Arts and Culture Indian Theatre and Performing Arts, Ritual performances, and Tuluva cultural and ritual performances.	7
(Self-study Component) **Contribution of Indian History to Culture** Ancient India – Persian and Macedonian invasions and its impact on Indian Culture, Development of Culture and Arts during the Mauryan Empire (Ashoka), the Guptas, the South Indian Dynasties – the Cholas, Nalanda as a Centre of Learning. Medieval India – Life of People under Delhi Sultanate, Rise of Islam and Sufism, Political Scene of India, Bhakti Movement, Folk Arts, Rise of Modern Indian Languages. Modern India – British Ruling and its impact on Indian Culture, Social and Religious Reforms, Indian National Movement and Achievement of Independence.	4

Course Outcomes: At the end of the course student will be able to

1.	Examine how the culture has a very important role in human life and growth of human civilization and have a general awareness on historical perspective of growth of Indian Culture and Arts.
2.	Appreciate their own local culture from an academic perspective.
3.	Know about the impact of Western Rule in India and Indian Struggle for Freedom and also its impact on Indian Culture and Arts and able to appreciate and the role of language in connecting people, growth of culture and arts beyond the barriers of religion and ages.
4.	Take interest in learning these forms of arts, and also appreciate and preserve them for the future generations feeling proud of Indian Culture, Arts and Architecture.
5.	Appreciate art performances in India which will enable them to get exposed to an artistic sphere, which eventually help them to be creative and imaginative.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
CO1		1				3		3	3	1		3		
CO2				2		3		2	3	3		3		
CO3						3		1				1		
CO4						3		2	1	2		3		
CO5						3		3	3	3		2		

1: Low 2: Medium 3: High

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PRINCIPLES TO PHYSICAL EDUCATION			
Course Code	**21HU8X71**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Appreciate and understand the value of physical education and its relationship to a healthy active lifestyle.
2. Work to their optimal level of physical fitness.
3. Show knowledge and understanding in a variety of physical activities and evaluate their own and others' performances.

UNIT - I

History of Physical Education - Olympic games, Modern Olympic games, Olympic Ideals & Objectives, Olympic Symbols, Olympic Flag, Olympic Emblem, Olympic Motto, Olympic Flame, Asian games
International Olympic Committee (IOC), Indian Olympic Association (IOA)
Sports awards - Eligibility, Objectives & Criteria
Yoga - Meaning and Importance
World Health organization (WHO)

10 Hours

UNIT – II

Concept of Health - Meaning of Health, Health Definition, Factors Affecting Health, Qualities of Healthy Person. Health Hazards of College Students, Physical Fitness and Exercises.
Food and Nutrition -Food & Nutrition Defined, Nutrients and their Functions - i) Proteins ii) Carbohydrates iii) Fats iv) Vitamins
Balanced Diet & Malnutrition

Health Education - Meaning of Health Education, Health Education Defined, Scope of Health Education, Importance of Health Education.
Posture - Concept of Posture, Correct Postures, Common Postural Defects
First Aid - First Aid Defined, Need and importance of First Aid, The Requisites of FirstAid, Scope of FirstAid, Qualities of a First Aider, Fundamental Principles to be followed and the Duties to be performed by the First Aider, First Aid in Different Cases.
Physical Education - Concept of Physical Education, Physical Education Defined, Importance of Physical Education, Scope of Physical Education, Aims and Objectives of Physical Education.
Teaching Aid in Physical Education
Competition - Introduction, Types of competition, Knock out, League or Round Robin Tournament.

12 Hours

UNIT – III

Training in Sports – Meaning, Principles, Warming Up & Limbering Down
Importance of Anatomy and Physiology in Physical Education, Oxygen Debt and Second wind
Leadership and Supervision – Leadership, Qualities of a good leader in Physical Education, Types of Leadership in Physical Education - 1. Teacher Leadership 2. Student Leadership.
Measurement & specification of various playing fields – Cricket, Volley Ball, Basket Ball, Badminton, Ball Badminton, Foot Ball, Hand Ball & their basic playing skills.

16 Hours

Course Outcomes:
At the end of the course, the student will be able to

1. Demonstrate an understanding of the principles and concepts related to a variety of physical activities.
2. Apply health and fitness principles effectively through a variety of physical activities.
3. Support and encourage others (towards a positive working environment).
4. Show self-motivation, organization and responsible behavior.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓	
↓ Course Outcomes													1	2
CO1						3			2	1		1		
CO2						3			2	1		1		
CO3						3			2	1		1		
CO4						3			2	1		1		
CO5						3			2	1		1		

1: Low 2: Medium 3: High

TEXT AND REFERENCE BOOKS:

1. A. K. Uppal, “Physical Education and Health”
2. M. L. Kamlesh, “Fundamental Elements of physical Education”,
3. Swami Ramdev, “Yog its philosophy and practice”, Divya Prakashan
4. V. K. Sharma, “Health and Physical Education”

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INTRODUCTION TO JAPANESE LANGUAGE

Course Code	**21HU8X72**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department:

Course Objectives:

1.	Have basic spoken communication skills
2.	Write Simple Sentences
3.	Listen and comprehend basic Japanese spoken Japanese
4.	Read and understand basic Japanese characters including Kanji

UNIT - I

(Lessons 1-6) **Grammar –** Introduction, Alphabets, Accents, Noun, Pronoun, Present Tense, Past tense **Vocabulary –** Numbers, Days, week days, months, Seasons, Nature, Dialogs and Video Clips	13

UNIT - II

(Lessons 7-13) Communication skills – Time, Addective, Seasons, Conversation, Q&A Hobby, 5-W/1-H, Entering School/Company, Body Parts, Colours, Features etc**.**	13

UNIT - III

(Lessons 14-21) Japanese Counting System, Birth/Death, Dialogs (Going to Party, Restaurant), My day, Success/Failure, Kanji Characters, and sentence making, Video Clips	13

Course Outcomes: At the end of the course student will be able to

1.	Understand Simple words, expressions and sentences, spoken slowly and distinctly
2.	Speak slowly and distinctly to comprehend
3.	Read and Understand common words and sentences
4.	Ask Basic questions and speak in simple sentences
5.	Write Hiragana/Katakana and Kanji (121) characters.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
CO1						3			2	1		1		
CO2						3			2	1		1		
CO3						3			2	1		1		
CO4						3			2	1		1		
CO5						3			2	1		1		

1: Low 2: Medium 3: High

INTRODUCTION TO GERMAN LANGUAGE			
Course Code	**21HU8X74**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical

Course Objectives:

1.	Distinguish - definite and indefinite articles, declension of singular and plural nouns by adding certain endings to them to differentiate between subjects, objects and indirect objects and construct sentences of simple day to day usage.
2.	Differentiate between nomnative and akkusative cases with transitive and intransitive verbs, and negation with Kein/e/er
3.	Differentiate use of dative object besides the subject for some specific verbs and Apply the grammar principles of use of personal pronoun as a substitute for noun as per the case, number and gender of the noun.
4.	Differentiate preposition forms when used exclusively in akkusative or Dative forms or on combination of the two cases
5.	Differentiate conjugation of verbs in present, present-perfect and past participle tenses, separable and inseparable verbs, application of conjugation of modal verbs and position of modal verb in a sentence.

UNIT - I

Introduction: Mein Name ist (saying who you are, greeting people and saying goodbye, asking people where they come from and where they live. Language point: I and you), Lesen der politischenKarte der Welt, Nationalitaeten und Spachen, Die Uhrzeit (The time) telling time and talking about daily routine, Tage der Woche, die Monate, die vierJahreszeiten, die Jahre Mir gehtes gut: Asking people how they are, saying how you are, saying which cities and counries people come from, Language points: verb endings), Wieschreibt man das (how do you write that?) Counting from 1-100 and above, alphabet, spelling our names and words, talking about us and them. Language points: Yes-no questions Artikel (Articles): As in English, there are definite (der/die/das) and indefinite (ein/eine) articles: the ┐ der/die/das; a/an ┐ ein/eine Die vierFälle (The four cases): Nominativ, Akkusativ, Dativ, Genitiv(Not in level A-1) Deklination des bestimmtenArtikels der/die/das Deklination des unbestimmtenArtikelsein/eine (Deklination/Declension: the variation of the form of a noun, pronoun, or adjective, by which its grammatical case, number, and gender are identified) Deklination von Substantiven (Declension of nouns) (Singular and Plural) (German nouns are declined by attaching certain endings to them, according to case, number and gender. This helps to differentiate between subjects, objects and indirect objects). Nominativ und Akkusativ(nominative and accusative cases) The verb determines the case of the noun. Some verbs only go with the nominative, others only with the accusative (or the dative). Thus, German verbs are either transitive or intransitive. (Nominative and accusative cases) Intransitive Verben (intransitive verbs) Transitive Verben (transitive verbs) Negation „kein/e/er "(negation with „kein/e/er ") (Singular und Plural) The negation of the indefinite article (ein/eine/ein) is kein/keine/kein. For this, you just have to put a „k" at the beginning of the declined form of ein/eine/ein. Peter siehteinHaus. ┐ Negation ┐ Peter siehtkeinHaus. (Peter sees a house. ┐ negation ┐ Peter does not see a house.) (With examples, writing and hearing exercises, and German to English Glossary as applicable)	13

UNIT - II

Dativ (the dative) (You are already familiar with verbs which require a direct accusative object in addition to the subject, which is in the nominative case. But there also some verbs which require a dative object besides the subject. To identify the dative object you ask "(To) whom?") Der Plural (the plural)	13

There are many different forms of the plural in the German language. Principally, the gender and the ending of the noun determine the plural form. Then, you either attach a plural ending to the noun, change a vowel, or keep the noun as it is in the singular. Das Personalpronomen (the personal pronoun) The personal pronoun is a substitute for a noun. Its forms are determined by the case, number and gender of the noun which is to be replaced. Die Formen des Personal pronomenimNominativ (The nominative forms of the personal pronoun): Präpositionen (prepositions) German prepositions are followed by an object, either in the accusative or the dative case. Some prepositions always take an accusative object, others always a dative object. But there are also prepositions which can be followed by both. In this case, the question "Where(to)?" (accusative) or "Where?" (dative) determines the case of the object. PräpositionenmitAkkusativ und Dativ (Prepositions with accusative and dative) 1. PräpositionenmitAkkusativ (prepositions with accusative) 2. PräpositionenmitDativ (prepositions with dative) 3. PräpositionenmitAkkusativoderDativ (prepositions with accusative or dative) (With examples, writing and hearing exercises, and German to English Glossary as applicable)	
UNIT - III	
Konjugation von VerbenimPräsens (Conjugation of verbs in present tense) Verbs are conjugated by attaching certain endings, depending on the person and number of the subject. Trennbare und untrennbareVerben (separable and inseparable verbs) Verbs with prefixes are dinstinguished between separable and inseparable verbs. The prefix of an inseparable verb must never be separated from the stem. Here the stress is on the stem: be-kommen. The prefix of a separable verb gets separated from the stem when the verb is conjugated. In the infinitive, the stress is on the prefix: an-kommen 1. TrennbareVerben (separable verbs) 2. UntrennbareVerben (inseparable verbs) Konjugation von VerbenimPerfekt (Conjugation of verbs in present perfect) The present perfect (Perfekt) describes something which happened in the past and is especially used in spoken German. It is formed with the present tense form of „haben" or „sein" and the past participle of the main verb. 1. Die Bildung des Partizips (the formation of the past participle) 2. Die Bildung des Perfektsmit „haben" und „sein" (the formation of the present perfect with „haben" and „sein") Modalverben (modal verbs) A modal verb is rarely used as a main verb; instead, it usually modifies the main verb. While the main verb remains in the infinitive, the modal verb is conjugated. In German, there are 7 modal verbs: können (can/be able), dürfen (may/be allowed), wollen (want), müssen (must/have to), sollen (shall), mögen (to like), möchten (wish/would like) 1. Konjugation der Modalverben (Conjugation of the modal verbs) 2. Stellung des ModalverbsimSatz (Position of the modal verb within a sentence) (With examples, writing and hearing exercises, and German to English Glossary as applicable)	13

Course Outcomes: At the end of the course student will be able to

1.	Distinguish - definite and indefinite articles, declension of singular and plural nouns by adding certain endings to them to differentiate between subjects, objects and indirect objects and construct sentences of simple day to day usage.
2.	Differentiate between nomnative and akkusative cases with transitive and intransitive verbs, and negation with Kein/e/er
3.	Differentiate use of dative object besides the subject for some specific verbs and Apply the grammar principles of use of personal pronoun as a substitute for noun as per the case, number and gender of the noun.
4.	Differentiate preposition forms when used exclusively in akkusative or Dative forms or on combination of the two cases
5.	Differentiate conjugation of verbs in present, present-perfect and past participle tenses, separable and inseparable verbs, application of conjugation of modal verbs and position of modal verb in a sentence.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
HU1502-1.1						3			2	1		1		
HU1502-1.2						3			2	1		1		
HU1502-1.3						3			2	1		1		
HU1502-1.4						3			2	1		1		
HU1502-1.5						3			2	1		1		

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Ulrich Haessermann, Georg Dietrich, Christianne C. Guenther, Diethelm Kaminski, Ulrike Woods and Hugo Zenker, Sprachkurs Deutsch Neusaffung 1, UnterrichtswerkfuerErwachsene, Verlag Moritz Diesterweg, Universitaetsdruckerei H. Stuertz AG Wuerzburg, 1989
2.	Paul Coggle and HeinerSchenke, Teach Yourself German (a complete course in understanding, speaking and writing), Teach Yourself Books, Hodden& Stoughton Educational, UK, 2101
3.	Langenscheidt German In 30 Days: Book + Cd Paperback, www.amazon.in, – 1 September 2111

REFERENCE MATERIALS:

1.	Deutsche SprachlehrefürAusländer.
2.	ThemenAktuell (Text and workbook).
3.	Deutsch alsFremdsprache 1A.
4.	Tangram Aktuell 1A/1B (Text and workbook).
5.	Wherever required the Videos/Audios are also played in the class room sessions

E-RESOURCES:

1.	https://onlinecourses.nptel.ac.in/noc21_hs30/preview NPTEL-Swayam, German-I by Prof. MilindBrahme | IIT Madras
2.	https://www.traingerman.com/en/ powered by Sprachinstitut TREFFPUNKT Online

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SUSTAINABLE DEVELOPMENT GOALS			
Course code	**21ME8X75**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

Sustainable Development Goals is a 2116 United Nations officially released Agendas for Sustainable approach environmental integrity, economic viability and a just society for present and future generations. It aims to provide the knowledge, skills, attitudes and values necessary to address sustainable development challenges. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice. Learn more and take action. This SDG program is organized in such a way to be research-led, applied interdisciplinary program that considers sustainability in both developed and developing societies, and addresses critical global challenges put forth by UN.

UNIT – I

The origin, development and idea of the SDGs

History and origins of the Sustainable Development Goals. What are the SDGs? What are their aims, methodology and perspectives? How are they related to the Millennium Development Goals?

SDGs and Society: Ensuring resilience and primary needs in society

In-depth discussion and analysis of goals related to poverty, hunger, health & well-being and education

13 Hours

UNIT – II

SDGs and Society: Strengthening Institutions for Sustainability

In-depth discussion and analysis of goals related to gender equality, affordable and clean energy, sustainable cities & communities, and peace, justice & strong institutions

SDGs and the Economy: Shaping a Sustainable Economy

In-depth discussion and analysis of goals related to work & economic growth, industry, innovation & infrastructure, inequalities, responsible production & consumption

13 Hours

UNIT – III

SDGs and the Biosphere: Development within Planetary Boundaries

In-depth discussion and analysis of goals related to clean water, climate, life below water and life on land

Realizing the SDGs: Implementation through Global Partnerships

In-depth discussion and analysis of SDG 17 which aims to implement the SDGs through partnerships, finance, technology and the development of coherence between policies.

13 Hours

Course Outcomes:

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

CO 1	Summarize the UN's Sustainable Development Goals and how their aims, methodology and perspectives.
CO 2	Analyze the major issues affecting sustainable development and how sustainable development can be achieved in practice.
CO 3	Identify and apply methods for assessing the achievement/possibilities of sustainable development in Nitte gram panchayath.
CO 4	Evaluate the implications of overuse of resources, population growth and economic growth and sustainability & Explore the challenges the society faces in making transition to renewable resource use
CO 5	Create skills that will enable students to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development.

TEXTBOOKS:

1. Sachs, Jeffrey D. The age of sustainable development. Columbia University Press, 2115
2. Gagnon, B., Leduc, R., and Savard, L., Sustainable development in engineering: a review of principles and definition of a conceptual framework. Cahier de recherche / Working Paper 08-18, 2108.
3. Dalby, Simon, et al. Achieving the Sustainable Development Goals: Global Governance Challenges. Routledge, 2119.
4. Sustainability: A Comprehensive Foundation by Tom Thesis and JonathanTomkin, Editors.

REFERENCE BOOKS:

1. Elliott, Jennifer. An introduction to sustainable development. Routledge, 2112.
2. Day, G.S., and P.J.H. Schoemaker (2111), Innovating in uncertain markets: 10 lessons for green technologies, MIT Sloan Management Review, 52.4: 37-45.

MOOC Resources:

1. https://www.un.org/sustainabledevelopment/poverty/

Course Articulation Matrix

Course Code / Name : 21ME/ SUSTAINABLE DEVELOPMENT GOALS														
Course Outcomes (CO)	**Program Outcomes (PO)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	**1**	**2**	**1**	**1**	**1**	**3**	**3**	**1**	**1**	**1**		**2**	**1**	**1**
2	**2**	**2**	**1**	**1**	**1**	**3**	**3**	**2**	**1**	**1**		**1**	**1**	**1**
3	**3**	**2**	**2**	**1**	**1**	**3**	**3**	**2**	**3**	**1**		**1**	**1**	**2**
4	**3**	**2**	**3**	**1**	**1**	**3**	**3**	**2**	**1**	**1**		**1**	**3**	**2**
5	**1**	**2**	**2**	**1**	**1**	**3**	**3**	**2**	**2**	**2**		**1**	**1**	**1**

1: Low 2: Medium 3: High

Scheme of SEE Question Paper

There will be **8** questions of **21** marks each in the question paper divided into **3 Units** as per the syllabi &contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I**&**Unit – II** and **1** full question from **Unit – III**.

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WEB TECHNOLOGIES			
Course Code	**21IS8X76**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives (CLOs):

At the end of the course student should be able to:

- Illustrate the Semantic Structure of HTML and CSS
- Compose forms and tables using HTML and CSS
- Design Client-Side programs using JavaScript and Server-Side programs using PHP
- Illustrate the Database connectivity using PHP
- Examine JavaScript frameworks such as jQuery

UNIT - I

Introduction to HTML- Html tags and simple HTML forms, web site structure, HTML table, Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colours and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

15 Hours

UNIT - II

Client side Scripting: Introduction to JavaScript: JavaScript language – declaring variables, scope of variables functions, event handlers (on click, on submit etc.), Document Object Model, Form validations. Introduction to PHP: Declaring variables, data types, arrays, strings, operations, expressions, control structures, functions, Reading data from web form controls like Text Boxes, radio buttons, lists etc.,

15 Hours

UNIT – III

PHP Databases: Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, File Handling in PHP, PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, jQuery Introduction: What is jQuery, Adding jQuery in to your web pages, jQuery Syntax, jQuery Selectors, jQuery Events.

9 Hours

Course Outcomes:

Sl. No.	Course Outcome (CO)	Bloom's Taxonomy Level (BTL)
C8X52.1	Adapt HTML and CSS syntax and semantics to build web pages	L2
C8X52.2	Construct and visually format tables and forms using HTML and CSS	L3
C8X52.3	Experiment with the usage of Event handling and Form validation using Java script	L3
C8X52.4	Understand the principles of object oriented development using PHP and Database concepts	L2
C8X52.5	Inspect JavaScript frameworks like jQuery whichfacilitates developer to focus on core features.	L2

Table: Mapping of COs to PIs, POs and BTL

Course Outcomes (COs)	Program Outcomes (POs) Addressed	Performance Indicators (PI)	Bloom's Taxonomy Level (BTL)
CO1	1,3	1.3.1,1.4.1,3.2.1,	L2
CO2	1,2,3	1.4.1,3.2.1,3.2.2,2.1.1,2.2.4,3.1.6	L3
CO3	1,3	1.4.1,3.2.1,3.2.2,3.4.3	L3
CO4	1,2,3	1.4.1,3.2.1,3.2.2,2.1.1,2.2.4,3.1.6	L2
CO5	1,3	1.4.1,3.2.1,3.2.2	L2

Mapping Course Outcomes with Programme Outcomes:

POs COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C8X52.1	1	2		2								1	2	
C8X52.2	1			2								1	2	
C8X52.3	1	2		2	3							1	2	
C8X52.4	1	2		2	3							1	2	
C8X52.5	1			2	3							1	2	

(L/1=Low30%-49%,M/2=Medium50%-69%,H/3=High>70%)

TEXTBOOK:

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1st Edition, Pearson Education India. (ISBN:978-9332575271)

E RESOURCES:

1. nptel.ac.in/courses/106105084/11

SEE Question Paper Pattern:

There will be **8** questions of **21** marks each in the question paper divided into**3 Units** as per the syllabus& contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I &Unit – II** and **1** full question from **Unit – III.**

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PROGRAMMING IN JAVA			
Course Code	**21CS8X77**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to:

1. Learn fundamental features of object oriented language and JAVA programming constructs.
2. Develop and run simple Java programs using OOPS concepts of java
3. Create multi-threaded programs and event driven Graphical User Interface (GUI) programming using swing package.

UNIT – I

Introduction to Java: Java's magic: The Byte code; Java Development Kit (JDK); the Java Buzzwords, Object-oriented programming; Simple Java programs. Data types, variables and arrays, Operators, Control Statements.

Classes, Inheritance: Classes fundamentals; Declaring objects; Call by value and Call by Reference, array of objects, Constructors, this keyword, and usage of static keyword.
Inheritance: inheritance basics, using super, creating multi-level hierarchy, method Overriding, abstract classes, final classes.

15 Hours

UNIT – II

Exception handling, packages and interfaces: Exception handling in Java, use of try, catch blocks, multiple catch blocks, finally block, use of throw and throws clauses, creating custom exceptions. Packages, Access Protection, Importing Packages, Interfaces. IO Streams for file handling.

Multi-Threaded Programming:
What are threads? How to make the classes threadable; Extending threads; Implementing runnable interface; creating multiple threads, join and is Alive methods of Thread class, Thread Synchronization; achieving thread synchronization among multiple threads. Thread priorities, methods to get and set thread priority

15 Hours

UNIT – III

Event Handling: Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model;

Swings:
The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing Applet; Jlabel and ImageIcon; JTextField; The Swing Buttons; JTabbedpane; JScrollPane; JList; JComboBox; JTable.

09 Hours

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

1. Apply the object-oriented concepts to solve real world problems using JAVA programming features
2. Illustrate the basic constructs and object orients features of the Java language
3. Design a multi-threaded program using Java with exception handling
4. Develop Java programs that includes packages and interfaces and preform file operations in Java
5. Develop simple GUI interfaces for a computer program to interact with users, and to understand the event-based GUI handling principles using swings

Table-2: Mapping Levels of COs to POs / PSOs															
COs	**Program Outcomes (POs)**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	3			2				1	1		1	2	3	
CO2	1	2	2		1				1	1		1		3	
CO3	1	2	3		1				1	1		1		3	2
CO4	1	2	3		1				1	1		1	2	3	3
CO5	1	2	3		1				1	1		1		3	3

Graduate Attributes (GA)

This course will map the following GA as per NBA:

1. Design/Development of Solutions
2. Problem Analysis
3. Modern tool usage

TEXTBOOK:

1. Herbert Scheldt, Java the Complete Reference, 7th Edition, Tata McGraw Hill, 2107. (Chapters 2-11, 22-24, 29,30)

REFERENCE BOOKS:

1. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education, 2108, ISBN:9788131721806
2. Rajkumar Buyya,S Thamarasi selvi, xingchen chu, Object oriented Programming with Java, Tata McGraw Hill education private limited.
3. Richard A Johnson, Introduction to Java Programming and OOAD, CENGAGE Learning.
4. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.

E-Books / Online Resources:

1. Online course material by Oracle :
   http://docs.oracle.com/javase/tutorial/index.html
2. https://www.udemy.com/courses/search/?q=java&price=price-free&view=grid

MOOC:

1. Oracle: *www.oracle.com/events/global/en/java.../java-a-beginners-guide-1721064.pdf*
2. NPTEL:*www.nptelvideos.com/java/java_video_lectures_tutorials.php*

SEE SCHEME:

There will be **8** questions of **21** marks each in the question paper divided into**3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit – III.**

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DATA STRUCTURES AND ALGORITHMS			
Course Code	**21CS8X78**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This course will enable students to:

1. **Outline** the concepts of data structures, its types, structures and pointers.
2. **Understand** linear data structures, namely, stack, queue, singly linked list and doubly linked list.
3. **Analyze** nonlineardata structures, namely, binary tree and graphs.
4. **Analyze** the non-recursive and recursive algorithms and to represent Efficiency of these algorithms in terms of the standard Asymptotic notations.
5. **Explain** the various algorithm design techniques and apply them to solve various real world problems.

UNIT – I

INTRODUCTION:

Data Structure, Classification (Primitive and non-primitive), data structure operations.

POINTERS:

Definition and Concepts, Accessing variables through pointers, Arrays and pointers. Structures, pointers to structures.

LINEAR DATA STRUCTURES – STACKS:

Introduction and Definition, Representation of stack: Array and structure representation of stacks, Operations on stacks using C functions (Push(), Pop(), IsStackFull(), IsStackEmpty()).

LINEAR DATA STRUCTURES – QUEUES:

Introduction and Definition Representation of Queue: Array and Structure representation of queue, Operations on Ordinary Queue using C functions (Insert(), Remove(), IsQueueFul(), IsQueueEmpty())

15 Hours

UNIT – II

LINEAR DATA STRUCTURES - SINGLY LINKED LISTS:

Dynamic Memory allocation functions. Definition and concepts singly linked List: Representation of link list in memory, Operations on singly Linked List using C functions (Insert node at front, Remove a node from front, display singly linked list).

LINEAR DATA STRUCTURES - DOUBLY LINKED LISTS:

Doubly Linked List: Representation. (Operations not included).

NONLINEAR DATA STRUCTURES – BINARY TREES:

Binary Trees: Properties, Linked representation of Binary Tree, Binary Tree Traversals, Introduction to Binary Search Tree.

INTRODUCTION TO ALGORITHMS:

What is an Algorithm? Fundamentals of Algorithmic Problem Solving, understanding and representing graphs using adjacency matrix and linked list.

FUNDAMENTALS OF THE ALGORITHMS EFFICIENCY:

Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms.

15 Hours

UNIT – III

DECREASE & CONQUER:

Concept of Decrease and Conquer, Graph traversal algorithms - Depth First Search, Breadth First Search.

DYNAMIC PROGRAMMING:

Concept of Dynamic Programming, Computing a Binomial Coefficient.

GREEDY METHOD:

Concept of Greedy technique, Prims algorithm.

BACKTRACKING:

Concept of Backtracking technique, N-Queens problem.

9 Hours

Course Outcomes:

1. **Acquire** the fundamental knowledge of various types of data structures and pointers using that knowledge, analyze and design the programs using pointers
2. **Apply** the fundamental programming knowledge of data structures to analyze and design linear data structures, namely, stack, queue, singly linked list and doubly linked list and use them for solving problems.
3. **Implement** and apply the concept of binary trees and graph data structures and also understand their traversals.
4. **Analyze** non-recursive or recursive algorithm and to represent in terms of standard Asymptotic notations.
5. **Apply** Divide and Conquer, Decrease and Conquer, Dynamic programming, Greedy, and Backtracking algorithm design techniques to solve real time problems.

Table-2: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2						1				1	3		
CO2	3	1	2					1				1	3		
CO3	3	2						1				1	3		
CO4	2	3												2	
CO5	2	2	3	2	3				1			1		3	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOKS:

1. Aaron M. Tenenbaum, Yedidyah Langsam & Moshe J. Augenstein, "Data Structures using C", Pearson Education/PHI, 2106.
2. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", 2nd Edition, Pearson Education, 2107.

REFERENCE BOOKS:

1. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd edition, Universities Press, 2114.
2. Seymour Lipschutz, "Data Structures, Schaum's Outlines", Revised 1st edition, McGraw Hill, 2114.
3. Thomas H. Cormen, Charles E.Leiserson, Ronal L. Rivest, Clifford Stein, "Introduction to Algorithms", 2nd Edition, PHI, 2106.

MOOCs:

1. Introduction to Data Structures by edx , URL: https://www.edx.org/course/
2. Advance Data Structures by MIT OCW , URL: https://www.mooclab.club/
3. Data Structure by Harvard Extension School, URL: http://www.extension.harvard.
4. http://nptel.ac.in/courses/106101060/

SEE SCHEME:

There will be **8** questions of **21** marks each in the question paper divided into**3 Units** as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **2** full questions from **Unit - I & Unit – II** and **1** full question from **Unit –III**

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ELECTRIC VEHICLE TECHNOLOGY			
Course Code	**21EE8X79**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Eligible Students: For all engineering stream except E&E Engineering

Course Learning Objectives:

1. To Understand the fundamental laws and vehicle mechanics.
2. To Understand working of Electric Vehicles and recent trends.
3. Ability to analyze different power converter topology used for electric vehicle application.
4. Ability to develop the electric propulsion unit and its control for application of electric vehicles.

UNIT – I

Vehicle Mechanics: Roadway Fundamentals, Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power, Force-Velocity Characteristics, Maximum Gradability, Velocity and Acceleration, Constant FTR, Level Road, Velocity Profile, Distance Traversed, Tractive Power, Energy Required, Nonconstant FTR, General Acceleration, Propulsion System Design.

Electric and Hybrid Electric Vehicles: Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains. **14 Hours**

UNIT – II

Energy storage for EV and HEV: Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Super capacitors.

Electric Propulsion:

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives. **16 Hours**

UNIT – III

Design of Electric and Hybrid Electric Vehicles: Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design.

9 Hours

Course Outcomes:

At the end of the course student will be able to

1. Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design.
2. Explain the working of electric vehicles and hybrid electric vehicles in recent trends.
3. Model batteries, Fuel cells, PEMFC and super capacitors.
4. Analyze DC and AC drive topologies used for electric vehicle application.
5. Develop the electric propulsion unit and its control for application of electric vehicles.

Course Outcomes Mapping with Program Outcomes & PSO												
Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
21EE8X .1	2	3										
21EE 8X .2	1	2	3									
21EE 8X .3	1	2	3									
21EE 8X .4	1	2	3									
21EE 8X .5	1	2	2									

1: Low 2: Medium 3: High

SEE QUESTION PAPER PATTERN:

- There will be **8** questions of **21** marks each in the question paper categorized into **3 Units** as per the syllabi & contact hours. The student will have to answer **5** full questions, selecting **2** full questions each from **Unit – I** & **Unit – II** and **1** full question from **Unit – III**.

TEXTBOOKS:

1. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, CRC Press, 2103
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, M. Ehsani, Y. Gao, S.Gay and Ali Emadi, CRC Press, 2105

REFERENCE BOOKS:

1. Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, Springer, 2113.
2. Modern Electric Vehicle Technology, C.C. Chan and K.T. Chau, OXFORD University, 2101
3. Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Chris Mi, M. Abul Masrur, David Wenzhong Gao, Wiley Publication, 2101

E-Books / MOOC:

1. Introduction to Mechanics | Coursera
2. NPTEL: Electrical Engineering - Introduction to Hybrid and Electric Vehicles
3. Electric Vehicles - Part 1 - Course (nptel.ac.in)
4. Hybrid Vehicles (edX) | MOOC List (mooc-list.com)
5. NPTEL: Electrical Engineering - Introduction to Hybrid and Electric Vehicles
6. Electric Cars: Technology | My MOOC (my-mooc.com)

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NATIONAL CADET CORPS: ORGANIZATION, FUNCTIONS AND CAPABILITIES

Course Code	**21HU8X81**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Chemistry

Course Learning Objectives:

1.	To create evolved youth, who will be equipped to contribute in the development of the nation.
2.	To train students so as to achieve their physical and mental endurance. To acquire body language of a smart soldier and to inculcate the sense of authority by commanding the troop under him/her.
3.	To inculcate spirit of adventure, undertake adventure activities, to hone leadership qualities and risk-taking abilities.
4.	To understand and develop life skills, soft skills and to improve the emotional quotient of the student.
5.	To impart basic military training, to develop awareness about the defense forces and expose learners to military ethos / values

UNIT – I

NCC: Aims, Objectives and Organization NCC General, Aims, Objectives and Organization of NCC. Duties of NCC Cadets, NCC Camps: Types and Conduct. National Integration: Importance and Necessity, Unity in Diversity.	7
Personality Development Self-Awareness, Empathy, Critical and Creative Thinking, Decision Making and Problem Solving. Communication Skills, Coping with stress and emotions. Leadership: Traits, Indicators, motivation, moral values, Honor Code. Social Service and Community Development.	7

UNIT – II

Naval Communication and Seamanship Naval Communication: Introduction, Semaphore, Navigation: Navigation of Ships- Basic requirements, Chart work. Seamanship: Introduction to Anchor work, Rigging Capsule, Boat work- Parts of Boat, Boat pulling instructions, Whaler sailing instructions. Ship Modeling.	8
Disaster management and environmental awareness Disaster Management- Organization, Types of Disasters, Essential Services, Assistance, Civil Defence organization. Adventure Activities. Dos and Don'ts, Fire services and Firefighting, Environmental Awareness and Conservation.	8

UNIT – III

Naval Orientation Naval Orientation- Armed Forces and Navy Capsule, EEZ Maritime Security & ICG. Border & Coastal Areas: Security setup and Boarder/Coastal management in the area. Naval Orientation: Modes of Entry- IN, ICG, Merchant Navy. Border and Coastal areas: Security Challenges & role of cadets in Border management	9

Course Outcomes: At the end of the course student will be able to

1.	Display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion.
2.	Demonstrate the sense of discipline, improve bearing, smartness, turnout and develop the quality of immediate and implicit obedience of orders, with good reflexes.
3.	Acquaint, expose & provide knowledge about Army/Navy/ Air force and acquire information about expanse of Armed Forces, service subjects and important battles.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**	
↓ Course Outcomes													1	2
HU1505-1.1						3	3	1						
HU1505-1.2						3	3							
HU1505-1.3									1					

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1. Cadets Handbook, R.K. Guptha, Ramesh Publishing House, New Delhi.

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FUNDAMENTALS OF IMAGE PROCESSING – A PRACTICAL APPROACH			
Course Code	**21EC8X82**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**2:0:1**	**SEE Marks**	**50**
Total Hours	**26:0:26**	**Credits**	**03**

Course Learning Objectives:

This course will enable the students to

1. Understand basic operations on images.
2. Understand the concepts of colour models.
3. Explain image enhancement techniques.
4. Perform morphological operations on images.
5. Perform thresholding operation for image segmentation.

Software Tool Required: MATLAB

Image Fundamentals: Description of Image and Basic operations: Image Brightening, Darkening, Addition, Subtraction, Multiplication and logic operations,Binary and Gray scale images, Color Fundamentals.

Image Enhancement Techniques: Concept & Importance of Histogram, Basic gray level transformations, Histogram processing, Basics of spatial filtering, smoothing spatial filters, sharpening filters.

Morphological Operations and Thresholding: Introduction, Erosion and Dilation, Opening and Closing, Thresholding, segmentation methods.

26 Hours

List of Experiments:

1. Introduction to MATLAB.
2. Reading and analyzing images.
3. Image Conversions.
4. Basic operations on images.
5. Basic Arithmetic operations on images- Addition, Subtraction and Multiplication.

6. Exploring Image manipulation operations.
7. Histogram processing.
8. Demonstration of Effects of Filters on images-Smoothing.
9. Demonstration of Effects of Filters on images-Sharpening.
10. Exploring different color models.
11. Demonstration of Morphological Operations.
12. Demonstration of thresholding operations.
13. Exploring image segmentation methods.

Scheme of SEE
Laboratory based evaluation

Course Outcomes:
At the end of the course the student will be able to

1. Demonstrate the understanding of basic operations on images
2. Apply image enhancement methods
3. Perform segmentation operation

Mapping of PO's/ PSO's & CO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	-	-	1	1	1	1	-	-	-	-
CO2	3	-	-	-	3	-	-	1	1	1	1	-	-	-	-
CO3	3	-	-	-	3	-	-	1	1	1	1	-	-	-	-

3 – High **2 – Medium** **1 - Low**

TEXTBOOKS:

1. R. C. Gonzalez and R. E Woods, "**Digital Image Processing**", Pearson education (Asia)/Prentice Hall of India, 3rd Edition, 2109.
2. R. C. Gonzalez and R. E Woods, "**Digital Image Processing Using MATLAB**", Pearson education (Asia)/Prentice Hall of India, 2nd Edition, 2111.
3. 1.S. Jayaraman, S Esskairajan "**Digital Image Processing**", illustrated, Tata McGraw-Hill Education,2111.

NPTEL/ MOOC Link:

1. https://nptel.ac.in/courses/117105135/
2. https://nptel.ac.in/courses/117105079

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INTRODUCTION TO YAKSHAGANA			
Course Code	**21HU8X86**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning objectives:

The course will enable the students to:

1. Gain basic understanding of Thenku Thittu Yakshagana.
2. Perform basic movements.
3. Understand speech/dialogue, rhythm, Entry and improvisation skills.

UNIT – I

Introduction: Meaning and features, Origin and development, Difference between Thenkuthittu
and Badaguthittu yakshagana. A brief introduction to Thenkuthittu Yakshagana.
Thalas-Aadi thala, yeka thala, Kore thala and Asta Thala with biditha and mukthya- Practice.
Dhingina – Practice…….

14 Hours

UNIT – II

Thalas- Rupaka Thala, Trivide Thala, Jampe thala etc. with biditha and mukthaya.
Dhigina – Practice
Rangasthala Pravesha steps and Eripada ettugade steps.
Revision of all Thalas. ……

14 Hours

UNIT – III

Yakshagana Prasanga Practice- Abhinaya and presentation……..

11 Hours

Performance: The final part of the course is the performance. A Prasanga will be chosen and taught
to the participants and they will perform the same in front of a live audience.

REFERENCE BOOKS:

1. Arthayana: Yakshagana Talamaddale Arthagarike: Ondu Vishleshane: Dr.Ramananda Banari.
2. Yaksha Naatyanjali Thenkuthittu- Sampadaka: Sathish Madivala, Karkala.
3. Yakshagna Shikshana Patya Pustka- Prathamika vibhaga (Karnatka Patya pusthaka sangha-
   Bengaluru)
4. Koralara: YakshaganaVimarsha Sankalana: Dr.M. Prabhakara Joshi
5. Vaagartha Gawrava: (Dr. Joshi Abhinandana Guchaha): Ga. Na. Bhat

MARKETING MANAGEMENT			
Course Code	**21ME8X88**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	**SEE Marks**	**50**
Total Hours	**39**	**Credits**	**03**

Course Learning Objectives:

This Course will enable students to

1. Understand and learn the marketing concepts and their application to profit-orientedand non-profit oriented organizations.
2. Able to apply the marketing concepts to analyze the buying behavior & marketing segments to solve these problems.
3. Understand and learn the need for a customer orientation in product pricing & marketing research in the competitive global business environment;
4. Able to develop an understanding and acquiring skills in how to successfully design and implement marketing plans and strategies.
5. Understand and learn the concept of sales, advertising &distribution of marketing mix and its application in traditional and novel environments characterized by emerging information technologies.

UNIT - I

BASICS

Definition, Marketing Process, Dynamics, Needs, Wants & Demands, Marketing Concepts, Environment, mix, types, philosophies, Selling Vs. Marketing, organization, Industrial Vs. Consumer Marketing, Consumer goods, Industrial goods, Product hierarchy.

8 Hours

BUYING BEHAVIOUR & MARKET SEGMENTATION

Cultural, Demographic factors, Motives, types, Buying decisions, segmentation factors, Demographic, Psychographic & Geographic Segmentation, Process, Patterns.

8 Hours

UNIT - II

PRODUCT PRICING & MARKETING RESEARCH

Objectives, pricing, Decisions and Pricing methods, Pricing Management. Introduction,Uses, process of Marketing Research.

8 Hours

MARKETING PLANNING & STRATEGY FORMULATION

Components of a marketing plan, strategy formulations and the marketing process, implementation, Portfolio analysis, BCG, GEC grids.

8 Hours

UNIT - III

ADVERTISING, SALES PROMOTION & DISTRIBUTION

Characteristics, Impact, goals, types, Sales promotion-Point of Purchase, Unique Selling proposition.

Characteristics, Wholesaling, Retailing, channel design, logistics, Modern Trends inretailing.

7 Hours

Course Outcomes (CO):

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

CO1	Explain the basic marketing concepts
CO 2	Interpret the buying behaviour of customers and role of marketing segments
CO3	Explain the role of product pricing and marketing research in the competitive global business environment
CO4	Analyse the marketing plans and strategies.
CO5	Explain the role of sales, advertising and distribution in marketing to achieve thegoals of marketing

TEXTBOOK:

1. Govindarajan. M. 'Modern Marketing Management', Narosa Publishing House,New Delhi, 1999

REFERENCE BOOKS:

1. Philip Kolter, " Marketing Management: Analysis, Planning, Implementation and Control ", 1998.
2. Green Paul.E. and Donald Tull, " Research for Marketing Decisions ", 1975.
3. Ramaswamy.V.S. and S.Namakumari, " Marketing Environment: Planning, Implementation and Control the Indian Context ", 1990
4. Jean Plerre Jannet Hubert D Hennessey Global Marketing Strategies.

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