Regulations and Curriculum for

Bachelor of Technology (B.Tech.) in Electrical and Electronics Engineering

Version 2025.Draft-1

NITTE (Deemed to be University)

(Established under Section 3 of UGC Act, 1956)
Placed under Category 'A' by MHRD, GoI | Accredited with 'A+' Grade by NAAC

Regulations and Curriculum for

Bachelor of Technology (B. Tech.)

IN

Electrical and Electronics Engineering

Choice Based Credit System (CBCS)

Effective for the batch admitted in

AY 2025-26

NITTE
(Deemed to be University)

(Deemed to be University under Section 3 of UGC Act, 1956)
(Placed under Category 'A' by MHRD, Govt. of India, Accredited with 'A+' Grade by NAAC)
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VISION

To build a humane society through excellence in the education and healthcare

MISSION

To develop
Nitte (Deemed to be University)
As a center of excellence imparting quality education,
Generating competent, skilled manpower to face the scientific and social
challenges with a high degree of credibility, integrity,
ethical standards and social concern

Regulations and Curriculum
B.Tech. Degree Programs
Choice based Credit System
(CBCS)

Effective for the batch admitted during Academic Year 2025 – 2026 and onwards

Curriculum for Acquiring Professional Skills (CAPS)

With Scheme of Teaching & Examination

REGULATIONS: 2025

COMMON TO ALL

B.Tech. DEGREE PROGRAMS

CHOICE BASED CREDIT SYSTEM

(CBCS)

Version 2025.01

Choice Based Credit System (CBCS)

1. Choice for the selection of courses during each semester.
2. Choice in planning the academic activities by selecting desired number of courses per semester.
3. Balanced curriculum with engineering, science, humanities, and management courses.
4. Project based learning (PBL) which focusses on experiential learning.
5. Opportunities to study inter-disciplinary courses.
6. Enabling slow learners by offering important courses in all semesters.
7. Optional Summer semester
8. Opportunity to get associated in research projects to acquire research experience.
9. Value addition with Honors / Minor credentials.

Curriculum for Acquiring Professional Skills (CAPS)

1. Practicing outcome-based education (OBE) where Courses made student-centric rather than teacher-centric.
2. Provisions for courses integrated with Lab/ PBL component.
3. Focus on experiential learning.
4. Ability enhancement and skill development courses as per National Education Policy (NEP) 2020.
5. Focus on Industry Internship and Research Internship.
6. Students to work on real world/interdisciplinary problems in major project.
7. Importance is given to creativity, innovation, and development of entrepreneurship skills.

Key Information

Program Title	Bachelor of Technology Abbreviated as B. Tech. Electrical and Electronics Engineering
Short description	Four-year, eight semester Choice Based Credit System (CBCS) type of Undergraduate Engineering Degree Program with English as medium of instruction.
Program Code	NMAMIT, Nitte:14ENGR—D2
	NMIT, Bangalore:14ENGR—D3
Revision version	**2025.01** These regulations may be modified from time to time as mandated by the policies of the University. Revisions are to be recommended by the Board of Studies for • Electrical and Electronics Engineering • Humanities • Mathematics • Science • Management and further approved by the Academic Council.
Effective from	01-08-2025
Approvals	Approved in the 61st Academic Council meeting of NITTE (Deemed to be University), held on 13.06.2025 and vide Notification of Registrar, N(DU) Ref: N(DU)/REG/AC-NMAMIT/2025-26/---- dated dd.mm.2025
Program offered at	1. NMAM Institute of Technology, N(DU) Off -Campus Centre, Nitte, 574110, Karkala Taluk 2. Nitte Meenakshi Institute of Technology N(DU) Off -Campus Centre, Bangalore P.B.No.6429, Yelahanka, Bangalore - 560064
Grievance and dispute resolution	All disputes arising from this set of regulations shall be addressed to the Executive Council. The decision of the Executive Council is final and binding on all parties concerned. Further, any legal disputes arising out of this set of regulations shall be limited to jurisdiction of Courts of Mangalore only

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PREAMBLE

Nitte Mahalinga Adyantaya Memorial Institute of Technology (NMAMIT), Nitte, established in 1986 and recognized by the All-India Council for Technical Education, New Delhi, is now a constituent college of Nitte (Deemed to be University), Mangaluru, since June 2022. Rank band 151-200 in the National Institutional Ranking Framework (NIRF) 2024 by Ministry of Education, Government of India, the College has been placed under 'Platinum' category for having high industry linkages by the AICTE-CII Survey of Industry-Linked Technical Institutes 2020. NMAMIT, the off-campus centre of Nitte DU located at Nitte in Karkala Taluk, has active collaborations with several international universities and organizations for faculty and student exchanges, research, internships and placements.

Nitte Meenakshi Institute of Technology (NMIT), Bangalore, established in 2001 and recognized by the All-India Council for Technical Education, New Delhi, is now a constituent college of Nitte (Deemed to be University), Mangaluru, since October 2024. NMIT is Ranked within the rank band 101-150, in the National Institutional Ranking Framework (NIRF)- 2024 by Ministry of Education, Government of India. Also, NMIT is accredited with NBA (Tier-1), accorded with 'A+' Grade by NAAC and Platinum Grade by AICTE-CII Survey of Industry-Linked Technical Institutes 2020. NMIT, the off-campus centre of Nitte Deemed to be University is located at Yelahanka, Bangalore.

NMAMIT:

The Institute offers UG engineering program in fourteen disciplines; Artificial Intelligence & Machine Learning (AIM), Artificial Intelligence & Data Science (AID), Biotechnology (BTY), Civil Engineering(CIV), Computer & Communication Engineering (CCE), Computer Science & Engineering(CSE),Computer Science (Cyber Security)(CYB), Computer Science (with minor in Full Stack Development), Electrical & Electronics Engineering (EEE), Electronics & Communication Engineering (ECE), Electronics (VLSI Design & Technology) (VDT), Electronics & Communication Engineering (ACT), Information Science & Engineering (ISE) , Mechanical Engineering(MEC) and Robotics & Artificial Intelligence (RAI). Out of these programs, seven UG programs i.e., BTY, CIV, CSE, EEE, ECE, ISE and MEC are accredited by NBA, New Delhi under Tier - I category. The institute also offers PG program M.Tech. in seven disciplines namely Construction Technology, Computer Science & Engineering, Cyber Security, Electric Vehicle Technology, Mechatronics, Structural Engineering and VLSI Design & Embedded Systems as well as MCA program. All the departments have qualified research guides for students interested in taking up research work leading to Ph.D.

NMIT:

The Institute offers UG engineering program in twleve disciplines; Artificial Intelligence & Data Science, Artificial Intelligence & Machine Learning, Aeronautical Engineering(AER), Civil Engineering, Computer Science & Business Systems(CBS), Computer Science & Engineering, Electrical & Electronics Engineering, Electronics & Communication Engineering, Electronics Engineering (VLSI Design & Technology), Information Science & Engineering, Mechanical Engineering and Robotics and Artificial Intelligence. Out of these programs, seven UG programs i.e., AER, CIV, CSE, EEE, ECE, ISE and MEC are accredited by NBA, New Delhi under Tier - I category. The institute also offers PG program M.Tech. in four disciplines namely Electric Vehicle Technology, Structural Engineering, Defence Technology and Robotics & AI as well as MCA and MBA program. All the departments have qualified research guides for students interested in taking up research work leading to Ph.D.

Curriculum: Engineering Programs

The curriculum is jointly approved by members of the Board of Studies (BoS) and Academic Council drawn from academia, Industry, Alumni, and working professionals from Industry, and has been designed to integrate hands-on practical training with the concepts of theory courses to enhance the learning experience.

The Curriculum focuses on students Acquiring Professional Skills (CAPS) through rigorous theoretical training using innovations in pedagogy, experiential learning, active learning, collaborative learning, critical thinking, project planning, Project Based Learning (PBL), Ability enhancement courses for skill-building, effective communication, professional practice, creativity & innovation and developing entrepreneurial skills.

The focus of the Institution is to impart 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 the present scenario, students wish to make plans for a bright future. However, student aspirations and industry demands are highly diverse. Employers expect the graduates possess multi-disciplinary competency, Information and Communication Technology (ICT), and leadership skills. In this context, Nitte Deemed to be University offers the opportunity to the students to select the courses of their choice and helps them in grooming to have well-rounded personalities and become industry ready.

Efforts have been made to make the syllabus compliant with international professional societies. As part of providing quality engineering education, Nitte Deemed to be University, has initiated the Choice Based Credit System (CBCS) into its academic curriculum. By this, the students can register for courses of their choice and alter the pace of learning within the broad framework of academic courses and credit requirements. CBCS allows students to plan for their academic load

and alter it as they progress in learning. Students also have the option of choosing courses from a pool of courses within each classification. Ample options are given to choose interdisciplinary courses from other programs which will help the student to develop additional skills. Slow learners will also be benefitted since important courses are offered in all semesters. This arrangement helps the students to re-register and clear the backlog courses in the subsequent semester. Suitable provisions are made for fast learners to associate them with research activities of faculty members and contribute to research beyond the working hours.

A mentor helps the student in identifying the courses to be studied in each semester based on program requirements, course prerequisites, student's interest in various disciplines, past academic performance, and courses offered by the departments.

Learning becomes more 'experiential' by carrying out labs associated with theory, mini-projects, and Project Based Learning (PBL) as a part of many courses which enhances the capability of students in understanding and apply Engineering /Technology concepts to solve real life-problems. Hence students will develop the ability to apply the gained knowledge in multi-disciplinary projects and be able to take up major projects based on real-world problems and come up with better solutions while addressing social concerns.

REGULATIONS

COMMON TO ALL B.Tech. (CBCS) DEGREE PROGRAMS OF NITTE (Deemed to be University)

1. INTRODUCTION

1.1. The general regulations are common to all B.Tech.(CBCS) Degree Programs offered by NITTE (Deemed to be University) at Nitte and Bangalore Off campuses and shall be called "B.Tech. Regulations".

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

1.3. This set of Regulations, on approval by the Academic Council and Excecutive council, shall supersede all the corresponding earlier sets of regulations of the B. Tech Degree program of NITTE (Deemed to be University) along with all the amendments thereto, and shall be binding on all students undergoing the Graduate Degree Program(s) (Choice Based Credit System) conducted at Nitte and Bangalore Off campuses 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 / Excecutive commitee from time to time and shall be binding on all stakeholders. The decisions of the Academic Council (AC) and Excecutive Council (EC) shall be final and binding.

1.4. To guarantee fairness and justice to the parties concerned given 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 Engineering courses for appropriate action, irrespective of whether a reference is made here in this set of Regulations or otherwise.

1.6. The program shall be called **Bachelor of Technology,** abbreviated as B.Tech. (Program Specialization).

2. ELIGIBILITY FOR ADMISSION

Sl. No	Program	Duration	Eligibility
1	B. Tech.	4 years	Passed 10+2 examination with Physics/ Mathematics / Chemistry/ Computer Science/ Electronics/ Information Technology/ Biology/ Informatics Practices/ Biotechnology/ Technical Vocational subject as per Table-1. Obtained at least 45% marks (40% marks in case of candidates belonging to reserved category) in the above subjects taken together.
2	B.Tech. (Lateral Entry to Second year)	3 years	Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in relevant branch of Engineering and Technology. (The University will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to prepare Level playing field and desired learning outcomes of the program).

Table-1
Academic Level and Credit Framework for admission to Bachelor of Technology (B.Tech.) degree program

Sl. No.	Academic Level	Desired Entry Qualifications at different levels.	NHEQF/ NCrF Level at Exit
1	12th Std.	-	4
2	First Year B.Tech.	12th Completed (NHEQF level 4 completed)	4.5
3	Second Year B.Tech. Degree	A candidate with a UG Certificate in Engineering or Diploma in the appropriate branch of Engineering/ Equivalent Vocational or Technical Program with NHEQF level 4.5	5

2.1. Qualifications from foreign countries

Candidates with qualifications from educational institutions outside of India may be admitted to the program(s) subject to the establishment of equivalence by the university. The Program Committee will evaluate and establish the eligibility of such candidates.

3. PROGRAM PATHS, EXIT OPTIONS, AND DURATION OF THE B. TECH. PROGRAM

3.1 Program paths, exit options.

Sl. No	Academic Level	Entry Level Qualifications	Qualifications at Exit	NCrF Level
1	1st yr. of UG Degree	A candidate completing 10+2 years with Diploma of Vocation or passed 12th std. or equivalent vocational training with NCrF level 4	**UG Certificate***	4.5
2	2nd yr. of UG Degree	A candidate with Diploma in appropriate branch of Engineering/ UG Certificate/ Equivalent Vocational or Technical Program NCrF level 4.5	**UG Diploma (Engg.) ***	5.0
3	3rd yr. of UG Degree	A candidate with 10+3+1/12+2/ UG Diploma (Engg.) in appropriate domain with NCrF level 5	**B. Sc (Engg.) ***	5.5
4	Final yr. of UG Degree	A candidate with 3 yrears' bachelor degree B.Sc. (Engg.) with NCrF level 5.5	**B. Tech (On completion of 165 credits with a minimum CGPA of 5)**	6
	Final yr. of UG Degree with Honours	A candidate with 3 yrs. Bachelor degree B.Sc. (Engg.) with NCrF level 5.5	**B. Tech (Honors)** 183 credits (Additional 18 credits over and above 165 credits in the same discipline)	6
	Final yr. of UG Degree with a minor in (Other Discipline).	A candidate with 3 yrs. Bachelor degree B.Sc. (Engg.) with NCrF level 5.5	**B. Tech with Minor** 183 credits. Additional 18 credits over and above 165 credits in other disciplines	6

*** It is mandatory to earn 4 credits through Discipline specific Internship/ Training/ Specialised courses before the award of Qualifications at Exit.**

3.2 Duration of the B. Tech. program

3.2.1 The B. Tech Program shall extend over a period of a total duration of 4 years for students admitted during the first year of the program.

3.2.2 The total duration shall be 3 years for students admitted to the second year under the lateral entry scheme.

3.2.3 The maximum period which a student can take to complete a full-time academic program is eight years / Six years for Lateral entry diploma students for B.Tech.

3.2.4 Each year shall have the following schedule with 5 ½ days a week. Suggested break down of Academic Year into Semesters.

i)	No. of Semesters / Year	There are three semesters in an academic year. • Two Main semesters (Odd, Even) followed by a summer semester. • Normally the Odd Semester will be from August to December and Even Semester from January to May during a calendar year. • The optional summer semester is offered during the vacation period of the even semester. • The summer semester is offered considering the demand for such courses of needy students, subject to the availability of time, faculty, and other resources under a fast-track mode as the available instructional days during even semester vacation periods are less. However, the number of instructional hours needed to cover the syllabi shall be maintained (equivalent to that in the regular semester) with a greater number of instructional hours per week. **Note:** The summer semester is primarily to assist slow learners and/or failed students in the main semesters. The summer semester may be used to arrange Add-On courses for other students and/or for deputing them for practical training elsewhere.
ii)	Semester Duration	Main semester (Odd, Even) each 20 Weeks; Summer Semester 8 Weeks
iii)	Academic Activities (Weeks)	**ODD / EVEN Semester** Registration of Courses & Course Work (16) Examination Preparation and Examination (04) Total (20) **Summer Semester** Registration of Courses & Course Work (05) Examination Preparation and Examination (03) Total (08) **Declaration of results:** 02 weeks from the date of the last examination **Inter-Semester Recess:** After each Main Semester (02) **Total Vacation:** 10 weeks (for those who do not register for the summer semester) and 4 weeks (for those who register for the summer semester)

Note:

- In each semester, there will be provision for students to register for courses at the beginning, dropping of courses in the middle, and withdraw from courses towards the end, under the advice of a faculty member. These facilities are expected to enhance the learning capabilities of students, minimizing their chances of failure in courses registered and ensuring their better monitoring by Faculty Advisors).
- A regular candidate shall be allowed a maximum duration of eight years from the day of admission to Ist semester to become eligible for the award of a Bachelor's degree.
- The calendar of events in respect of the program shall be fixed by the Institution from time to time, but preferably in line with the suggested academic calendar of the NITTE (Deemed to be University).

4. DEGREE PROGRAMS

4.1 Undergraduate B. Tech. Degree Programs are offered in the following disciplines by the respective program hosting departments listed below:

i)	Biotechnology	(BTY)
ii)	Computer Science & Engineering	(CSE)
iii)	Computer Science & Engineering (Cyber Security)	(CYB)
iv)	Civil Engineering	(CIV)
v)	Electronics & Communication Engineering	(ECE)
vi)	Electronics Engineering (VLSI Design and Technology)	(VDT)
vii)	Electronics & Communication (Advanced Communication Technology)	(ACT)
viii)	Electrical & Electronics Engineering	(EEE)
ix)	Information Science & Engineering	(ISE)
x)	Mechanical Engineering	(MEC)
xi)	Artificial Intelligence and Machine Learning	(AIM)
xii)	Computer and Communication Engineering	(CCE)
xiii)	Robotics and Artificial Intelligence	(RAI)
xiv)	Artificial Intelligence and Data Science	(AID)
xv)	Computer Science and Bussiness Systems	(CBS)
xvi)	Aeronautical Engineering	(AER)
Other teaching departments are –		
i)	Chemistry	(CHY)
ii)	Humanities and Social Sciences	(HSS)
iii)	Mathematics	(MAT)
iv)	Management	(MGM)
v)	Physics	(PHY)

4.2 The provisions of these regulations shall apply to any new discipline that may be introduced from time to time and appended to the above list.

5. CREDIT SYSTEM

In the Credit System, the course work of students is unitized, and each unit is assigned one credit after a student completes the teaching-learning process as prescribed for that unit and is successful in its assessment.

5.1 **Credit Definition:** The following widely accepted definition for credit can provide good flexibility to the students and strengthens CBCS under the University. Here, one unit of course work and its corresponding one credit (while referring to the main semester) shall be equal to:

- Four-credit theory courses (4-0-0) shall be designed for 60 hours of the Teaching-Learning process.
- Four-credit theory + tutorial courses (3-1-0) shall be designed for 45 Lecture hours and 15 turoriual hours of the Teaching-Learning process.
- Three-credit theory courses (3-0-0) shall be designed for 45 hours of the Teaching-Learning process.

- Three-credit theory + tutorial courses (2-1-0) shall be designed for 30 Lecture hours and 15 turoriual hours of the Teaching-Learning process
- Two-credit theory courses shall be designed for 30 hours of the Teaching-Learning process.
- Two-credit theory + Practical courses (1-0-2) shall be designed for 15 Lecture hours and 30 hours of Practical classes of the Teaching-Learning process
- One credit theory course shall be designed for 15 hours of the Teaching-Learning process.

The above figures shall also be applicable in the case of the summer semester. Other student activities which are not demanding intellectually, or which do not lend to effective assessment, like practical training, study tours, and attending guest lectures shall not carry any credit.

5.2 Credit Assignment and Lower & Upper Limits for Course Credits Registration in a Semester

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

Lecture / Tutorials / Practical:

- 1-hour Lecture per week is assigned 1.0 Credit.
- 1-hour Tutorial session per week is assigned 1.0 Credit.
- 2-hour Lab. Session/project work per week is assigned 1.0 credit.

  For example,
- A theory course with L-T-P schedule of 3-1-0 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

  Example:

  An L-T-P-C of 2-1-2-4 means 2 instructional units based on classroom lecture (L), one instructional unit of the tutorial (T), and one laboratory (P) based instructional unit all delivered during a calendar week and repeated for the entire duration of the semester to earn 4 credits (C) after passing the course.
- As advised by the faculty advisor, a student may register, between a minimum of **16 credits and up to a maximum of 28 credits.**

  The maximum number of credits a student can register during a summer semester shall be 16. However, in special cases, the student may be permitted to register additional credits with the approval of the Department Undergraduate Committee (DUGC). There is no minimum number of credits fixed for course registration during the summer semester.

6. REGISTRATION

6.1. Every student after consulting his/ her Faculty Advisor in the parent department shall register for the approved courses (core and elective) to earn credits for meeting the requirements of a 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 be allowed to register within one week of the last date by paying a late fee. Such courses together with their grade and credits earned will be included in the grade card issued by the University at the end of each semester, like ODD, EVEN, and summer and it forms the basis for determining the student's performance in that semester.

- Each course will be identified by a unique Course Code of six alpha-numerals (Three alphabets followed by 3 digits). The alphabets reflect the discipline to which the course belongs. The first numeral (after the alphabet) indicates the learning level (based on prerequisites) of the course, and the rest of the two numerals indicate a running serial number. Example: EEE101 represents the course offered by EEE Dept., Academic Level-1, course serial number is 01

6.2. Mandatory Pre-Registration for higher semester

To facilitate proper planning of the academic activities of the Semester, the students must declare their intention to register for courses of every semester (2nd Semester 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 before the last working day of the semester.

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

- Satisfied all the academic requirements to continue with the program of studies.
- Cleared all Institute, hostel, and library dues and fines, if any, of the previous semester.
- Paid all required fees of the Institute and the hostel for the current semester.
- Has not been debarred from registering on any specific grounds by the Institute.

6.3. Registering for Backlog Courses

6.3.1. Students who have not cleared a course (Theory/ Lab/ project) are shown with "F" grade. A course having an 'F' grade will be considered as a backlog and it has to be re-registered in the subsequent semesters. F-graded courses are eligible to register for the next level course (pre-requisite is met).

6.3.2. Re-registration fee will be as per the university norms existing at the time of re-registration. When a course is re-registered, the evaluation marks of that course shall be treated as canceled/ reset.

6.3.3. To provide an early opportunity for students to clear their backlog of courses, efforts will be made to offer as many courses as possible during Odd, Even and summer semesters.

7. ADD/DROP/AUDIT OPTIONS

7.1 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 the course teacher and under faculty advice. The permissible course load is to be either average credits (20) or to be within the credit limits of minimum (16) and maximum (28).

7.2 DROP-option

During a specified period in the middle of a semester student's performance in CIE is reviewed by the faculty advisor. Following a 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 are to be re-registered by these students and taken up for study in a subsequent odd / even/ summer semester.

7.3 Withdrawal from courses (Letter Grade "W")

During a specific period specified towards the end of the semester, a student's performance in CIE is reviewed by the faculty advisors. Following a poor performance by a student in the identified course (s) he/she is advised to withdraw from such course(s) (up to the minimum credits specified for the semester) with a mention in the Grade card (Grade "W"). Such courses to be re-registered by these students and taken up for study at a later point in time.

7.4 AUDIT-option (Letter Grade "U")

A student can register for courses for audit only, to supplement his/her knowledge and/or skills. The audit courses shall not be considered in determining the student's academic performance (SGPA and CGPA) in the semester. "U" grade is awarded to such courses and will be reflected in the grade card on satisfying the attendance requirements and CIE requirements. The candidate need not appear for SEE in such courses. However, CORE courses shall not be made available for audit.

8. COURSE STRUCTURE:

8.1 Types of courses

A "Course" is defined as a unit of learning that typically lasts one semester, led by one or more teachers, for a fixed roster of students. A course has identified course outcomes, modules/units of study, specified teaching-learning methods, and assessment schemes. A course may be designed to include lectures, tutorials, practical, laboratory work, field work, project work, internship experiences, seminars, self-study components, online learning modules, etc. in any combination.

The following types of courses are included in the B. Tech. program:

(a) **Humanities, Social Sciences, and Management Courses (HSMC):** These are common courses for all disciplines.

(b) **Basic Science Courses (BSC):** Physics, Chemistry, and Mathematics: These are mandatory for all disciplines.

(c) **Engineering Science Courses (ESC):** Basics of Electrical/ Electronics/ Civil/ Mechanical/ Computer Engineering, etc. These are mandatory for all disciplines.

(d) **Professional Core Courses (PCC):** These are the professional Core Courses, relevant to the chosen specialization/ branch. The core courses shall be compulsorily studied by students, and it is mandatory to complete them to fulfill the requirements of a Program.

(e) **Professional Elective Courses (PEC):** These are professional Electives, relevant to the chosen specialization/branch and can be chosen from the pool of courses. It shall be supportive to the discipline providing extended scope/enabling exposure to some other discipline /domain and nurturing student proficiency skills.

(f) **Open Elective Courses (OEC):** These are the Elective Courses from other technical areas and/ or emerging fields. Students of other departments shall opt for these courses for fulfilling the eligibility and prerequisites mentioned in the syllabus.

(g) **Integrated Professional Core Courses (IPCC):** It refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC shall be 04 considering L: T: P as 3:0:1 or L: T: P as 2:1:1, (where L, T, and P represent credits not hours per week)

(h) Emerging Technology Courses (ETC): These courses are designed to teach students about developing technologies that will be available within the next five to ten years and are expected to create significant social or economic effects.

(i) **Programming Language Courses (PLC):** These courses are designed to teach students languages that can be used to communicate with computers for developing and working on different applications.

(j) **Project Work (PRJ):** Provide experiential learning opportunities for students. Students are required individually, or in a small group, to select and complete a project that may include review, design, development, curation, analysis, etc. with the application of skills and knowledge relevant to the area of study. Project work to be carried out at the parent Institution, or any university / Government recognized organization without affecting the regular class work.

(k) **Internship (INT):** The internship (a form of experimental learning) program is a workplace-based professional learning experience that offers supervised exposure to real-life work experience in an area related to the field of study or career interest. An internship may be undertaken at a workplace such as an industry/R&D organization/Government organization, or any other reputed organization/ institution recognized for the purpose by the University. The internship program not only helps fresh pass-outs in gaining professional know-how but also benefits corporate sectors. The internship also enhances the employability skills of the student passing out from Technical Institutions.

(l) **Community Engagement (CEN):** enable students to learn about challenges faced by vulnerable households and develop an understanding of local wisdom and lifestyle in a respectful manner. It enables the students to

- Gain an understanding of rural life, Indian culture and ethos and social realities.
- Develop a sense of empathy and bonds of mutuality with the local community.
- Appreciate significant contributions of local communities to Indian society and economy.

- Learn to value the local knowledge and wisdom of the community
- Identify opportunities for contributing to community's socio-economic improvements.

(m) **Mandatory Non-Credit Courses (MNC):** These courses are mandatory, without the benefit of a grade or credit, passing each mandatory course is required to qualify for the award of a degree.

- Assessment of these courses is conducted in the college and will include Continuous Internal Evaluation (CIE). University Semester End Evaluation (SEE) may not be necessary for these courses.
- A minimum of 40% of the prescribed marks of CIE are required to secure a passing grade in these courses.
- The 'PP' grade is awarded for a Pass in the course and the 'NP' grade is awarded for a Fail in the course. In case an 'NP' grade is awarded, the student has to re-register for the same course wherein he has no alternative options.
- The "PP" and "NP" grades do not carry grade points and are 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 records (transcript) with Pass or Fail (PP or NP).
- Courses that come under this category are Employability Skill Development, Kannada etc.

(n) **Ability Enhancement Courses (AEC):** These courses are designed to help students to enhance their skills in language, communication, personality development, etc. They also promote a deeper understanding of courses like social sciences, ethics, culture, human behavior human rights, and the law. Ability Enhancement Courses are based upon the content that leads to knowledge enhancement.

8.2 Typical Breakdown for the B.Tech. Degree Curriculum:

Sl. No.	Course Category	Credit Range		Suggested Credits
1.	Basic Science Courses (BSC)	30-32		31
2.	Engineering Science Courses (ESC)	12-15	18-21	14
3.	Emerging Technology Courses (ETC)	02		02
4.	Programming Language Courses (PLC)	04		04
5.	Professional Core Courses (PCC)*	52 - 55		55
6.	Professional Elective Courses (PEC)	12-15		12
7.	Open Elective Courses (OEC)	6		06
8.	Humanities, Social Sciences and Management courses (HSMC)	12-15		14
9.	Ability Enhancement Courses (AEC)/Skill Enhancement Courses (SEC)	8-12		11
10.	Mandatory Non-credit Courses (MNC)	Non-Credit		00
13.	Project Work (PRJ)	10		10
14.	Internship (INT)	04		04
15	Community Engagement (CEN)	02		02
15.	Note: **Student can register between 16 to 28 credits per semester**			**165**
	Total minimum Credits to be earned: 165			

* Including One discipline specific vocational Skill enhancement course

8.2.1 The Department Undergraduate Committee (DUGC) will discuss and recommend the exact credits offered for the program 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 Academic Council for consideration and approval.

8.3 The earned Credit Requirements for the B.Tech. Degree is 165.

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

8.4 Suggested Program structure

8.4.1 Suggested distribution of credits for the Common B. Tech Curriculum N(DU) for Nitte and Bangalore off campuses effective from the AY 2025-26

Type of Course		Credits range		Suggested Semester Wise Credit Distribution										Total Credits	
				I	II	III	IV	V	VI	VII	VIII				
Basic Science Courses (BSC)		31		11	8	4	8							31	
Engineering Science Courses (ESC)		14		8	6									14	
Emerging Technology Courses (ETC)		2							2					2	
Programming Language Courses (PLC)		4			3+1									3	
Professional Core Courses (PCC)		52-55				15	12	12	11	8				55	
Professional Elective Courses (PEC)		12-15						3	3	6				12	
Open Elective Courses (OEC)		6						3	3					6	
Humanities, Social Sciences and Management Courses (HSMC)		14		2	1	2	1	3	2	3				14	
Ability & Skill Enhancement Courses (AEC)	Option-1	8		0	2	2	2	1	1					8	
	Option-2			1	2+1	1	1								
Foreign Language Course/Research Methodology (AEC)		3							-	3				3	
Community Engagement (CEN)		2									2			2	
Professional Practice (PRP)		14	-								14	-	14	14	
Capstone Project/ Research Project (PRJ)		-	10								-	10	14		
Internship (INT)		-	4								-	4			
Mandatory Non-credit Courses (MNC)						0		0						0	
Option-1		165		21	21	23	23	22	22	17	16			165	
Option-2				22	22	22	22								

There are two options in choosing Ability Enhancement Courses (AEC)

- NMAMIT Nitte, has chosen Option-1
- NMIT Bangalore, has chosen Option-2

8.4.2 Suggested Course Offerings

First Year: 21 credits/semester

Option-1: 21 Credits															
I/II SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT102	Matrix Algebra and Calculus	MAT	3	1	-	-	1	3	50	50	100	4
2	BSC	CHY104	Materials Chemistry for Devices and E-waste Management	CHY	3	-	2	-	2	3	50	50	100	4
3	BSC	CIV104	Environmental Science & Sustainability	CIV	2	-	-	-	1	3	50	50	100	2
4	ESC	MEC112	Elements of Mechanical Engineering	MEC	3	-	-	-	1	3	50	50	100	3
5	ESC	EEE101	Electrical Circuit Analysis – I	EEE	3	-	-	-	1	3	50	50	100	3
6	HSMC	HSS102	Universal Human Values & Professional Ethics	Any	2	-	-	-	1	3	50	50	100	2
7	BSC	BTY111	Biology for Engineers	BTY	1	-	-	-	-	1	50	50	100	1
8	ESC	CSE121	IT Skills	CSE/ Any	-	-	2	-	1	3	50	50	100	1
9	ESC	MEC122	Engineering Visualization	MEC	-	-	2	-	1	-	50	-	50	1
			Total Option-1		17	01	6	-	9	**22**	**450**	**400**	**850**	**21**
Additional Academic activities beyond class hours					-	-	-	-	7					
Learning hours per week					17	01	6	-	16					
Total notional learning hours (L+T+P+J+SL)			Per week		40									
			Per semester		40x16=640									

Optipon-1, 21 credits															
I/II SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT105	Differential equations and Laplace Transforms	MAT	3	1	0	-	1	3	50	50	100	4
2	BSC	PHY104	Wave Mechanics and Optoelectronics	PHY	3	0	2	-	2	3	50	50	100	4
3	ESC	ECE111	Basic Electronics	ECE	3	0	0	-	1	3	50	50	100	3
4	ESC	ECE101	Applied Digital Logic Design	ECE (Allied)/ EEE	2	0	2	-	1	3	50	50	100	3
5	PLC	CSE101	Introduction to C Programming	CSE (Allied)	2	0	2	-	1	3	50	50	100	3
6	AEC	HSS131	Communicative English	HSS	1	0	2	-	**1**	3	50	50	100	2
7	PLC	MAT107	Mathematics with MATLAB	MAT	0	0	2	-	-	0	50	0	50	1
8	HSMC	HSS101	Constitution of India & Global Citizenship	HSS	1	0	0	-	-	0	50	0	50	1
				Total	**15**	**01**	**10**	**-**	**7**	**18**	**400**	**300**	**700**	**21**
Additional Academic activities beyond class hours								-	7					
Learning hours per week					15	01	10	-	14					
Total notional learning hours (L+T+P+J+SL)			Per week		40									
			Per semester		40x16=640									

Mandatory community Engagement							
9	INT	Community Engagement (Activity-based Internship)	1) **Social connect & Responsibility** (15 hours lecture to be engaged during second semester)	50	0	100	2*
			2) Activity based Internship to focus on the activities pertaining to Social Connect & Responsibility (1 week duration (40 - 45 hours) to be completed during the vacations of II, IV, V & VI Semesters.)	50	0		

*The grades will be included in the VIII semester grade card

Option-2, First Year: 22 credits/semester

Option-2, 22 credits															
I/II SEMESTER															
Sl. No	Course Type and Course Code		Course Title	Teaching Department	Contact Hours/Week				SL	Examination				Credits
					L	T	P	J		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	BSC	MAT102	Matrix Algebra and Calculus	MAT	3	1	0	-	1	3	50	50	100	4
2	BSC	CHY104	Materials Chemistry for Devices and E-waste Management	CHY	3	-	2	-	2	3	50	50	100	4
3	BSC	CIV104	Environmental Science & Sustainability	CIV	2	-	-	-	1	3	50	50	100	2
4	ESC	MEC112	Elements of Mechanical Engineering	MCE	3	-	-	-	1	3	50	50	100	3
5	ESC	EEE101	Electrical Circuit Analysis – I	EEE	3	-	-	-	1	3	50	50	100	3
6	HSMC	HSS102	Universal Human Values & Professional Ethics	Any	2	-	-	-	1	3	50	50	100	2
7	BSC	BTY111	Biology for Engineers	BTY	1	-	-	-	-	1	50	50	100	1
8	ESC	CSE121	IT Skills	CSE/ Any	-	-	2	-	1	3	50	50	100	1
9	ESC	MEC122	Engineering Visualization	MEC	-	-	2	-	1	-	50	-	50	1
10	AEC	HSS132	Enhancing Self-awareness and Communication	HSS	-	-	2	-	-	-	50	-	50	1
			Total Option-1		17	01	8	-	9	**22**	**500**	**400**	**900**	**22**
Additional Academic activities beyond class hours					-	-	-	-	7					
Learning hours per week					17	01	8	-	16					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=672									

Option-2, 22 credits															
I/II SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT105	Differential equations and Laplace Transforms	MAT	3	1	0	-	1	3	50	50	100	4
2	BSC	PHY104	Wave Mechanics and Optoelectronics	PHY	3	0	2	-	2	3	50	50	100	4
3	ESC	ECE111	Basic Electronics	ECE	3	0	0	-	1	3	50	50	100	3
4	ESC	ECE101	Applied Digital Logic Design	ECE (Allied) EEE	2	0	2	-	1	3	50	50	100	3
5	PLC	CSE101	Introduction to C Programming	CSE (allied)	2	0	2	-	1	3	50	50	100	3
6	AEC	HSS131	Communicative English	HSS	1	0	2	-	**1**	3	50	50	100	2
7	PLC	MAT107	Mathematics with MATLAB	MAT	0	0	2	-	-	0	50	0	50	1
8	HSMC	HSS101	Constitution of India & Global Citizenship	HSS	1	0	0	-	-	0	50	0	50	1
9	AEC	HSS133	Building of Psychological Assets	HSS	-	-	2		-	0	50	0	50	1
				Total	**15**	**01**	**12**	**-**	**7**	**18**	**450**	**300**	**750**	**22**
Additional Academic activities beyond class hours								-	8					
Learning hours per week					15	01	11	-	15					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=672									

Mandatory community Engagement							
10	INT	Community Engagement (Activity-based Internship)	1) **Social connect & Responsibility** (15 hours lecture to be engaged during second semester)	50	0	100	2*
			2) Activity based Internship to focus on the activities pertaining to Social Connect & Responsibility (1 week duration (40 - 45 hours) to be completed during the vacations of II, IV, V & VI Semesters.)	50	0		

*The grades will be included in the VIII semester grade card

Option-1, III Semester: 23 credits

Option-1, 23 credits															
Option-1: III SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT203	Complex variables and Transform Techniques	MAT	3	1	0	0	1	03	50	50	100	4
2	IPCC	EEE201	Electrical Circuit Analysis – II	EEE	2	1	2		1	03	50	50	100	4
3	IPCC	EEE202	Instrumentation and Measurements	EEE	3	0	2		1	03	50	50	100	4
4	PCC	EEE111	Electrical Power Generation and Utilization	EEE	3	0	0	✓	1	03	50	50	100	3
5	PCC	EEE211	Analog Circuit Analysis and Design	EEE	3	0	0		1	03	50	50	100	3
6	PCC	EEE221	Analog Circuit Analysis and Design Lab	EEE	0	0	2		1	03	50	50	100	1
7	HSMC	HSS104	Indian Knowledge Systems and Indian Culture	HSS	2	0	0	0	-	03	50	50	100	2
8	AEC	HSS232	Enhancing Self Competence	HSS	1	-	2	-	1	03	50	50	100	2
9	MNC	HSS105	Kannada (Balake / Samskrithika)	Any	1	0	0	0	-	0	50	0	50	0
Total					**18**	**02**	**8**	**0**	**7**	**24**	**450**	**400**	**850**	**23**
Additional Academic activities beyond class hours									9					
Learning hours per week					18	02	8		16					
Total notional learning hours (L+T+P+J+SL)			Per week		44									
			Per semester		44x16=672									

Bridge Course prescribed only to lateral entry Diploma holders admitted to III semester of Aeronautical Engineering Program														
10	BSC	MAT002	Basic Calculus and Matrix algebra	MAT	3	0	0	0	-	03	100	-	100	0

Option-2, III Semester: 22 credits

Option-2, 22 credits															
III SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT203	Complex variables and Transform Techniques	MAT	3	1	0	0	1	03	50	50	100	4
2	IPCC	EEE201	Electrical Circuit Analysis – II	EET	2	1	2		1	03	50	50	100	4
3	IPCC	EEE202	Instrumentation and Measurements	EET	3	0	2		1	03	50	50	100	3
4	PCC	EEE111	Electrical Power Generation and Utilization	EEE	3	0	0	✓	1	03	50	50	100	3
5	PCC	EEE211	Analog Circuit Analysis and Design	EEE	3	0	0		1	03	50	50	100	3
6	PCC	EEE221	Analog Circuit Analysis and Design Lab	EEE	0	0	2		1	03	50	50	100	2
7	HSMC	HSS104	Indian Knowledge Systems and Indian Culture	HUSS	2	0	0	0	-	03	50	50	100	2
8	AEC	HSS134	Augmenting Employability Skills	HSS	-	-	2	-	1	0	50	0	50	1
9	MNC	HSS105	Kannada (Balake / Samskrithika)	Any	1	0	0	0		0	50	0	50	0
Total					**17**	**2**	**8**	**0**	**7**	**21**	**450**	**350**	**800**	**22**
Additional Academic activities beyond class hours									8					
Learning hours per week					17	2	8	0	15					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=672									

Bridge Course prescribed only to lateral entry Diploma holders admitted to III semester of Aeronautical Engineering Program														
10	BSC	MAT002	Basic Calculus and Matrix algebra	MAT	3	0	0	0	-	03	100	-	100	0

Option-1, IV Semester: 22credits

Option-1: 22 Credits															
IV SEMESTER															
Sl. No	Course Type and Course Code		Course Title	Teaching Department	Contact Hours/Week				SL	Examination				Credits
					L	T	P	J		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	BSC	MAT207	Numerical Methods and Probability Theory	MAT	3	1	0	0	1	03	50	50	100	4
2	BSC	MAT211 / PHY213	Linear Algebra and Discrete Mathematics/ Quantum Physics	EEE	3	1	0		1	03	50	50	100	4
3	IPCC	ECE201	Digital System Design using HDL	EEE	3	0	2		2	03	50	50	100	4
4	PCC	EEE212	Electromagnetic Fields	EEE	3	0	0	✓	2	03	50	50	100	3
5	PCC	EEE213	Electrical Machines	EEE	3	0	0		1	03	50	50	100	3
6	PCC	EE222	Electrical Machines Lab	EEE	0	0	2		1	03	50	50	100	1
7	HSMC	HSS103	Gender, Diversity & Inclusion	HSS	1	0	0	0		-	50	-	50	1
8	AEC	HSS231	Developing Professional Skills	HSS	1	0	2	0		03	50	50	100	2
				Total	17	2	6	0	8	21	400	350	750	22
Additional Academic activities beyond class hours									9					
Learning hours per week					17	2	6	-	17					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=672									

Bridge Course prescribed only to lateral entry Diploma holders admitted to III semester of Aeronautical Engineering Program															
9	BSC	MAT005	Basic Differential equations and Laplace Transforms	MAT	3	0	0	0	-	03	100	-	100	0

Option-2, IV Semester: 21 credits

Option-2: 21 credits															
Option2: IV SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT207	Numerical Methods and Probability Theory	MAT	3	1	0	0	1	03	50	50	100	4
2	BSC	MAT211 / PHY213	Linear Algebra and Discrete Mathematics/ Quantum Physics	EEE	3	1	0		1	03	50	50	100	4
3	IPCC	ECE201	Digital System Design using HDL	EEE	3	0	2		2	03	50	50	100	4
4	PCC	EEE212	Electromagnetic Fields	EEE	3	0	0	✓	2	03	50	50	100	3
5	PCC	EEE213	Electrical Machines	EEE	3	0	0		1	03	50	50	100	3
6	PCC	EE222	Electrical Machines Lab	EEE	0	0	2		1	03	50	50	100	1
7	HSMC	HSS103	Gender, Diversity & Inclusion	HSS	1	0	0	0		-	50	-	50	1
8	AEC	HSS135	Developing Interpersonal Skills	HSS	0	0	2	0		-	50	-	50	1
				Total	16	2	6	0	8	18	400	300	700	21
Additional Academic activities beyond class hours									8					
Learning hours per week					16	2	6	-	16					
Total notional learning hours (L+T+P+J+SL)			Per week		40									
			Per semester		40x16=640									

Bridge Course prescribed only to lateral entry Diploma holders admitted to III semester of Aeronautical Engineering Program														
9	BSC	MAT005	Basic Differential equations and Laplace Transforms	MAT	3	0	0	0	-	03	100	-	100	0

V Semester: 22 credits

V SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	IPCC	EEE301	Digital Signal Analysis and Processing	EEE	2	1	2	-	2	3	50	50	100	4
2	IPCC	EEE203	Microcontroller Programming with C	EEE	3	0	2	-	2	3	50	50	100	4
3	PCC	EEE311	Power System Analysis -1	EEE	3	0	0	-	1	3	50	50	100	3
4	PCC	EEE321	Power System Analysis Lab	EEE	0	0	2	-	1	3	50	50	100	1
5	PEC	EEEXXX	Professional Elective – I	EEE	3	0	0	✓	1	3	50	50	100	3
6	OEC	XXXXXX	Open Elective – I	Any	3	0	0	-	-	3	50	50	100	3
7	HSMC	MGM102	Management, Entrepreneurship and IPR	Any Dept	3	0	0	0	1	3	50	50	100	3
8	AEC	MEC131	Innovation and Design Thinking	MEC /AEC	0	0	2	0	-	-	50	-	50	1
9	MNC	UCC102	Employability Skill Development	Any Dept	1	0	0	0	-	-	50	-	50	0
					18	**1**	**8**	**0**	**8**	**24**	**550**	**400**	**950**	**22**
Additional Academic activities beyond class hours									7					
Learning hours per week					18	1	8	0	15					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=672									

VI Semester: 22 credits

VI SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	IPCC	EEE302	Power Electronics	EEE	3	0	2	-	2	3	50	50	100	4
2	PCC	EEE312	Linear Control Systems	EEE	3	0	0	-	1	3	50	50	100	3
3	PCC	EEE322	Linear Control Systems Lab	EEE	0	0	2	-	2	3	50	50	100	1
4	PCC	EEE313	Power System Analysis – II	EEE	3	0	0	-	1	3	50	50	100	3
5	PEC	EEEXXX	Professional Elective - II	EEE	3	0	0	✓	1	3	50	50	100	3
6	OEC	XXXXXX	Open Elective – II	Any	3	0	0	-	1	3	50	50	100	3
7	ETC	EEE331	AI for Electrical Engineers	EEE	2	0	0	✓	1	3	50	50	100	2
8	HSMC	HSS106	Globalization and its Implications	HSS	2	0	0	0		3	50	50	100	2
9	AEC	EEE131/ EEE132/ EEE133	Python Programming / Internet of Things / Soldering Practice	EEE	0	0	2	0	1	3	50	50	100	1
					19	**0**	**6**	**0**	**10**	**24**	**400**	**400**	**800**	**22**
Additional Academic activities beyond class hours									7					
Learning hours per week					19	0	6	0	7					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=608									

VII Semester: 17 credits

VII SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	IPCC	EEE303	Electric Vehicle Technology	EEE	3	0	2	-	2	3	50	50	100	4
2	PCC	EEE314	DSP Processor	EEE	1	0	2	-	2	3	50	50	100	2
3	PEC	EEEXXX	Professional Elective-III	EEE	3	0	0	-	1	3	50	50	100	3
4	PEC	EEEXXX	Professional Elective - IV	EEE	3	0	0	-	1	3	50	50	100	3
5	HSMC	MGM101	Economics and Fiscal Management – An Engineers Perspective	Any Dept	3	0	0	0	1	3	50	50	100	3
		MGM104	Project Management for Professionals											
		MGM103	Operations Research and Project Management											
6	AEC	HSS136	Japanese Language	HSS / SWAYAM	3	0	0	0	1	3	50	50	100	3
			German Language											
		HSS137	Research Methodology	Any										
7	MNC	UCC301	Capstone Design Project – Phase I	EEE	0	0	2	0	1	0	50	0	50	0
					16	**0**	**6**	**0**	**9**	**18**	**350**	**300**	**650**	**18**
Additional Academic activities beyond class hours									4					
Learning hours per week					17	0	4	0	13					
Total notional learning hours (L+T+P+J+SL)			Per week		34									
			Per semester		34x16=544									

VIII Semester: 16 credits

VIII SEMESTER																
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**	**Total Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**		
1	CE	UCC101	Community Engagement	EEE	1) Social connect & Responsibility (15 hours lecture to be engaged during second semester) 2) Activity based Internship to focus on the activities pertaining to Social Connect & Responsibility (1 week duration (40 - 45 hours) to be completed during the vacations of II, IV, V & VI Semesters.)				-	-	100	-	100	2	2
2	INT	UCC401	Professional Practice	At Industry	Professional Practice at for 20 weeks. Minimum 34 hours /week and 1 hour / week for interaction between the project guide and students.				1	3	150	150	300	14	14
OR															
2a	INT	UCC201	Internship (Research/ Industry Internship)	EEE	Mandatory Research Internship / Industry Internship of 4 weeks (160 – 180 hours) to be completed in one/two stretches during the vacation periods between IV to VII semesters				-	3	50	50	100	4	
2b	PRJ	UCC302	Capstone Design Project Phase - II	EEE	Student should carry out project in research institute/industry/intra institute Center of Excellences for 16 weeks. Minimum 34 hours /Week and 1 hour / week for interaction between the project guide and students.				1		100	100	200	10	
					34				**1**	**3**	**250**	**150**	**400**	**16**	**16**

Learning hours per week		35	
Total notional learning hours (L+T+P+J+SL)	Per week	35	
	Per semester	80+160+(35x16) =800	

8.5 Eligibility for submission of Capstone Project Work/Professional Practice Report

8.5.1 Capstone project work during the 8th semester shall be taken up batch-wise and report can be submitted for evaluation only on completion of a minimum of 126 credits and for Diploma lateral entry students (those who have joined the second year B.Tech.) the same is 92 credits.

8.5.2 Project work can be carried out as domain-specific /interdisciplinary under the guidance of faculty/ faculty members or the students can also opt for Professional Practice in an Industry / Research Institution/Center of excellence.

8.5.3 Viva-voce examination shall be conducted individually.

8.6 ELECTIVES

8.6.1 A candidate shall take electives in each semester from groups of electives, commencing from the 5th semester.

8.6.2 The minimum number of students to be registered for any Elective offered shall not be less than fifteen (15) and should not exceed forty (40).

8.6.3 A candidate shall opt for his/her choice of electives and register for the same at the beginning of each of the 5th to 7th semesters if pre-registration is not done. The candidate is permitted to opt for a change of elective within 15 days from the date of commencement of the semester as per the academic calendar of the college.

9. ATTENDANCE REQUIREMENT:

9.1 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 the principal for reasons such as medical grounds, participation in University level sports, cultural activities, seminars, workshops, and paper presentation.

9.2 The basis for the calculation of the attendance shall be the term prescribed by the institution by its calendar of events. For the first semester students, the same is reckoned from the date of admission to the course.

9.3 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 for the shortage.

9.4 A candidate having a 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 an 'N' grade in these courses.

9.5 He/she shall have to repeat those course(s) with an 'N' grade and 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 summer semester.

9.6 Attendance in CIE and SEE: Attendance in 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.

10. WITHDRAWAL FROM THE PROGRAM

10.1 Temporary Withdrawal

A student who has been admitted to a degree program of the college may be permitted once during the program to withdraw temporarily, for 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 with the genuineness of the case and that even by considering the expected period of withdrawal, the student can complete the program requirements (165 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 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 of 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.

10.2 Permanent Withdrawal

Any student who withdraws the 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.

i) A student who wants to leave the College for good will be permitted to do so (and take a Transfer Certificate from the College, if needed), only after clearing all other dues if any.
ii) Those students who have received any scholarship, stipend, or other forms of assistance from the College shall repay all such amounts.
iii) The decision of the Principal of the College regarding the withdrawal of a student is final and binding.

11. EVALUATION SYSTEM

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

11.2 The Letter grades O, A+, A, B+, B, C, P, and F indicate the level of academic achievement, assessed on a decimal (0-10) scale.

11.3 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)
CIE for Non-PBL Courses			
i)	Learning activities (LA): Quizzes (MCQs), Tutorials, Assignments, Seminars, Participative learning etc.	:	20 marks
ii)	Sum of two Mid-semester Examinations	:	30 marks
CIE for IPCC Courses or courses with PBL component			
Theory Part: (Assesment =50 marks)			
i)	Learning activities (LA): Quizzes (MCQs), Tutorials, Assignments, Seminars, Participative learning etc.		20 marks
ii)	Sum of two Mid-semester Examinations	:	30 marks
Practical part /PBL component: (Assesment =50 marks)			
i)	Practical part /Project Based Learning (PBL)	:	50 marks
Final; CIE marks for IPCC Courses or courses with PBL component is sum of the marks of Theory Part and Practical part with weightages as given below.			
60% weightage for theory part (0.6x50=30 marks) + 40% weightage forPractical part / PBL component (0.4x50=20 marks)			

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

11.4 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 the specified period in a semester.

11.5 **Evaluation Scheme** *(Refer to Appendix-B for detailed evaluation guidelines)*: The course Instructor shall announce in the class and/or display at the Notice board/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.

11.5.1 **Internship:** Mandatory Internship is in two parts. Community Engagement (2 weeks-(2 credits)) and Industry Internship (4 weeks-(4 credits))

11.5.1.1 **Community Engagement**

All the students admitted to the 1st semester of engineering programs shall have to undergo Community Engagement

- Social connect & Responsibility (15 hours lecture to be engaged during second semester)

- Community Engagement to focus on the activities pertaining to Social Connect & Responsibility (1 week duration (40 - 45 hours) to be completed during the vacations, preferably during II Semester or IV semester (only for lateral entry students)
- The internship shall include Inter / Intra Institutional activities. A viva – voce examination (Presentation followed by question-answer session) shall be conducted during the 2nd semester (for lateral entry students, during the 4th semester) and the prescribed credit shall be included in the 8th -semester grade card.
- All the students admitted to the 3rd semester of Engineering programs (Lateral Entry Category) shall have to undergo a mandatory internship of 02 weeks (during the 3rd semester or the intervening period of the 3rd and 4th semesters). The internship shall include Inter/Intra Institutional activities.
- The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up / complete the internship shall be declared to fail and shall have to complete it during subsequent University examinations after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the student's internship progress and interact to guide them for the successful completion of the internship).
- **Procedure for the Evaluation of Community Engagement**
  - Students should submit the reports immediately on completion of the Community Engagement to the respective mentors.
  - The Examination of the Community Engagement will be carried out by the mentor.
  - The Community Engagement shall be slated for 100 marks CIE only and will not have SEE.
  - Community Engagement marks are based on CIE marks (25 marks for the Social Connect and Responsibility, 25 marks for the presentation, and 50 marks for the report and final presentation).
  - A Viva-Voce examination is conducted during II/IV Semesters (Presentation followed by question-answer session) and the prescribed credit shall be included in the VIII semester grade card.

11.5.1.2 Industry Internship

- All the students admitted to engineering programs shall have to undergo Industrial Internship of 04 weeks during the second and third year of their Engineering studies.
- During the intervening period of the IV & V semesters and VI & VII semesters, students shall be ready for industrial experience. Therefore, they shall choose to undergo 4 weeks Internship

involving Innovation / Entrepreneurship or at Industry appropriate to the Decipline with the approval of respective HODs.

11.5.2 **Capstone Project work/Professional practice 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 the project evaluation committee at the department level shall form the SEE of the project work.

11.1.1. In the case of other requirements, such as seminar, field work, or comprehensive viva voce, if any, the assessment shall be made as laid down by the DUGC with the approval of BOS and Academic council.

11.1.2. There shall be no re-examination for any course in the credit system.

However, re-registration and examination is permitted for 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 shortage 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 "P" Grade in each case.
- While such students should re-register for the same course(s) if core, they can re-register for the 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 summer semester.

11.6 Qualifying standards

Evaluation Method	Qualifying Standard
Sessional (CIE)	Score: ≥40% (≥20 marks)
Terminal (SEE)	Score: ≥40% (≥20 marks)
For securing a final Pass in a course	Total **40 % of the Course maximum marks (100)** i.e., the sum of the CIE and SEE marks prescribed for the Course is desired.

11.7 Grading System

The letter grade awarded to a student for his/her performance in a course is based on Absolute Grading.

a. Absolute Grading – Letter Grade and its range

The grade point scale for absolute grading

Marks Range (%)	Grade Point	Letter Grade	Descriptor
90 & above	10	O	Outstanding
80-89	9	A+	Excellent
70-79	8	A	Very Good
60-69	7	B+	Good
55-59	6	B	Above Average
50-54	5	C	Average
40-49	4	P	Pass
00-39	0	F	Fails
Absent	0	Ab	Absent

CGPA	Classification
7.00-& above	**First Class with Distinction**
6.00-6.99	**First Class**
5.00-5.99	**Second Class**
CGPA < 5.00*	**Academic Probation / Non-compliance**

***** If a student secures CGPA< 5.0 at any point time during his/her studies, he/she will be on Academic Probation/Noncompliance (refer to sections 14.2 and 17.3 for more details.)

i) **Grade "N":** A candidate having a shortage of attendance **(<75%)** in any course(s) or CIE marks less than **40%** shall not be allowed to appear for SEE of such course(s). Such students will be awarded an 'N' grade in these courses with a grade point of 0.

ii) The grade points are 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 total of all the credit points earned by the student for all the courses registered in that semester.

11.8 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 of O-P. The letter grade "F" in any course implies the failure of the student in that course and no credits earned.

a. 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 (O-F) after the student completes the course requirements.

b. **Grade "I"**: To a student having attendance ≥85% and CIE ≥70% (35 marks), in a course, 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 required the student to be away from the College.

   iii. However, the committee chaired by the Principal is authorized to relax the requirement of CIE ≥ 70% if the student is hospitalized or advised long-term rest after discharge from the hospital by the Doctor.

   iv. 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 Makeup Examinations within 2 working days of that examination for which he or she is absent, failing which they will not be given permission.

c. **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

d. Grade "X": To a student having attendance ≥85% and CIE ≥70%, in a course but SEE performance could result in an F grade in the course. **(No "F" grade will be awarded in this case, but the student's performance record is maintained separately).**

11.9 Summer / Fast Track semester

a. The students who have satisfied CIE and Attendance requirements for the course/s and obtained an F grade in SEE are permitted to appear directly in ensuing examination/s as backlog paper/s. The students need not re-register for such course/s in the summer / fast track semester. In case the student wishes to improve CIE/ he/she has to re-register for the summer / regular semester as and when offered next.

b. The student who obtains required attendance and CIE in the summer semester, but obtains an 'F' grade in SEE; is permitted to appear for SEE subsequently as backlog course/s. The student need not repeat the course for Attendance and CIE.

c. The course/s for which the student does not possess satisfactory attendance and CIE score shall be marked as 'N' on the Grade sheet. Such students are not permitted to SEE for the Courses marked as 'N' on the Grade sheet. The students have to re-register only for course/s marked as 'N' in the summer/ subsequent semester whenever that course is offered and obtain the required CIE and attendance. Subsequently, they are eligible to appear for SEE in such course/s.
d. Courses with Transitional Grades viz "W", "I", and "X" are also eligible to register in the summer semester in case they wish to improve their score in CIE.
e. All courses may not be offered in the summer semester. It is the discretion of the University to offer the courses based on the availability of resources. The Institutes shall notify timetable for the summer semester well in advance.
f. Summer Semester is optional; it is for the student to make the best use of the opportunity.
g. A student is permitted to register for a maximum of 16 credits in the Summer / fast track semester.
h. A student has to choose those courses which are offered by the Institution in a given summer Semester.
i. In the summer semester, each course needs to be offered for the required number of lectures/ tutorial/ laboratory hours as prescribed in the syllabus.

11.10 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 are 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.**

11.11 Re-evaluation and paper seeing.

Re-evaluation is permitted only for theory papers. The University, on receiving application within the stipulated time and remittance of a prescribed fee for re-evaluation, shall permit re-evaluation for the course/s applied. The marks obtained after re-evaluation shall be the final marks awarded.

11.12 The Make-Up Examination

The Make-Up Examination facility would be available to students who may have missed attending 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 during the summer semester.** 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 the 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" grades.

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/ Summer semester and fulfill the passing standards for their CIE and (CIE+SEE).

11.13 Rules for grace marks

Grace marks up to 1% of the maximum total marks of the courses for which he/she is eligible and have registered (non-credit courses excluded) in the examination or 10 marks whichever is less shall be awarded to the failed course(s), (with a restriction of a maximum of 5 marks per course) provided on the award of such grace marks the candidate passes in that course(s)

12. 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.

$$SGPA = \frac{\sum[(Course\ Credits) \times (Grade\ Point)] \text{ (for all courses in that semester)}}{\sum[Course\ Credits]}$$

CGPA is computed as follows:

$$CGPA = \frac{\sum[(Course\ Credits) \times (Grade\ Point)] \text{ (for all courses excluding those with F grades until that semester)}}{\sum[Course\ Credits] \text{ (for all courses excluding those with F grades until that semester)}}$$

13. COMMUNICATION OF GRADES

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

14. REQUIREMENTS FOR VERTICAL PROGRESSION (PROMOTION / ELIGIBILITY TO HIGHER SEMESTERS)

14.1 All students are promoted to the next semester or year of their program, irrespective of their academic performance.

14.2 However, at any stage of his/her study, if a student reaches a CGPA below 5.00, the student will be on **Academic Probation** and is permitted to register for a maximum of 16 credits during odd semester of an academic year. However, the student has the choice to re-register for the courses/courses in which he/she has obtained an 'F' / 'N' grade.

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

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

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

14.4 **Vertical Progression for regular students who have taken admission to the first year:**

Normally a student is expected to complete a minimum of 85% of credits by the end of the 7th semester. Completion of 126 credits is a pre requisite for submission of **B.Tech. Capstone Project/Professional Practice report in 8th semester. However, the students who have not earned 126 credits will not be eligible for the Semester End Examinations of the 8th Semester.**

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

14.5.1 Lateral entry students should complete at least 85% of credits by the end of the 7th semester. Completion of 92 credits is a pre requisite for submission of B.Tech. Capstone Project/Professional Practice report in 8th semester. However, the students who have not earned 92 credits will not be eligible for the Semester End Examinations of the 8th Semser.

14.5.2 Diploma students should register for mandatory non-credit Mathematics Courses Bridge Courses as prescribed during III and IV semesters respectively. They shall attend these bridge course classes during the respective semesters to satisfy attendance and CIE requirements.

14.5.3 Completion of Mathematics Courses Bridge Courses shall be mandatory for the award of the degree.

14.6 **Termination from the program**

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

14.6.1 Failure to secure a minimum CGPA of 5.0 at the end of the 8 years (6 years for lateral entry students).

14.6.2 Failure to earn 165 credits (125 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).

14.6.3 Absence from classes for more than **six weeks at a time** in a semester without leave of absence being granted by competent authorities.

14.6.4 Failure to meet the standards of discipline as prescribed by the college from time to time.

15 AWARD OF CLASS

Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or classes 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 in the following Table.

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

Grade Point	Percentage of Marks*	Class
≥ 7.00	≥ 70%	First class with Distinction
≥ 6.00	≥ 60%	First Class
5.0 ≥ CGPA <6.00	50≥ Percentage <60%	Second Class

Percentage * = (CGPA) x 10

16 APPEAL FOR REVIEW OF GRADES

16.1 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 the review of grades is incorporated into 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.

16.2 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.

17 AWARD OF DEGREE

17.1 B.Tech. Degree

a) Students shall be declared to have completed the Program of 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 have earned the prescribed number of credits (165 credits for regular students registered for 4-year degree programs & 125 for lateral entry students).

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

c) Completion of two Bridge courses in Mathematics shall be mandatory for the award of degree to lateral entry diploma students.

d) Earning of Activity Points:

i. Every student entering 4-year degree program should earn 100 activity points & every student entering 4-year degree program through Lateral Entry should earn 75 activity points as per the AICTE Activity Point Program for the award of an Engineering degree.

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

iii. The Activity Points earned shall be reflected on the student's eighth-semester Grade Card.

iv. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression.

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

17.2 Honours/ Minors Degree

17.2.1 B.Tech. (Honours) Degree

i. Students must earn a minimum of 18 additional credits in his/her major program discipline entitles a student to get an 'Honours' credential.

ii. Students have to pay additional fees for all the courses registered for 'Honours'

iii. Students with a minimum of 7.5 CGPA and no backlog at the end of the 4th semester will qualify for registering for courses under the 'Honours credential.

iv. Students shall register for 'Honours' courses from the 5th semester onwards.

v. Students should register for additional courses and plan to take courses that are prescribed under that 'Honours' list as per 'pre-requisite' courses to earn the 'Honours' credential.

vi. Students who wish to acquire an 'Honours' credential need to carry out 'Honours' course registration along with their regular semester course registration.

vii. He/she accumulates credits by registering for the required courses, and if the requirements for 'Honours' are met within the prescribed minimum time limit of the program, the 'Honours' will be awarded along with the degree.

viii. Also, the student should meet the following requirements to become eligible for the 'Honours award.

- Minimum CGPA of 7.5 in this major discipline at the end of the 8th semester
- Minimum CGPA of 7.0 in the registered 'Honours' courses

ix. In case a student withdraws from the 'Honours' registration in the middle of the program, the 'Honours' courses completed will be converted to 'Audit' courses and indicated accordingly in subsequent Grade Sheets and Consolidated Grade Sheets.

x. It must be noted that the 'Honours' award will be mentioned in the Degree Certificate as "Bachelor of Technology in (specialization) with Honours".

xi. This fact will also be reflected in the Consolidated Grade Sheet under a separate heading 'Honours' with similar details shown for other credited courses and the CGPA for 'Honours' will be indicated at the end of the list of courses under 'Honours'.

xii. The grades obtained in the courses credited towards the 'Honours' award is not counted and shall not influence the GPA/ CGPA of the 'program' student has registered.

17.2.2 Minor Degree

i. Students have to earn a min of 18 additional credits from the courses focused on discipline other than his/her major program discipline entitles a student to get a 'Minor' credential.
ii. Students have to pay additional fees for all the courses registered for 'Minor'.
iii. Students with a minimum of 5.0 CGPA and no backlog at the end of the 3rd semester will only qualify for registering for the course under the 'Minor' credential.
iv. Students shall register for 'Minor' degree courses from the 4th semester onwards.
v. All Departments will offer 'Minors' in their varied disciplines and will prescribe what set of courses and/or projects is necessary for earning a minor in that discipline.
vi. Students should register for additional courses and plan to take courses that are prescribed under that 'Minors' list as per 'pre-requisite' courses to earn the 'Minor' credential.
vii. If any of the courses listed under the 'minor' option is a course listed under his/her curriculum as PCC then the student cannot opt for that 'Minor', since all minor courses need to be earned as additional courses to his/her program curriculum and depts decision is final and binding.
viii. Students who wish to acquire a 'Minor' can register for 'Minor' courses along with their regular semester course registration.
ix. Also, the student should have a minimum CGPA of 5.0 in the 'Minor' courses registered to become eligible for the Minor credential. This fact will also be reflected in the Consolidated Grade Sheet under a separate heading 'Minor in (specialization)'.
x. If the course requirements for a particular 'Minor' are met within the prescribed minimum time limit of the program, the minor will be awarded along with the degree, and it will be mentioned in the Degree Certificate as "Bachelor of Technology in (Major discipline) with Minor in (specialization)."
xi. In case a student withdraws from the 'Minor', the 'Minor' courses completed, will be converted to 'Audit' courses and indicated accordingly in subsequent Grade Sheets and Consolidated Grade Sheets.
xii. The grades obtained in the courses credited towards the 'Minor' award are not counted and shall not influence the GPA/ CGPA of the program the student has registered for.

17.2.3 Additional norms for Honours/Minors

i. Students shall register for additional courses to earn Honours/Minors in consultation with their Class Advisor from the list of courses suggested by the DUGC.

ii. DUGC may recommend Massive Open Online Courses (MOOCs)/SWAYAM/NPTEL courses to students who wish to register for Honours/Minors after justifying and establishing the equivalence of the curriculum. The decision of DUGC should be communicated to the Dean of Academics and Controller of Examinations for seeking approval.

iii. The credits prescribed for Honors/Minors may be earned through SWAYAM/NPTEL

iv. Students may choose to take up additional course work, from the MOOCs courses list suggested by various departments (which can be from SWAYAM/NPTEL) with proctored examinations as approved by the University and complete the same before the last working day of the VIII semester with a final score (online assignments: 25 % + Proctored examination: 75 %) leading to the following certificates: Completed the course (40-59)– ELITE (60 to 75 %) or ELITE + SILVER (76 to 89 %) or ELITE + GOLD (≥ 90 %)

v. In case, there is no proctored examination for SWAYAM/NPTEL Courses, the University will conduct a SEE as deemed to be fit for the award of Credits

vi. The Credit equivalence for online courses shall be as follows –
   - 4 weeks of online course duration – 1 credit (approx. 13-14 hours)
   - 8 weeks of online course duration – 2 credits (approx. 26-28 hours) and
   - 12 weeks of online course duration – 3 credits (approx. 39-42 Hours)

17.2.4 Examination for Swayam Courses

a) Students are advised to check well in advance the availability of SWAYAM courses to be enrolled in the SWAYAM portal (**Ref: Notification of Registrar N(DU)/REG/AC/2024-25/1040)**

b) Students must complete the entire SWAYAM course and submit a minimum of 75% of assignments and quizzes to be eligible for the end-term examination

c) End-term proctored examinations for all SWAYAM-based credit courses are conducted by the National Testing Agency (NTA) and National Programme on Technology Enhanced Learning (NPTEL) at their designated centers across the country.

d) Alternatively, for select courses, the university will conduct end-term examinations during the current semester in alignment with the regular academic calendar. These exams will be conducted in accordance with the UGC's framework to facilitate learning on SWAYAM.

e) The end-term examination will carry 70-75% weightage, while continuous assessments consisting of assignments and quizzes completed on the SWAYAM portal will carry 25-30% weightage depending on the evaluation plan announced by SWAYAM course cooedinators.

f) Completion certificate from SWAYAM must be submitted within the first week of commencement of respective semesters.

g) Re-examinations will be conducted in the subsequent two semesters for students who could not pass or appear in the end-term exams.

17.3 Noncompliance

17.3.1 Noncompliance of CGPA ≥ 5.00 at the end of the Program

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

b) In the cases of 17.3 (1), a student shall be permitted to appear again for SEE in course/s (other than Internship, Technical seminar, Project (Mini and Major), and Laboratories) of any Semester/s without the rejection of CIE marks for any number of times, subject to the provision of a maximum duration of the Program to make up the CGPA equal to or greater than 5.00 for the award of the Degree.

c) Students shall obtain written permission from the Controller of Examinations to reappear in SEE to make up the CGPA equal to or greater than 5.00.

d) 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 17.3.1 (b).

e) 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 17.3.1 (b).

f) 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 17.3.1 (b).

g) In case, the students fail (i.e., earns an 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 17.3.1 (b).

17.3.2 Noncompliance with Capstone Project/Professional Practice

The Capstone Project/Professional Practice 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 Capstone Project/Professional Practice shall have to complete the same during subsequent University examinations after satisfying the Capstone Project/Professional Practice requirements.

17.3.3 Noncompliance of Internship

All the students of B. Tech shall have to undergo mandatory Internship-for 4weeks to earn 4 credits-during the vacations at the end of the 2/3 academic year. The evaluation of Internship shall be during VIII semester. The internship shall be considered mandatory for the award of a degree. Those, who do not take up/complete the internship shall have to complete the same during subsequent University examinations after satisfying the internship requirements.

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

18 GRADUATION REQUIREMENTS AND CONVOCATION

18.1 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 centers
c) No disciplinary action is pending against him/her.

18.2 The award of the degree must be recommended by the Excecutive council.

18.3 **Convocation:** Degree will be awarded to 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 to "Award of Degree") within the specified date to arrange for the award of the degree during convocation.

19 AWARD OF PRIZES, MEDALS, CLASS & RANKS

19.1 For the award of Prizes and Medals, the conditions stipulated by the Donor may be considered as per the statutes framed by the University 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 Section 15.

19.2 An attempt means the appearance/registration of a candidate for an examination in one or more courses either in part or failing a particular examination.

a. A candidate who fails/remains absent (after submitting exam application) in the main examination and passes one or more subjects/courses or all subjects/courses in the summer / Make-up examination shall be considered as taken more than an attempt.

19.3 Merit Certificates and University Medals/ will be awarded based on overall CGPA, governed by the specific selection criteria that may be formulated by the University for such Medals / Awards

a. Only those candidates who have completed the Program and fulfilled all the requirements in the minimum number of years prescribed (i.e., 3 years for Diploma lateral entry students or 4 years for students who joined after the 12th standard) and who have passed each semester in the **first attempt** are eligible for the award of Merit Certificates and /or University Medals.

b. Candidates with W, N, I, X & F grades and who passes the courses in the subsequent **summer** /make up examinations are not eligible for the award of Gold Medal or Merit Certificate.

20 CONDUCT AND DISCIPLINE

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

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

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

i. Ragging.
ii. Lack of courtesy and decorum; indecent behavior anywhere within or outside the campus.
iii. Willful damage or stealthy removal of any property/belongings of the College/Hostel or fellow students/citizens.
iv. Possession, consumption, or distribution of alcoholic drinks or any kind of hallucinogenic drugs.
v. Mutilation or unauthorized possession of Library books.
vi. Noisy and unseemly behavior, disturbing studies of fellow students.
vii. Hacking in computer systems (such as entering into another Person's area without prior permission, manipulation and/or Damage of computer hardware and software, or any other Cybercrime, etc.).
viii. Plagiarism of any nature.
ix. Any other act of gross indiscipline as decided by the Senate from time to time.
x. Use of Mobile in the college Academic area.
xi. Smoking in College Campus and supari chewing.
xii. Unauthorized fundraising and promoting sales.
xiii. Commensurate with the gravity of the offense 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.

20.4 For an offense committed in (i) a hostel (ii) a department or a classroom 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.

20.5 All cases involving punishment other than reprimand shall be reported to the

principal.

20.6 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.

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

21 Pursuing two academic Programs:

21.1 Nitte (Deemed to be University) permits students to pursue two academic programs simultaneously, in alignment with the National Education Policy (NEP) 2020 and the UGC's guidelines (Ref: Notification of Registrar N(DU)/REG/AC/2024-25/1039)

21.2 Regulations and guidelines from statutory regulatory authorities will take precedence over these regulations, any updates or amendments to the regulatory guidelines will be incorporated into the university's regulations as required.

21.3 The university reserves the right to amend these regulations as required.

21.4 **Eligibility**

- Students are permitted to pursue a second academic program of the same qualification level – i.e., undergraduate students can enrol for a second undergraduate level program and post-graduate students can enrol for another post-graduate level program.
- Students may enrol for the second program at Nitte (Deemed to be University) or any other recognized university.
- PhD students are not permitted to pursue any other academic program along with their PhD.

21.5 **Modes of Learning:**

- The second program may be pursued in-person, online, or through Open and Distance Learning (ODL) mode.
- Students must seek prior written approval from Nitte (Deemed to be University) before enrolling in the second academic program.
- The application for approval must include details of the second program and its alignment with the student's primary program of study.
- A student can pursue two full time academic programmes in physical mode provided that in such cases, class timings for one programme do not overlap with the class timings of the other program.
- Degree or diploma programmes under ODL/Online mode shall be pursued with only such HEIs which are recognized by UGC/Statutory Council/Govt. of India for running such programmes.

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APPENDIX - A

Definitions, terminology, and abbreviations

1. **Nitte DU / University**
   a. Refers to Nitte (Deemed to be University)

2. **EC**
   a. Refers to Executive Council of Nitte (Deemed to be University)

3. **BoS**
   a. Refers to the Board of Studies in Mechanical Engineering

4. **Institute/Institution**
   a. Refers to NMAM Institute of Technology, Nitte

5. **Program**
   a. A range of learning experiences over a specified period, leading to the award of a degree/diploma/certificate. A program is completed when the courses that make up the program are completed, and other requirements as specified in the program regulations are met.

6. **Course**
   a. A unit of learning that typically lasts one semester, led by one or more teachers, for a fixed roster of students. Often referred to as a "subject". A course has identified course outcomes, modules/units of study, specified teaching-learning methods, and assessment schemes. A course may be designed to include lectures, tutorials, practical, laboratory work, fieldwork, project work, internship experiences, seminars, self-study components, online learning modules, etc. in any combination.

7. **Semester**
   a. An academic session, usually of 16 weeks duration, with a minimum of 90 working days during which coursework and assessments are to be completed. Typically, two semesters make up an academic year, with the first of these referred to as the Odd Semester and the second as the Even Semester.

   b. An additional short semester (usually 8 weeks) may be offered between an even semester and subsequent odd semester (in the interval between two academic years) and is termed a summer semester. The summer semester is offered to enable students to register for:
      i. Fast-tracked courses required for clearing backlog courses.
      ii. Fast-tracked courses for earning additional credit / completing non-credit mandatory requirement.
      iii. Value added courses.
      iv. The courses offered in summer semesters are bound by the same regulations as that of regular semesters, except that they are run at an accelerated pace to provide the required contact hours and conduct assessments within the 8 weeks.

8. Credit

a. A unit by which the course work is measured. It determines the number of hours of formal learning (contact hours) required per week. Credits are calculated based on the concept of "notional learning time". Notional learning time is the number of hours that a learner is expected to spend, on average, to achieve the specified learning outcomes of the course. This may comprise a variable combination of scheduled learning activities, (lectures, seminars, labs, etc.) and supervised learning time (reading required before classes, working on assignments, examination preparation, and completion of assessments).

9. Credit equivalence of notional learning time for different types of activities

a. The credit values assigned to various teaching-learning activities are as follows:

Type of teaching-learning	Nature of activity	No. of contact hours per week equivalent to one credit	The total number of contact hours over a 16-week semester is equivalent to one credit
Lectures / Seminars / synchronous virtual classes / synchronous webinars	Scheduled instruction	1:1	15
Tutorials	Scheduled instruction	2:1	30
Supervised Demonstrations /Laboratory sessions / Studio / Workshops / Workplace simulation / Skill Practice Sessions	Scheduled instruction	2:1	30
Supervised Field visits/community visits/Internships	Scheduled instruction	3:1	45
Scheduled supervised study (individual or group)	Scheduled instruction	2:1	30
Asynchronous E-Learning modules (structured self-directed study	Independent learning	2:1	30
Student Seminar	Independent /small group learning	2:1	30
Project work/dissertation	Independent /small group learning	3:1	45
Internship for credit	Industry placement/ Research Internship	3:1	40-45

10. Choice-based credit system (CBCS)

A program structure for higher education requires students to earn a minimum of credits by completing various types of courses, including electives, which facilitate a student to have some freedom in selecting his/her own choices, within as well as across disciplines.

11. Course Registration

Refers to formal registration of the Courses in the study every semester (Credits and Audit) by every student under the supervision of a faculty advisor. The institution will maintain records of the same and communicate them to the University.

12. Learning outcomes

a. Program Outcomes (PO) - Statements defining the skills, knowledge, and attitude that graduates of a program will be able to demonstrate upon completing the program.
b. Course Outcomes (CO) - Statements defining the skills, knowledge, and attitude that students will be able to demonstrate upon completing the course. COs are mapped to the POs such that attaining the course outcomes leads to the attainment of program outcomes.
c. Attainment of COs are mapped to POs such that attaining the course outcomes leads to the attainment of program outcomes

13. Evaluation

For all courses, the evaluation will be based on both formative assessment (Continuous Internal Evaluation, CIE) and summative assessment (Semester End Evaluation, SEE). Weightage for CIE and SEE will be 50% and 50 % respectively.

13.1 Continuous Internal Evaluation (CIE)

Refers to the periodic and continuous *formative assessment* of students' performance during the semester by the teacher(s) of the course to provide timely feedback to students and for guiding "course corrections" by the teachers. The assessment methods may include tests, quizzes, assignments, project evaluations, portfolio evaluations, seminar assessments, etc. CIE will have a weightage of 50% in the determination of the final grading of the course.

13.2 Semester End Evaluation (SEE)

Refers to a *summative assessment* that covers the entire course syllabus, conducted by the University, at the end of the semester. Appropriate assessment methods aligned with the learning domain and teaching-learning methods are to be used. SEE will have a weightage of 50% in the determination of the final grading of the course.

14. Grading

Course Grade refers to a qualitative measure of performance of a student in each course, based on the percentage of marks secured in Continuous Internal Evaluation (CIE) and Semester End Evaluation (SEE). A Letter grade is awarded for each course.

15. Semester Grade Point Average (SGPA)

Refers to the measure of a student's academic performance in a semester. It is calculated based on the credits and the grades obtained in the courses offered in the semester.

16. Cumulative Grade Point Average (CGPA)

Refers to the measure of the cumulative performance of a student in all the previous semesters and is computed from the 2nd semester onwards. It is calculated based on the credits and the grades obtained in all the courses taken.

17. Academic Bank of Credits (ABC)

The Academic Bank of Credits is a national-level facility for "credit transfer". It is provided by the Ministry of Education, Govt. of India, to promote the flexibility of the curriculum framework and interdisciplinary/multidisciplinary academic mobility of students across the Higher Education Institutions in the country. The banking and redemption of credits through ABC will be governed by the University's guidelines.

APPENDIX-B

Evaluation Guidelines

CIE and SEE details for various types of courses

1. Theory: PCC/IPCC/PEC/OEC

1.1. Scheme of examinations: CIE+SEE =50+50=100 marks

1.2. Continuous internal evaluation (CIE):

1.2.1. CIE (PCC/PEC/OEC)

Type of Questions	Questions to be set (Can have sub-questions a and b)	Questions to Be answered	Marks per question	Total marks
Mid Sem Exam-1				
40-50 % of the total syllabus				
Descriptive Part-1	2	1	7-8	7.5
Descriptive Part-2	2	1	7-8	7.5
Mid Sem Exam-2				
40-50% of the total syllabus				
Descriptive Part-1	2	1	7-8	7.5
Descriptive Part-1	2	1	7-8	7.5
TASKS				
TASK	The task comprises class tests/quizzes/assignments conducted for all 5 units/modules each for a max mark of 20. The final task mark is based on the average of all 5 assessments, All tests/quizzes/Assignments are compulsory.			20
Maximum Marks				**50**

1.2.2 CIE (IPCC/PBL)

Type of Questions	Questions to be set (Can have sub-questions a and b)	Questions to be answered	Marks per question	Total marks
Mid Sem Exam-1				
40-50 % of the total syllabus				
Descriptive Part-1	2	1	7-8	7.5
Descriptive Part-2	2	1	7-8	7.5
Mid Sem Exam-2				
40-50 % of the total syllabus				
Descriptive Part-1	2	1	7-8	7.5
Descriptive Part-1	2	1	7-8	7.5
Learning Activities	The learning activity comprises class tests/quizzes/assignments conducted for all 5 units/modules each for a max mark of 20. The final task mark is based on the average of all 5 assessments, All tests/quizzes/Assignments are compulsory.			20
Maximum Marks (A)				**50**
Minimum Eligibility 40% of Maximum mark (A)=20 marks				
Practical/Project Based Learning (PBL)				
Practical/PBL	Practical/PBL (comprises of implementation of theoretical concepts through projects/problem solving)			**50**
Maximum Marks (B)				**50**
Minimum Eligibility 40% of Maximum mark (B) =20 marks				
Maximum CIE Marks [60% of Max marks (A) (Theory)+ 40% of Max marks (B) (Practical/PBL)]				**50**

1.2.3 Semester End Evaluation (SEE): 3 Hours Duration

Type of Questions	**Module & Teaching hours**	**Questions to be set**	**Questions to be answered**	**Marks per question**	**Total marks**
MCQ	Entire Syllabus	20 (4 questions from each unit/module)	All Questions	1	20
Type of Questions	**Module & Teaching hours**	**Questions to be set (Can have sub-questions a, b, and c)**	**Questions to be answered**	**Marks per question**	**Total eligible max marks**
Descriptive	• Unit-1 • 7-8 teaching hours	**2**	**1**	16	16
Descriptive	• Unit-2 • 7-8 teaching hours	**2**	**1**	16	16
Descriptive	• Unit-3 • 7-8teaching hours	**2**	**1**	16	16
Descriptive	• Unit-4 • 7-8 teaching hours	**1**	**1**	16	16
Descriptive	• Unit-5 • 7-8 teaching hours	**1**	**1**	16	16
				Maximum Marks	**100**
Minimum SEE Marks to be scored out of 100 marks					**40**
Minimum SEE Marks to be scored with 50% Weightage					**20**

1.2.4 CIE & SEE for various types of courses

Sl. No.	Courses		Evaluation scheme						
			CIE (Minimum eligibility marks 40% of Max CIE marks to appear for SEE)		SEE (Minimum eligibility marks 40 % of Max marks			Total Marks = (CIE+ SEE)	Requirement for securing a final Pass (Letter Grade P)
			Max Marks	Min eligibility marks 50% of max marks	Max Marks 100 or 50	Minimum eligibility marks required: 40% of max marks	Minimum eligibility marks required: Out of 50 marks		40 % marks (Agrgregate of CIE +SEE)
1	Integrated Professional Core Course (IPCC)	Theory	50	20	100	40	20	100	40
		Practical	50	20					
		Total (60% of theory +40% of Lab)	50	20					
2	PCC with PBL component	Theory	50	20	100	40	20	100	40
		PBL component	50	20					
		Total (60% of theory +40% of PBL)	50	20					
3	PCC/PEC/OEC		50	20	100	40	20	100	40
4	Laboratory		50	20	50	20	20	100	40
5	Community Engagement		100	40	-	-		100	40
6	Internship Industry/Govt./ MSME/Research center =Total of 4 weeks)		50	20	50	20	20	100	40
7	Capstone Project Research Internship/ Advanced Industry Internship/Project work		100	40	100	40	-	200	80
8	Professional Practice		100	40	100	40	-	200	80

All university examinations (SEE) shall be conducted for a maximum of 100 marks. For assigning the letter grade the university examination marks secured by a student, shall be reduced to 50 marks (except for serial no.04,05, 06,07 and 08) and added to CIE marks. The minimum marks for securing a passing grade **'P'** shall be 40% of the agreegate marks (CIE+ SEE). If the total marks result in a fraction during reduction, it shall be rounded off to the nearest higher value.

2 Laboratory/Practical Course

2.1 Split-up of Marks for evaluation of Practical for 50 CIE marks and 50 SEE marks.

2.2 Split-up of Marks for evaluation of Laboratory work:

2.2.1 Laboratory in-charge faculty will follow rubrics given in the Tables below for an evaluation of laboratory courses

2.2.2 In the case of Practical, the IA marks shall be based on laboratory observation, records, viva, and at least one practical test.

2.2.3 Continuous Evaluation in every lab session will be done using the format mentioned in the Table to evaluate PO9 (Individual and teamwork) and PO10 (Communication).

2.2.4 Rubrics used for continuous Evaluation of **laboratory courses involving experiments with hardware**

Lab conduction and Record			Lab Internal Assessment		
Split-up: **60% (30 Marks) of Maximum CIE marks (50).** Each experiment is to be evaluated for conduction with an observation book and record write-up (**30 marks per experiment).** The final marks for conduction and record are the average of all the specified experiments in the syllabus.			Split-up: **40% (20 Marks) of Maximum CIE marks (50). One test of 20 Marks** In the test, conduction of the experiment and acceptable result with viva-voce will carry a weightage of 60% per experiment, with the rest 40% for procedural knowledge and regularity of the student.		
Rubrics per experiment	**Marks Distribution**	**Remarks**	**Rubrics**	**Marks Distribution**	**Remarks**
Circuit	02	Evaluation of Record write-up to include weightage for submission on time, neatness, etc.	Write-up	04	
Design	02		Conduction	10	
Procedure	02		Results	06	
Conduction	06				
Viva	06				
Record write-up	12				
Total Marks	30		**Total Marks**	20	

2.2.5 Split-up of Marks used for continuous Evaluation of laboratory involving experiments with software (Sample for PCC)

Rubrics for Split up of Marks	Methodology / Process Steps per Experiment	Marks
#R1	Observation, Write up of Procedure / Algorithm/ Program execution, and Conduction of experiment	12
#R2	Viva – Voce	06
#R3	Record writing	12
	Total Marks for each experiment	30
#R4	Internal Test: Lab Internal Assessment (i) Write-up of Procedure/Program/Algorithm (ii) Conduction/Execution (iii) Viva-Voce	 04 10 06
	Total Marks	20

3. Internship and Evaluation

3.1 Introduction

The rise in global competition has prompted organizations to devise strategies to have a talented and innovative workforce to gain a competitive edge. Developing an internship policy is an impactful strategy for creating a future talent pool for the industry. The internship (a form of experiential learning) program not only helps fresh pass–outs in gaining professional know-how but also benefits corporate sectors. The internship also enhances the employability skills of the student passing out from Technical Institutions.

The following list provides a brief illustrative overview of the knowledge, skills, work habits, and character traits commonly associated with 21st-century skills and to be acquired by graduates:

- Critical thinking, problem solving, reasoning, analysis, interpretation, and synthesizing information.
- Scientific literacy and reasoning, the scientific method.
- Research skills and practices, interrogative questioning.
- Creativity, artistry, curiosity, imagination, innovation, and personal expression.
- Information and communication technology (ICT) literacy, media and internet literacy, data interpretation and analysis, and computer programing.
- Oral and written communication, public speaking and presenting, listening.
- Economic and financial literacy, entrepreneurial skills.
- Global awareness, multicultural literacy, humanitarianism.
- Environmental and conservation literacy, ecosystems understanding.

- Civic, ethical, and social-justice literacy.
- Leadership, teamwork, collaboration, cooperation, and facility in using virtual workspaces.
- Perseverance, self-direction, planning, self-discipline, adaptability, initiative.
- Health and wellness literacy, including nutrition, diet, exercise, and public health and safety.

  The internship experience will augment the outcome- based learning process and inculcate various attributes mentioned above in a student in line with the graduate attributes defined by the NBA as well as NEP 2020

Following are the intended objectives of internship training.

(i) Expose Technical students to the industrial environment, which cannot be simulated in the classroom, and hence create competent professionals in the industry.

(ii) Provide possible opportunities to learn, understand and sharpen the real- time technical/managerial skills required at the job.

(iii) Expose to the current technological developments relevant to the subject area of training.

(iv) Use the experience gained from the industrial internship in discussions held in the classrooms.

(v) Create conditions conducive to the quest for knowledge and its applicability on the job.

(vi) Learn to apply technical knowledge in real industrial situations.

(vii) Gain experience in writing reports on technical works/projects.

(viii) Expose students to the engineer's responsibilities and ethics.

(ix) Familiarize with various materials, processes, products, and their applications along with relevant aspects of quality control and safety measures.

(x) Promote academic, career, and/or personal development.

(xi) Expose the students to future employers.

(xii) Make students available to the industry for employment.

(xiii) Understand the psychology of the workers and their habits, attitudes, and approach to problem-solving.

(xiv) Understand the social, economic, and administrative considerations that influence the working environment of industrial organizations.

3.2 Academic credit framework for the internship and project work undergone as part of the B.Tech. program.

- A minimum of 16 credits to be earned through community engagement activities, Internship and Project work/ professional practice may be counted towards B. Tech. degree program
- Here, 1 credit is equivalent to a minimum of 40-45 hours of work. Therefore, a full-time intern is expected to spend 40 - 45 hours per week on Internship/Training/Project work etc. This will result in about 640 to 720 hours of total internship and project duration for the B. Tech program.

- To derive the benefits of an internship, it may be introduced in two stages of the B.Tech. program.
- Internships may be full-time or part-time; they are full-time during the summer vacation and part-time during the academic session. The curriculum is flexible to adjust internship duration. Therefore, opportunities must be provided for experiences that cannot be anticipated when planning the course.
- The departments have the flexibility to schedule internships, Project work, Seminars, etc. according to the availability of the opportunities. However, the suggested minimum requirement regarding Internship duration and credits are as given in Table -B1.

Table-B1 Suggested Credit Framework for Internship and Capstone Project.

Sl. No.	Title	Schedule	Duration	Activities	Credits
1	Community Engagement	Ongoing First-year academic session/ Vacation of 2nd Semester/ vacation during 3rd semester (for lateral entry students)	02 weeks	3) Social connect & Responsibility (15 hours lecture to be engaged during second semester) 4) Activity based Internship to focus on the activities pertaining to Social Connect & Responsibility (1 week duration (40 - 45 hours) to be completed during the Vacation of 2nd Semester/ vacation during 3rd semester (for lateral entry students) 5) Award of credits in 8th semester	02
2	Internship	a) Summer vacation after 4th Semester	02-04 weeks	Industrial/Govt./ NGO/ MSME/ Rural Internship/ Innovation / Entrepreneurship	---
		b) Summer vacation after 6th Semester	02-04 weeks	Industrial/Govt./ NGO/ MSME/ Rural Internship/ Innovation / Entrepreneurship	
		c) Total of a) and b) should be completed before the beginning of the 8th semester	04 weeks	Evaluation in 8th Semester	04
3	Capstone Project work / Professional Practice	7th Semester	3hours/week	Capstone project phase 1	00
		8th Semester	16 weeks	Professional Practice /Research Internship/ Capstone project phase 2	10
				Report preparation and writing	
Total Credits					**16**

Table-B1 states that during the ongoing/ summer vacations after the 2nd Semester, students are required to be involved in Inter/ Intra Institutional community engagement activities as outlined in section 3.3

3.3 Community Engagement

While intra-activities are within the institution, inter-activities shall be between the concerned institution and neighboring institutions. Intra and Inter activities are the activities that are the impetus to learning techniques. It adds to the comprehensive growth of the mind and associated activities.

As the students are on the verge of learning technical aspects and have a limited period of engagement, it is preferable to expose students to polygonal activities instead of one type of activity. Therefore, activities completed by the students shall not be one type of activity but can be few activities. In this regard, Intra and Inter-Institutional activities shall be completed under the supervision of a faculty on a self-learning basis.

The faculty have to kindle the latent abilities of the students, encourage, guide, supervise and shape them to achieve the desired result. Therefore, a learning agenda in the form of specific learning objectives and outcomes shall be prepared before the start of community engagement.

Whatever the activity/activities that are/are done under Intra and Inter-Institutional activities, should ignite the inquisitiveness to learn, enhance the knowledge, thinking ability and imagination, planning, application of mind, execution ability, innovation attitude, listening and understanding, vocabulary, personal expression, public speaking, written communication, oral presentation of the subject matter, acquire leadership qualities and teamwork requirements, responsiveness, ethics, etc.

3.3.1 Societal (Social) related activities

Short-term internships (about 2 weeks) in villages, slums, or urban areas can be under social internship. The internship will be more fruitful if students work in teams. The teams can select one or more fields to do their best in the field of agriculture, watershed management, wastelands development, non-conventional energy, low-cost housing, sanitation, nutrition and personal hygiene, schemes for skill development, income generation, blood bank, and government schemes such as

i) (Swachch Bharat: Swachh Bharat Mission, Swachh Bharat Abhiyan, or Clean India Mission is a country-wide campaign to eliminate open defecation and improve solid waste management.
ii) Accessible India: Accessible India Campaign or Sugamya Bharat Abhiyan is a program to serve the differently able community of the country.
iii) Digital India: A campaign to ensure the Government's services are made available to citizens electronically by improved online infrastructure and by increasing Internet connectivity or making the country digitally empowered in the field of technology.
iv) Beti Bachao and Beti Padhao: A campaign of the Government of India that aims to generate awareness and improve the efficiency of welfare services intended for girls in India.
v) Environment and Energy Conservation and Education, legal aid, consumer protection, and allied field including Indian Red Cross Society, National Cadet Corps, Bharat Scouts, and Guides.

Societal activities are one of the NBA graduate attributes that are part of PO6 and PO7, which are reproduced below.

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

vii) PO-7: Environment and Sustainability: Understand the impact of the professional engineering solution in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development. The long-term goal under Societal (social work) related activities, particularly in a rural area, results in a rural internship. In urban areas, the student may adopt slum/ economically weaker section areas for short duration social internship to uplift the living conditions.

Given the above, internship coordinators should encourage students to take up a societal internship as far as possible.

3.3.2 List of proposed activities

a. Activities concerned with the works of Indian scholars like Charaka and Susruta, Aryabhata, Bhaskaracharya, Chanakya, Madhava, Patanjali, Panini, and Thiruvalluvar, among numerous others
b. Community Photography.
c. Short film production: Contemporary aspects, technical aspects, etc.
d. Internship in Disaster Management.
e. Solar energy connected activities that help the common man.
f. Working with Smart City Administration.
g. Hackathon (it is a design sprint-like event in which computer programs and others involved in software development, including graphic designers, interface designers, project managers, and others, often including domain experts collaborate intensively on software projects).
h. Industrial Safety, Fire Safety, Electrical Safety, Chemical Process Safety, Food Safety, etc.
i. Internship and project work in Indian Knowledge System related Areas/Topics.

3.3.3 Documents to be submitted by Students for Community Engagement Evaluation

3.3.3.1 Student's Diary

The main purpose of writing a daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the student's thought process and reasoning abilities. The students shall record in the daily training diary the day-to-day account of the observations, impressions, information gathered, suggestions given, if any, and activities carried out. It should contain sketches and drawings related to the observations made by the students. The daily training diary should be signed after every day or at least twice a week by the faculty/ in charge of the section (external expert) where the student has been working.

Student's Diary should be submitted by the students along with attendance records. It shall be evaluated based on the following criteria:

i) Regularity in the maintenance of the diary.
ii) Adequacy and quality of information recorded.

iii) Drawings, sketches, and data were recorded.
iv) Thought processes and recording techniques were used.
v) Organization of the information

3.3.3.2 Report: Community Engagement (CEN)

After completion of the CEN, the student shall prepare, with a daily diary as a reference, a comprehensive report in consultation with the mentor/s to indicate what he/she has observed and learned in the training period along with the internship outcomes. The CEN report should be signed by the mentor. The Internship report shall be evaluated based on the following criteria and/or other relevant criteria about the activity completed.

i) Originality.
ii) Adequacy and purposeful write-up.
iii) Organization, format, drawings, sketches, style, language, etc.
iv) Practical applications, relationships with basic theory, and concepts taught in the appropriate course.
v) Variety and relevance of learning experience.

3.3.3.3 Procedure for the Evaluation of Community Engagement

a) Students should submit the reports immediately on completion of the Internship to the respective mentors as outlined in **Table B-2**
b) The Examination of the Community Engagement will be carried out by the mentor
c) The Community Engagement shall be slated for 100 marks CIE only and will not have SEE.
d) Community Engagement marks are based on CIE marks (25 marks for the Social Connect and responsibility, 25 marks for the presentation, and 50 marks for the report and final presentation).
e) A Viva-Voce examination to be conducted (Presentation followed by question-answer session) and the prescribed credit shall be included in the VIII semester grade card.

3.3.4 Assessment Rubrics for evaluation of Community engagement (Intra and Inter-Institutional Activities)

Table – B2 Community Engagment Assessment Rubrics Scheduled during the first year (Prescribed Period 02 weeks and Prescribed credits: 02)

Sl No	Sub Activity Head	Performance/ Appraisal	Assessment Rubrics (Allotted Percentage marks decide the letter grade) Percentage Marks	Proposed Document as Evidence	Evaluated by
1	Community Engagement: Inter/ Intra Institutional activitiues.	Excellent	80 to 100	(i) Student's Diary and (ii) Community Engagement Report along with the certificate issued from the relevant	Institute Faculty (mentor) together with External Expert, if any.
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 40		
Note: The total CIE marks are 100 (25 marks for the Social Connect and responsibility, 25 marks for the presentation, and 50 marks for the report and final presentation). shall be the sum of marks allotted to completed activities by the student.					

3.4 Industry Internship (04 weeks) [Scheduled during the intervening period of IV & V semesters and VI & VII semesters]

3.4.1 Industrial Internships

The gap between the theoretical knowledge obtained in the classrooms and the practical skills required in the actual workplace scenarios is fast growing. This has put forth varied challenges to graduating students when it comes to job placements. As institutes cannot have a relevant facility to expose students to a real-time industrial environment, an industrial internship is an appropriate solution.

The main objective of the industry internship is to ensure that the intern is exposed to a real job world environment and gains practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned.

3.4.1.1 Industry Internship Benefits

i) Have ample opportunities to attend seminars, symposiums, workshops, etc. This in turn provides an opportunity to establish rapports with professionals and pioneers in their respective fields for further growth.

ii) Have wide scope to publish paper/s in journals.
iii) Good recommendation letter/s that increase the prospectus for further internships, higher studies, and placements.
iv) Helps to acquire team spirit, motivated acts, techniques to resolve conflicts, etc.
v) Helps to develop a lot of leadership skills.
vi) Increases the prospect of placement in the same concern, provided the intern has exhibited a clear understanding of basics and completed the internship.
vii) Fosters to substantiate the issues with facts and figures.

For AICTE Internship opportunities refer to https://internship.aicte-india.org/

3.4.2 Industry Internship Supervision

During the intervening period of the IV & V semesters and VI & VII semesters, students shall be ready for industrial experience. Therefore, they shall choose to undergo an Internship involving Innovation / Entrepreneurship/short-term (about 4 weeks) societal-related activities. Students may choose to work on innovation or entrepreneurial activities, or both resulting in start-up or undergo internship with industry/NGO/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.

- The internship shall be carried out under the supervision of a faculty mentor. The faculty mentor/guide should,
- Serve as a teacher, mentor, trainer, critic, leader, and boss.
- Provide sufficient time to guide the interns. (Interns are students or a trainee who does a job to gain work experience)
- Play a vital role, along with the Training and Placement Officer, in providing internship opportunities for the students.
- Exhibit qualities such as leadership, strong communication skills, and patience.
- Provide a letter of recommendation in due consultation with students and the industrial organization (if possible) where the internship is intended to be carried out, endorsed by the authority (Principal/Institution Internship Coordinator).
- Each faculty mentor shall supervise the students/Student batches allotted to them. Often, the supervision may be by an external expert also. In such cases, the faculty mentor shall jointly guide the student/s without causing miscommunications/embarrassment to either side.
- Depending on the activity taken up by the students, the internship shall be carried out individually or in batches having not more than three students.
- Faculty Mentor, along with the external expert, shall scrupulously evaluate the work of an individual student or students of a batch and maintain the relevant documents.
- For allotment of CIE marks, the institutions shall prepare the rubrics for each activity offered by the institution as given in Table - B2. The marks shall be allotted by the Internship committee designated by HOD in consultation with the mentors.
- For all activities conducted by the institution, the attendance of the students shall be maintained by the faculty and maintained in their respective departments.

3.4.3 Innovation

Innovation refers to a new or improved product or process or a combination thereof that differs marginally or significantly from the unit's previous product. An innovation center is a place where students are encouraged to implement the innovative ideas formed through imagination, brainstorming sessions, design thinking, and associated activities to bring them to reality. It is a place, where creative minds are shaped.

3.4.4 Entrepreneurship

Entrepreneurship refers to setting up a new business or business and taking on financial risks in the hope of profit. It involves investment to undertake production along with arranging inputs like land, labour, material, and capital, introducing new techniques and products, identifying new sources for the enterprise, etc.

3.4.5 Incubation Center

An organized unit designed for innovation as well as to accelerate the growth and success of new entrepreneurial companies through mentorship and an array of business support resources and services that could include physical space, capital, coaching, common services, and networking connections.

3.4.6 Startup

An entity that develops a business model based on either product innovation or service innovation and makes it scalable, replicable, and self-reliant.

An entity shall be considered a Startup

i) Up to ten years from the date of incorporation/ registration, if it is incorporated as a private limited company (as defined in the Companies Act, 2013) or registered as a partnership firm (registered under section 59 of the Partnership Act, 1932) or a limited liability partnership (under the Limited Liability Partnership Act, 2008) in India.

ii) Turnover of the entity for any of the financial years since incorporation/ registration has not exceeded one hundred crore rupees.

iii) The entity is working towards innovation, development, or improvement of products or processes, or services, or if it is a scalable business model with a high potential for employment generation or wealth creation.

iv) Provided that an entity formed by splitting up or reconstruction of an existing business shall not be considered a Startup.

3.4.7 Places for Innovation/Entrepreneurial Activities

Students shall carry out Innovation or Entrepreneurial activities or both at the Incubation Center and Entrepreneurship Cell of the parent institution or elsewhere such as ATAL Incubation Centers [A flagship of Atal Innovation Mission (AIM), NITI Aayog for promoting the culture of innovation and entrepreneurship in India], institutes of national importance, public sector units, IT companies, government organizations, and non-governmental organizations, industries including MSME, etc.

- **Institutes should deter students to opt for internships at places established for commercial benefits.**

3.4.8 Assessment Rubrics for Innovation / entrepreneurship/ Industry Internship Activities (refer Table B3)

Once the internship begins, the students are required to maintain a diary/journal and submit a report regularly to the guide. These reports should summarize the activities in which the student was involved during the previous week's period. At the end of the

internship, each student is required to submit a hard copy of the consolidated diary/journal and report for evaluation. The report should indicate the learning and achievements of the internship.

Table – B3 Innovation/entrepreneurship/ Industry Internship Activities and Assessment Rubrics Scheduled during the intervening period of IV & V semester and VI & VII Sem (Prescribed Period 04 weeks: Credits 04)				
Sub Activity Head	**Performance/ Appraisal**	**Assessment Rubrics**	**Proposed Document as Evidence**	**Evaluated by**
(1) Development of new product/ Business Plan/ registration of start-up	Excellent	80 to 100	(i) Student's Diary and (ii) Internship Report or the activity report along with Certificate or Declaration from relevant Authorized Authority. Wherever only Certificate is issued, Assessment shall be at the institute as per (i) and (ii) to decide the letter grade.	(i)Institute Faculty (mentor) together with External Expert if any.
	Good	60 to 79		
	Satisfactory	40 to 59		
	Unsatisfactory and fail	< 40		
(2) Internship with Industry/ Govt. / NGO/ PSU/ Any Micro/ Small/Medium Enterprise.	Excellent	80 to 100		
	Good	60 to 79		
	Satisfactory	40 to 59		
	Unsatisfactory and fail	< 40		
Note: **(i)** The total CIE marks shall be the sum of marks allotted to successfully completed activities by the student.				

4. Capstone Project/Professional Practice / Research Internships

4.1 Capstone project/Research Internship/Professional practice of sufficient duration encourages students early on in their careers. Its main goal is to allow improving their analytical and technical skills in an international environment. An internship can be in an industry or at an appropriate workplace.

- Research internships/industrial projects have different purposes and come with a set of benefits. A prior experience in any field is always preferred over a fresh start. Therefore, one of them can be selected depending on the interest the students have. Internships pose unexpected challenges and make students think appropriately, tackle difficulties with ease, and act in a scholarly way to get past the hurdles and practical constraints. An internship is always beneficial however good or bad it is.
- Professional practice not only enhance one's learning but also identifies him/her as someone who commits to approaching a project and completing it with or without guidance. Internship learning is an impetus for professional development.
- While a research internship is a stepping stone to higher studies, an industry internship is a pathway to a placement. Those who are self-motivated and interested in searching for new things that are original and unique can choose a research internship. Those who are interested in real industry- experience and aspire to get a job soon after graduation can choose an industry internship.
- Research Internships (Also known as dissertation internships) are focused research projects that push students' intellectual abilities beyond those driven by the classroom. Often, a research internship typically helps solve problems that are usually part of major research

projects. It involves a short theoretical or experimental research project supervised by a researcher.

- The research internships, under the advice of a faculty supervisor, can be one's own selected project or a project on which a Researcher is researching, or a new project/real-world project offered by an organization. The research area may be about single or multidisciplinary fields such as science, technology, engineering, mathematics, management, and business studies. Research internships can be carried out either individually or in teams (not exceeding 3 or 4 students).
- Research internship opportunities, before graduation, maybe in a laboratory of college, a research institute, or a company's R & D department. Apart from fixed working hours of the day of an organization, the researcher can devote sufficient time to other research-related activities for early and successful completion of the Research Internship.

4.2 Necessary Skills for Research Internship and Industrial Internship

For the internships to progress without hurdles and for successful completion, the Researchers should maintain a harmonious relationship with the guide/s, administrators, co-workers, and others, and strictly adhere to the rules and regulations of the workplace.

The other skills required or acquirable during the Internship are,

- Good Communication skills.
- Attention to detail.
- Planning and scheduling.
- Documentation.
- Critical thinking.
- Data collection.
- Data analysis.
- Ability to maintain quality, safety, and/or infection control standards.
- Appreciating and practicing ethical issues.

4.3 Responsibilities of an Intern

Interns,

a) If working with a researcher, shall assist the researcher in an ongoing research project or work collaboratively in designing a new project of mutual interest.
b) Shall engage in literature survey and get an insight of the research work at the initial stages.
c) Shall compile data, sort, file, implement ideas with minimal guidance and assist write papers.
d) Shall become familiar with several tools [meters (Electrical and Electronics, mechanical, computer, etc.)] used in data collection, software, graphic software, Statistical Package for the Social Sciences (SPSS) software [IBM's statistical software platform], etc.
e) Shall attain skills with Microsoft Word Office, Excel, PowerPoint, Outlook, etc.
f) Shall give a mid-term oral presentation to a committee for review and feedback.
g) Shall attend discussions, meetings, symposiums, classroom lectures, etc., to learn new scientific techniques, design experiments, analyze results, and formulate different hypotheses.
h) Shall learn to write reports and be able to correspond independently.
i) Shall manage time effectively.
j) Shall keep a track of the progress of the project.

k) Shall develop integrative thinking.

4.4 Research internship Outcomes

a) Generating technical paper/s and publishing in refereed journal/s.
b) Possibility of acquiring intellectual ownership and patent.
c) Build a prototype for an idea on which the research was carried out.
d) File patent/s.
e) Add academic knowledge to the field.
f) Enhanced ability in arranging meetings, presentations, seminars, training, etc.
g) Improved conscientiousness and ethics.

4.5 Research internships Benefits

a) Are a great way to pursue an academic career in teaching and research, as a Research Scientist at a Research Organization, Company, Industry sector, etc.
b) Establish professional networks for a future career.
c) Pave the way to join a research team and work alongside leading experts in the field.
d) Introduced to new ideas through interaction with like-minded students and others.
e) Develop research skills and knowledge in a specific area of interest.
f) Provide opportunities for growth, achievement, and personal development.
g) Offer an opportunity to publish a research paper that will boost the resume while applying for Post Graduate Studies

5. Evaluation Procedure of Rresearch Internship /professional practice /and Capstone Project (16 weeks)

5.1 The students pursuing the course Research **Internship /professional practice /and Capstone Project** shall submit the diary recordings of day-to-day activities to the concerned guide, reporting progress achieved in the course and seeking guidance to proceed with the internship. The interns should provide all the details to the guide so that he/she can discuss with the employer to make the internship successful.

5.2 The intern should constantly update the guide about the progress of the internship. The guide should know the intern's internship tasks, duties, responsibilities, and potential projects. The evaluation of interns and their internship progress should be honest and constructive.

5.3 The hardcopy or softcopy of the diary maintained by the interns must be signed at regular intervals by the guide.

5.4 Regarding the intern's feedback, the guides should propose changes in internship activities so that they are helpful to the internship.

5.5 Illustrations, drawings, photos, forms, samples, classified materials, etc., are to be included in the report only after obtaining the consent of the concerned authorities and should indicate the source of all such material. The final report should also be submitted to the place where the internship was carried out. The report should avoid a tone that is predominantly cynical or unduly critical of the employer or of those with whom the student intern has worked. The content of the report must be based on interns' own work.

5.6 Recommendation letter

The guide must state whether the intern,

a) Exceeded the expectations of the internship.
b) Met the expectations of the internship.
c) Did not meet the expectations of the internship.
d) Did work to a satisfactory level.
e) Did an unsatisfactory internship.

In the end, the guide should issue a recommendation letter.

5.7 Continuous Internal Evaluation (CIE)

The guides should evaluate the interns using the following as well as any other appropriate methods.

a) Punctuality of intern.
b) Conduct and character.
c) Tactfulness and politeness with colleagues and the public.
d) Attitude regarding professionalism.
e) Inquisitiveness and eagerness to learn.
f) Research attitude.
g) Problem-solving techniques.
h) Innovation mindset.
i) Time management and meeting deadlines.
j) Receptiveness to feedback and critiques.
k) Ability to work in a team as a member.
l) Ability to work without supervision.
m) Supervisory skills and leadership skills.
n) Judgment and decision-making skills.
o) Writing skills, oral communication skills, technical communication skills, computer skills, analysis skills, and business writing skills.
p) Appropriateness of technical skills.
q) Familiarization with writing technical papers, standards, codes, etc.
r) Reading Behavioural attitude.
s) Outcomes.
t) Successes and failures experienced

5.8 Assessment of CIE marks

5.8.1 **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the internship, shall be based on the evaluation of the diary, presentation skill, and viva-voce in the ratio of 50:25:25.

5.8.2 **Interdisciplinary:** The CIE marks awarded for the internship, shall be group-wise at the institution level with the participation of all guides of the internship. Participation of external guide/s, if any, is desirable.

5.8.3 The CIE marks awarded for the internship, shall be based on the evaluation of the diary, presentation skill, and viva-voce in the ratio of 50:25:25.

5.9 Assessment of SEE marks

5.9.1 Single discipline: Contribution to the internship and the performance of each group member shall be assessed individually in the semester-end examination

(SEE) conducted at the department. Marks shall be awarded based on the evaluation of the report, presentation skill, and viva-voce in the ratio of 50:25:25.

5.9.2 Interdisciplinary: Contribution to the internship and the performance of each group member shall be assessed individually in the semester-end examination (SEE) conducted separately at the departments to which the student/s belongs. Marks shall be awarded based on the evaluation of the report, presentation skill, and viva-voce in the ratio of 50:25:25.

5.10 Evaluation Industry Internship/Professional Practice /Project Work:
Split-up of marks for evaluation of Project work for 100 CIE marks and 100 SEE marks.

Split up	Rubrics		% Marks
Report (50 % Marks)	Content Development	Abstract/ Synopsis Write-up	10
		Selection of Topic/ Relevance of the subject to the concerned discipline	05
		Problem Identification	05
		Objectives and Methodology	05
	Problem-Oriented Exposition	Literature Survey (Papers/Sites/Sources Surveyed)	10
		Documentation/ Systematic Approach	10
		Results (with inferences, Conclusions, etc.)	05
Project Presentation Skill (25 % Marks)		Quality of preparation of presentation	05
		Communication Skills	05
		Technical knowledge and awareness	05
		Individual involvement	10
Viva-Voce (25 % Marks)		The clarity in answering questions relating to fundamentals and concepts	10
		The clarity in answering the questions related to the project	05
		The understanding ability of the questions asked	05
		The confidence in answering the questions asked.	05
		Total Marks	100 %

Dept of Electrical and Electronics Engineering

Vision:
Pursuing excellence in Electrical & Electronics Engineering, creating a research environment to promote innovation and address global challenges

Mission:

- Equip students to face global challenges by excelling in a professional career and higher education
- Offer high-quality graduate and post graduate programs in electrical & electronics engineering
- Promote excellence in research, collaborative activities and contribute to social development with ethical values

Program Educational Objectives (PEOs):
To satisfy the mission of the Electrical & Electronics engineering program, the graduates will:
PEO1: Excel in professional career and / or higher education by acquiring knowledge in mathematical, electrical, electronics and computer engineering principles

PEO2: Analyze real life problems, design electrical and electronics & multidisciplinary engineering systems and solutions that are socially acceptable

PEO3: Inculcate and exhibit ethical values, communication skills and provide supportive and leadership roles in their profession to emerge as excellent professionals and adapt to current trends by engaging in lifelong learning to promote research

Program Outcomes (POs):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8: Individual and Collaborative Team work: Function effectively as an individual,

and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs):

PSO1: An ability to demonstrate the electrical and electronics engineering concepts by developing working models.

PSO2: Ability to model, simulate and develop application specific systems to meet industrial /societal needs.

I/II SEMESTER

First Year: 21 credits/semester

Option-1: 21 Credits															
I/II SEMESTER															
Sl. No	Course Type and Course Code		Course Title	Teaching Department	Contact Hours/Week				SL	Examination				Credits
					L	T	P	J		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	BSC	MAT102	Matrix Algebra and Calculus	MAT	3	1	-	-	1	3	50	50	100	4
2	BSC	CHY104	Materials Chemistry for Devices and E-waste Management	CHY	3	-	2	-	2	3	50	50	100	4
3	BSC	CIV104	Environmental Science & Sustainability	CIV	2	-	-	-	1	3	50	50	100	2
4	ESC	MEC112	Elements of Mechanical Engineering	MEC	3	-	-	-	1	3	50	50	100	3
5	ESC	EEE101	Electrical Circuit Analysis I	EEE	3	-	-	-	1	3	50	50	100	3
6	HSMC	HSS102	Universal Human Values & Professional Ethics	Any	2	-	-	-	1	3	50	50	100	2
7	BSC	BTY111	Biology for Engineers	BTY	1	-	-	-	-	1	50	50	100	1
8	ESC	CSE121	IT Skills	CSE/ Any	-	-	2	-	1	3	50	50	100	1
9	ESC	MEC122	Engineering Visualization	MEC	-	-	2	-	1	-	50	-	50	1
Total Option-1					17	01	6	-	9	**22**	**450**	**400**	**850**	**21**
Additional Academic activities beyond class hours					-	-	-	-	7					
Learning hours per week					17	01	6	-	16					
Total notional learning hours (L+T+P+J+SL)			Per week		40									
			Per semester		40x16=640									

Optipon-1, 21 credits															
I/II SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT105	Differential equations and Laplace Transforms	MAT	3	1	0	-	1	3	50	50	100	4
2	BSC	PHY104	Wave Mechanics and Optoelectronics	PHY	3	0	2	-	2	3	50	50	100	4
3	ESC	ECE111	Basic Electronics	ECE	3	0	0	-	1	3	50	50	100	3
4	ESC	ECE101	Applied Digital Logic Design	ECE (Allied) EEE	2	0	2	-	1	3	50	50	100	3
5	PLC	CSE101	Introduction to C Programming	CSE (Allied)	2	0	2	-	1	3	50	50	100	3
6	AEC	HSS131	Communicative English	HSS	1	0	2	-	**1**	3	50	50	100	2
7	PLC	MAT107	Mathematics with MATLAB	MAT	0	0	2	-	-	0	50	0	50	1
8	HSMC	HSS101	Constitution of India & Global Citizenship	HSS	1	0	0	-	-	0	50	0	50	1
				Total	**15**	**01**	**10**	**-**	**7**	**18**	**400**	**300**	**700**	**21**
Additional Academic activities beyond class hours								-	7					
Learning hours per week					15	01	10	-	14					
Total notional learning hours (L+T+P+J+SL)			Per week		40									
			Per semester		40x16=640									

Mandatory community Engagement							
9	INT	Community Engagement (Activity-based Internship)	3) **Social connect & Responsibility** (15 hours lecture to be engaged during second semester)	50	0	100	2*
			4) Activity based Internship to focus on the activities pertaining to Social Connect & Responsibility (1 week duration (40 - 45 hours) to be completed during the vacations of II, IV, V & VI Semesters.)	50	0		

*The grades will be included in the VIII semester grade card

Option-2, First Year: 22 credits/semester

Option-2, 22 credits															
I/II SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT102	Matrix Algebra and Calculus	MAT	3	1	0	-	1	3	50	50	100	4
2	BSC	CHY104	Materials Chemistry for Devices and E-waste Management	CY	3	-	2	-	2	3	50	50	100	4
3	BSC	CIV104	Environmental Science & Sustainability	CIV	2	-	-	-	1	3	50	50	100	2
4	ESC	MEC112	Elements of Mechanical Engineering	MEC	3	-	-	-	1	3	50	50	100	3
5	ESC	EEE101	Electrical Circuit Analysis – I	EEE	3	-	-	-	1	3	50	50	100	3
6	HSMC	HSS102	Universal Human Values & Professional Ethics	Any	2	-	-	-	1	3	50	50	100	2
7	BSC	BTY111	Biology for Engineers	BTY	1	-	-	-	-	1	50	50	100	1
8	ESC	CSE121	IT Skills	CSE/ Any	-	-	2	-	1	3	50	50	100	1
9	ESC	MEC122	Engineering Visualization	MEC	-	-	2	-	1	-	50	-	50	1
10	AEC	HSS132	Enhancing Self-awareness and Communication	HSS	-	-	2	-	-	-	50	-	50	1
			Total Option-1		17	01	8	-	9	**22**	**500**	**400**	**900**	**22**
Additional Academic activities beyond class hours					-	-	-	-	7					
Learning hours per week					18	-	8	-	16					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=672									

Option-2, 22 credits															
I/II SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT105	Differential equations and Laplace Transforms	MAT	3	1	0	-	1	3	50	50	100	4
2	BSC	PHY104	Wave Mechanics and Optoelectronics	PHY	3	0	2	-	2	3	50	50	100	4
3	ESC	ECE111	Basic Electronics	ECE	3	0	0	-	1	3	50	50	100	3
4	ESC	ECE101	Applied Digital Logic Design	EEE	2	0	2	-	1	3	50	50	100	3
5	PLC	CSE101	Introduction to C Programming	CSE/ Any	2	0	2	-	1	3	50	50	100	3
6	AEC	HSS131	Communicative English	HSS	1	0	2	-	**1**	3	50	50	100	2
7	PLC	MAT107	Mathematics with MATLAB	MAT	0	0	2	-	-	0	50	0	50	1
8	HSMC	HSS101	Constitution of India & Global Citizenship	HSS	1	0	0	-	-	0	50	0	50	1
9	AEC	HSS133	Building of Psychological Assets	HSS	-	-	2		-	0	50	0	50	1
				Total	**15**	**01**	**12**	**-**	**7**	**18**	**450**	**300**	**750**	**22**
Additional Academic activities beyond class hours								-	8					
Learning hours per week					16	0	11	-	15					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=672									

Mandatory community Engagement							
10	INT	Community Engagement (Activity-based Internship)	3) **Social connect & Responsibility** (15 hours lecture to be engaged during second semester)	50	0	100	2*
			4) Activity based Internship to focus on the activities pertaining to Social Connect & Responsibility (1 week duration (40 - 45 hours) to be completed during the vacations of II, IV, V & VI Semesters.)	50	0		

*The grades will be included in the VIII semester grade card

MATRIX ALGEBRA & CALCULUS

Course Code:	**MAT102**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P):	**3:1:0**	**Credits:**	**04**
Total Teaching Hours:	**45+15+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mathematics

Course Objectives:

1	This course will enable the students to master the basic tools of elementary linear algebra, eigen values and eigenvectors of a square matrix using the characteristic polynomial, differential calculus, partial differentiation, multiple integration and become skilled for solving problems in science and engineering.

UNIT-I

Matrices — **9+3 Hours**

Elementary row transformations of a matrix, Rank of a matrix by echelon form, Consistency of system of equations, Solution of system of linear equations, Gauss-elimination method, solving system of equations by Gauss- Siedel Method, LU decomposition method, Tridiagonal system,

UNIT-II

Eigen Values and Eigen vectors — **9+3 Hours**

Eigen values and Eigenvectors (Direct method), Trace, relation between trace and Eigen values of a matrix, Characteristic equation, Power method of finding dominant Eigen value and corresponding Eigenvector, Eigen values of symmetric matrices using Jacobi Method and Given's method. Diagonalization.

UNIT - III

Differential calculus — **9+3 Hours**

Polar curves, angle between the radius vector and the tangent, angle of intersection of two curves. derivatives of arcs, radius of curvature - Cartesian, parametric and polar forms. Rolle's Theorem (without proof), mean value theorems, Taylor and Maclaurin series.

UNIT-IV

Partial Differentiation — **9+3 Hours**

Partial derivatives of simple functions, total differentiation - differentiation of composite and implicit functions, Jacobians. Taylor's theorem for functions of two variables, maxima and minima for functions of two variables, Lagrange's method of undetermined multipliers.

UNIT -V

Multiple Integrals — **9+3 Hours**

Double integrals and triple integrals, evaluation by change of order of integration, change of variables and applications to area and volume. Beta and Gamma functions and their properties.
Applications: Calculation of mass, centre of gravity

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

1	Solve system of equation numerically to get approximate solution
2	Compute and interpret Eigen values and Eigen vectors
3	Apply mean value theorem, Taylor's series and concepts of polar curves for engineering problems
4	Differentiate multivariate functions and Extremize the same.
5	Evaluate multiple integrals and apply the concept of special fuctions

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2										
2	2	2										
3	3	1										
4	3	2										
5	3	2										

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, 2015.
2	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition (Reprint), 2016.
3	N.P. Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
REFERENCE BOOKS:	
1	G.B. Thomas and R.L.Finney, "Calculus and Analytic geometry", Pearson, 2002.
2	Shanthi Narayan, " Differential Calculus, 6th edition, Shyam Lal Charitable Trust, Delhi.
3	Seymore Lipschutz, Marc Lipson, "Linear Algebra" 3rd edition, Schaum series,Tata McGraw Hill,2011
4	Gilbert Strang "Linear Algebra for everyone" 2020,PHI
E Books / MOOCs/ NPTEL	
1	***http://nptel.ac.in/courses/111107108/***
2	***https://nptel.ac.in/courses/122101003***

MATERIALS CHEMISTRY FOR DEVICES AND E-WASTE MANAGEMENT

(EE/EC/ACT/VLSI and All IT branches)

Course Code:	**CHY104**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**45+0+30**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Chemistry

Course Learning Objectives:

1.	To explain the principles and applications of various electrodes and energy systems, including batteries and solar cells, in sustainable technologies
2.	To explore corrosion mechanisms and control methods, alongside metal finishing processes such as electroplating and electroless plating
3.	To understand the principles and applications of sensors, memory devices, and advanced display systems in modern engineering
4.	To examine the synthesis, properties, and applications of polymers and nanomaterials in engineering
5.	To learn the principles of green chemistry and e-waste management, emphasizing sustainable practices in engineering applications.

UNIT-I

ELECTRODES AND ENERGY SYSTEMS — **09 Hours**

Electrodes: Introduction, types of electrodes; Reference electrode - introduction, Calomel electrode – construction, working, advantages and applications; Concentration cell – definition, construction, working, and numerical problems; Ion selective electrode – introduction, glass electrode - construction, working and advantages of glass electrode, determination of pH using glass electrode, Concentration cell – definition, construction, working, and numerical problems;

Energy Systems: Introduction to batteries; classification of batteries; construction, working and applications of Li-ion battery; Flow battery – introduction, construction, working and applications of vanadium redox flow battery; Construction, working and applications of solar photovoltaic cell, advantages and disadvantages; synthesis of solar grade silicon by union carbide method

UNIT II

CORROSION SCIENCE AND METAL FINISHING — **09 Hours**

Corrosion Science: Introduction; electrochemical theory of corrosion (taking Fe as example), corrosion types – differential metal corrosion, differential aeration corrosion, pitting corrosion; factors affecting corrosion – primary and secondary factors; corrosion penetration rate – numerical problems; corrosion control – metal coating (galvanization and tinning), anodization, sacrificial anode method,

Metal Finishing: Introduction; electroplating – definition, principle, factors affecting electroplating, electroplating of chromium (hard chromium and decorative chromium); electroless plating – definition, advantages, application of electroless plating of copper in the manufacture of PCB; comparison between electroplating and electroless plating

UNIT-III

ANALYTICAL TECHNIUQES, MEMORY DEVICES AND DISPLAY SYSTEMS — **09 Hours**

Analytical technique and sensors: Conductometry- principle, instrumentation, conductometric titration of strong acid and acid mixture; Potentiometry- principle, instrumentation and application of potentiometry in the estimation of iron; determination of pKa of weak acid, Colorimetry- principle (Beer Lambert's law), instrumentation and application in determination of Cu/Fe; **Electrochemical sensors** – introduction, construction and working of electrochemical sensors for detection oxides of sulphur

(Industry), diclofenac (medicine); disposable sensors and their advantages

Memory Devices: Introduction; basic concepts of electronic memory; classification of electronic memory devices; types of organic memory devices (organic molecules, polymeric materials, organic-inorganic hybrid materials)

Display Systems: Liquid crystals (LCs) – introduction; classification of LCs and types of mesophases; electro-optic effect; Liquid Crystal Display (LCD) unit – construction and application in numerical display; characteristics, working and applications of organic light emitting diode (OLED) and quantum light emitting diode (QLED)

UNIT IV

POLYMERS AND NANOMATERIALS	**09 Hours**

Polymers: Introduction; classification based on origin, structure, methods of polymerization, response to heat; Molecular weight of polymers: number average molecular weight, weight average molecular weight and poly dispersion index (PDI) - numerical problems;; **Polymer composites** – introduction, synthesis, properties and applications of carbon fiber; **Conducting polymers** – introduction, conducting mechanism of polyacetylene by oxidative and reductive doping, applications of conducting polymers.

Nanomaterials: Introduction; classification based on dimension; catalytic and thermal properties of nanoparticles; synthesis of nanomaterials by top-down approach (photolithography) and bottom-up approach (sol-gel method); synthesis by CVD technique

UNIT-V

E-WASTE MANAGEMENT	**09 Hours**

E-waste management: Introduction; sources of e-waste; composition, characteristics and need of e-waste management; health hazards due to exposure to e-waste; heavy metals present in the E-waste and their ill effect on health and environment. Extraction of metals from e-waste- Pretreatment, Pyrometallurgy-smelting, combustion, incineration and pyrolysis. Hydrometallurgy- Use of different leaching agents in metal extraction, Metal recovery- Use of solvents, adsorption, ion exchange and electrodeposition, extraction of gold and copper from e-waste. . Role of stakeholders in environmental management of e-waste (producers, consumers, recyclers, and statutory bodies).

List of Experiments (Any ten)

1	Determination of strength of an acid in Pb-acid battery.
2	Determination of Total Hardness of a sample of water using disodium salt of EDTA.
3	Estimation of iron in TMT bar by diphenylamine/external indicator method.
4	Conductometric estimation of strong acid/weak acid with standard NaOH solution.
5	Conductometric estimation of acid mixture with standard NaOH solution.
6	Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution.
7	Determination of pKa of vinegar using pH sensor (Glass electrode).
8	Determination of the viscosity coefficient of a given liquid using Ostwald's viscometer.
9	Estimation of Copper present in electroplating effluent by optical sensor (colorimetry).
1	Colorimetric determination of iron.
1	Estimation of Sodium present in soil/effluent sample using a flame photometer.
1	Synthesis of biodiesel (Demonstration).
1	Synthesis of Iron-oxide Nanoparticles (Demonstration).
1	Synthesis of polyurethane (Demonstration).

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

1	Apply the principles, types, and applications of various electrodes and energy systems, such as batteries and solar cells, in promoting sustainability in engineering

2	Apply corrosion control techniques, including metal finishing methods like electroplating and electroless plating, in real-world engineering contexts.
3	Analyze the principles and evaluate the applications of sensors, memory devices, and display systems in modern engineering technologies.
4	Analyze the synthesis, properties, and practical applications of polymers and nanomaterials in various engineering fields.
5	Apply the principles of green chemistry and assess e-waste management strategies, focusing on sustainability and environmental impact in engineering practices.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓		
↓ Course Outcomes														
CHY104-1.1	3	1												
CHY104-1.2	3	2												
CHY104-1.3	3	2												
CHY104-1.4	2	1												
CHY104-1.5	2	1												

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Engineering Chemistry by P.C. Jain & Monica Jain., Dhanpat Rai Publications, New Delhi.2015.
2	A Textbook of Engineering Chemistry, R. V. Gadag and Nityananda Shetty, I. K. International Publishing house. 2nd Edition, 2016.
3	A Textbook of Engineering Chemistry, SS Dara &Dr. SS Umare, S. Chand & Company Ltd., 12th Edition, 2011.

REFERENCE BOOKS:

1	Wiley Engineering Chemistry, Wiley India Pvt. Ltd. New Delhi, 2013-2nd Edition.
2	Engineering Chemistry, Satya Prakash &Manisha Agrawal, Khanna Book Publishing, Delhi.
3	Essentials of Physical Chemistry, Bahl & Tuli, S. Chand Publishing.
4	Applied Chemistry, Sunita Rattan, Kataria 5. Engineering Chemistry, Baskar, Wiley.
5	Engineering Chemistry – I, D. Grour Krishana, Vikas Publishing.
6	Textbook of Polymer Science, F.W. Billmeyer, John Wiley & Sons,4th Edition, 1999.
7	Nanotechnology A Chemical Approach to Nanomaterials, G.A. Ozin & A.C. Arsenault, RSC Publishing, 2005.
8	Linden's Handbook of Batteries, Kirby W. Beard, Fifth Edition, Mc GrawHill,2019.
9	OLED Display Fundamentals and Applications, Takatoshi Tsujimura, Wiley–Blackwell,2012
10	Supercapacitors: Materials, Systems, and Applications, Max Lu, Francois Beguin, Elzbieta Frackowiak, Wiley-VCH;1stedition,2013.
11	Handbook on Electroplating with Manufacture of Electro-chemicals", ASIAPACIFIC BUSINESS PRESS Inc., 2017. Dr. H. Panda.
12	Laboratory manual in Engineering Chemistry Sudharani, Dhanpat Rai Publishing Company, New Delhi.
13	Expanding the Vision of Sensor Materials. National Research Council 1995, Washington, DC: The National Academies Press. doi:10.17226/4782.
14	Engineering Chemistry, Edited by Dr. Mahesh B and Dr. Roopa Shree B, Sunstar Publisher, Bengaluru, ISBN978-93-85155-70-3, 2022.
15	High-Performance Metallic Materials for Cost-Sensitive Applications, F.H. Froes, et al. John Wiley

	& Sons, 2010.
16	Instrumental Methods of Analysis, Dr. K. R. Mahadik, and Dr. L. Satyanarayana, Nirali Prakashan, 2020.
17	Principles of Instrumental Analysis, Douglas A. Skoog, F. James Holler, Stanley R. Crouch Seventh Edition, Cengage Learning, 2020.
18	Polymer Science, VR Gowariker, N V Viswanathan, Jayadev, Sreedhar, New Age Int. Publishers, 4th Edition, 2021.
19	Nanostructure materials and nanotechnology, Hari Singh, Nalwa, academic press, 1st edition, 2002.
20	"Engineering Chemistry", O. G. Palanna, Tata Mc Graw Hill Education Pvt. Ltd. New Delhi, Fourth Reprint, 2015.
E-Books / MOOCs/ NPTEL	
1	http://libgen.rs/ • https://nptel.ac.in/downloads/122101001/
2	https://nptel.ac.in/courses/104/103/104103019/ • https://ndl.iitkgp.ac.in/.
3	https://www.youtube.com/watch?v=faESCxAWR9k

ENVIRONMENTAL SCIENCE AND SUSTAINABILITY

Course Code:	**CIV104**	**Course Type**	**BSC**
Teaching Hours/Week (L: T: P: S)	**2:0:0:0**	**Credits**	**02**
Total Teaching Hours	**30**	**CIE + SEE Marks**	**50+50**
Prerequisite	*		

Teaching Department: Civil Engineering

Course Objectives: This Course will enable students to:

1.	To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation
2.	To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters
3.	To facilitate the understanding of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
4.	To familiarize the concept of sustainable development goals.
5.	To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles.

UNIT-I

ENVIRONMENT AND BIODIVERSITY — **06 Hours**

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In- situ and ex-situ.

ENVIRONMENTAL POLLUTION — **06 Hours**

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

RENEWABLE SOURCES OF ENERGY — **06 Hours**

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Bio energy, Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT-II

SUSTAINABILITY AND MANAGEMENT — **06 Hours**

Sustainability- concept, needs and challenges-environmental, social and economic aspects of sustainability- Sustainable Development Goals-targets, indicators and intervention areas-Protocols-Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint, water Foot print Environmental management in industry-A case study

SUSTAINABILITY PRACTICES — **06 Hours**

Zero waste and R concept, Circular economy, LCA standards-ISO 14000 Series, Material Life cycle

assessment, Environmental Impact Assessment. Sustainable habitat: green buildings, green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles- carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization-Socio- economic and technological change

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

1.	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
2.	To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
3.	To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
4.	To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
5.	To demonstrate the knowledge of sustainability practices and identify green materials, energy Cycles and the role of sustainable urbanization

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	3
CIV104.1	1	2				2	3	2					1	3	
CIV104.2	1	1	2			2	3	2					1	3	
CIV104.3	2	1				2	3	2					1	3	
CIV104.4	2	1				2	3	2					1	3	
CIV104.5	1	1				2	3	2					1	3	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Anubha Kaushik and C. P. Kaushik ‘s ―Perspectives in Environmental Studies‖, 6th Edition, New Age International Publishers ,2018.
2.	Benny Joseph, _Environmental Science and Engineering ‘, Tata McGraw-Hill, New Delhi, 2016.
3.	Gilbert McMasters, _Introduction to Environmental Engineering and Science‘, 2nd edition, Pearson Education, 2004

REFERENCE BOOKS:

1.	R.K. Trivedi, _Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards ‘, Vol. I and II, Enviro Media. 38 Edition 2010.
2.	Cunningham, W.P. Cooper, T.H. Gorhani, _Environmental Encyclopedia‘, Jaico Publ., House, Mumbai, 2001.
3.	Dharmendra S. Sengar, _Environmental law ‘, Prentice Hall of India PVT. LTD, New Delhi, 2007.
4.	Rajagopalan, R, _Environmental Studies-From Crisis to Cure ‘, Oxford University Press, Third Edition, 2015.
5.	Erach Bharucha ―Textbook of Environmental Studies for Undergraduate Courses‖ Orient Blackswan Pvt. Ltd. 2013
6.	R.K. Trivedi, _Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards ‘, Vol. I and II, Enviro Media. 38. Edition 2010.

ELEMENTS OF MECHANICAL ENGINEERING

Course Code:	**MEC112**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T: P):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

Students belonging to all branches of Engineering are made to learn certain fundamental topics related to mechanical engineering so that they will have a minimum understanding of mechanical systems, equipment and processes.

1. Understand the principles of energy sources, formation of steam and boilers.
2. Know the working principles of pumps, compressors, and turbines.
3. Understand basic principles of I. C. Engines, Future mobility and Refrigeration, Air-Conditioning.
4. Understand the basic principles of power transmission and metal joining processes.
5. Understand the different machining operations, automation, and robotics.

UNIT-I	**09 Hours**

Introduction to Mechanical Engineering (Overview only):
Role of Mechanical Engineering in Industries and Society- Emerging Trends and Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors. Biomaterials, Biomedical applications, implants, Additive manufacturing.

Heat Transfer & Steam Formation
Definition, Modes of heat transfer with examples, Laws of Thermodynamics, Steam Formation and its applications.

Energy Sources and Power Plants:
Energy sources Types, Basic working principles of Hydel power plant, Thermal power plant, nuclear power plant, Solar power plant, Tidal power plant and Wind power plant.

UNIT-II	**09 Hours**

Pumps and compressors: Introduction, Working principles of Centrifugal Pump and Single Stage Reciprocating Compressor.

Turbines: Working principles of Impulse and Reaction steam turbines (De Laval and Parson's turbines), Water turbines (Pelton wheel, Kaplan, and Francis turbines), Gas turbines (Open and Closed cycles).

UNIT-III	**09 Hours**

Introduction to IC Engines: Components and working principles, 4-Stroke Petrol and Diesel engines, Application of IC Engines, performance of IC engines (Simple numericals).

Insight into future mobility technology; Electric and Hybrid Vehicles, Components of Electric and Hybrid Vehicles. Advantages and disadvantages of Electric Vehicles (EVs) and Hybrid vehicles.

Introduction to Refrigeration and Air Conditioning: Principle of refrigeration, Refrigerants and their desirable properties. Working principle of VCR refrigeration system, working principle of room air conditioner & Applications of air Conditioners

UNIT-IV	**09 Hours**

Mechanical Power Transmission & Metal Joining Processes:

Gear Drives: Types - spur, helical, bevel, worm and rack and pinion, velocity ratio, simple and compound gear trains (simple numerical problems)

Belt Drives: Introduction, Types of belt drives (Flat and V-Belt Drive, Timing belts), length of the belt

and tensions ratio (No derivations, simple numerical problems).
Joining Processes: Soldering, Brazing and Welding, Definitions, classification of welding process, Arc welding, Gas welding, (types of flames), TIG welding, MIG welding and Fusion welding.

UNIT-V	09 Hours

Machine Tool Operations:
Lathe: Principle of working of a center lathe, lathe operations: Turning, facing, knurling, thread cutting, taper turning by swiveling the compound rest,
Drilling Machine: Working of simple drilling machine, drilling operations: drilling, boring, reaming, tapping, counter sinking, counter boring,
Milling Machine: Working and types of milling machine, milling operations: plane milling, end milling and slot milling.
(No sketches of machine tools, sketches to be used only for explaining the operations). **Mechatronics and Automation:** Meaning, Need for automation, Types -Fixed, Programmable & Flexible automation. Elements of automated systems, Open and Closed loop control systems, Introduction to CNC machines.
Robotics: Introduction, Robot Anatomy, Classification based on Robot Configuration, Applications of Robots.

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

- Explain the principles of energy sources, formation of steam and Energy sources.
- Discuss the working principles of pumps, compressors, and turbines.
- Explain basic principles of I. C. Engines, Future mobility and Refrigeration, Air-Conditioning.
- Discuss the basic principles of power transmission and metal joining processes.
- Explain the different machining operations, automation, and robotics.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
MEC 112.1	3	1	-	-	-	1	1	-	1	-	-	-	-
MEC 112.2	3	1	-	-	-	-	-	-	1	-	-	-	-
MEC 112.3	3	2	-	-	-	-	-	-	1	-	-	-	-
MEC 112.4	3	2	-	-	-	-	-	-	1	-	-	-	-
MEC 112.5	3	2	-	-	-	-	1	1	1	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. K.R.Gopalkrishna, "A text Book of Elements of Mechanical Engineering" Subhash Publishers, Bangalore, 2010
2. Mikell P. Groover, "Automation, Production Systems & CIM", 3rd Edition, PHI, 2012
3. V.K. Manglik, "Elements of Mechanical Engineering", PHI Publications, 2013.

REFERENCE BOOKS

1. S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", 4th Edition 2006, Universities Press (India) Pvt. Ltd, Hyderabad.
2. K.P. Roy, S.K. Hajra Choudhury, Nirjhar Roy, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt Ltd, Mumbai,7th Edition,2012.
3. Pravin Kumar, "Basic Mechanical Engineering", 2013 Edition, Pearson.

E Books / MOOCs/ NPTEL

1. https://nidm.gov.in/iec.asp (Study material of National Institute of Disaster management)

ELECTRICAL CIRCUIT ANALYSIS-I			
Course Code	EEE101	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	ESC
PREREQUISITE:			

Course Objectives	
1.	To familiarise the basic laws and its applications to analyse the electrical circuits.
2.	To analyse the response of electrical circuits with DC input.
3.	To analyse the response of electrical circuits with sinusoidal AC input.
4.	To explain the concept of resonance in electrical circuits.
5.	To understand the concept of electromagnetism and its relevance in electrical machines.

Course Contents	
UNIT – 1	**9 Hours**
Network reduction techniques	
Introduction to DC circuits, series circuits, parallel circuits, series-parallel circuits, star/delta transformation, source transformation.	
UNIT – 2	**9 Hours**
Analysis of DC circuits	
Analysis of DC multi loop circuit for both independent and dependent sources: mesh, node, super mesh and super node.	
UNIT – 3	**9 Hours**
Analysis of AC circuits	
Instantaneous value, RMS values, Average value, Form factor, Peak factor (sine and square waveform). Analysis of R, L, C, RL, RC and RLC series circuits.	
UNIT – 4	**9 Hours**
AC multiloop circuit analysis	
Analysis of AC multi loop circuit for both independent and dependent sources: mesh, super mesh(restricted to 2 loops only) node, super node (restricted to 2 nodes only).	
Resonance	
Series and parallel circuit, half power frequencies, Q factor, bandwidth.	
UNIT – 5	**9 Hours**
Concept of magnetic circuits	
Statically induced emf (Self and Mutually induced emf) (transformer concepts), Dynamically induced emf (DC generator, motor concepts).	
Coupled circuits	
Coefficient of coupling, dot convention for coupled coils and analysis of simple coupled circuits.	

Course Outcomes	
At the end of the course student will be able to	
1.	Analyse the DC Circuits using network reduction techniques.
2.	Analyse the DC Circuits using mesh and nodal techniques.
3.	Understand the AC electrical circuit concepts and analyse the AC electrical circuits.

4.	Analyse the AC Circuits with /without variable frequency source.
5.	Understand the electromagnetic concepts and apply them in analysis of electrical machines.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
EEE101.1	3	2					1	1			
EEE101.2	3	2					1	1			
EEE101.3	3	2					1	1			
EEE101.4	3	2					1	1			
EEE101.5	3	2					1	1			

31: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Electrical Technology	Edward Hughes	Pearson Education	10th edition 2010.
2.	Electric circuits	A. Chakrabarthi	Dhanpath Rai and company	6th edition 2014.
3.	Engineering Circuit Analysis	W.H. Hayt and J.E Kemmerley	McGraw Hill	8th edition 2014.

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Electrical Engineering Fundamentals	Vincent Del Toro	Pearson	2nd edition, 2015.
2.	Electrical Technology	H. Cotton,	CBS publishers	7th edition, 2005.
3.	Basic Electrical Engineering	A. Mittle and V. N. Mittle	Tata McGraw Hill	2005.

UNIVERSAL HUMAN VALUES & PROFESSIONAL ETHICS

Course Code	**HSS102**	**Course Type**	**HSMC**
Teaching Hours/Week (L:T:P:S)	**02:0:0:0**	**Credits**	**02**
Total Teaching Hours	**30+0+0**	**CIE + SEE Marks**	**50 + 50**

Teaching Department: Any

Course Objectives:

1	To enable the students to appreciate the 'values', "Skills' and 'Behaviour' with an appropriate understanding of the 'self' to attain sustained happiness and prosperity with right aspirations of life
2	To develop a holistic perspective among the students towards physical needs and prosperity of life
3	To develop a holistic approach and understanding the importance of co-existence and living in harmony ensuring mutually fulfilling interaction with society and nature

UNIT - I

10 Hours

Self-exploration – Content and Process; Natural Acceptance and Empirical Validation
Continuous Happiness and Prosperity – Understanding basic human aspirations; Mindfulness and awareness of right aspirations
Right Understanding, Relationships and Physical Facilities – Requirements for the fulfillment of aspirations with correct priority - Happiness and Prosperity

UNIT - II

10 Hours

Understanding Harmony in the 'Human being' and Harmony in 'Self' – Human being as a co-existence of sentient 'I' (Self) and 'Body'; Body as an instrument

UNIT - III

10 Hours

Understanding Harmony in Family and Society – Harmony in Human Relationships; Universal harmonious order in Family, Society and Universe (Journey from Family to World Family); Personal and Professional Ethics;
Understanding Harmony in Nature and Existence – Existence as 'Co-existence'; Holistic Perception of Harmony at all levels of existence

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

1.	have better self-exploration and understanding with a capacity to identify the priorities of life
2.	Generate sustainable solutions to problems with focus on human values and value-based living
3.	Understand and practice living in harmony, co-existence and natural acceptance at all levels
4.	Be ethically upright in their personal and professional 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
HSS102.1						2	3	2	2	1		2	-	-
HSS102.2						2	3	2	2	1		2		
HSS102.3						2	3	2	2	1		2		
HSS102.4							3	2	1	1		2		

1: Low 2: Medium 3: High

TEXT BOOK	
1	'A Foundation Course in Human Values and Professional Ethics' by R.R. Gaur (Author), R.Sangal (Author), G.P. Bagaria (Author)
REFERENCE BOOKS	
1	The power of Positive Thinking by Norman Vincent Peale
2	The power of Now by Eckhart Tolle
3	Mindfulness Yoga by Frank Jude Boccio
Websites, Movies and Documents	
1	Value Education websites, http://uhv.ac.in, *http://www.uptu.ac.in*
2	Story of Stuff, *http://www.storyofstuff.com*
3	Al Gore, *An Inconvenient Truth*, Paramount Classics, USA
4	Charlie Chaplin, *Modern Times*, United Artists, USA
5	IIT Delhi, *Modern Technology – the Untold Story*
6	*Gandhi A., Right Here Right Now, Cyclewala Productions*

BIOLOGY FOR ENGINEERS

Course Code:	**BTY111**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: J):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours	**15+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Biotechnology

Course Objectives:

1.	To learn the types of cells, biomolecules and life processes
2.	To know the applications inspired by nature in various streams and real-life scenarios.

UNIT-I

INTRODUCTION FOR BIOLOGY FOR ENGINEERS	**05 Hours**

Why Biology for Engineers? Living cell Types & Properties: Prokaryotes - Bacteria, Viruses and Fungi, Eukaryotes - Plant and Animal Cells, Biomolecules, Life Processes at Cellular Level.

UNIT-II

APPLICATIONS INSPIRED BY NATURE & REAL-LIFE SCENARIOS	**10 Hours**

Composites in Construction, Termite Mound architecture, Countercurrent heat exchangers, Design of Aeroplan, helicopter and submarine, Information Theory and Biology, SONAR, Medical Devices. Recent scenarios in Environment, Agriculture and Medical Technology.

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

1.	Ascertain the importance of Biology and understand the basics of cell and life processes
2.	Draw the inspiration from nature in engineering design and visualize the application of biology in recent scenarios

Course Outcomes Mapping with Program Outcomes & PSO

Program outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
BTY111	3	3	-	-	-	-	-	-	1	-	-	1
BTY111	3	3	-	-	-	-	-	-	1	-	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Suraishkumar, G.K. *Biology for Engineers*, Oxford University Press India, 2019.
2.	Chakraborty, T, Akthar, N *Biology for Engineers*, PHI learning Print Book ISBN: 9789391818142 eBook ISBN: 9789391818197

REFERENCE BOOKS:

1.	Rao C.V., *Biology for Engineers*, 2021
2.	Raven, P. H. and Johnson, G. B. *Biology*. 4th Ed. WCB publishers, 2010.
3.	Ethier, R. S. and Simmons, C. A. *Introductory biomechanics*- From cells to organisms. Cambridge University Press, 2012

IT SKILLS

Course Code:	**CSE121**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T: P):	**0:0:2**	**Credits:**	**01**
Total Teaching Hours:	**0+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Any Dept.

Course Objectives:

1.	Demonstrate the basics of Android Programming.
2.	Design and develop effective static web pages.
3.	Describe the basic concepts of Cloud.
4.	Analyze data using Microsoft Excel.
5.	Create interactive gaming applications through Scratch coding.

Suggested List of Experiments

1	**Design and create simple game using MIT-scratch/Code.org** ● Design and create a catch game using MIT scratch coding. ● Design and create a Jumping game using MIT scratch coding. ● Design and create pong game using MIT scratch coding.
2	**Design and create simple android applications using MIT app inventor.** ● Create an application to display a "Hello, World!" message on screen. Application should also display the current time and date. ● Implement an application to change the background colour and image of the screen. ● Create a simple calculator which can perform basic arithmetic operations like addition, subtraction, multiplication, or division depending upon the user input. ● Build a bouncing ball app or make a ball bounce around on the screen (on a Canvas). ● Write an application to send SMS using MIT app inventor and also implement a text-to-speech application by passing text from the user.
3	**HTML and CSS** HTML: Basic Tags - paragraph, headings, Hyperlinks, image, tables, HTML forms.
4	HTML Lists: Unordered Lists, Ordered Lists and Definition list.
5	Create a form for a survey on the topic of your choice. Include a variety of answer options, including text fields, dropdowns, radio buttons, checkboxes, and a submit button. Use CSS to improve the look of your form.
6	Design and create web page for a travel book /recipe book with more than 3 pages, add table to list places /recipes (iframe, hyperlink)
7	**Create user account and demonstrate use of Google drive, Google docs, Google Form.** ● Upload and share any files and folders in google drive using different file permissions. ● Creation of google forms for applications such as a registration form, feedback form,quiz etc. ● Creation of google docs with citation from websites.
8	**Data Analysis using Microsoft Excel.** ● Basic Excel Formulas: Concatenate(),Len(),Days(), Net workdays(), Count(), Counta(), If(), Iferror(), Find(), Search(),Left(), Right() and Rank().

- Conditional Math: Learn to use SUMIF(), SUMIFS(), AVERAGE(), AVERAGEIF(), AVERAGEIFS(), COUNTIF(), COUNTIFS() to add cells only when certain conditions are met.
- VLOOKUP with Approximate or Exact Match: Learn to use VLOOKUP to find an approximate or exact match and return the corresponding value, work with INDEX, MATCH, and HLOOKUP as alternatives to the VLOOKUP function.
- Conditional Formatting: Apply the different rules to the values of the cell in sheets to carry out the analysis of data.
- Optimizing Data: Sorting, Filtering, Excel PivotTables
- Data Validation: Use Data Validation to ensure that users enter valid data in input cells, o restrict users' ability to enter invalid data in cells by providing them with a drop-down list of valid options.
- Data Visualization in Excel-Charts by generating various types of charts.

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

1.	Develop Applications using Scratch Coding, android programming and design attractive and effective Static Web pages.
2.	Analyze the basic concepts of Cloud and utilize Microsoft Excel to conduct data analysis.

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	3
CS1651-1.1	3	2	2	-	2	-	-	-	-	-	-		-	-	2
CS1651-1.2	3	2	1	-	2	-	-	-	-	-	-		-	-	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Suman M, Chinmaya Dash, R Sreenivas Rao "Digital Fluency", Himalaya Publishing House Pvt. Ltd., 2021.
2.	MelwynAmrithraj, Prem Sagar, Pradeep, "Digital Fluency", Himalaya Publishing House Pvt. Ltd., 2021.
3.	R G Saha, Dr. Kantesha S, Niha Asif, "Digital Fluency", Himalaya Publishing House Pvt. Ltd., 2021.

REFERENCE BOOKS:

1.	Randy Connolly and Ricardo Hoar, "Fundamentals of Web Development", 1st Edition, Pearson Education India.

E Books / MOOCs/ NPTEL

1.	https://www.sas.com/en_in/insights/analytics/machine-learning.html
2.	https://www.aig.com/IoT
3.	14 Types of Phishing Attacks That IT Administrators Should Watch For (syscloud.com)
4.	6 Common Phishing Attacks and How to Protect Against Them (tripwire.com)
5.	Important Applications of Cloud Computing (jigsawacademy.com)
6.	Phishing Attack Prevention: How to Identify & Avoid Phishing Scams in 2021 | Digital GuardianIT Security FAQ (udel.edu)

ENGINEERING VISUALIZATION

Course Code:	**ME1004-1**	**Course Type**	**ESC**
Teaching Hours/Week (L: T: P: S)	**0:0:3:0**	**Credits**	**1**
Total Teaching Hours	**30**	**CIE + SEE Marks**	**50+00**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To impart and inculcate understanding of the concept of orthographic projection and projection of plane surfaces and solids in different position in first angle projection system.
2.	To draw the orthographic views of the simple machine parts and to draw the isometric projection of simple solids.

UNIT-I

Chapter 1: Orthographic Projection: Introduction to orthographic projection, Quadrants, principal planes, principal views, Difference between First angle and third angle projection, Dimensioning, Conventions employed for drawing. Projection of points and projection of lines(First quadrant only)	**02 Hours**
Chapter 2: Projection of plane surface: Triangle, Square, Rectangle, Pentagon, & Hexagon in simple position (Resting on HP with inclination to HP and VP, true length with true inclination only- No Beta angle)	**06 Hours**

UNIT-II

Chapter 3: Projection of Solids: Prisms and Pyramids in simple position (Resting on HP with inclination to HP and VP, true length with true inclination only)	**10 Hours**

UNIT-III

Chapter 5: Isometric projection: Isometric scale, Isometric dimensions, to draw Isometric views of simple solids and machine components using their orthographic projections.	**06 Hours**
Chapter 6: Pictorial View into Orthographic Views: Orthographic projection (First angle projection) of simple machine components using their pictorial view.	**06 Hours**

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

1.	Draw the orthographic projections of a plane for a given position using Solid Edge software.
2.	Draw the orthographic projections of a solids and simple machine parts for a given position using Solid Edge software.
3.	Draw the orthographic views of the simple machine parts. Draw isometric projection of solid objects individually or in combination using Solid Edge software.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
ME1004-1.1	3	1							1	1		2	1
ME1004-1.2	3	1							1	1		2	1
ME1004-1.3	3	1							1	1		2	1

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	Engineering Drawing by N. D. Bhat & V. M. Panchal, Pramod R. Ingle, 53 Ed. 2014, Charotar Publishing House, Gujarat.
2.	Engineering Drawing by K R Gopalakrishna, Subhas publishers, Bangalore , 32nd edition, 2012.
REFERENCE BOOKS:	
1.	1. A Primer on computer aided Engineering Drawing, Published by VTU, Belgaum, 8thedition, 2011.
2.	Engineering Drawing and Computer Graphics, Shah, Pearson, 2010
3.	Engineering Graphics, Agarwal & Agarwal, TMH, Second edition, 2013
4.	A Text book of Engineering Graphics And Drafting by P. S. GILL, 11th Ed.2009, S. K. Kataria & sons, ISBN- 8185749612, 9788185749617, New Delhi.

ENHANCING SELF AWARENESS AND COMMUNICATION

SEMESTER I

Course Code	HSS132		**Credits**	01
CIE Marks	50**		**Hours/Week (L-T-P)**	1-0-0
Total Teaching Hours	15L+0T+0P		**SEE Marks**	-
Exam hours	1.5 Hours		**Course Type**	AEC
Stream	All departments		**Integrated Lab**	NO
Course Component				

COURSE OUTCOMES

Students will be able to

1. reflect on their strengths and capacities
2. identify their areas of improvement
3. set and submit short term and long-term professional and personal goals
4. make a presentation on a specified topic

COURSE CONTENTS

UNIT -1- 9 HOURS

- **Self-awareness:** Identifying and mapping interests, capacities and competencies; Tree of Life exercise; Reflections on personal strengths and identifying areas of improvement.
- **Goal setting exercises:** Short term and long term personal and professional goal setting; reviewing the set goals; Listing immediate actionable steps to be taken.
- **Dealing with distractions and time management strategies:** Identifying sources of distraction; tips to deal with procrastination; effective use of screentime.

UNIT -2- 6 HOURS

- **Professional Behaviours:** Professional and non-professional behaviours; Power dressing and self-grooming.
- **Professional Communication:** Language etiquettes; Practice in expressing opinions and ideas in public; Strategies to manage stage fear.

REFERENCE BOOKS

1. Eurich, T. (2017). Insight: why we're not as self-aware as we think, and how seeing ourselves clearly helps us succeed at work and in life. New York, Crown Business.
2. Seligman, M. E. P. (2011). Flourish: A visionary new understanding of happiness and well-being. Free Press.
3. American Psychological Association. The Psychology of Procrastination: Why People Put Off Important Tasks Until the Last Minute. 2010.

ONLINE RESOURCES *	
Topic/Title	**Link**
1. A psychological perspective	https://www.verywellmind.com/what-is-self-awareness-2795023#toc-how-does-self-awareness-develop
2. Procrastination	https://jamesclear.com/procrastination

**COURSE ASSESSMENT METHOD:
Attendance : 5 Marks [95% and above- 5 marks; 94%-90%-4 marks; 89%-85%-3 marks; 84%-80%-2 marks; 79%-75%-1 mark] If students have less than 75% attendance , they will not be allowed to attend the end semester exam. LA1: 15 Marks LA2: 15Marks (The average of two LA will be taken) MSE: 30 Marks

PEDAGOGY
1. Activity based learning 2. Case studies 3. Group discussions and presentations 4. Reflective activities

*Additional reading materials and online resources will be shared with the learners as required

DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

Course Code:	**MAT105**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P):	**3:1:0**	**Credits:**	**04**
Total Teaching Hours:	**45+15+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mathematics

Course Objectives:

- The course provides extensive knowledge of methods to solve Differential equations
- The course also provides knowledge of Laplace transforms
- The course imparts numerical techniques to fit and interpolate data

UNIT-I

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS — **9+3 Hours**

Exact equation, Reducible to exact, linear and Bernoulli's differential equations, orthogonal trajectories of cartesian and polar curves. Applications: Rate of growth and decay, Newton' law of cooling, Mixing.

UNIT-II

ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER — **9+3 Hours**

Second and higher order linear differential equation with constant coefficients, solution by inverse differential operator, method of variation of parameters, Cauchy and Legendre equations
Applications: Oscillations of spring, LCR circuits

UNIT - III

LAPLACE TRANSFORMS — **9+3 Hours**

Definitions, transforms of elementary functions, transforms of derivatives and integrals- properties. Periodic functions, unit step functions and unit impulse functions.
Inverse Laplace Transforms and properties, convolution theorem,
Applications: Solution of ODE, LCR circuits

UNIT-IV

NUMERICAL METHOD-1: INTERPOLATION — **9+3 Hours**

Interpolation: Newton's forward and backward formulae, Newton's divided difference formulae and Lagrange's formula for unequal intervals and inverse interpolation by Lagrange's formula,
Numerical differentiation with Newton's forward and backward difference interpolation.

UNIT -V

PARTIAL DIFFERENTIAL EQUATIONS — **9+3 Hours**

Formation of partial differential equations by elimination of arbitrary constants/arbitrary functions. Derivation of one-dimensional heat and wave equations, Solution of PDE's by direct integration method, by the method of separation of variables. Solution of heat, wave and Laplace equation.

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

1	Apply concept of analytic functions, expand into series and integration to complex functions
2	Apply concept of Z transform to discrete signals and functions
3	Apply Fourier analysis to periodic and aperiodic functions
4	Apply concepts of vector differential calculus to engineering problems
5	Adopt techniques of vector integration to engineering problems

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2										
2	3	2										
3	2	2										

4	2	2										
5	3	2										

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, 2015
2	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition (Reprint), 2016.
3	S.S.Sastry, "Introductory methods of Numerical Analysis", 2nd edition, 1990, Prentice Hall.
4	N.P. Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
REFERENCE BOOKS:	
1	W.E. Boyce and R.C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.
2	G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.
3	Shepley L Ross, "Differential equations" 3rd edition, Wiley, 2004
4	M K Jain, S R K Iyengar, R K Jain, Numerical Methods for Scientific and Engg. Computation, New Age, 2012
5	V Krishnamurthy, S K Sen , Numerical Algorithms, East West press, 2007
E Books / MOOCs/ NPTEL	
1	***http://nptel.ac.in/courses/111106100***
2	***http://nptel.ac.in/courses/111106139***
3	***http://nptel.ac.in/courses/111107111***

WAVE MECHANICS AND OPTOELECTRONICS

(For ECE, EE, ACT and VLSI Branches)

Course Code:	**PHY104**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**45+0+30**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Physics

Course Objectives:

1.	To understand and apply the concepts of wave mechanics.
2.	To study the properties of conductors and superconductors and their applications.
3.	To identify the fundamental principles of semiconductors for optoelectronic devices.
4.	To understand the concept of dielectric materials and their applications
5.	To understand the principles, construction, and applications of LASERs and Optical fibers.

UNIT-I

Wave Mechanics	**09 Hours**

Introduction to Matter waves and de Broglie Hypothesis, de Broglie wavelength, Phase Velocity and Group Velocity, Relation between the Phase Velocity and Group Velocity, Relation between the Group Velocity and Particle velocity, Physical significance of a wave function, Heisenberg's Uncertainty Principle and application, Schrodinger wave equation (time independent), Eigen functions and Eigen Values, Particle in one dimensional infinite potential well, waveforms and probabilities. Numerical problems.

UNIT-II

Conductors and Superconductors	**09 Hours**

Free-electron concept. Classical free-electron theory – Assumptions, Drift velocity, mean collision time, mean free path and relaxation time, Expression for electrical conductivity in metals (Drude-Lorentz theory), Failures of classical free-electron theory. Quantum free-electron theory – Assumptions, Success of QFET (Specific heat and electrical conductivity), Fermi - Dirac Statistics, Fermi energy and Fermi factor for metals. Numerical problems.

Introduction to superconductors, characteristic properties. Type-I and Type-II superconductors. BCS theory (qualitative). High temperature superconductors, Numerical problems.

UNIT-III

Semiconductors	**09 Hours**

Introduction to semiconductors, intrinsic and extrinsic semiconductors - carrier generation, Direct and indirect band gap semiconductors. Expression for concentration of electrons in conduction band, holes concentration in valance band (only mention the expression), Fermi energy, Fermi level in Intrinsic semiconductor (derivation), Extrinsic Semiconductors and its behaviour with temperature, Electrical conductivity of an intrinsic semiconductor (derivation) and effect of temperature on intrinsic conductivity, Hall effect, Expression for Hall coefficient (derivation) and its application.

p-n junction: Junction formation, Unbiased and biased p-n junction, Devices: LED, Photodiode and solar cell. Numerical problems.

UNIT-IV

Dielectrics	**09 Hours**

Introduction to dielectrics, Dipoles, Polar and non-polar dielectrics, Dielectric constant, Electrical polarization, Polarizability, Electrical Polarization Mechanisms, Electric susceptibility, Internal fields in solids (Qualitative), Clausius-Mossotti equation (Derivation), Dielectric in AC fields - Dielectric loss (Qualitative), Frequency dependence of polarization, Temperature dependence of polarization, Dielectric breakdown, Application of dielectrics. Ferroelectric materials and Piezoelectric materials, properties, and

applications, Numerical Problems.

UNIT-V

LASERs and optical fibers	**09 Hours**

Introduction to lasers, Characteristics of LASER, Interaction of radiation with matter, Einstein's coefficients, Requisites of a Laser System. Conditions for LASER action. Principle, Construction and Working of Nd:YAG LASER and semiconductor LASER, Application of Lasers in Bar code scanner and Laser Printer. Numerical Problems.

Introduction and Principle of Optical Fibers (TIR), Propagation mechanism in optical fibers - Angle of Acceptance and Numerical Aperture N.A.), Expression for NA, Fractional Index Change, Modes of Propagation, Number of Modes and V Number, Types of Optical Fibers, Attenuation, Factors contributing and Mention of Expression for Attenuation coefficient, Point to point communication, Numerical problems.

List of Experiments (Any Ten experiments)

1.	Diffraction of White light using optical Grating.
2.	Wavelength by Laser diffraction.
3.	Numerical aperture of the given Optical Fiber.
4.	Energy gap of semiconductor (any method)
5.	Hall effect
6.	Determination of Fermi Energy of Copper.
7.	Photo electric effect – Determination of the work function of the material of the emitter of a photocell.
8.	Photo-Diode characteristics
9.	Solar cell characteristics
10.	LED characteristics and determination of Planck's Constant using LEDs.
11.	Ferroelectric phase transition in Barium titanate.
12.	Zener diode Characteristics
13.	Transistor Characteristics
14.	Charging and Discharging of a Capacitor.
15.	Simulation experiment

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

1.	Apply the knowledge of quantum mechanics to analyse the physical properties exhibited by particles at sub-atomic level.
2.	Analyze the dynamics of free electrons in metals to interpret the mechanism of electrical conduction.
3.	Analyze the role of semiconductors in electronic devices, exploring the properties of semiconductors.
4.	Apply the knowledge of dielectric materials for engineering applications.
5.	Analyze the properties of optical waves in the phenomena of lasing action and signal propagation.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓		
↓ Course Outcomes														
PHY104-1.1	3	2						2			1			
PHY104-1.2	3	2						2			1			

PHY104-1.3	3	2						2			1			
PHY104-1.4	3	2						2			1			
PHY104-1.5	3	2						2			1			

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill Education Private Limited, Special Indian Edition, 2009.
2.	B. G. Streetmann, "Solid State Electronic devices", 6th edition, Prentice Hall India Learning Private Limited.
3.	A. Ghatak, "Optics", Tata McGraw Hill Pub., 5th edition, 2012.

REFERENCE BOOKS:

1.	A. J. Dekker, "Electrical Engineering Materials", Prentice Hall India Pub., New Delhi, Reprint 2011.
2.	W. A. Wahab, "Solid State Physics, Structure and Properties of Materials", Narosa Publishing House Pvt. Ltd., New Delhi.
3.	Gupta and Kumar, "Solid State Physics", K. Nath & Co., Meerut
4.	M. Ali. Omar, "Elements of Solid-State Physics: Principles and Applications", Pearson Publishers.
5.	S O Kasap, "Principles of electronic materials and device's", 4th edition, McGraw Hill, 2017.
6.	M N Avadhanulu, P G Kshirsagar and TVS Arun Murthy, "A Textbook of Engineering Physics", S. Chand and Company Limited, New Delhi.
7.	Kenneth Krane "Modern Physics", Wiley International, 3rd Edition, 2012.
8.	B. P. Pal, "Fundamentals of Fibre Optics in Telecommunication & Sensor Systems", New Age International Publishers

E Books / MOOCs/ NPTEL/ Web links

1.	Laser: https://www.britannica.com/technology/laser,k
2.	Laser: https://nptel.ac.in/courses/115/102/115102124/
3.	Quantum mechanics: https://nptel.ac.in/courses/115/104/115104096/
4.	Physics: http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
5.	Numerical Aperture of fiber: https://bop-iitk.vlabs.ac.in/exp/numerical-aperture-measurement

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1.	http://nptel.ac.in
2.	https://swayam.gov.in
3.	https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham
4.	https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1
5.	https://virtuallabs.merlot.org/vl_physics.html
6.	https://phet.colorado.edu
7.	https://www.myphysicslab.com

BASIC ELECTRONICS

Course Code:		**ECE111**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T:P: S):		3-0-0-0	**Credits:**	**3**
Total Teaching Hours:		45 Hrs	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics and Communication Engineering

Course Objectives:

1	Familiarize the student with Semiconductor devices like Diodes with simple applications such as Rectifiers.
2	Familiarize the student with Semiconductor devices like Transistors with simple applications such as switch and amplifier circuits.
3	Analyze the working of simple electronic circuits involving Op-amps and Linear Regulator ICs.
4	Understand the concepts of feedback and analyze Feedback amplifier and Oscillator circuits.
5	Explore the fundamentals of Modern communication and Embedded Systems.

UNIT-I

Diodes and their Applications — **09 Hours**

Semiconductor Diode, Diode Equivalent circuits, Half Wave Rectifier, Full wave Bridge Rectifier, capacitor filter circuit (only qualitative approach). Zener Diode and its use in Voltage Regulation.
T1: Chapter 2-2.1, 2.2, 2.3, 2.9. T1: Chapter 3-3.1, 3.2, 3.7.

UNIT-II

Transistors and their Applications — **09 Hours**

Bipolar Junction Transistor: (npn only) Construction and operation, Common Emitter Characteristics, CE-RC coupled amplifier (frequency response excluded), BJT as a switch.Field Effect Transistor: Construction, Drain and Transfer Characteristics of n-channel Enhancement mode MOSFET, CMOS Inverter.
T1: Chapter 4-4.1, 4.2, 4.3, 4.6. T1: Chapter 5-5.10. T1: Chapter 6: 6.4.
T2: Chapter 6-6.8, 6.11.

UNIT-III

Op-Amp & Linear IC Applications — **09 Hours**

Introduction, Op-Amp Specifications, Differential & Common-Mode operation, Op-Amp applications: Inverting/Non- Inverting Amplifier, Inverting Summer, Integrator, Differentiator, Comparator.78XX series IC Voltage Regulators.
T3: Chapter 2-2.2, 2.3, 2.4, 2.5, 2.6. T2: Chapter 10: 10.4, 10.5. T3: Chapter 8: 8.2, 9.4.3. T2: Chapter 15-15.5.

UNIT-IV

Feedback and Oscillator Circuits — **09 Hours**

Feedback– Principle and advantages of negative feedback, Voltage series feedback amplifier, Concept of positive feedback, Op-Amp Oscillators – RC phase shift, Hartley and Colpitts's Oscillator.
T2: Chapter 14-14.1, 14.2, 14.5, 14.6, 14.8.

UNIT-V

Fundamentals of Communication and Embedded Systems — **09 Hours**

Modern communication system scheme (Block scheme), Information source, Input Transducers, Transmitter, Channels, Receivers, Noise, Fundamentals of Cellular communication. Embedded system definition, Elements of Embedded systems, Core of Embedded systems, Microprocessor v/s Microcontroller, Sensors and Actuators with Examples.
T4: Chapter 1-1.1, 1.2 T5: Chapter 1-1.4.3, 1.4.3.1, Chapter 2-2.1, 2.2, 2.3, 2.4 T6: Chapter 1-1.1, 1.3, Chapter 2- 2.1, 2.1, 2.2, 2.3

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

1	Design diode-based circuits and voltage regulators
2	Analyze the operation of transistors and CMOS inverters
3	Apply operational amplifiers in analog signal processing

4	Evaluate the effects of feedback and oscillator circuits
5	Describe the components of modern communication and embedded systems

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
CO-1	3	2	1								1	2	
CO-2	3	2	1					1				2	
CO-3	3	2	1									2	
CO-4	3	2	1		1						1	2	
CO-5	3	2	1									2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1	"Electronic Devices and Circuits" David A. Bell,PHI,5th, 2014
2	"Electronic Devices and Circuit Theory"Robert L. Boylestad, Louis Nashelsky, Pearson,11th Edition, 2016.
3	"Op-Amps and Linear Integrated Circuits", Ramakanth A Gayakwad, Pearson, 4th Edition, 2016.
4	"Introduction to Analog and Digital Communications "Simon Haykin, Wiley Publishers,2nd Edition, 2019.
5	Wireless Communications: Principles and Practice", Theodore Rappaport, Pearson, 2nd Edition, 2016.
6	"Introduction to Embedded Systems", Shibu K V,TATA Mc Graw Hill Edu,2nd Edition, 2016.

REFERENCE BOOKS:

1	Electronic Devices"Thomas L Floyd,Pearson,9th , 2012
2	D P Kothari, I J Nagrath,.Mc Graw Hill,2nd, 2018

E Books / MOOCs/ NPTEL

1	https://nptel.ac.in/courses/117107095
2	https://nptel.ac.in/courses/117103063
3	https://www.coursera.org/learn/electronics/syllabus
4	https://www.coursera.org/learn/diode-pn-junction-metal-semiconductor-contact specialization=semiconductor-devices
5	https://www.coursera.org/learn/transistor-field-effect-transistor-bipolarjunction-transistor specialization=semiconductor-devices

APPLIED DIGITAL LOGIC DESIGN

Course Code:	**ECE101**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T:P: S):	**2-0-2-0**	**Credits:**	**3**
Total Teaching Hours:	**30+15P**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electrical and Electronics Engineering

Course Objectives:

1	To enable students to understand and simulate fundamental concepts of digital electronics including number systems, binary arithmetic, logic gates, and Boolean algebra.
2	To introduce methods for simplifying Boolean expressions and verifying them through simulation using basic logic gates.
3	To equip students with the knowledge and simulation skills to analyze and design combinational logic circuits.
4	To provide students with an understanding of flip-flops and their simulation for sequential circuit behavior.
5	To enable students to apply flip-flops in the design and simulation of sequential circuits such as shift registers and counters.

UNIT-I

Fundamentals of Digital Design	**06 Hours**

Difference between Analog and Digital Signals, Number Systems: Decimal, Binary, Octal and Hexadecimal. Binary Addition and Subtraction, Digital Logic Gates, Boolean Algebra, Boolean Functions: Canonical Forms, Completely and Incompletely Specified Functions
T1 - Chapter 1.-1.2, Chapter 2.-2.1, 2.2, 2.3.1, 2.3.2, 2.4, 2.5, 2.8 Chapter 3.-3.1 - 3.5, 3.7, 3.8, 3.9.1, 3.9.2, 3.9.6, 3.9.7

UNIT-II

Simplification of Boolean expressions	**06 Hours**

Simplification of Boolean Functions using Boolean Algebra, Karnaugh Maps, Quine-McCluskey (up to four variables), Realization of Boolean functions using Basic Gates
T1 - Chapter 4.- 4.4, 4.5, 4.6, 4.8

UNIT-III

Combinational Logic Circuits	**06 Hours**

Introduction to Combinational Logic Circuits, Half/Full Adders/Subtractors, Parallel Adders/Subtractors, Binary Comparators, Decoders, Encoders, Multiplexers.
T1: chapter 5.- 5.1, 5.1.1, 5.3, 5.4, 5.5, 5.6

UNIT-IV

Sequential Logic Circuits	**06 Hours**

Basic Bistable Element, SR Flip-Flop, D Flip Flop, JK Flip Flop, T Flip Flop, Master Slave JK Flip Flop, Characteristic Equations, Conversion of Flip Flops.
T1: chapter 6- 6.1, 6.2, 6.4.2, 6.6

UNIT-V

Applications of Flip Flops	**06 Hours**

Design of Shift Register using D- flip flop, Design of Counters: Asynchronous counters using T-flip flop, Synchronous Counters using D-flip flop and T Flip Flop.
T1: chapter 6- 6.7, 6.8.1, 6.9

List of Experiments
(Use this section wherever applicable, else delete this section)

	Introduction to Simulation tool
2.	Simulation of Basic Logic Gates and Binary Arithmetic Operations
3.	Simulation and Verification of Simplified Boolean Functions using K-Map and Logic Gates
4.	Simulation and verification of a Half Adder and Full adder
5.	Simulation and verification of a Half subtractor and Full subtractor
6.	Simulation and verification of a Binary Adder and Multiplexer Circuit

7.	Simulation and verification of D,T,SR and JK Flip-Flops
8.	Simulation of Flip-Flops and Conversion Between Flip-Flop Types
9.	Simulation of 4-bit Shift Register and Asynchronous Counters
10	Simulation of 4-bit Shift Register and Synchronous Counters

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

1	Demonstrate binary operations, convert between number systems, and simulate basic digital logic circuits using Boolean functions.
2	Simplify Boolean functions using Boolean algebra, Karnaugh maps, and the Quine-McCluskey method, and simulate the implementation using basic logic gates.
3	Design and simulate combinational circuits such as adders, subtractors, comparators, decoders, encoders, and multiplexers.
4	Describe, simulate, and analyze various flip-flops, perform conversions, and determine their characteristic equations.
5	Design and simulate shift registers and both asynchronous and synchronous counters using appropriate flip-flops.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
CO-1	3	2	2		3							3	2
CO-2	3	2	3		3							3	2
CO-3	3	2	3		3							3	3
CO-4	3	2	2		3							3	2
CO-5	3	2	3		3							3	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Digital Principles and Design ,Donald D. Givone ,McGraw Hill, ,2002

REFERENCE BOOKS:

1	Digital Design, Morris Mano,Prentice Hall of India, 3rd Edition
2	Digital Logic Applications and Design ,John M Yarbrough ,Thomson Learning,2001
3	D. P. Kothari and J. S Dhillon,Pearson,2016
4	Fundamentals of Logic Design, Charles H Roth, Cengage Learning

E Books / MOOCs/ NPTEL

1	https://nptel.ac.in/courses/117106086

INTRODUCTION TO C PROGRAMMING

Course Code:	**CSE101**	**Course Type:**	**PLC**
Teaching Hours/Week (L: T: P)	**2:0:2**	**Credits:**	**03**
Total Teaching Hours:	**30+0+30**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science & Engineering

Course Objectives:

1.	Make students learn the basics of C programming language including the basic data types, Operators and Evaluating expressions in C.
2.	Apply the concepts of decision making and looping, arrays in problem solving to demonstrate its usage using simple programs.
3.	Apply the concepts of User-defined functions and code reusability in problem solving along with parameter passing and returning with the help of user defined functions and demonstrate the usage of Strings.
4.	Demonstrate the usage of Structures
5.	Demonstrate the usage of Pointers, and File handling that are essential for understanding the concepts with simple examples.

UNIT-I

Introduction To C Programming Language	**10 Hours**
Basic C Data Types, operators, Operator precedence, Arithmetic expressions and type conversion.	
Decision Making and Branching:	
Decision making with if statement, Nesting of if…else statements, ternary operator, the switch statement, the go to statement, break and continue statements.	

UNIT-II

Decision Making and Looping:	**10 Hours**
The while statement, the do…while statement, the for statement, Jump statements (goto, break, continue).	
Arrays	
Declaration of arrays, accessing the elements of an array, storing values in arrays, Operations on arrays, Passing arrays to functions, Multidimensional arrays-Two dimensional arrays, operations on two-dimensional arrays, two-dimensional arrays to functions.	

UNIT-III

Functions	**10 Hours**
Introduction, function definition and declaration, function call, return statement, Argument Passing – call by value, call by reference, recursive functions, Category of Functions. Examples: Linear Search, Binary Search, Bubble sort, Selection Sort, Trace and Transpose, Matrix Multiplication.	
Strings	
Declaring and Initializing strings, String manipulation functions.	

UNIT-IV

Structures	**05 Hours**
Defining Structure, Declaration of Structure Variable, Accessing Structure members, copying and comparing structure variable, operation on individual member, nesting of structures, Array of structures.	

UNIT-V

Pointers and File Handling:	**05 Hours**

Accessing of variables using Pointers, array of pointers
Basic file operations: Open, Close, Read, Write, Append and concatenate

Suggested List of Experiments

PART A

1.	Write a C program to find the roots of a quadratic equation $ax^2+bx+c=0$
2.	Write a C program to find the sum of all the digits and occurrence of a digit in the number.
3.	Write a C program to find the GCD and LCM of given two numbers using Euclid's method.
4.	Write a C program to print the prime numbers in a given range.
5.	Write a C program to find if a given string is a palindrome or not using string manipulation functions.
6.	Write a C program to input N real numbers in 1-D array. Compute mean, variance and Standard Deviation. [Mean= sum/N, Variance = Σ (Xi-mean) 2 /N, STD Deviation= √variance.]
7.	Write a C program to read N integers into an array A and find the sum of elements using pointers.
8.	Write a C program to copy contents of one file to another file.

PART B

1.	Write a C program to perform a binary search for a given key integer in a single dimensional array of numbers in ascending order and report success or failure in the form of a suitable message.
2.	Write a C program to input N integer numbers into a single dimension array, sort them in to ascending order using selection sort technique, and then to print both the given array and the sorted array with suitable headings.
3.	Write a C program to transpose a matrix of order M x N and find the trace of the resultant matrix.
4.	Write a C program using functions to read two matrices A (M x N) and B (P x Q) and to compute the product of A and B if the matrices are compatible for multiplication.
5.	Write a C program using functions readmat( ), rowsum ( ), colsum ( ), totsum ( ) and printmat( ) to read the values into a two dimensional array A, find the sum of all the elements of a row, sum of all the elements of a column, find the total sum of all the elements of the two dimensional array A and print the results.
6.	Write a C program to perform a linear search for a given key integer in a single dimensional array of numbers and report success or failure in the form of a suitable message using functions.
7.	Write a C program to enter the information like name, register number, marks in 6 subjects of N students into an array of structures, and find the average & display grade based on average for each student.

Average	**Grade**
80-100	Distinction
60-79	First Class
40-59	Second Class
<40	Fail

8.	Write a C program, to implement a bubble sort technique using function to sort given N integers in ascending/ descending order as per user's preference.
9.	Write a program to demonstrate the use of pointers and files.

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

1.	**Describe** the process of problem-solving aspects using algorithmic solution for a given

	problem and branching.
2.	**Develop** the C program using control statements such as decision making and looping for a given problem.
3.	**Apply** the concepts including user defined functions and strings to write programs.
4.	**Identify** and describe the use of structures in a C program.
5.	**Implement** and demonstrate the use of pointers and file handling mechanisms in C programs.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	1	2
CS1004-1.1	3	2	1	-	-	-	-	1	-	-	-	1	3
CS1004-1.2	3	2	2	-	-	-	-	1	-	-	-	1	3
CS1004-1.3	3	2	1	-	-	-	-	1	-	-	-	1	3
CS1004-1.4	3	2	1	-	-	-	-	1	-	-	-	1	3
CS1004-1.5	3	2	1	-	-	-	-	1	-	-	-	1	3

COMMUNICATIVE ENGLISH

Course Code	**HSS131**	**Course Type**	**AEC**
Teaching Hours/Week (L:T:P:S)	**1:0:2:0**	**Credits**	**02**
Total Teaching Hours	**15+0+30**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Objectives:

1.	Develop proficiency in phonetics, pronunciation, and effective oral communication.
2.	Strengthen foundational grammar and language skills.
3.	Improve academic writing skills for various contexts by appreciating texts.
4.	Enhance comprehension and analytical thinking through the skill of writing

Unit – I

Phonetics & Communication — **15 Hours**

- Introduction to Phonetics, IPA, stress, rhythm, and intonation.
- Rhythm, Intonation, Past Tense and Plural Pronunciation, Awareness of Accents
- Fundamentals of Communication, Barriers, Strategies, Requests and Permissions.
- Verbal and Non-Verbal Communication, Telephone etiquette, greetings, requests.
- Short Formal Speech

Practical Activities:

- Phonetic drills, speech exercises, interactive speaking activities.
- Communication and telephone conversation simulations

Unit – II

Language Skills & Grammar — **15 Hours**

- Texts – Prose & Poetry
- Grammar Essentials: Prepositions, Articles, Sentence structure.
- Language Skills: Sentence construction, comprehension, and structured writing techniques.
- Comprehension

Practical Activities:

- Grammar exercises, sentence correction, editing tasks.
- Reading comprehension exercises and discussion-based learning

Unit – III

Writing Skills — **15 Hours**

- Cohesive Devices: Conjunctions, linkers, and sequence of ideas in writing.
- Writing Skills: Paragraph development, linkers, structured writing.
- Argumentation and Refutation
- Application Letter

Practical Activities:

- Writing focused on clarity, coherence, and structure.

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

1.	Identify the nuances of phonetics, intonation, and pronunciation to appreciate and incorporate Received Pronunciation
2.	Interpret and assess nuances of oral communication skills and non-verbal communication

	for professional usage
3.	Identify, interpret, and describe the critical ideas, values, and themes to appreciate literary pieces for its language and social interpretations
4.	Implement English vocabulary in both personal and professional contexts, enhancing language proficiency while also honing effective writing skills adaptable to various forms of written communication.

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
HSS131.1	1	1						2		2		3		
HSS131.2	2					2				3		3		
HSS131.3		2					3	2		3		3		
HSS131.4		2				2			2	2		2		

1: Low 2: Medium 3: High

TEXT BOOK

1.	Tidings, Victor, R. et al. (2022). A Textbook of English Language & Communication Skills.

REFERENCES

1.	Jones, D (2011). English Pronunciation Dictionary.
2.	Woods (2016). A Remedial English Grammar for Foreign Students.
3.	Kumar, S. (2011). Communication Skills. Oxford University Press.
4.	CIEFL, Hyderabad (Year). Exercises in Spoken English Part I. Oxford University Press.
5.	CIEFL, Hyderabad (Year). Exercises in Spoken English Part II. Oxford University Press.
6.	CIEFL, Hyderabad (Year). Exercises in Spoken English Part III. Oxford University Press.
7.	Zinsser, W. (1976). On Writing Well.
8.	Swan (2014). Practical English Usage. Oxford University Press.
9.	Lyons, L. H. (2006). Study Writing. Cambridge University Press.
10.	Subhashini, Victor, R. et al. (2022). A Textbook of English Language & Communication Skills.

E Resources

1.	https://www.macmillandictionary.com/dictionary/british/

MATHEMATICS WITH MATLAB

Course Code:	**MAT107**	**Course Type:**	**PLC**
Teaching Hours/Week (L-T-P):	**0-0-2**	**Credits:**	**01**
Total Teaching Hours:	**0+0+26**	**CIE + SEE Marks:**	**50**

Teaching Department: Mathematics

Course Objectives:

This course will enable the students to learn to use MATLAB for basic operations, array handling, plotting, and solving problems using symbolic and numerical methods.

List of Experiments

1. Introduction to MATLAB: Basic Operators: Arithmetic, Logical and Relational Operators. Elementary math functions such as algebraic, trigonometric, logarithmic, exponential functions, Conditions and Loops.
2. Symbolic Computation, plotting curves, surfaces and vector fields.
3. Computation of angle between (a) radius vector and tangent (b) two curves
4. Computation of radius of curvature
5. Taylor's/ Maclaurin's series expansion of a function of a single variable.
6. Differentiation of composite and computation of partial derivatives.
7. Computation of Jacobian.
8. Computation of extreme values of multivariate functions.
9. Solution of first-order ordinary differential equation and second and higher-order linear differential equation with constant coefficients
10. Evaluation of double/triple integrals with constant/variable limits.

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

1	Introduction to MATLAB: Basic Operators: Arithmetic, Logical and Relational Operators. Elementary math functions such as algebraic, trigonometric, logarithmic, exponential functions, Conditions and Loops.
2	Symbolic Computation, plotting curves, surfaces and vector fields.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1	Rudra Pratap, "MATLAB", OXFORD University press, 2010
2	Dorothy C. Attaway Ph.D., A practical introduction to prog. And problem solving, 5th edition

E Books / MOOCs/ NPTEL	
1	https://www.mathworks.com › matlab › matlab_prog
2	https://www.coursera.org/specializations/mathematics-engineers
3	https://www.coursera.org/specializations/matlab-programming-engineers-scientists
4	https://www.coursera.org/learn/matlab

CONSTITUTION OF INDIA & GLOBAL CITIZENSHIP

Course Code	**HSS101**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T:P:S)	**01:0:0:0**	**Credits**	**01**
Total Teaching Hours	**15+0+0**	**CIE + SEE Marks**	**50 + 00**

Teaching Department: Humanities

Course Objectives:

1.	To Understand the Obligations, Responsibilities, Privileges and Rights, Duties and the Role that they have to play in deciding the Administrative Machinery of the nation as citizens.
2.	To empower learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies.

UNIT - I

Evolution of the Indian Constitution — **05 Hours**

Cabinet Mission Plan of 1946 – Partition Plan of 1947 and Indian Independence Act 1947, Constituent Assembly and Committees – Drafting, Enactment and Enforcement of Indian Constitution, Basic structure of Indian Constitution, Salient Features of Indian Constitution, Fundamental Rights, Fundamental Duties.

Separation of Powers (Organs of the Constitution) — **03 Hours**

Executive: Union and State
Legislature: Union and State
Indian Judicial System

UNIT - II

Structure of Government — **04 Hours**

Union: Prime Minister, Council of Ministers
State: Chief Minister, Council of Ministers
Local Self-Governance: Panchayat Raj Institutions, Urban Governance

Global Citizenship — **03 Hours**

Meaning of Global Citizenship – '*VasudhaivaKutumbakam*, Types of Global Citizenship, Globalization and Interconnectedness, Characteristics/Attributes of a Global Citizen, Rights of Global Citizenship, Responsibilities of a Global Citizen, Ethical Dimensions and Sustainability practices.

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

1.	Analyze the legalities and related issues of Indian Constitution as a fundamental law of the nation and the rights and duties of Indian Citizen.
2.	Become a responsible citizen being interconnected; has knowledge about his/her role in the community, State and the country; has a role in making the world a better place to live by applying critical thinking and ethical reasoning.

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
HSS101.1	-	-	-	-	-	1	3	2	-	-	-	2	-	-
HSS101.2	-	-	-	-	-	1	3	2	1	1		2	-	-

1: Low 2: Medium 3: High

REFERENCE BOOKS	
1	Basu, D.D., "Introduction to the Constitution of India",Twentieth Edition, Reprint 2011. LexisNexis Butterworths Wadhwa, Nagpur, Haryana, India, 2011.
2	Pylee, M.V. "Introduction to Constitution of India",Fourth Revised Edition. Vikas Publishing House Pvt. Ltd., New Delhi, 2005.
3	Sharma, B.K. "Introduction to Constitution of India",Second Edition. Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
4	Venkatesh, B.R. &Merunandan, K.B., "An Introduction to Constitution of India and Professional Ethics",Second Edition. Merugu Publications, Bangalore, 2007.
5	United Nations. "The Sustainable Development Goals Report."
6	UNESCO. (2015). "Global Citizenship Education: Topics and Learning Objectives."
7	Amartya Sen. (1999). "Development as Freedom."
8	Martha Nussbaum. (2011). "Creating Capabilities: The Human Development Approach."
9	Martha Nussbaum, *Cultivating Humanity: A Classical Defense of Reform in Liberal Education*
E Resources	
1	NPTEL course: "Constitution of India". http://nptel.ac.in/courses/109104032/
2	"Constitution of India" eBook. https://pothi.com/pothi/book/ebook-ministry-law-and-justice-constitution-india.
3	iasplanner.blogspot.com/2010/11/free-ebook-download-constitution-of.html
4	www.iasabhiyan.com
5	Samvidhaan, Documentary by Prasaar Bharathi
6	http://en.unesco.org/gced
7	https://www.theglobalcitizensinitiative.org/the-rights-and-responsibilities-of-global-citizenship/
8	https://www.un.org/en/academic-impact/global-citizenship
9	UN Sustainable Development Goals: https://sdgs.un.org/
10	UNESCO Global Citizenship Education: https://en.unesco.org/themes/gced

UILDING PSYCHOLOGICAL ASSETS

SEMESTER II

Course Code	HSS133		**Credits**	01
CIE Marks**	50 marks		**Hours/Week (L-T-P)**	1-0-0
Total Teaching Hours	15L+0T+0P		**SEE Marks**	-
Exam hours	1.5 hours		**Course Type**	AEC
Stream	All Departments		**Integrated Lab**	NO
Course Component				

COURSE OUTCOMES

Students will be able to

1. recognize failures as pathways to success
2. recognize the markers of a growth mindset in themselves
3. practice simple mindfulness exercises

COURSE CONTENTS

UNIT -1 **9 HOURSE**

- **Pathways to Success**: Introduction to the non-cognitive factors that are precursors to success; Suggested case studies: Sundar Pichai, Indira Nooyi
- **Learning to Fail:** Decoding failures; Why do we fail? ; Failure as an opportunity- Suggested case studies: Steve Jobs- Apple, ISRO-Chandrayaan
- **Growth mindset:** Comparing growth and fixed mindsets; techniques to develop a growth mindset; communication tools for a growth mindset.

UNIT -2- **6 HOURS**

- **Grit and Resilience:** Importance in crafting success; Tools to develop grit and be resilience. Suggested case studies: Narayana Murthy and Infosys; Ratan Tata
- **Self-regulation of Emotions:** The connect between thought, emotions and behaviours; tips to control my emotions; recognizing depression; mindfulness practice.

REFERENCE BOOKS

1. Duckworth, A. (2016). Grit: The power of passion and perseverance. Scribner/Simon C Schuster.
2. Khera, S. (2014) You Can Win: A Step-by-Step Tool for Top Achievers. ACC Black.

ONLINE RESOURCES*	
Topic/Title	**Link**
1. TED talk by Angela Duckworth on grit	https://www.youtube.com/watch?v=H14bBuluwB8Ct=1 11s
3. 5 Practices of Highly Resilient People with Dr. Taryn Marie Stejskal:	https://www.youtube.com/watch?v=gIYHQAeOy-w
4. Learning from failure	https://hbr.org/2011/04/strategies-for-learning-from-failure
5. Carol Dweck on Growth Mindset	https://www.youtube.com/watch?v=hiiEeMN7vbQ

****COURSE ASSESSMENT METHOD:**
Attendance : 5 Marks [95% and above- 5 marks; 94%-90%-4 marks; 89%-85%-3 marks; 84%-80%-2 marks; 79%-75%-1 mark] If students have less than 75% attendance , they will not be allowed to attend the end semester exam. LA1: 15 Marks LA2: 15Marks (The average of two LA will be taken) MSE: 30 Marks
PEDAGOGY
1. Activity based learning 2. Case studies 3. Group discussions and presentations 4. Reflective activities

*Additional Reading materials and online resources will be shared with the learners as required

III- VIII SEMESTER

Option-1, III Semester: 23 credits

Option-1, 23 credits															
Option-1: III SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT203	Complex variables and Transform Techniques	MAT	3	1	0	0	1	03	50	50	100	4
2	IPCC	EEE201	Electrical Circuit Analysis – II	EEE	2	1	2		1	03	50	50	100	4
3	IPCC	EEE202	Instrumentation and Measurements	EEE	3	0	2		1	03	50	50	100	4
4	PCC	EEE111	Electrical Power Generation and Utilization	EEE	3	0	0	✓	1	03	50	50	100	3
5	PCC	EEE211	Analog Circuit Analysis and Design	EEE	3	0	0		1	03	50	50	100	3
6	PCC	EEE221	Analog Circuit Analysis and Design Lab	EEE	0	0	2		1	03	50	50	100	1
7	HSMC	HSS104	Indian Knowledge Systems and Indian Culture	HSS	2	0	0	0	-	03	50	50	100	2
8	AEC	HSS232	Enhancing Self Competence	HSS	1	-	2	-	1	03	50	50	100	2
9	MNC	HSS105	Kannada (Balake / Samskrithika)	Any	1	0	0	0	-	0	50	0	50	0
Total					**18**	**2**	**8**	**0**	**7**	**24**	**450**	**400**	**850**	**23**
Additional Academic activities beyond class hours									9					
Learning hours per week					18	2	8		16					
Total notional learning hours (L+T+P+J+SL)			Per week		44									
			Per semester		44x16=672									

Bridge Course prescribed only to lateral entry Diploma holders admitted to III semester of Aeronautical Engineering Program														
10	BSC	MAT002	Basic Calculus and Matrix algebra	MAT	3	0	0	0	-	03	100	-	100	0

Option-2, III Semester: 22 credits

Option-2, 22 credits															
III SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT203	Complex variables and Transform Techniques	MAT	3	1	0	0	1	03	50	50	100	4
2	IPCC	EEE201	Electrical Circuit Analysis – II	EEE	2	1	2		1	03	50	50	100	4
3	IPCC	EEE202	Instrumentation and Measurements	EEE	3	0	2		1	03	50	50	100	3
4	PCC	EEE111	Electrical Power Generation and Utilization	EEE	3	0	0	✓	1	03	50	50	100	3
5	PCC	EEE211	Analog Circuit Analysis and Design	EEE	3	0	0		1	03	50	50	100	3
6	PCC	EEE221	Analog Circuit Analysis and Design Lab	EEE	0	0	2		1	03	50	50	100	2
7	HSMC	HSS104	Indian Knowledge Systems and Indian Culture	HSS	2	0	0	0	-	03	50	50	100	2
8	AEC	HSS134	Augmenting Employability Skills	HSS	-	-	2	-	1	0	50	0	50	1
9	MNC	HSS105	Kannada (Balake / Samskrithika)	Any	1	0	0	0		0	50	0	50	0
Total					**17**	**2**	**8**	**0**	**7**	**21**	**450**	**350**	**800**	**22**
Additional Academic activities beyond class hours									8					
Learning hours per week					17	2	8	0	15					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=672									

Bridge Course prescribed only to lateral entry Diploma holders admitted to III semester of Aeronautical Engineering Program														
10	BSC	MAT002	Basic Calculus and Matrix algebra	MAT	3	0	0	0	-	03	100	-	100	0

Option-1, IV Semester: 22credits

Option-1: 22 Credits															
IV SEMESTER															
Sl. No	Course Type and Course Code		Course Title	Teaching Department	Contact Hours/Week				SL	Examination				Credits
					L	T	P	J		Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	BSC	MAT207	Numerical Methods and Probability Theory	MAT	3	1	0	0	1	03	50	50	100	4
2	BSC	MAT211 / PHY213	Linear Algebra and Discrete Mathematics/ Quantum Physics	EEE	3	1	0		1	03	50	50	100	4
3	IPCC	ECE201	Digital System Design using HDL	EEE	3	0	2		2	03	50	50	100	4
4	PCC	EEE212	Electromagnetic Fields	EEE	3	0	0	✓	2	03	50	50	100	3
5	PCC	EEE213	Electrical Machines	EEE	3	0	0		1	03	50	50	100	3
6	PCC	EEE222	Electrical Machines Lab	EEE	0	0	2		1	03	50	50	100	1
7	HSMC	HSS103	Gender, Diversity & Inclusion	HSS	1	0	0	0		-	50	-	50	1
8	AEC	HSS231	Developing Professional Skills	HSS	1	0	2	0		03	50	50	100	2
				Total	17	2	6	0	8	21	400	350	750	22
Additional Academic activities beyond class hours									9					
Learning hours per week					17	2	6	-	17					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=672									

Bridge Course prescribed only to lateral entry Diploma holders admitted to III semester of Aeronautical Engineering Program														
9	BSC	MAT005	Basic Differential equations and Laplace Transforms	MAT	3	0	0	0	-	03	100	-	100	0

Option-2, IV Semester: 21 credits

Option-2: 21 credits															
Option2: IV SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	BSC	MAT207	Numerical Methods and Probability Theory	MAT	3	1	0	0	1	03	50	50	100	4
2	BSC	MAT211 / PHY213	Linear Algebra and Discrete Mathematics/ Quantum Physics	EEE	3	1	0		1	03	50	50	100	4
3	IPCC	ECE201	Digital System Design using HDL	EEE	3	0	2		2	03	50	50	100	4
4	PCC	EEE212	Electromagnetic Fields	EEE	3	0	0	✓	2	03	50	50	100	3
5	PCC	EEE213	Electrical Machines	EEE	3	0	0		1	03	50	50	100	3
6	PCC	EE222	Electrical Machines Lab	EEE	0	0	2		1	03	50	50	100	1
7	HSMC	HSS103	Gender, Diversity & Inclusion	HSS	1	0	0	0		-	50	-	50	1
8	AEC	HSS135	Developing Interpersonal Skills	HSS	0	0	2	0		-	50	-	50	1
				Total	16	2	6	0	8	18	400	300	700	21
Additional Academic activities beyond class hours									8					
Learning hours per week					17	1	6	-	16					
Total notional learning hours (L+T+P+J+SL)			Per week		40									
			Per semester		40x16=640									

Bridge Course prescribed only to lateral entry Diploma holders admitted to III semester of Aeronautical Engineering Program															
9	BSC	MAT005	Basic Differential equations and Laplace Transforms	MAT	3	0	0	0	-	03	100	-	100	0

V Semester: 22 credits

V SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	IPCC	EEE301	Digital Signal Analysis and Processing	EE	2	1	2	-	2	3	50	50	100	4
2	IPCC	EEE203	Microcontroller Programming with C	EE	3	0	2	-	2	3	50	50	100	4
3	PCC	EEE311	Power System Analysis -1	EE	3	0	0	-	1	3	50	50	100	3
4	PCC	EEE321	Power System Analysis Lab	EE	0	0	2	-	1	3	50	50	100	1
5	PEC	EEEXXX	Professional Elective – I	EE	3	0	0	✓	1	3	50	50	100	3
6	OEC	XXXXXX	Open Elective – I	Any	3	0	0	-	-	3	50	50	100	3
7	HSMC	MGM102	Management, Entrepreneurship and IPR	Any Dept	3	0	0	0	1	3	50	50	100	3
8	AEC	MEC131	Innovation and Design Thinking	ME/ AE	0	0	2	0	-	-	50	-	50	1
9	MNC	UCC102	Employability Skill Development	Any Dept	1	0	0	0	-	-	50	-	50	0
					18	**1**	**8**	**0**	**8**	**24**	**550**	**400**	**950**	**22**
Additional Academic activities beyond class hours									7					
Learning hours per week					18	1	8	0	15					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=672									

VI SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	IPCC	EEE302	Power Electronics	EE	2	1	2	-	2	3	50	50	100	4
2	PCC	EEE312	Linear Control Systems	EE	3	0	0	-	1	3	50	50	100	3
3	PCC	EEE322	Linear Control Systems Lab	EE	0	0	2	-	2	3	50	50	100	1
4	PCC	EEE313	Power System Analysis – II	EE	3	0	0	-	1	3	50	50	100	3
5	PEC	EEEXXX	Professional Elective - II	EE	3	0	0	✓	1	3	50	50	100	3
6	OEC	XXXXXX	Open Elective – II	Any	3	0	0	-	1	3	50	50	100	3
7	ETC	EEE331	AI for Electrical Engineers	EE	2	0	0	✓	1	3	50	50	100	2
8	HSMC	HSS106	Globalization and its Implications	HU	2	0	0	0		3	50	50	100	2
9	AEC	EEE131/ EEE132/ EEE133	Python Programming / Internet of Things / Soldering Practice	EE	0	0	2	0	1	3	50	50	100	1
					19	**0**	**6**	**0**	**10**	**24**	**400**	**400**	**800**	**22**
Additional Academic activities beyond class hours									7					
Learning hours per week					19	0	6	0	7					
Total notional learning hours (L+T+P+J+SL)			Per week		42									
			Per semester		42x16=608									

VI Semester: 22 credits

VII Semester: 17 credits

VII SEMESTER															
Sl. No	**Course Type and Course Code**		**Course Title**	**Teaching Department**	**Contact Hours/Week**				**SL**	**Examination**				**Credits**
					L	**T**	**P**	**J**		**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	IPCC	EEE303	Electric Vehicle Technology	EEE	3	0	2	-	2	3	50	50	100	4
2	PCC	EEE314	DSP Processor	EEE	1	0	2	-	2	3	50	50	100	2
3	PEC	EEEXXX	Professional Elective-III	EEE	3	0	0	-	1	3	50	50	100	3
4	PEC	EEEXXX	Professional Elective - IV	EEE	3	0	0	-	1	3	50	50	100	3
5	HSMC	MGM101	Economics and Fiscal Management – An Engineers Perspective	Any Dept	3	0	0	0	1	3	50	50	100	3
		MGM104	Project Management for Professionals											
		MGM103	Operations Research and Project Management											
6	AEC	HSS136	Japanese Language	HSS / SWAYAM	3	0	0	0	1	3	50	50	100	3
			German Language											
		HSS137	Research Methodology	Any										
7	MNC	UCC301	Capstone Design Project – Phase I	EEE	0	0	2	0	1	0	50	0	50	0
					16	**0**	**6**	**0**	**9**	**18**	**350**	**300**	**650**	**18**
Additional Academic activities beyond class hours									4					
Learning hours per week					17	0	4	0	13					
Total notional learning hours (L+T+P+J+SL)			Per week		34									
			Per semester		34x16=544									

VIII Semester: 16 credits

VIII SEMESTER																
Sl. No	Course Type and Course Code		Course Title	Teaching Department	Contact Hours/Week				SL	Examination				Credits	Total Credits
					L	T	P	J		Duration in Hours	CIE Marks	SEE Marks	Total Marks		
1	CE	UCC101	Community Engagement	EEE	1) Social connect & Responsibility (15 hours lecture to be engaged during second semester) 2) Activity based Internship to focus on the activities pertaining to Social Connect & Responsibility (1 week duration (40 - 45 hours) to be completed during the vacations of II, IV, V & VI Semesters.)				-	-	100	-	100	2	2
2	INT	UCC401	Professional Practice	At Industry	Professional Practice at for 20 weeks. Minimum 34 hours /week and 1 hour / week for interaction between the project guide and students.				1	3	150	150	300	14	14
OR															
2a	INT	S	Internship (Research/ Industry Internship)	EEE	Mandatory Research Internship / Industry Internship of 4 weeks (160 – 180 hours) to be completed in one/two stretches during the vacation periods between IV to VII semesters				-	3	50	50	100	4	
2b	PRJ	UCC302	Capstone Design Project Phase - II	EEE	Student should carry out project in research institute/industry/intra institute Center of Excellences for 16 weeks. Minimum 34 hours /Week and 1 hour / week for interaction between the project guide and students.				1		100	100	200	10	
					34				**1**	**3**	**250**	**150**	**400**	**16**	**16**
Learning hours per week					35										
Total notional learning hours (L+T+P+J+SL)			Per week		35										
			Per semester		80+160+(35x16) =800										

	Department of Electrical and Electronics Engineering								
	List of Program Elective Courses offered for B. Tech (EEE)								
Sl. No.	Group	Course Code	Category	Subject Name	L: T:P: J				CREDIT
					L	T	P	J	
Elective courses									
Power Systems									
1	1	EEE341	PEC	Electrical Estimation and Costing	3	0	0	0	3
2	2	EEE361	PEC	Advanced Power System Analysis and Control	3	0	0	0	3
3	1	EEE241	PEC	High Voltage Engineering	3	0	0	0	3
4	2	EEE362	PEC	FACTS and HVDC Transmission	3	0	0	0	3
5	1	EEE242	PEC	Energy Auditing and Demand Side Management	3	0	0	0	3
Power Electronics									
1	1	EEE243	PEC	Power Semiconductor Devices	3	0	0	0	3
2	2	EEE363	PEC	Switched Mode Power Converters	3	0	0	0	3
3	1	EEE342	PEC	Converters for Solar and Wind Energy	3	0	0	0	3
4	2	EEE364	PEC	Electrical Drives	3	0	0	0	3
5	2	EEE365	PEC	Resonant and Multilevel Converter	3	0	0	0	3
Microelectronics									
1	1	EEE343	PEC	Linear Integrated Circuits	3	0	0	0	3
2	1	EEE344	PEC	VLSI Circuits and Design	3	0	0	0	3
3	2	EEE366	PEC	Digital CMOS Circuits Design	3	0	0	0	3
4	1	EEE345	PEC	Analog CMOS IC Design	3	0	0	0	3
5	2	EEE261	PEC	VLSI Technology	3	0	0	0	3
IT + AI									
1	1	EEE346	PEC	MATLAB Programming for Engineers	3	0	0	0	3
2	2	EEE262	PEC	Computational Linear Algebra	3	0	0	0	3
3	2	EEE263	PEC	Probability and Information Theory	3	0	0	0	3
4	1	EEE347	PEC	Basics of Machine Learning with Python	3	0	0	0	3
5	2	EEE264	PEC	Matrix Methods in Machine Learning	3	0	0	0	3
6	1	AID111	PEC	Essentials of Data Science	3	0	0	0	3
7	1	AID212	PEC	Principles of Artificial Intelligence	3	0	0	0	3
Electric Vehicles									
1	1	EEE244	PEC	Electric Vehicle Battery Charging Methods and Topologies	3	0	0	0	3
2	2	EEE265	PEC	Autonomous and Connected Vehicles	3	0	0	0	3
3	2	EEE367	PEC	EV's in Smart Grid	3	0	0	0	3
4	1	EEE245	PEC	Battery Control and Monitoring	3	0	0	0	3
5	1	EEE348	PEC	Fundamentals of Automotive Systems	3	0	0	0	3

Embedded Systems									
1	2	EEE368	PEC	Embedded Systems with ARM	3	0	0	0	3
2	1	EEE246	PEC	Embedded Systems for IoT Applications	1	0	4	0	3
3	1	EEE247	PEC	Industrial Automation and Control	3	0	0	0	3
4	2	EEE369	PEC	Automotive Electronics	3	0	0	0	3
5	2	EEE266	PEC	Device Drivers	3	0	0	0	3
Renewable Energy Systems									
1	1	EEE349	PEC	Solar Photovoltaics	3	0	0	0	3
2	2	EEE370	PEC	Smart Grid	3	0	0	0	3
3	1	EEE248	PEC	Artificial Intelligence and Machine Learning in Renewable Energy	3	0	0	0	3
4	2	EEE371	PEC	Hybrid Renewable Energy Systems	3	0	0	0	3
5	2	EEE372	PEC	Grid Integration of Renewable Energy Sources	3	0	0	0	3
	Signal Processing								
1	2	EEE373	PEC	Digital Image Processing	3	0	0	0	3
2	1	EEE350	PEC	Computer Vision with Python	3	0	0	0	3
3	2	EEE374	PEC	Application of Signal Processing in Electrical Engineering	3	0	0	0	3
4	2	EEE375	PEC	Statistical Signal Processing	3	0	0	0	3
5	1	EEE351	PEC	System Identification	3	0	0	0	3
	Instrumentation and Control								
1	2	EEE376	PEC	Advanced Control Theory	3	0	0	0	3
2	2	EEE377	PEC	Digital Control Systems and State Variable Methods	3	0	0	0	3
3	1	EEE352	PEC	Measurement Data Analysis	3	0	0	0	3
4	1	EEE353	PEC	Biomedical Instrumentation	3	0	0	0	3
	Quantum Technology								
1	1	EEE249	PEC	Introduction to Quantum Computing	3	0	0	0	3
2	1	EEE354	PEC	Quantum Communication	3	0	0	0	3
3	2	EEE378	PEC	Quantum Sensing	3	0	0	0	3
4	2	EEE379	PEC	Quantum Materials	3	0	0	0	3

Basic Science Courses (BSC)

COMPLEX VARIABLES AND TRANSFORM TECHNIQUES

Course Code:	**MAT203**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P):	**4:0:0**	**Credits:**	**04**
Total Teaching Hours:	**45+15+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mathematics

Course Objectives:

- The course details concept and application of analytical functions, complex integration, poles and residues
- The course imparts knowledge about Fourier series, Fourier and Z transforms in detail
- The course covers concepts and applications of vector differential and integral calculus

UNIT-I

Complex analysis — **9+3 Hours**

Analytic function, Cauchy Riemann equations, Construction of analytic function, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula, Laurent's Series, Residues and poles, Cauchy's Residue theorem.

UNIT-II

Z- transforms — **9+3 Hours**

Definition, Standard Z transforms, Linearity property, Damping Rule, Shifting rule, multiplication by n, initial and final value theorems, Bivariate Z-transforms, region of convergence, Inverse by partial fractions method, convolution theorem. Solution of difference equations.

UNIT - III

Fourier series and Fourier Transforms: — **9+3 Hours**

Fourier Series: Euler's formulae, Dirichlet's conditions for Fourier series expansion, change of interval, Even and odd functions, half-range expansions, Practical harmonic analysis.

Fourier Transforms: Definition, Complex Fourier transforms, Cosine and Sine transforms, Inverse Fourier transforms

UNIT-IV

Vector Calculus — **9+3 Hours**

Vector algebra (review), vector differentiation-gradient, directional derivatives, divergence, curl, Laplacian, solenoidal and irrotational vectors. Curvilinear, spherical and cylindrical co-ordinates.

UNIT -V

Vector Integration — **9+3 Hours**

Line integrals, Surface integrals, Volume Integrals. Applications to work done by a force and flux. Green's theorem, Stoke's theorem and Gauss divergence theorem, Problems.

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

1	Apply concept of analytic functions, series expansion and Complex integration.
2	Adopt concept of Z transforms to discrete signals and functions occurring in Engineering
3	Expand periodic functions into series and transform aperiodic functions using Fourier analysis
4	Solve engineering problems adopting concepts vector differential calculus
5	Apply vector integration techniques to engineering problems

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2										
2	2	2										
3	3	1										
4	3	2										
5	3	2										

	1: Low 2: Medium 3: High
TEXTBOOKS:	
1	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, 2015.
2	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition (Reprint), 2016
3	N.P. Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
REFERENCE BOOKS:	
1	J.W. Brown and R.V. Churchill, "Fourier Series and Boundary Value Problems", McGraw-Hill Education, 8th Edition, 2011
2	J R Hanna, J H Rowland, Fourier Series, Transforms and Boundary Value Problems, Dover, 2018
3	E.Kreyszig, "*Advanced Engineering Mathematics, Volume II*" ,Wiley ,2014
E Books / MOOCs/ NPTEL	
1	***http://nptel.ac.in/courses/111107108/***
2	***https://nptel.ac.in/courses/122101003***
3	NPTEL :: Mathematics - NOC:Transform Techniques for Engineers

NUMERICAL METHODS AND PROBABILITY THEORY

Course Code:	**MAT207**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P):	**3:1:0**	**Credits:**	**04**
Total Teaching Hours:	**45+15+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mathematics

Course Objectives:

- The course introduces numerical methods to estimate roots and integration of complicated functions.
- The course also covers numerical techniques to get approximate solutions of differential equations.
- The course details the basic concepts of probability theory, random variables, probability distributions, sampling and testing of hypothesis.

UNIT-I

Numerical Methods-2: Solution of equations and integration — **9+3 Hours**

Numerical solution of algebraic and transcendental equations: Regula-falsi method and Newton Raphsons method Bisection method and ordinary iteration method.
Numerical Integration by Trapezoidal, Simpson's 1/3rd and3/8th rule, Weddle's rule, Gaussian Quadrature.

UNIT-II

Numerical Methods-3: solutions of ODE & PDE — **9+3 Hours**

Numerical solution of first order ordinary differential equations: Taylor's series method, modified Euler's method, 4th order R-K Method. Milne's Predictor -Corrector method.
Classification of second order partial differential equations. Numerical solution of Laplace equation by standard five point formula and solution of heat and wave equations by explicit method.

UNIT - III

Fundamentals of probability distribution — **9+3 Hours**

Finite sample space, conditional probability and independence, Bayes' theorem (overview). One dimensional random variable: discrete and continuous random variable, probability functions, cumulative distribution function, expectation and variance. Two dimensional random variable, covariance and correlation coefficient.

UNIT-IV

Types of Probability distribution — **9+3 Hours**

Binomial, poison, normal, exponential distributions, chi-squared distribution, sampling distribution of means, central limit theorem applications

UNIT -V

Hypothesis Testing — 9+3 Hours

Simple and composite hypothesis, Null hypothesis, one-tailed, two tailed test, significance level, difference between means, difference between proportions, student's t – distribution and test, Chi square test as goodness of fit.

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

1	Apply numerical techniques to estimate roots and integrate when data is given.
2	Apply numerical methods to solve ODE and PDE arising in engineering field
3	Apply probabilistic concept and random variables to data given
4	Apply concept of standard probabilistic distributions to fit the data
5	Test and draw conclusions about the data provided

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2										
2	2	2										
3	3	1										

4	3	2										
5	3	2										

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	Gupta, S. C. & Kapoor, V. K. ***Fundamentals of Mathematical Statistics***, 11th Ed., S.Chand and Company Pvt. Ltd., 2014.
2	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, 2015.
3.	S.S.Sastry, "Introductory methods of Numerical Analysis", 2nd edition, 1990, Prentice Hall.
REFERENCE BOOKS:	
1	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition (Reprint), 2016
2	Paul L Meyer, "Introductory Probability and Statistical Applications", Addison-Wesley Publishing Company, 2ndEdition (Reprint), 1970.
3	Schaum Outlines, "Probability and Statistics", Mc Graw Hill, 3rdedition , 2010.
4	G Shanker Rao, " Probabilty and Statistics for Science and Engg", Univ Press, 2011
5.	M.K.Jain, S.R.K. Iyengar and R.K. Jain, "Numerical methods for Scientific and Engineering Computations", 4th edition, 2003, New Age international.
6	V Krishnamurthy, S K Sen , Numerical Algorithms, East West press, 2007
E Books / MOOCs/ NPTEL	
1	NPTEL :: Mathematics - NOC:Numerical methods
2	NPTEL :: Mathematics - NOC:Introduction to Probability Theory and Stochastic Processes

FUNDAMENTALS OF MATRICES AND CALCULUS

Course Code:	**MAT002**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P):	**3:0:0**	**Credits:**	**00**
Total Teaching Hours:	**40+0+0**	**CIE Marks(no SEE):**	**100**

Teaching Department: Mathematics

Course Objectives:

1	This course will enable the students to master the basic tools of elementary linear algebra, eigen values and eigenvectors of a square matrix using the characteristic polynomial, differential calculus, partial differentiation, multiple integration and become skilled for solving problems in science and engineering.

UNIT-I

Matrices — **8 Hours**

Elementary row transformations of a matrix, Rank of a matrix by echelon form, Consistency of system of equations, Solution of system of linear equations, Gauss-elimination method, solving system of equations by LU decomposition method

UNIT-II

Eigen Values and Eigen vectors — **8 Hours**

Eigen values and Eigenvectors (Direct method), Trace Characteristic equation, Power method of finding dominant Eigen value and corresponding Eigenvector, Diagonalisation.

UNIT - III

Differential calculus — **8 Hours**

Polar curves, angle between the radius vector and the tangent, angle of intersection of two curves.. Rolle's Theorem (without proof), mean value theorems, Taylor and Maclaurin series.

UNIT-IV

Partial Differentiation — **8 Hours**

Partial derivatives of simple functions, total differentiation - Jacobians., maxima and minima for functions of two variables, Lagrange's method of undetermined multipliers.

UNIT -V

Multiple Integrals — **8 Hours**

Double integrals and triple integrals, , change of variables and applications to area and volume. Beta and Gamma functions and their properties.

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

1	Solve system of equation numerically to get approximate solution
2	Compute and interpret Eigen values and Eigen vectors
3	Apply mean value theorem, Taylor's series and concepts of polar curves for engineering problems
4	Differentiate multivariate functions and Extremize the same.
5	Evaluate multiple integrals and apply the concept of special fuctions

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2										
2	2	2										
3	3	1										
4	3	2										
5	3	2										

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, 2015.
2	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition (Reprint), 2016.
3	N.P. Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
REFERENCE BOOKS:	
1	G.B. Thomas and R.L.Finney, "Calculus and Analytic geometry", Pearson, 2002.
2	Shanthi Narayan, " Differential Calculus, 6th edition, Shyam Lal Charitable Trust, Delhi.
3	Seymore Lipschutz, Marc Lipson, "Linear Algebra" 3rd edition, Schaum series,Tata McGraw Hill,2011
4	Gilbert Strang "Linear Algebra for everyone" 2020,PHI
E Books / MOOCs/ NPTEL	
1	***http://nptel.ac.in/courses/111107108/***
2	***https://nptel.ac.in/courses/122101003***

FUNDAMENTALS OF DIFFERENTIAL EQUATIONS AND INTERPOLATION

Course Code:	**MAT005**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P):	**3:0:0**	**Credits:**	**00**
Total Teaching Hours:	**40+0+0**	**CIE Marks(SEE Marks):**	**100**

Teaching Department: Mathematics

Course Objectives:

- The course provides extensive knowledge of methods to solve Differential equations
- The course also provides knowledge of Laplace transforms
- The course imparts numerical techniques to fit and interpolate data

UNIT-I

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS — **8 Hours**

Exact equation, linear and Bernoulli's differential equations, Applications: Rate of growth and decay, Newton' law of cooling, Mixing.

UNIT-II

ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER — **8 Hours**

Second and higher order linear differential equation with constant coefficients, solution by inverse differential operator, method of variation of parameters.

UNIT - III

LAPLACE TRANSFORMS — **8 Hours**

Definitions, transforms of elementary functions, transforms of derivatives and integrals
Inverse Laplace Transforms, Solution of ODE

UNIT-IV

NUMERICAL METHOD-1: INTERPOLATION — **8 Hours**

Interpolation: Newton's forward and backward formulae, Newton's divided difference formulae and Lagrange's formula for unequal intervals, Numerical differentiation with Newton's forward and backward difference interpolation.

UNIT -V

PARTIAL DIFFERENTIAL EQUATIONS — **8 Hours**

Formation of partial differential equations by elimination of arbitrary constants/arbitrary functions. Solution of PDE's by the method of separation of variables. Solution of heat, wave and Laplace equation.

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

1	Apply concept of analytic functions, expand into series and integration to complex functions
2	Apply concept of Z transform to discrete signals and functions
3	Apply Fourier analysis to periodic and aperiodic functions
4	Apply concepts of vector differential calculus to engineering problems
5	Adopt techniques of vector integration to engineering problems

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2										
2	3	2										
3	2	2										
4	2	2										
5	3	2										

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, 2015
2	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition (Reprint), 2016.
3	S.S.Sastry, "Introductory methods of Numerical Analysis", 2nd edition, 1990, Prentice Hall.
4	N.P. Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
REFERENCE BOOKS:	
1	W.E. Boyce and R.C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.
2	G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.
3	Shepley L Ross, "Differential equations" 3rd edition, Wiley, 2004
4	M K Jain, S R K Iyengar, R K Jain, Numerical Methods for Scientific and Engg. Computation, New Age, 2012
5	V Krishnamurthy, S K Sen , Numerical Algorithms, East West press, 2007
E Books / MOOCs/ NPTEL	
1	***http://nptel.ac.in/courses/111106100***
2	***http://nptel.ac.in/courses/111106139***
3	***http://nptel.ac.in/courses/111107111***

LINEAR ALGEBRA AND DISCRETE MATHEMATICS

Course Code	MAT211	**Credits**	4
Hours/Week (L :T:P:S)	3:1:0:0	**CIE Marks**	50
Total Hours	45+15	**SEE Marks**	50
Exam Hours	3	**Course Type**	BSC

PREREQUISITE: Engineering Visualization, Matrix Algebra and Calculus

Course Objectives

1.	get familiar with the concept of vector spaces and orthogonality.
2.	To comprehend eigen-decomposition and singular value decomposition.
3.	To develop a broad understanding of logic, relations, functions and groups.

Course Contents

UNIT – 1

Vector Spaces — **9+3 Hours**

Vectors and linear combinations, lengths and dot products, matrices. Elimination matrices, LU decomposition, permutation matrices.
Vector spaces and subspaces, Rank and Row reduced form, Independence, Basis and dimension, Dimensions of the four subspaces, Rank-Nullity Theorem.

UNIT – 2

Orthogonality — **9+3 Hours**

Orthogonal Vectors and Subspaces, Projections and Least squares, Orthogonal Bases and Gram-Schmidt Orthogonalization procedure, Householder transformation.

UNIT - 3

Matrix Decompositions — **9+3 Hours**

Review of Eigenvalues and Eigenvectors and diagonalization, Jordan canonical form, Symmetric matrices, Positive definite matrices, Similar matrices, Singular Value Decomposition, Linear transformation and matrix of linear transformation.

UNIT - 4

Fundamentals of Logic — **9+3 Hours**

Review of Set theory, Basic Connectives and Truth Tables, Logic Equivalence – The Laws of Logic, Logical Implication – Rules of Inference. Quantifiers, The Use of Quantifiers, Definitions and the Proofs of Theorems, Properties of the Integers: Mathematical Induction, The Well Ordering Principle, Recursive Definitions.

UNIT - 5

Relations and Functions — **3+1 Hours**

Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions.

Groups — **6+2 Hours**

Definitions, properties, Homomorphisms, Isomorphisms, Cyclic Groups, Cosets and Lagrange's theorem.

Course Outcomes

At the end of the course student will be able to

1.	Develop a basic idea of vector spaces and their interrelation.
2.	Appreciate the advantages of orthogonal bases.
3.	Understand the significance of matrix decompositions and linear transformations.
4.	Comprehend the basics of Boolean algebra.
5.	Understand the attributes of groups.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
Code.1	3	2											1
Code.2	3	2											1
Code.3	3	2											1

	Code.4	3	2											1
	Code.5	3	2											1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Introduction to Linear Algebra	Gilbert Strang	Wellesley Cambridge Press	4th Edition
2.	Discrete Mathematics and Its Applications	Kenneth H Rosen	McGraw Hill Education	8th Edition

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Linear Algebra and Its Applications	Gilbert Strang	Cengage India	4th Edition
2.	Introductory Discrete Mathematics	V. K. Balakrishnan	Dover Publications Inc.	1991.

QUANTUM PHYSICS

Course Code	**PHY213**	**Course type**	**BSC**
Hours/Week (L :T:P:S)	**4:0:0:0**	**Credits**	**4**
Total Hours	**60**	**CIE + SEE Marks:**	**50+50**

PREREQUISITE: Basics of Quantum Mechanics, Linear Algebra

Course Objectives

1.	To understand the fundamentals of quantum computing and the representation of a qubit.
2.	To equip students with a solid foundation in linear algebra concepts and techniques essential for quantum computing.
3.	To understand quantum probability measurements on physical systems.
4.	To understand the fundamentals of qubits, quantum states, and entanglement.
5.	To introduce quantum gates and circuits, highlight their correspondence with classical logic gates.

Course Contents

UNIT – 1	**12 Hours**

Introduction to Quantum Computing:

Basics of Quantum Computing, Moore's law & its end. Single particle quantum interference, Classical & quantum information comparison. Differences between classical & quantum computing, quantum superposition and the concept of qubit. Quantum Entanglement, Representation of a qubit by the Bloch sphere. Dirac representation and matrix operations: Matrix representation of 0 and 1 States, Identity Operator I, Applying I to $|0\rangle$ and $|1\rangle$ states.

UNIT – 2	**12 Hours**

Basics of Vectors and Matrices

Vector Spaces, Linear Dependence and Independence of Vectors, Orthonormal Basis and Completeness Relation, Projection Operators, Gram-Schmidt Orthonormalisation, Linear Operators and Matrices, Eigenvalue Problems, Pauli Matrices, Spectral Decomposition, Singular Value Decomposition (SVD), Tensor Product (Kronecker Product).

UNIT – 3	**12 Hours**

Introduction to Quantum Information:

The density operator. The density operator for pure and mixed states. The density matrix for a product space. Partial traces in a bipartite system. The positivity of the density matrix. Schmidt decomposition of a bipartite pure state. Entanglement and the Schmidt number. Evolution of density matrices: quantum channels/super operators. Generalized measurements (POVM). Operator sum decompositions. Transformations of the density matrix. Decoherence. Channel-state duality.

UNIT – 4	**12 Hours**

Entanglement Qubits and Quantum Key Distribution

Qubit Entanglement, Three or More Parties, Cluster and Graph States, Experiment: Entangled Photonic Qubits, EPR/Bell State, Multi-Qubit Systems and Entangled States, Measurements, Einstein-Podolsky-Rosen (EPR) Paradox, Quantum Key Distribution (BB84 Protocol), Fundamental Postulates, Multipartite System, Tensor Product and Entangled State, Mixed States and Density Matrices.

UNIT – 5	**12 Hours**

Quantum Gates, Quantum Circuit and Quantum Computation

Introduction, Quantum Gates, Correspondence with Classical Logic Gates, No-Cloning Theorem, Dense Coding and Quantum Teleportation, Universal Quantum Gates.

Course Outcomes

At the end of the course student will be able to

1.	Apply the knowledge of quantum mechanics in representation of qubits as a quantum state and differentiate classical quantum computing.
2.	Apply fundamental concepts of vector spaces for solving eigenvalue problems.
3.	Apply density operator formalism to characterize quantum states and analyse quantum channel evolution.
4.	Apply the basic concepts of quantum entanglement in multi-qubit systems and various states.
5.	Illustrate quantum gates and circuits, compare them with classical logic gates, and explain key principles.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
PHY213-1.1	3	2	1		1		2					1	1
PHY213-1.2	3	2	1		1		2					1	1
PHY213-1.3	3	2	1		1		2					1	1
PHY213-1.4	3	2	1		1		2					1	1
PHY213-1.5	3	2	1		1		2					1	1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Picture book of Quantum Mechanics	Siegmund Brandt , Hans Dieter Dahmen	Springer	Fourth Edition
2.	QUANTUM COMPUTING From Linear Algebra to Physical Realizations	Mikio Nakahara Tetsuo Ohmi	CRC Press Taylor & Francis Group	2008
3.	Lectures on Quantum Mechanics	Steven Weinberg	Cambridge University Press	Second Edition

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Quantum Teleportation and Entanglement: A hybrid approach to Optical Quantum Information Processing	Akira Furusawa and Peter van Loock	Wiley VCH	2011
2.	The Physics of Quantum Mechanics	James Binney and David Skinner	Cappella Archive	2011
3.	Quantum Mechanics Theory and Applications	Quantum Mechanics Theory and Applications	Kluwer Academic Publishers	2005

E Books / MOOCs/ NPTEL

1.	https://archive.nptel.ac.in/courses/122/106/122106034/
2.	https://onlinecourses.nptel.ac.in/noc24_ph15/preview

Integrated Professional Core Courses (IPCC)

ELECTRICAL CIRCUIT ANALYSIS-II			
Course Code	EEE201	**Credits**	4
Hours/Week (L :T:P:S)	2:1:2:0	**CIE Marks**	50
Total Hours	45+30	**SEE Marks**	50
Exam Hours	3	**Course Type**	IPCC
PREREQUISITE: Electrical Circuit Analysis-I			

Course Objectives	
1.	To introduce graph theory concepts for solving linear electrical networks using topological methods.
2.	To familiarise with the electrical network theorems.
3.	To explain the concept of resonance phenomena in electric circuits.
4.	To analyze the transient response of circuits with DC and sinusoidal AC excitations.
5.	To solve and obtain the behavioral equation for a given network using Laplace Transform method and classical method.
6.	To represent the two port network by its two port network parameters.
7.	To familiarize with the analysis of three-phase circuits and computation of electric power.

Course Contents	
UNIT – 1	
Graph Theory	**6+3 Hours**
Sources and Types of networks: Ideal and practical, independent and dependent sources, Linear and nonlinear, active and passive, unilateral and bilateral, time variant and invariant, lumped and distributed networks**.** **Graph Theory:** Introduction, graph of a network, graph terminologies, concept of tree and co-tree, incidence matrix, tie set and cutset matrices, formulation of equilibrium equations in matrix form, solution of resistive network.	
UNIT – 2	
Network Theorems	**6+3 Hours**
Superposition, Reciprocity, Thevenin's and Norton's theorem, Maximum power transfer theorem, Millman's theorem as applied to AC and DC circuits.	
UNIT – 3	
Transient behavior and initial conditions	**6+3 Hours**
Behavior of circuit elements under switching. Conditions and their representations, evaluation of initial and final conditions in RL, RC and RLC circuits with AC and DC excitations. **Solution of networks by classical method:** Solution of RL and RC networks for DC excitations **Waveform Synthesis:** Impulse, Step, Ramp and sinusoidal signals. Synthesis of aperiodic and periodic signals and their Laplace Transforms	
UNIT – 4	
Transform method of analysis	**6+3 Hours**
Solution of networks by Laplace Transform method for ac and dc excitations. Concept of time constant. **Two port networks:** Short circuit admittance parameters(y), Open circuit impedance parameters(z), T parameters, h parameters, Relationship between parameter sets	
UNIT – 5	
Three phase AC circuits	**6+3 Hours**

Analysis of three phase balanced and unbalanced circuits, Three phase power and measurement	
Laboratory Component	
Suggested List of Experiments	
1.	Analysis of Resonant phenomena in LTspice and experimental validation
2.	Analysis of Filter circuits using LTspice
3.	Verification of KVL, KCL for multi-loop electrical circuits with DC/AC independent sources through simulation software.
4.	Verification of KVL, KCL for multi-loop electrical circuits with DC / AC controlled dependent sources through simulation software.
5.	Verification of Superposition and Reciprocity theorem
6.	Verification of Thevenin, Norton and maximum power theorem
7.	Analysis of First order R-L and R-C circuits and second order RLC circuits through simulation software and validation of results using Laplace transform method
8.	Analysis of First order R-L and R-C circuits circuits through hardware setup and obtain the time constant.
9.	Verification of impedance/ admittance parameters of two port network through simulation software
10.	Verification of h and T parameters of two port network.
11.	Analysis of 3 phase star and delta networks
12.	3 phase power measurement of a balanced network.
Course Outcomes	
At the end of the course student will be able to	
1.	Formulate network equations using graph theory concepts and hence solve electrical circuits.
2,	Apply the network theorems to solve the electrical circuits for both DC and AC excitations.
3.	Compute the (i) transient and steady state response of networks using time domain analysis. (ii) synthesised waveforms.
4.	Compute the (i) transient and steady state behavior using Laplace transform method. (ii) parameters of two port networks.
5.	Analyse the three-phase circuits to compute current, voltage and power.
Course Outcomes Mapping with Program Outcomes & PSO	

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
EEE201.1	3	3					1	3	2		1
EEE201.2	3	3			3		1	3	2		1
EEE201.3	3	3			3		1	3	2		1
EEE201.4	3	3			3		1	3	2		1
EEE201.5	3	3					1	3	2		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Engineering circuit	W.H. Hayt and	McGrraw Hill	8th edition 2014.

	Analysis	J.E Kemmerley		
2.	Circuit Theory and network Analysis and synthesis	Ravish R Singh	McGrraw Hill Education (India)	2nd edition 2017
3.	Network Analysis	M.E Van Valkenberg	Prentice Hall Publishers	3rd edition, Series Volume: 7,2014
REFERENCE BOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Network Analysis And Synthesis	Franklin F Kuo	Wiley	Student edition (India) 2020
2.	Network Analysis and Synthesis	Ravish R. Singh	McGraw Hill Education	2nd edition, 2019
3.	Signals and Systems	Simon Haykin Barry Van Veen	John Wiley and Sons Pte Ltd	2nd edition, 2007
E Books / MOOCs/ NPTEL				
1.	NPTEL course on Basic Electrical Circuits, IIT Madras, Prof. Gajendranath Chowdary.			
2.	NPTEL course on Basic Electric Circuits, IIT Kanpur, Prof. Ankush Sharma**.**			
3	NPTEL course on Basic Electrical Circuits, IIT Madras, Prof. Nagendra Krishnapura, Prof. Gajendranath Chowdary			

INSTRUMENTATION AND MEASUREMENTS			
Course Code	EEE202	**Credits**	4
Hours/Week (L :T:P:S)	3:0:2:0	**CIE Marks**	50
Total Hours	45+30	**SEE Marks**	50
Exam Hours	3	**Course Type**	IPCC

PREREQUISITE: Electrical Circuit Analysis- I

Course Objectives

1.	To introduce the fundamentals of electrical measurements.
2.	To develop competency in the use of bridges, modern instruments for measuring, shielding and grounding in measurement systems.
3.	To provide insights into the working principles of Frequency meter, Instrument transformers, Oscilloscopes & Signal Measurements.
4.	To equip the students with the knowledge of working principles and applications of various transducers.
5.	To cultivate analytical skills for engineering processes using Virtual Instrumentation.

Course Contents

UNIT – 1

Fundamentals of Measurement	**9 Hours**

Importance of measurements in electrical engineering, types of measurements (e.g., voltage, current, power, frequency), and measurement systems.

Classification of Measuring Instruments: Analog and digital instruments, functions of instruments and measurement systems

Static and Dynamic Characteristics of Instruments: Accuracy, precision, sensitivity, resolution, linearity, hysteresis, repeatability, reproducibility, drift and error analysis.

Standards and Calibration: Understanding measurement standards, calibration procedures, and traceability.

Errors in Measurement: Types of errors (e.g., systematic, random), error sources, and methods of error reduction, loading effects due to shunt-connected instruments, loading effects due to series connected instruments, Principles of Shunts and multipliers used to extend instrument range.

UNIT – 2

Measurement of Resistance, Inductance, Capacitance	**9 Hours**

Wheatstone's bridge, Kelvin Double Bridge, Measurement of High resistance, Maxwell's bridge, Schering bridge, LCR Meters, Measurement of earth resistance by fall of potential method, Fault detection using Murray Loop Test.

Shielding and Grounding in Measurement Systems: Noise reduction techniques in electrical and industrial measurement setups.

Electrical Measurement Instruments: Analog and Digital voltmeter, ammeter, Multimeter, Meter Protection, Digital Energy meters, Digital Power analyzer.

UNIT - 3

Frequency and Phase Measurement	**9 Hours**

Power factor meters, phase sequence indicators, Weston frequency meter, Digital frequency meters Content Introduction, Use of Instrument transformers, Current transformer (CT), Potential transformer (PT).

Oscilloscopes and Signal Measurement: Digital storage oscilloscope-Construction and working principle, Probes.

UNIT - 4

Sensors and Transducers	**9 Hours**

Role of sensors in automation, classification (resistive, capacitive, inductive, piezoelectric), selection criteria and performance characteristics.

Displacement: Resistive-potentiometers, LVDT, capacitive, piezoelectric, optical, proximity sensors, ultrasonic sensors.
Speed: Tachometers, magnetic pickups, digital encoders, photoelectric pickups.
Temperature: Thermocouples, RTD, thermistors, Brief discussion on AD590 (characteristics and features), LM35 (characteristics and features).
Mechanical sensing- strain gauge, measurement of pressure.
Optoelectronic Transducers: Semiconductor sensors, LDR, photodiodes, phototransistors, photovoltaic.

UNIT - 5

Virtual Instrumentation and Data Acquisition Systems	**9 Hours**

Introduction to Virtual Instrumentation, traditional and virtual measurements, role of hardware and software in Virtual Instrumentation, Virtual Instrumentation in the Engineering process.
ADC (Flash, SAR), DAC, signal conditioning, sampling and digitization.

Laboratory Component

Suggested List of Experiment

1.	Study of loading effect of shunt and series connected instruments and Calculation of static error
2.	To study the construction and working principle of PMMC and moving iron instrument
3.	Measurement of low resistance using Kelvin Double Bridge
4.	Measurement of Capacitance using Schering Bridge
5.	To study the construction and working principle of phase sequence indicator and frequency meter
6.	Study of DSO, probes and its application in measurement
7.	a) To study thermistor characteristics and conversion of heat energy to electrical signal b) To study conversion of strain to electrical signal using strain gauge.
8.	a) Study of distance measurement using ultrasonic transducer. b) Study of differential pressure transducer and signal conditioning of output signal
9.	Signal conditioning sample, digitalization using Labview
10.	Simulated Sensor Interface using Labview

Course Outcomes

At the end of the course student will be able to

1.	Understand the principles of electrical measurement systems, standards and the nature of systematic and random errors
2.	Apply a suitable measurement technique to determine the value of unknown resistance/capacitance/ inductance and Shielding & Grounding
3.	Describe the working principle of frequency measurement and oscilloscope.
4.	Demonstrate the working and application of various sensors and transducers.
5.	Apply the virtual instrumentation in engineering process.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE202.1	3	3					1	3	2		1	1	
EEE202.2	3	3					1	3	2		1	1	
EEE202.3	3	3					1	3	2		1	1	
EEE202.4	3	3			3		1	3	2		1	1	1
EEE202.5	3	3			3		1	3	2		1	1	1

1: Low 2: Medium 3: High

TEXTBOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	A Course in Electrical And Electronics Measurements And Instrumentation	A K. Sawhney.	Dhanpatrai and Sons, New Delhi	2021.
2.	Electronic Instrumentation and Measurement	David A. Bell	PHI	2nd edition, 2006
3.	Virtual Instrumentation using Labview	Jovitha Jerome	PHI	2010
REFERENCE BOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Modern Electronic Instrumentation and Measuring Techniques	William D. Cooper A.D. Heifrick	Pearson	3nd 2015.
2.	Electronic Instrumentation	H.S. Kalsi	Tata McGraw hill publications	3nd edition 2004
3.	Electrical Measurements and measuring Instruments	R.K. Rajput	S. Chand	2nd edition, reprint 2019
3.	Virtual Instrumentation Using LABVIEW	Sanjay Gupta, Joseph John	McGraw Hill Education India	2nd edition
E Books / MOOCs/ NPTEL				
1.	http://nptel.ac.in/courses/108105064/			

DIGITAL SYSTEM DESIGN WITH HDL

Course Code:	**ECE201**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T:P: J:S):	**3-0-2-1-1**	**Credits:**	**4**
Total Teaching Hours:	**45(T)+15(P)**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electrical and Electronics Engineering

Course Objectives:

1	Understand the basics of Verilog HDL
2	Understand the use of Gate-level, Dataflow and Behavioral styles of modeling in Verilog
3	Understand the process of Combinational circuit design and sequential circuit design
4	Understand the need for and use of State Machines in digital design
5	Understand the principles of digital circuit testing and functional verification, including the development and use of testbenches.

UNIT-I

Introduction to HDL: **09 Hours**

FPGA Design Flow, ASIC Design Flow, Verilog as HDL, Verilog Design Description
Verilog Constructs: Datatypes, Module, Operators, Concurrent assignments. Verilog system Tasks & Test bench.
Fault Diagnosis: Introduction, Fault-classes, Tests generation using Fault Table Method and Path-Sensitization Methods.

UNIT-II

Modelling Combinational Circuits: **09 Hours**

Adder and Subtractor (1-Bit and Multibit), Comparators and Parity Detectors, Multiplier, Multiplexer, Demultiplexer, Encoder, Decoder, Code Converters

UNIT-III

Sequential Functionality in HDL: **09 Hours**

Procedural assignment, conditional programming constructs, Modelling of Latches and Flip-flops and Shift Registers.

UNIT-IV

Design of Sequential circuits: **09 Hours**

Modelling of Asynchronous counters, Synchronous counters, RAM and ROM using HDL

UNIT-V

Finite State Machines: **09 Hours**

Moore and Mealy machines, Encoding styles, Design and modelling of FSM Examples: Level to pulse converter, Debouncing circuit, Sequence detectors

List of Experiments

15(P)

1.	Overview of a general FPGA device, Real Digital Boolean Board, and AMD Vivado project navigator Create the design project and HDL codes [Example: Basic Gates] Create a testbench and perform the RTL simulation
2.	Add a constraint file and synthesize and implement the code, Generate and download the configuration file to an FPGA device.
3.	Gate-level Adder, Gate-level Subtractor
4.	Gate-level multiplier, Gate-level greater than circuit, Sign-magnitude adder
5.	Gate-level binary decoder, Hexadecimal digit to seven-segment LED decoder,
6.	Barrel shifter, Multifunction barrel shifter
7.	ALU Design
8.	Binary counter

9.	Programmable square-wave generator
10.	Stopwatch
11.	PWM and LED dimmer
12.	Traffic Light Controller

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

1	Derive the Test vector for the given two/three-level logical circuit, using Fault Table or Path sensitization method, and implement a test bench to test the circuit
2	Design/Simulate/Implement Combinational circuits for a given specification
3	Design/Simulate/Implement Sequential circuits using Latches, F/Fs and Shift Register for a given specification
4	Design/Simulate/Implement counters and Memory circuits for a given specification
5	Derive the Moore and Mealy type Finite State Machine from the given specification and Simulate/Implement the same.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO	
↓ Course Outcomes												1	2
CO-1	3	1	1	1	3			1	2		1	2	2
CO-2	3	1	1		3			1	2		1	2	2
CO-3	3	1	1		3			1	2		1	2	2
CO-4	3	1	1		3			1	2		1	2	2
CO-5	3	1	1		3			1	2		1	2	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Digital Logic Design Using Verilog Coding and RTL Synthesis, Vaibbhav Taraate, Springer, 2nd Edition, 2022
2	Design through Verilog HDL, T. R. Padmanabhan, B. Bala Tripura Sundari, Wiley-IEEE Press, 2003
3	Quick Start Guide to Verilog, Brock J. Lamares Springer 1st Edition, 2019
4	Fundamentals of Digital Logic with Verilog Design, Stephen Brown and Zvonko Vranesic McGraw Hill Education 2nd Edition, 2007

REFERENCE BOOKS:

1	Verilog Digital System Design, Zainalabedin Navabi McGraw-Hill 2nd Edition/2005
2	Advanced Digital Design with Verilog HDL, Michael D. Ciletti PHI 2009
3	Verilog HDL, Samir Palnitkar Pearson Education 2nd Edition/2009
4	Logic Design Theory, Nripendra N Biswas Prentice Hall of India 2013
5	FPGA Prototyping by Verilog examples, Pong P. Chu John Wiley & Sons 2008

E Books / MOOCs/ NPTEL

1	HARDWARE MODELING USING VERILOG https://nptel.ac.in/courses/106105165
2	https://www.logic-fruit.com/blog/fpga/fpga-design-an-ultimate-guide-for-fpga-enthusiasts/
3	https://www.logic-fruit.com/blog/fpga/fpga-vs-asic-design/
4	System Design Through Verilog, Iit Guwahati, https://www.youtube.com/playlist?list=PLwdnzlV3ogoVGq4TIpX4NH6QEFYiAnyvA

DIGITAL SIGNAL ANALYSIS AND PROCESSING			
Course Code	EEE301	**Credits**	4
Hours/Week (L :T:P:S)	2:1:2:0	**CIE Marks**	50
Total Hours	45+30	**SEE Marks**	50
Exam Hours	3	**Course Type**	IPCC

PREREQUISITE: Electrical Circuit Analysis-II

Course Objectives

1.	To understand the i. Basic operations on signals and properties of systems ii. Importance of sampling theorem in signal processing.
2.	To explain the properties of linear time invariant systems in terms of impulse response description
3.	To know the Fourier representation of Discrete time aperiodic signals using Discrete time Fourier Transform and its properties.
4.	To design and formulate the transfer functions for Infinite Impulse Response (IIR) digital filters using Bilinear Transformation
5.	To design and formulate the transfer functions for Linear phase Finite Impulse Response (FIR) filters using various window for a given problem specification.

Course Contents

UNIT – 1

Signals and Systems	**6+3 Hours**

Continuous Time: Classification of Signals, Basic Operations on Signals, Properties of continuous time systems

Fourier Analysis: Continuous Time Fourier series (exponential only) (CTFS), Continuous Time Fourier Transform (CTFT) (Excluding properties)

UNIT – 2

Discrete Time Signals and Systems	**6+3 Hours**

Process of converting Analog signal to Digital Conversation. (Sampling, quantization, Coding) Discrete time signals: Classification of signals, Transformation in time and amplitude. Discrete time systems: System inter connections, Properties of systems, Impulse response, convolution sum, Difference equation and solution with iterative techniques.

UNIT - 3

Discrete Fourier Transform	**6+3 Hours**

Representation of Discrete Time Fourier Transform from Discrete time Fourier series. Representation of Discrete Time Fourier Transform (DFT): Efficient computation of DFT Properties of DFT – FFT algorithms – Radix-2, Decimation in Time (DIT), Decimation in Frequency algorithms (DIF).

UNIT - 4

IIR Filter Design	**6+3 Hours**

Review of z transform: basics and concepts of ROC

Analog Filters: Design using low pass prototype transformation, Normalized Butterworth Functions. Bilinear Transformation and Frequency Warping. Design of Discrete time IIR filter from continuous time filter – IIR filter design by Bilinear transformation. (Low Pass filter). Frequency Transformations, Direct I and Direct II form Structures.

UNIT – 5

FIR Filter Design	**6+3 Hours**

Symmetric and Anti-symmetric FIR filters: Linear phase filter – Windowing techniques – rectangular, Hamming, Hanning, Blackman and Kaiser windows – Frequency sampling techniques – Structure for FIR systems. (Direct Form and Linear phase structure).

Laboratory Component	
Suggested List of Experiments	
1.	Getting Started with Matlab® for programming DSP.
2.	Representation of basic signals and verification of properties of signals.
3.	i. Realization of Dirichlet Conditions for Fourier Series. ii. Synthesis of Square wave using Fourier series
4.	Testing ADC and DAC : i. Compare input voltage and digitized ADC output. ii. Compare DAC waveform with input signal using an oscilloscope.
5.	Implementation of differential equation using backward Euler algorithm
6.	Verification of DFT properties: i) Frequency shift ii) Time shift iii) Linearity iv) Auto Correlation and Cross Correlation v) Parseval's Theorems.
7.	Computation of N point FFT for a signal
8.	Implementation of IIR filter in Direct I form
9.	Implementation of IIR filter in Direct II form
10.	Implementation of FIR filter in Direct Form using Rectangular window
11.	Implementation of FIR filter with Hamming window
12.	Implementation of frequency response of RC low pass filter
Course Outcomes	
At the end of the course student will be able to	
1.	Analyse the continuous periodic and aperiodic signals and also to perform operations on systems
2.	Analyse Discrete time signals and systems and comprehend their properties
3.	Apply Discrete Fourier Transform to obtain the frequency domain representation of discrete time aperiodic signals
4.	Design of IIR filters to determine the filter coefficients for a given specification
5.	Design of FIR filters to determine the filter coefficients for a given specification

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE301.1	3	3			3		1	3	2	2	1	1	2
EEE301.2	3	3			3		1	3	2	2	1	1	2
EEE301.3	3	3			3		1	3	2	2	1	1	2
EEE301.4	3	3	2		3		1	3	2	2	1	1	2
EEE301.5	3	3	2		3		1	3	2	2	1	1	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Signals and Systems	Alan V Oppenheim, Alan S. Willsky and S. Hamid Nawab	PHI	2nd edition,2009

2.	Digital Signal Processing Principles, Algorithms and Application	John G Proakis and Dimtris G Manolakis	Electronic Industry Press	4th edition,2013
REFERENCE BOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Discrete time signal processing	Alan V Oppenheim and Ronald W Schafer	PHI	5th edition,2015
E Books / MOOCs/ NPTEL				
1.	Reference guide on TI Sitara Processor am6442.pdf			
2.	Reference Manual of 16/32 Bit Arm Cortex-R5F Flash MCU, RISC, EMAC. ti.com/product/RM57L843			
3.	NPTEL on digital signal processing by Dr. Ramalingam, IIT Madras. https://www.youtube.com/playlist?list=PLHj96QRJ0kOjwP_TaJOJ5IHIdOuATovLl			

MICROCONTROLLER PROGRAMMING WITH C			
Course Code	EEE203	**Credits**	4
Hours/Week (L :T:P:S)	3:0:2:0	**CIE Marks**	50
Total Hours	40	**SEE Marks**	50
Exam Hours	3	**Course Type**	IPCC

PREREQUISITE: Introduction to C programming

Course Objectives

1.	To introduce the architecture and functional blocks of a generic microcontroller
2.	To develop proficiency in programming microcontrollers using Embedded C
3.	To enable students to interface various digital and analog peripherals
4.	To apply timer, interrupt, and communication features of microcontrollers for real-time applications
5.	To design and implement embedded system-based projects addressing real-world needs

Course Contents

UNIT – 1

Fundamentals of Microcontrollers	**9 Hours**

Overview of microcontrollers: types, applications, microcontroller vs. microprocessor
Architecture of a generic microcontroller: CPU, Flash, RAM, EEPROM, GPIO, buses, special function register, timers, ADC, serial interfaces
Introduction to Embedded C: Structure of a C program for embedded systems, Data types, operators, control structures, Development tools: IDE, compiler, programmer/debugger

UNIT – 2

Digital I/O	**9 Hours**

GPIO pin configuration for input/output, interfacing with LEDs, switches and buzzers
Timers and Interrupts:
Timer modules: Timer configuration, delay generation, Square wave generation using timers
Introduction to interrupts: ISR structure and usage, external and timer interrupts

UNIT - 3

Analog Interfacing and PWM	**9 Hours**

ADC configuration and operation, Analog sensor interfacing (e.g., temperature sensor, potentiometer), PWM generation: Timer-based PWM
Applications in LED dimming and motor control, DC motor speed control using PWM

UNIT - 4

Serial Communication Interfaces	**9 Hours**

Introduction to serial communication: synchronous vs. asynchronous
UART: Data framing, baud rate, Transmit and receive using polling/interrupts
I2C and SPI protocols: Protocol structure, Master-slave communication, Sensor and memory interfacing (RTC, EEPROM, etc.)

UNIT - 5

Embedded Application Design	**9 Hours**

Modular code design: using functions, header files
Power management: Sleep modes, Watchdog timer
Case studies: Bluetooth controlled home automation, security system, automatic irrigation system, temperature control and monitoring, DC voltmeter, water level indication

Laboratory Component

Suggested List of Experiments

1.	LED blinking using GPIO

2.	Switch controlled LED
3.	Timer based LED blinking
4.	Interrupt-based LED Toggling
5.	Analog to Digital Converter interface
6.	Digital to Analog Converter interface
7.	LED Brightness Control using PWM
8.	DC motor speed control using PWM
9.	Buzzer and relay control using Serial communication
10.	Seven segment display
11.	I2C based LCD

Course Outcomes

At the end of the course student will be able to

1.	Understand the architecture of a generic microcontroller and write basic Embedded C programs using standard development tools
2.	Develop programs for real-time control using GPIOs, timers, and interrupts to interact with digital input/output devices
3.	Implement analog sensor interfacing and apply PWM techniques for actuator control using embedded C
4.	Develop embedded applications using UART, I2C, and SPI communication protocols to interface memory and sensors
5.	Design and implement complete embedded systems integrating multiple peripherals and programming concepts to control real word applications

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE203.1	3				2		1						
EEE203.2	3				3		1					2	2
EEE203.3	3				3		1					2	2
EEE203.4	3			2	3		1					2	2
EEE203.5	3	3		3	3	2	1	2	2	2	2	3	3

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	16-Bit Digital Signal Controllers with High-Speed ADC, Op Amps, Comparators and High-Speed PWM	Microchip Technology	Datasheet	2019-2020
2.	Beginner's Guide to Programming the PIC24/dsPIC33: Using the Microstick and Microchip C	Thomas Kibalo	Createspace Independent Pub	2012

	Compiler for PIC24 and dsPIC33 Paperback – Import, 8 February 2012			
REFERENCE BOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Programming 32-bit Microcontrollers in C: Exploring the PIC32 (Embedded Technology)	Lucio Di Jasio	Newnes	PAP/CDR edition/ 2008

POWER ELECTRONICS			
Course Code	EEE302	**Credits**	4
Hours/Week (L :T:P:S)	3:0:2:0	**CIE Marks**	50
Total Hours	45+30	**SEE Marks**	50
Exam Hours	3	**Course Type**	IPCC
PREREQUISITE: Analog Circuit Analysis and Design, Electrical Machines			

Course Objectives	
1.	To provide in-depth knowledge of power semiconductor devices and their applications in power conversion.
2.	To analyze the characteristics, operation, and control of power converters.
3.	To introduce modern electric drive systems and their industrial applications.
4.	To familiarize students with recent trends in power electronics and motor drives.
5.	To equip students with hands-on experience in designing and simulating power electronic circuits.

Course Contents	
UNIT–1	
Power Semiconductor Devices	**9 Hours**
Characteristics and operation of Power Diodes, SCR, TRIAC, GTO, IGBT, MOSFET, and SiC/GaN-based devices, Switching characteristics, protection circuits, Thermal considerations and reliability aspects in power electronic devices. Applications.	
UNIT–2	
AC-DC Converters	**9 Hours**
Single-phase fully controlled rectifier – Resistive Load and Motor Load, Performance parameters. Three phase fully controlled rectifier, Dual Converter (Qualitative Analysis).	
UNIT-3	
DC-DC Converters	**9 Hours**
Design and Analysis of Buck, Boost, Buck-Boost Converters, Isolated Converters – Flyback Topology (Qualitative Analysis), MOSFET Gate Drive Circuits.	
UNIT-4	
DC-AC Converters (Inverters)	**9 Hours**
Single-phase and three-phase voltage source inverters (VSI) and current source inverters (CSI) Modulation Techniques: SPWM, and Hysteresis control (Qualitative Analysis)	
UNIT-5	
AC-Voltage Controllers and Drives	**9 Hours**
Single phase bi-directional controllers with resistive load and motor load. Induction Motor Drives : Stator Voltage Control and V/f Control	

Laboratory Component	
Suggested List of Experiments	
1.	Static characteristics of SCR.
2.	Static characteristics of MOSFETand IGBT.
3.	Study the effect of firing angle variation, observe and analyze the output voltage waveform for resistive and motor load for Single-Phase Fully Controlled Rectifier.
4.	Study continuous and discontinuous conduction modes and verify the voltage conversion ratio and efficiency for different duty cycles for Buck Converter
5.	Study continuous and discontinuous conduction modes and Verify the voltage conversion ratio and efficiency for different duty cycles for Boost Converter.
6.	Study continuous and discontinuous conduction modes and Verify the voltage conversion ratio and efficiency for different duty cycles for Buck-Boost Converter.
7.	Control of Single Phase VSI using SPWM Technique
8.	Implement 120° and 180° conduction modes for Three-Phase Voltage Source Inverter.
9.	Implementation of Single-phase bidirectional AC Voltage controller.

10.	Implement open-loop speed control of Induction Motor using a three-phase inverter to obtain speed vs frequency characteristics.

Course Outcomes

At the end of the course student will be able to

1.	Explain the working principles and characteristics of power semiconductor devices.
2.	Analyse and design rectifiers.
3.	Evaluate and control DC-DC converters for various applications.
4.	Evaluate and control DC-AC converters for various applications.
5.	Analyse AC voltage Controllers and AC drives for industrial applications.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE302.1	3	3	-	-	-	-	1	3	3	-	1	2	1
EEE302.2	3	3	-	-	-	-	1	3	3	-	1	2	1
EEE302.3	3	3	1	-	-	-	1	3	3	-	1	2	1
EEE3024	3	3	1	-	-	-	1	3	3	-	1	2	1
EEE302.5	3	3	1	-	-	-	1	3	3	-	1	2	1

1: Low 2: Medium 3: High

Textbooks

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Power Electronics: Circuits, Devices, and Applications	M. H. Rashid	Pearson	3rd Edition, 2014
2.	Modern Power Electronics and AC Drives	B.K. Bose	Prentice Hall	1st Edition, 2002

Reference Books

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Power Electronics: Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley	2nd Edition, 1995
2.	Power Electronics	P. C. Sen	McGraw Hill	1st Edition, 1992
3.	Power Electronics: Essentials and Applications	L. Umanand	Wiley	1st Edition, 2009

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/108101038
2.	https://www.coursera.org/learn/power-electronics

ELECTRIC VEHICLE TECHNOLOGY			
Course Code	EEE303	**Credits**	4
Hours/Week (L :T:P:S)	3:0:2:0	**CIE Marks**	50
Total Hours	45+30	**SEE Marks**	50
Exam Hours	3	**Course Type**	IPCC
PREREQUISITE: Power Electronics			

Course Objectives	
1.	To understand the basic structure and emerging technologies of Electric Vehicle .
2.	To model and design an Electric Vehicle.
3.	To analyse the application of different power electronics converters, electrical machines and their control for EV.
4.	To understand various energy storage technologies and EV charging systems.
5.	To gain insights into futuristic advancement in EV Technology.

Course Contents

UNIT – 1	
Introduction to Electric Vehicles	**9 Hours**
Environmental Impact and History of Modern Transportation, EV Market- Present & Future Trends, Role of Electric Vehicles in Sustainable Development, Types of EV- Battery Powered, Solar Powered, Super Capacitor Fed, Fuel Cell Based. EV Configuration- General Configuration, Based on Propulsion System, Based on Energy Sources. EV Parameters- Weight & Size, Force, Energy, Performance. EV Functional Units- Electric Motors, Power Electronics, Micro Electronics, Control Strategies.	
UNIT – 2	
Electric Vehicle Modeling	**9 Hours**
General Description of Vehicle Movement, Vehicle Resistance: Rolling Resistance, Aerodynamic Drag, and Grading Resistance (with numerical). Dynamic Equation. Tire–Ground Adhesion and Maximum Tractive Effort, Power Train Tractive Effort and Vehicle Speed, Vehicle Power Plant and Transmission Characteristics.	
UNIT - 3	
Power Train for EV	**9 Hours**
Power Electronic Circuits Used for Control and Distribution of Electric Power in EV: AC-DC Converters, DC-DC Bidirectional Converters, Inverter and Modulation Techniques. Induction Motor Drive, Permanent Magnet Synchronous Motor Drive, Brushless DC Motor Drive, Switched Reluctance Motor Drive (only block diagrams for drives).	
UNIT - 4	
Energy Storage Technologies	**9 Hours**
Batteries, Ultra-Capacitors and Fuel Cells. Comparison between all storage technologies. Battery Parameters, Concepts and estimation of SOC/SOH, Cell Balancing: Passive and Active Balancing. Battery Modeling, Battery Equivalent Circuits. **EV Charging Technologies:** Basic Requirements for Charging System, Charger Architectures, Charger Functions, Charging Standards, Charging Technologies: Conductive Charging & Wireless Charging.	
UNIT - 5	
Advanced Technologies in EV	**9 Hours**
Vehicle-to-Grid (V2G) Integration, Grid-Interactive Electric Vehicles (GIVs), Vehicle-to Everything (V2X) Communication. Artificial Intelligence (AI) in BMS of EV, Advanced Driver-Assistance Systems (ADAS) for EVs, Cybersecurity in EVs, Blockchain Technology in EV Charging, Energy Management Strategies, Predictive Maintenance Using IoT and Big Data.	

Laboratory Component	
Suggested List of Experiments	
1	Identification of Li-Ion Cells Used in Batteries and Analysis of Battery Components
2	Charging, Discharging, and Cell Balancing using Microcontroller-Based BMS
3	Cell Performance Analysis, Balancing Assessment, and Battery Bank Life Cycle Evaluation
4	Load-Dependent Power Management of Hub Motor-Based EV
5	Performance Characteristics of Electric Motors (BLDC, PMSM & IM)
6	Vehicle Control Unit: Subsystem and Mode Switching Analysis
7	Battery Bank Balancing using Active Cell Balancer
8	Charge and Discharge Testing of Li-Ion and Lead-Acid Batteries
9	Hands-On Battery Pack Assembly using Spot Welding
10	Electric 2-Wheeler Harness Identification and Demonstration
Course Outcomes	
At the end of the course student will be able to	
1.	Explain the types of Electric Vehicles, battery technologies and market trends for Electric Vehicle.
2.	Develop the model for the Electric vehicle.
3.	Analyse the application of power electronics converters and electric drive systems used in Electric Vehicle.
4.	Explain the various energy storage systems and charging technologies used for Electric vehicle.
5.	Explain the recent developments in the field of Electric Vehicle.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE303.1	3	3					1	3	2		1	2	
EEE303.2	3	3					1	3	2		1	2	
EEE303.3	3	3					1	3	2		1	2	
EEE303.4	3	3					1	3	2		1	2	
EEE303.5	3	3					1	3	2		1	2	

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Electric vehicle technology explained	Larminie, James and John Lowry	John Wiley & Sons	2nd edition,2012
2.	Modern electric vehicle technology	Chan, C. C., and K. T. Chau	Oxford University Press on Demand	1st edition,2001
3.	Electric power train: energy systems, power electronics and drives for hybrid, electric and fuel cell vehicles (Unit 1,2,3 & 4)	Hayes, John G., and G. Abas Goodarzi	Wiley-Blackwell	1st edition,2018

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication

1.	Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles,	Sheldon S. Williamson	Springer	1st edition,2013
2.	Modern electric, hybrid electric, and fuel cell vehicles	Ehsani, Mehrdad, Yimin Gao, Stefano Longo, and Kambiz M. Ebrahimi	CRC press	3rd edition,2018
3.	Build your own electric vehicle	Leitman, Seth, and Bob Brant	McGraw Hill Professional	3rd edition,2013
E Books / MOOCs/ NPTEL				
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.	Electric Cars: Technology | My MOOC (my-mooc.com)			

Professional Core Courses (PCC)

ELECTRICAL POWER GENERATION AND UTILIZATION			
Course Code	EEE111	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:J	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC
PREREQUISITE:			

Course Objectives	
1.	To understand the concepts of power generation by solar and wind energy.
2.	To understand the power generation by non-conventional energy sources - Fuel cell, Tidal, Ocean, and Geothermal energy.
3.	To understand the power generation by conventional energy sources.
4.	To study the various parameters of economic aspects, tariff and illumination.
5.	To study the concepts of energy storage, microgrid and electric traction.

Course Contents

UNIT – 1

Solar and wind energy	**9 Hours**

Energy scenario and renewable energy sources. Solar Energy Basics, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Block diagram of solar photovoltaic systems, Solar Radiation Geometry (numerical), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical); Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer estimation of solar energy, Solar Photovoltaic – Solar Cell fundamentals, characteristics, model of PV cell, PV cells in series/parallel, PV system design and solar pumped storage.

Wind energy: Introduction, Wind and its Properties, Principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of a WECS (block diagram), Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection.

UNIT – 2

Non-conventional energy sources	**9 Hours**

Basics of Hydrogen Energy, Role of Hydrogen in a Sustainable Future, Electrolysis Using Renewable Energy, Blue Hydrogen & Carbon Capture Techniques. Types of fuel cells and their relative merits and demerits. Durability & cost challenges.

Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP),
Classification of Tidal Power Plants, and wave energy.

Energy from Ocean and Geothermal: Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Geothermal Energy: Types of wells, methods of harnessing the energy, scope in India.

UNIT – 3

Conventional energy resources	**9 Hours**

Hydroelectric Power Generation: Availability and sustainability issues. Hydro Power generation (mini hydro and micro hydro)-selection of site classification of hydroelectric plants.

Thermal, Diesel and Nuclear Power generation: Introduction, main parts, working, Plant layout. Diesel Electric plants, Gas turbine plants-components, layout, advantages over steam turbine plants. Nuclear Power Station- Introduction, Adverse effects of fossil fuels, components of reactors, Description of fuel sources

UNIT – 4

Economics Aspects and Illumination	**9 Hours**

Diversity factor, load factor, Plant capacity factor, plant use factor, plant utilization factor, loss factor, Load duration curve, energy load curve, Interconnection of power station, effect of variable load on power system.

Tariff: Objective and Desirable characteristics of a Tariff—Types of Tariffs and numerical. Improvement of power factor.

Illumination: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux, Laws of illumination. Different types of lamps, filament lamp, mercury vapour lamp, fluorescent lamp, metal halide lamp, neon lamp, General ideas about street lighting, flood lighting, monument lighting and decorative lighting.

UNIT – 5

Energy Storage and electric traction	**9 Hours**

Introduction and concepts of microgrid**.** Batteries, Super capacitors, Superconducting Magnetic Energy Storage (SMES), charging methodologies, SoC, SoH estimation techniques.

Electric traction: Systems of traction and systems of electric traction, Series and Shunt Motors for Traction Services, Tractive Effort and Horsepower, AC Series Motor, Tramways, The Trolley – Bus, and Diesel Electric Traction.

Course Outcomes

At the end of the course student will be able to

1.	Analyse the operation of solar and wind power generating systems
2.	Acquire the knowledge of power generation by non-conventional energy sources
3.	Acquire the knowledge of power generation by conventional energy sources
4.	Compute the electrical power tariff and apply the illumination concepts in designing lighting systems
5.	Interpret the concepts of Microgrid and electric traction

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO ↓**	
↓ Course Outcomes												1	2
EEE111.1	3	3	2		2	1	1	3	3	2	1	2	2
EEE111.2	3	3	2		2	1	1	3	3	2	1	2	2
EEE111.3	3	3	2		2	1	1	3	3	2	1	2	2
EEE111.4	3	3	2		2	1	1	3	3	2	1	2	2
EEE111.5	3	3	2		2		1	3	3	2	1	2	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Non-conventional Energy Sources	G. D. Rai	Khanna Publishers	6th edition, 2017
2.	Alternate Energy-Sources, Applications and Technologies	Dr. N K Giri.	Khanna Publishers	2012
3.	Principles of power system.	V. K Mehta and Rohit Mehta	S Chand Publishers	3rd edition, 2005

REFERENCE BOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Renewable Energy Resources.	Tiwari and Ghosal.	Narosa Publication	2004
2.	Fuel cell fundamentals	O'Hayre R. P., Cha S. W., Colella W., and Prinz F. B.,	John Wiley	3rd edition, 2016
E Books / MOOCs/ NPTEL				
1.	NPTEL by Professor Umanand: https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ee62/			

ANALOG CIRCUIT ANALYSIS AND DESIGN			
Course Code	EEE211	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC
PREREQUISITE: Electrical Circuit Analysis – I, Basic Electronics			

Course Objectives	
1.	To understand the structural properties, characteristics and operation of MOSFET
2.	To study the MOSFET parameters when used as an amplifier and as a switch
3.	To design MOSFET a single stage amplifier and analyse its behaviour at various frequencies
4.	To introduce the concept of feedback and analyse the oscillator circuits using MOSFET
5.	To analyse and design operational amplifiers based circuit for various linear and nonlinear applications

Course Contents

UNIT – 1

MOSFET :Construction and Operation	**9 Hours**

Device structure and Physical operation, I-V Characteristics.
Large signal operation, Graphical derivation of the transfer characteristics, operation as a switch, operations as a linear amplifier, Analytical expressions.

UNIT – 2

Biasing and Small-signal Operation	**9 Hours**

Biasing by Fixing VGS, biasing by fixing VGS and connecting a resistance in the source, Biasing using a Drain-to-gate feedback amplifier, Biasing using a constant current source.
DC bias point, signal current in the drain terminal, voltage gain, DC analysis and signal analysis, small signal equivalent, Transconductance, T equivalent circuit model.

UNIT - 3

MOS Amplifiers and High Frequency Model	**9 Hours**

Basic Structure, characterizing amplifiers, Common source amplifier, CS amplifier with a source resistance, Common gate amplifier, Common drain amplifier.
Gate capacitive effect, junction capacitances, high frequency MOSFET model, Unity- Gain frequency, Circuit operation of CMOS Logic Inverter

UNIT - 4

Frequency Response and Feedback Amplifiers	**9 Hours**

Frequency Response of CS amplifier, Miller effect, General Feedback structure, Properties of negative feedback, Feedback topologies, FET based RC phase shift oscillator
.
FET Differential Amplifiers: MOS Differential pair with common mode and differential input voltage, Small-signal operation of MOS Differential pair

UNIT - 5

Operational Amplifier-Applications	**9 Hours**

Op-Amp internal architecture. Ideal and practical Op-Amp. Offset error voltages and currents. Op-Amp as an AC Amplifier: Capacitor Coupled Voltage Follower, non-inverting amplifier, inverting amplifier, and difference amplifier.
Op-Amp in Signal Processing Circuits: Precision Half wave rectifiers, peak clipper, clamping circuits, sample and hold circuits.
Op-Amps in Switching, Differentiating, and Integrating Circuits, crossing detectors, Schmitt trigger circuits, Active filter: Types, first order & second order LPF design.

Course Outcomes	
At the end of the course student will be able to	
1.	Analyse internal structure, working of MOSFET to infer the operating characteristics
2.	Analyze the large-signal behavior of the MOSFET, design bias circuits to locate operating point and small-signal operation to obtain the transconductance
3.	Design CS, CG & CD MOSFET single-stage amplifier circuits to obtain performance parameters
4.	Perform frequency sweep on CS MOS amplifier circuit to obtain the response curve
5.	Analyse and design operational amplifiers based circuit for various linear and nonlinear applications

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO ↓**	
↓ Course Outcomes												1	2
EEE211.1	3	3					1				1		
EEE211.2	3	3	2				1				1		
EEE211.3	3	3	3		2		1				1	1	2
EEE211.4	3	3			2		1				1	1	2
EEE211.5	3	3	2		2		1				1	1	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Microelectronic Circuits	Sedra /Smith	Oxford University	6th edition, 2016
2.	Operational Amplifier and Linear IC's	David A Bell	Oxford University	3rd edition, 2011

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Integrated Electronics	Jacob Millman & Christos C. Halkias	McGraw Hill	2nd edition, 2011
2.	Electronic Devices & Circuit Theory	Nashelesky & Boylestead	PHI	11th edition, 2015

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc22_ee11/preview
2.	https://ocw.mit.edu/courses/6-101-introductory-analog-electronics-laboratory-spring-2007/
3.	https://ocw.mit.edu/courses/6-012-microelectronic-devices-and-circuits-fall-2009/
4.	https://onlinecourses.nptel.ac.in/noc20_ee89/preview
5.	https://www.coursera.org/learn/mosfet

ELECTROMAGNETIC FIELDS			
Course Code	EEE212	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:J	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC
PREREQUISITE: Complex Variables and Transform Techniques			

Course Objectives	
1.	To study the application of Coulomb's Law and Gauss Law for electric fields produced by different charge configurations.
2.	To evaluate the energy and potential due to a system of charges.
3.	To study the behavior of electric field across a boundary between a conductor and dielectric and between two different dielectrics.
4.	To study the magnetic fields and magnetic materials.
5.	To study the time varying fields and propagation of waves in different media.

Course Contents

UNIT – 1

Electric Field	**9 Hours**

Coulomb's Law and Electric Field Intensity: The Experimental Law of Coulomb, Electric Field Intensity, Field Arising from a Continuous Volume Charge Distribution, Field of a Line Charge, Field of a Sheet of Charge (Theory Only)

Electric Flux Density, Gauss's Law, and Divergence: Electric Flux Density, Gauss's Law, Application of Gauss's Law: Some Symmetrical Charge Distributions, Application of Gauss's Law: Differential Volume Element, Divergence and Maxwell's First Equation, The Vector Operator ∇ and the Divergence Theorem

UNIT – 2

Electric Potential and Capacitance	**9 Hours**

Energy and Potential: Energy Expended in Moving a Point Charge in an Electric Field, The Line Integral, Definition of Potential Difference and Potential, The Potential Field of a Point Charge, The Potential Field of a System of Charges: Conservative Property, Potential Gradient

Conductors and Dielectrics: Current and Current Density, Continuity of Current, Conductor Properties and Boundary Conditions, The Nature of Dielectric Materials, Boundary Conditions for Perfect Dielectric Materials

Capacitance: Capacitance Defined, Parallel-Plate Capacitor, Several Capacitance Examples,
Poisson's and Laplace's Equations, Examples of the Solution of Laplace's Equation – parallel plate capacitor

UNIT - 3

Magnetic Field	**9 Hours**

Steady Magnetic Field: Biot-Savart Law, Ampere's Circuital Law, Curl, Stokes' Theorem, Magnetic Flux and Magnetic Flux Density, The Scalar and Vector Magnetic Potentials.

Magnetic Forces: Force on a Moving Charge, Force on a Differential Current Element, Force between Differential Current Elements, Force and Torque on a Closed Circuit.

Inductance: Magnetization and Permeability, Magnetic Boundary Conditions, The Magnetic Circuit, Potential Energy and Forces on Magnetic Materials, Inductance and Mutual Inductance

Time-Varying Fields and Maxwell's Equations: Faraday's Law, Displacement Current, Maxwell's Equations in Point Form, Maxwell's Equations in Integral Form, The Retarded Potentials

Magnetic Forces: Force on a Moving Charge, Force on a Differential Current Element, Force between Differential Current Elements, Force and Torque on a Closed Circuit

UNIT - 4

Inductance and Time-Varying Fields	**9 Hours**

Inductance: Magnetization and Permeability, Magnetic Boundary Conditions, The Magnetic Circuit, Potential Energy and Forces on Magnetic Materials, Inductance and Mutual Inductance
Time-Varying Fields and Maxwell's Equations: Faraday's Law, Displacement Current, Maxwell's Equations in Point Form, Maxwell's Equations in Integral Form, The Retarded Potentials

UNIT - 5

Transmission Lines and Uniform Wave Plane Wave	**9 Hours**

Transmission Lines: Physical Description of Transmission Line Propagation, The Transmission Line Equations, Lossless Propagation, Lossless Propagation of Sinusoidal Voltages, Complex Analysis of Sinusoidal Waves, Transmission Line Equations and Their Solutions in Phasor Form, Low-Loss Propagation, Power Transmission and The Use of Decibels in Loss Characterization, Wave Reflection at Discontinuities, Voltage Standing Wave Ratio
Uniform Plane Wave: Wave Propagation in Free Space, Wave Propagation in Dielectrics, Poynting's Theorem and Wave Power, Propagation in Good Conductors: Skin Effect

Course Outcomes

At the end of the course student will be able to

1.	State and apply the Coulomb's, Gauss's Law to determine the electric field intensity resulting from various charge distributions
2.	Use the concept of electric potential to compute electric field intensity & understand the conductor properties, interpret boundary conditions between conductor to free space and calculate capacitance of various shapes.
3.	Analyse magnetic properties by using the concept of curl, Stokes theorem and the magnetic force on a current carrying conductor.
4.	Derive inductances of various geometry and analyse time varying fields using Faraday's law and Maxwell's equations.
5.	Develop transmission line model using equivalent electrical parameters and analyse wave propagation in various mediums.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE212.1	3	3	2	-	1	-	1	2	2	2	1	3	1
EEE212.2	3	3	2	-	-	-	1	2	2	2	1	3	1
EEE212.3	3	3	2	-	1	-	1	2	2	2	1	3	1
EEE212.4	3	3	2	-	1	-	1	2	2	2	1	3	1
EEE212.5	3	3	2	-	-	-	1	2	2	2	1	3	1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Engineering Electromagnetics	William H. Hayt Jr. and John A. Buck	Tata McGraw-Hill	8th edition, 2017

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Electromagnetics with Applications	John Krauss and Daniel A. Fleisch	McGraw Hill	5th edition, 1999.

2.	Elements of Electromagnetics	Matthew N. O. Sadiku	OUP USA	7th Edition, 2018
3.	Electromagnetic Waves and Radiating Systems	Edward C. Jorden and Keith G Balmain	Prentice – Hall of India / Pearson Education	2nd edition, 1968
E Books / MOOCs/ NPTEL				
1.	https://onlinecourses.nptel.ac.in/noc21_ee83/preview			

ELECTRICAL MACHINES			
Course Code	EEE213	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC

PREREQUISITE: Electrical Circuit Analysis-I

Course Objectives

1.	To understand the working principle and operating characteristics of DC machine
2.	To study the principle, types and analysis of the performance of single phase and 3-phase transformer
3.	To understand the working principle of an Autotransformer and compare it with two winding transformers.
4.	To understand the construction, types and analysis of induction machines.
5.	To comprehend the construction, working principle and application of synchronous motor.

Course Contents

UNIT – 1

DC Machines	**9 Hours**

Construction, operating principle, torque equation for DC motor, armature reaction, commutation, characteristics, speed control of shunt motor, losses & efficiency, necessity of starter-3 point starter, dc generator. PMDC motor and its working, BLDC motor construction and working principle.

UNIT – 2

Single phase transformers: analysis & performance	**9 Hours**

Construction and working principle, transformers on no load, EMF equation, phasor diagrams, equivalent circuit, losses, polarity test, SC, OC test, power and all-day efficiency, regulation. Parallel operation of single-phase transformers – Conditions and operation.

UNIT - 3

Transformers and Induction Machine	**9 Hours**

Autotransformers: Principle of autotransformers, calculation of saving of copper, advantages/disadvantages.
Three-phase transformers: Construction, 3-phase transformer connections, bank of 1-phase transformer for 3-phase operation, Tertiary winding and its importance.
Three-Phase Induction Machines: Construction and classification, concept of rotating magnetic field, operating principle.

UNIT - 4

Analysis and Performance of Three-Phase Induction Motor	**9 Hours**

Induction motor on no load & load, losses & efficiency, phasor diagram, power factor evaluation, No load & BR tests, equivalent circuit, Torque equation, condition for maximum torque, slip torque characteristics covering regions of motoring generating and braking, Induction generator.

UNIT - 5

Induction Motor, Synchronous Motor, Special Motors	**9 Hours**

Starters for 3-phase IM: Necessity for starters, DOL,Y-Δ starting, rotor resistance starting.
Single-Phase Induction Motor: Principle of operation -double revolving field theory, Types of single-phase induction motor - split phase, capacitor start, capacitor run.
Synchronous Motors: Principle of operation, starting methods. Motor at constant load variable excitation. V and inverted V curves, hunting in synchronous machines, synchronous condenser and applications, construction and working principle of PMSM and SRM motors.

Course Outcomes

At the end of the course student will be able to

1.	Describe the operation, speed control of DC Motors and analyse their characteristics.

2.	Describe the working principle of single-phase transformer and conduct OC-SC test to determine the efficiency and regulation.
3.	Appreciate the construction of 3-phase transformers and Induction Machines and describe the operating principle of induction motors.
4.	Analyse the equivalent circuit and slip-torque characteristics of 3-phase induction machines.
5.	Describe the working principle of 1-phase induction motor, 3-phase synchronous motor and special motors.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE213.1	3	3					1				1	2	1
EEE213.2	3	3					1				1	2	1
EEE213.3	3	3					1				1	2	1
EEE213.4	3	3					1				1	2	1
EEE213.5	3	3					1				1	2	1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Electric machinery	P. S. Bhimbra	Khanna publishers	7th edition, 2011
2.	Electrical Machines	Ashfaq Hussain	Dhanpat Rai & Co. (P) Limited	3rd edition 2016
3.	Switched reluctance motor drives: fundamentals to applications-	Bilgin, Berker Emadi, Ali Jiang, James Weisheng	CRC Press	1st edition 2019

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Performance & design of DC machine	AE Clayton & Hancock	ELBS Publication	1st edition,2004.
2.	Theory of alternating current machines	Alexander Langsdorf	TMH	2nd Edition, 2004
3.	AC and DC Machines	J.B. Gupta	S K Kataria & Sons publications	2012 edition
4.	Permanent Magnet Synchronous and Brushless DC Motor Drives	Ramu Krishnan	CRC Press, Marcel Applications CRC Press	2009
5.	Special Electrical Machines	K Venkataratham	University Press	2009

E Books / MOOCs/ NPTEL

1.	NPTEL: Electrical Engineering - NOC:Electrical Machines - II
2.	NPTEL: Electrical Engineering - NOC:Electrical Machines - I
3.	(202) Electrical Machines (Prof. G.Bhuvaneshwari) - YouTube
4.	https://nptel.ac.in/courses/108106071

POWER SYSTEM ANALYSIS - I			
Course Code	EEE311	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC

PREREQUISITES: Electrical Machines

Course Objectives

1.	To comprehend the working principle and performance characteristics of an alternator.
2.	To grasp the working principles of switchgear and protection equipment deployed with electrical machines.
3.	To understand potential distribution in insulator strings and underground cables.

Course Contents

UNIT – 1

Synchronous Generators — **9 Hours**

Principle of operation, construction of salient- and non-salient-pole synchronous machines. Generated EMF in a concentrated winding, effect of distribution of winding & use of chorded coils, Regulation by EMF, MMF, ZPF Methods, losses and efficiency.

Parallel Operation of Alternators: Conditions for parallel operation of alternators, Synchronizing of alternators to infinite bus bars, power angle characteristics, operation at constant load with variable excitation for generating mode.

UNIT – 2

Salient-pole Synchronous Machines and Protective Relaying Basics — **9 Hours**

Salient-pole Synchronous Machines: Two reaction theory, power angle diagram, reluctance power, slip test.

Fuses and Switches: Fuses: Material used, fuse law, cut-off characteristics, Time-current characteristics, HRC fuse, Application of fuse, Isolating switch, load breaking switch.

Basics of Protective Relaying: Requirement of protective relaying, zones of protection, Electromechanical relay, primary and back-up protection, essential qualities of protective relaying. Non-directional and directional over current relays, IDMT and directional characteristics.

UNIT - 3

Apparatus Protection — **9 Hours**

Transformer Protection: differential relay, biased differential relay and its application to transformer protection, Buchholz relay.

Generator protection: stator and rotor protection, protection against abnormal conditions.

Induction Motor Protection: protection against electrical faults such as phase fault, ground fault. Protection against abnormal operating conditions such as single phasing, phase reversal and overload.

UNIT - 4

Earthing and Circuit Breakers — **9 Hours**

Earthing: System earthing - resistance and reactance earthing (qualitative treatment only), equipment earthing.

Basics of Circuit Breakers: Principles of AC circuit breaking, initiation of arc, maintenance of arc, theory of arcing and arc quenching, ratings of circuit breakers, rate of rise of restriking voltage (RRRV), resistor switching and capacitor switching, current chopping, DC circuit breaking and its problems.

Types of Circuit Breakers: Air-break, Air-blast, Bulk-oil, Minimum oil, Vacuum and SF6.

UNIT – 5

Typical Transmission and Distribution System — **9 Hours**

General layout of power system, Standard voltages for transmission: HVAC, EHVAC, UHVAC, Advantages of high voltage transmission.

Insulators: Types and material, potential distribution over a string of suspension insulators, string efficiency and methods of increasing string efficiency.

Underground Cables: Types, material used, insulation resistance, thermal rating of cables, charging current, capacitance grading of cables.

Course Outcomes	
At the end of the course student will be able to	
1.	Elaborate the tests required to predetermine the voltage regulation of an alternator, and describe the process of synchronization of alternators.
2.	Comprehend the roles of fuses and switches, and describe the working principles of electromechanical relays.
3.	Select appropriate protection schemes for generators, transformers and induction motors.
4.	Appreciate the nuances of the phenomenon of circuit breaking.
5.	Determine potential distribution in insulator strings and underground cables.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE311.1	3	3					1					2	2
EEE311.2	3	3					1					2	2
EEE311.3	3	3					1					2	2
EEE311.4	3	3					1					2	2
EEE311.5	3	3					1					2	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Electric machinery	P. S. Bhimbra	Khanna Publishers	7th edition, 2011
2.	Fundamentals of Power System Protection	Y. G. Paithankar and S.R. Bhide	PHI Learning Pvt. Ltd.	2nd edition, 2010
3.	Electrical Power Generation, Transmission and Distribution	S. N. Singh	PHI Learning Pvt. Ltd	2nd edition, 2008.

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Theory of Alternating Current Machinery	A. S. Langsdorf	McGraw Hill Education Pvt. Ltd.	2nd edition, 1984.
2.	Power System Protection and Switchgear	Badri Ram and Vishwakarma	Tata McGraw Hill Education Pvt. Ltd.	2nd edition, 2017.

LINEAR CONTROL SYSTEMS

Course Code	EEE312	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC

PREREQUISITE: Electric Circuit Analysis-II

Course Objectives

1.	To develop mathematical models of electrical, mechanical and electromechanical linear systems to study the system dynamics
2.	To compute system transfer function using block diagram reduction and signal flow graph techniques to carry out time domain analysis
3.	To Apply Routh Hurwitz criterion and root locus technique to assess system stability
4.	To Analyse sinusoidal transfer function of physical systems using Bode plot to study the stability
5.	To understand various compensators and controllers to design the system.
6.	To represent the system by transfer function approach and state space analysis.

Course Contents

UNIT – 1

Modelling of Systems	**9 Hours**

Mathematical modelling of physical system-electrical, mechanical, electromechanical systems, analogous system, Force voltage and force current analogy, Torque voltage and torque current analogy.
Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra, Signal Flow graphs (State variable formulation excluded)

UNIT – 2

Transient and Steady-State Response Analyses of systems	**9 Hours**

State Space Analysis: Definition of state, state variables, state vectors and state space. State space equations and block diagram of electrical systems. State-Space representation of scalar differential equation systems.
Transient and Steady-State Response Analysis: Standard test signals, Unit step response of first and second order systems, time response specifications of first & second order systems, steady–state static errors, and error constants, P, PI, PID (qualitative analysis)

UNIT – 3

Stability analysis	**9 Hours**

Concepts of stability, necessary conditions for stability, Routh- stability criterion, relative stability analysis.
Root–Locus Techniques: Introduction, root locus concepts, construction of root loci, effect of addition of poles and zeroes

UNIT – 4

Frequency domain analysis	**9 Hours**

Frequency response specification, correlation between time and frequency response, gain margin, phase margin, Bode plots. All pass, minimum & non-minimum phase systems, assessment of relative stability using Bode plots, determination of transfer functions from Bode plots.

UNIT – 5

Stability analysis and compensators	**9 Hours**

Nyquist criterion: Nyquist stability criterion, gain margin, phase margin
Compensators: Compensators, op-amp based lead, lag, lag-lead networks

Course Outcomes

At the end of the course student will be able to

1.	Develop mathematical models of electrical, mechanical, and electromechanical linear systems to study their dynamic behavior, and perform state-space analysis to evaluate system performance.

2.	Compute the system transfer function using block diagram reduction and signal flow graph techniques to analyze overall system behavior, and carry out time-domain analysis of first and second-order systems to compute performance parameters
3.	Apply Routh Hurwitz criterion and root locus technique to assess system stability
4.	Analyze the sinusoidal transfer function of physical systems using Bode plots to evaluate frequency response and assess system stability.
5.	Identify and analyze the effect of various compensators such as lead, lag, and lead-lag on system behavior to improve performance and stability.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
EEE312.1	3	3			2		1		2	2	
EEE312.2	3	3			2		1		2	2	
EEE312.3	3	3			2		1		2	2	
EEE312.4	3	3			2		1		2	2	
EEE312.5	3	3			2		1		2	2	

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Modern Control Engineering	K. Ogata	Pearson Education Asia/ PHI	5th edition,.2010
2.	Control Systems Engineering	J. Nagarath and M.Gopal	New Age International (P) Limited	5th edition-2007

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Modern Control Systems	Richard C. Dorf and Robert H Bishop	Prentice Hall	14th edition, 2021
2.	Control Systems Engineering	Norman S. Nise	Wiley India Pvt. Ltd	7th edition, 2014

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc20_ee90/preview

POWER SYSTEM ANALYSIS - II			
Course Code	EEE313	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC

PREREQUISITES: Electric Circuit Analysis-II, Power System Analysis – I

Course Objectives

1	To understand the performance characteristics of transmission lines.
2	To calculate fault currents when a power system is subjected to different shunt faults.
3	To develop a broad idea about power system stability.

Course Contents

UNIT – 1

Line Parameters	**9 Hours**

Calculation of inductance of single phase, Inductance of composite conductor lines (GMR and GMD), 3-phase lines with equilateral & unsymmetrical spacing. Capacitance calculation for three-phase line with equilateral and unsymmetrical spacing, Bundle conductor and its advantages, transposition of lines.

UNIT – 2

Characteristics and Performance of Transmission Lines	**9 Hours**

Classification of lines, Transmission line model for short transmission lines, medium transmission lines-nominal T and pi models, long transmission lines, line regulation. Ferranti effect, ABCD constants of transmission lines.
Introduction to HVDC and FACTS.
Corona: Phenomenon of corona, methods of reducing corona (qualitative treatment only).

UNIT - 3

Transmission Line Protection and Power System Representation	**9 Hours**

Distribution: Requirements of power distribution, ac distribution - radial & ring main systems, calculation for concentrated loads.
Protection of Transmission Lines: Distance Protection – impedance relay, reactance relay and admittance relay. 3-stepped protection of transmission lines.
Representation of Power System Components: Steady-state models of transmission line, synchronous machines, transformer and load. One-line diagram, impedance diagram, per unit notation, selection and change of base for per unit quantities, per unit impedance and reactance diagrams of power system.

UNIT - 4

Symmetrical Three-phase Faults and Symmetrical Components	**9 Hours**

Symmetrical Three-phase Faults: Transients in RL series circuits, short-circuit current and reactance of synchronous machine on no-load, internal voltage of loaded synchronous machine under transient conditions, symmetric short circuit MVA calculations, short-circuit current computation through Thevenin's theorem.
Symmetrical Components: Symmetrical component transformation, Resolution of unbalanced phasors into their symmetrical components and vice-versa, Power in terms of symmetrical components, Phase shift of symmetrical components in Star – Delta transformer bank. Positive, Negative and Zero Sequence impedances and Sequence networks of power system elements (Transmission line, Synchronous machine and Transformer).

UNIT - 5

Unsymmetrical Faults and Power System Stability	**9 Hours**

Unsymmetrical Faults: Symmetrical component analysis of Unsymmetrical faults: Line-To-Ground (L-G), Line-To-Line (L-L), Double Line-To-Ground (L-L-G) faults with and without fault impedance on an unloaded alternator and on a power system.
Power System Stability: Steady-state and Transient stability, rotor dynamics and the swing equation, equal – area criterion of stability and its application for transient stability evaluation.

Course Outcomes

At the end of the course student will be able to

1	Calculate different parameters of transmission lines based on dimensional specifications.
2	Comprehend the practical protection scheme for a transmission line, and draw the reactance diagram for a power system.
3	Determine the regulation for a given load and a given model of a transmission line.
4	Calculate fault current in a power system subjected to a symmetrical fault, and draw the sequence networks for an unbalanced power system.
5	Calculate fault currents for unsymmetrical faults, and appreciate the significance of rotor angle stability.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE313.1	3	3					1					2	3
EEE313.2	3	3					1					2	3
EEE313.3	3	3					1					2	3
EEE313.4	3	3					1					2	3
EEE313.5	3	3					1					2	3

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Elements of Power System Analysis	W. D. Stevenson Jr.	McGraw Hill Education (India) Pvt. Ltd.	4th edition, 1982.
2.	Electrical Power Generation, Transmission and Distribution	S. N. Singh	PHI Learning Pvt. Ltd.	2nd edition, 2008.

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Electrical Power Systems	C. L. Wadhwa	New Age International	5th edition, 2009.

DSP PROCESSOR			
Course Code	EEE314	**Credits**	2
Hours/Week (L :T:P:S)	1:0:2:0	**CIE Marks**	50
Total Hours	15+30	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC

PREREQUISITE: Digital Signal Analysis and Processing

Course Objectives	
1	To recognize the fundamentals of fixed and floating point architectures of various DSPs.
2	To learn the architecture details and instruction sets of fixed and floating point DSPs
3	To Infer about the control instructions, interrupts, and pipeline operations.
4	To illustrate the features of on-chip peripheral devices and its interfacing along with its programming details.
5	To understand and learn to implement the signal processing algorithms in DSPs
6	To learn the DSP programming tools and use them for applications
7	To design and implement signal processing modules in DSPs

Course Contents

UNIT – 1

Introduction to DSP processor	**15 Hours**

Need for DSPs and real-time processing Difference between DSP and general-purpose processors. Basic features of DSP processors. DSP applications overview. Introduction to TMS320C54XX family (or equivalent)Harvard architecture and Modified Harvard architecture. CPU features, memory organization. Pipelining and its importance Addressing modes and instruction formats

Assembly Language Programming and Instruction Set: Instruction set of DSP processor: Data move instructions, Arithmetic instructions, Logical instructions, Program control instructions, Addressing modes in detail: Immediate, Direct, Indirect, Circular, Sample assembly programs, Looping, conditional execution, Stack and subroutine usage, Introduction to cross-compilation and simulation

Programming Concepts and DSP Applications: Algorithm implementation in assembly/C: Convolution, Correlation, FIR and IIR filters, Interfacing DSP with peripherals (memory-mapped I/O),Applications in Audio Processing.

Laboratory Component

Suggested List of Experiments	
1.	Getting Started with Code Composer Studio.
2.	Testing ADC and DAC : a. Compare input voltage and digitized ADC output. b. Compare DAC waveform with input signal using an oscilloscope.
3.	Implementation of differential equation on dsp using discretization using backward Euler Algorithm
4.	Computation of DFT and FFT for a signal
5.	Implementation of IIR filter in Direct I form

6.	Implementation of IIR filter in Direct II form
7.	Implementation of FIR filter in Direct Form using Rectangular window
8.	Implementation of FIR filter with Hamming window
9.	Implementation of frequency response of RC low pass filter
10.	Audio Processing using FFT

Course Outcomes

At the end of the course student will be able to

1.	Describe the basic concepts and significance of Digital Signal Processing and differentiate DSP processors from general-purpose processors.
2.	Explain the architecture of DSP processors and describe the memory organization and addressing modes.
3.	Develop and analyse assembly language programs for DSP processors using different instruction types and addressing modes.
4.	Implement basic DSP algorithms and real-time applications using DSP programming tools.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	1	**PSO↓**	
↓ Course Outcomes											1	1	2
EEE314.1	3	3			3		1	3	2		3	2	2
EEE314.2	3	3			3		1	3	2		3	2	2
EEE314.3	3	3	1		3		1	3	2		3	2	2
EEE314.4	3	3	2		3		1	3	2		3	3	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1	Digital Signal Processing, Implementation using DSP microprocessors	Avatar singh, S. Srinivasn	Cengage Learning	1st edition, 2003
2	Digital Signal Processor, Architecture, Programming and Applications	B. Venkataramani & M. Bhaskar	McGraw-Hill,2010	2nd edition, 2003

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1	Digital Signal Processors: Architectures, Implementations, and Applications	Sen M. Kuo & Woon-Seng S. Gan	Pearson	1st edition,2004

2	Discrete time signal processing	Alan V Oppenheim and Ronald W Schafer	PHI	5th edition, 2015
3	Digital Signal Processing Principles, Algorithms and Application	John G Proakis and Dimtris G Manolakis	Electronic Industry Press	4th edition,2013

E Books / MOOCs/ NPTEL	
1.	Reference guide on TI Sitara Processor am6442.pdf
2.	Reference Manual of 16/32 Bit Arm Cortex-R5F Flash MCU, RISC, EMAC. ti.com/product/RM57L843
3.	NPTEL on digital signal processing by Dr. Ramalingam, IIT Madras. https://www.youtube.com/playlist?list=PLHj96QRJ0kOjwP_TaJOJ5IHIdOuATovLl

Professional Core Courses Lab(PCC)

ANALOG CIRCUIT ANALYSIS AND DESIGN LABORATORY

Course Code	EEE221	**Credits**	1
Hours/Week (L :T:P:S)	0:0:2:0	**CIE Marks**	50
Total Hours	30	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC

Course Objectives

1.	To study the MOSFET characteristics
2.	To design and test biasing circuits of MOSFET.
3.	To use MOSFET as an amplifier and verify its frequency response.
4.	To design and test MOSFET based oscillator circuit.
5.	To design and test Opamp circuits

Suggested List of Experiments

1.	Study of MOSFET characteristics and determine transconductance & output resistance.
2.	Design different types of biasing circuits and validate the operating point
3.	Design Common Source (CS) MOSFET amplifier to determine frequency response
4.	Application of MOSFET as a switch.
5.	Design MOSFET source follower to determine input & output impedance
6.	Design and test MOSFET based RC phase shift oscillator.
7.	Design MOSFET based differential amplifier to determine differential and common mode gains.
8.	Design and testing of capacitor couple voltage follower and determine frequency response.
9.	Design and testing of capacitor coupled non inverting and determine input & output impedance
10.	Design and testing of adjustable Schmitt trigger circuit

Course Outcomes

At the end of the course student will be able to

1.	Analyze MOSFET parameters and design linear & nonlinear application circuit using discrete MOSFET.
2.	Use of Opamp to design application specific circuit

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	**PSO↓** 1	**PSO↓** 2
EEE221.1	1	2	3							1			2
EEE221.2	1	1	2	3						1			2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Microelectronic Circuits	Sedra /Smith	Oxford University	6th Edition, 2013
2.	Operational Amplifier and Linear IC's	David A Bell	Oxford University	3rd Edition, 2011

ELECTRICAL MACHINES LABORATORY			
Course Code	EEE222	**Credits**	1
Hours/Week (L :T:P:S)	0:0:2:0	**CIE Marks**	50
Total Hours	30	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC

PREREQUISITE: Electrical Circuit Analysis-I

Course Objectives

1.	To study operating characteristics of DC machine
2.	To study performance of single phase and 3-phase transformer
3.	To study the performance analysis of the induction machine.

List of Experiments

1.	Load test on DC Motor-Determination of speed torque and BHP efficiency characteristics.
2.	Speed control of DC motors by Armature Voltage and Flux control methods.
3.	Load test on single phase transformers.
4.	OC, SC test on single-phase transformer, predetermination of efficiency & regulation.
5.	Parallel operation of two dissimilar (different KVA) Single -phase transformers.
6.	Polarity test & connection of three- single-phase transformers and determination of efficiency & regulation – for balanced direct loading for UPF.
7.	Load test on 3-phase induction motor- performance evaluation (Torque- speed, BHP- efficiency, BHP-PF, slip- BHP).
8.	Speed control of 3-phase slip-ring induction motor- rotor resistance control (performance for at least two different rotor resistance values).
9.	Load test on single-phase induction motor.
10.	No load and Blocked rotor test on 3-phase Induction motor to determine equivalent circuit parameters.
11.	Closed loop and Open loop control of BLDC Motor.
12.	Speed control of permanent magnet synchronous motor.
13.	Speed control of Switched Reluctance Motor.

Course Outcomes

At the end of the course student will be able to

1.	Verify the performance of DC motors and special motors.
2.	Verify the performance of transformers and induction motors

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE222.1	2	3			1		1	2	2		1		1
EEE222.2	2	3		2	1		1	2	2		1		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Electric machinery	P. S. Bhimbra	Khanna	7th edition, 2011

			publishers	
2.	Electrical Machines	Ashfaq Hussain	Dhanpat Rai Publications	3rd edition 2016
REFERENCE BOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	AC and DC Machines	J.B. Gupta	S K Kataria & Sons publications	Reprint 2012 edition
E Books / MOOCs/ NPTEL				
1.	NPTEL: Electrical Engineering - NOC:Electrical Machines - II			
2.	NPTEL: Electrical Engineering - NOC:Electrical Machines - I			
3.	(202) Electrical Machines (Prof. G.Bhuvaneshwari) - YouTube			
4.	https://nptel.ac.in/courses/108106071			

POWER SYSTEM ANALYSIS LABORATORY

Course Code	EEE321	**Credits**	1
Hours/Week (L :T:P:S)	0:0:2:0	**CIE Marks**	50
Total Hours	30	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC Lab

PREREQUISITES: Electrical Machines Laboratory

Course Objectives

1.	To develop an idea about regulation of an alternator.
2.	To understand the performance of a synchronous condenser.
3.	To be able to appreciate the role played by different types of electrical protection relays.

List of Experiments

1.	Determination of Voltage Regulation of Alternator by EMF and MMF method
2.	Determination of Voltage regulation of alternator by ZPF method
3.	Slip test on salient-pole synchronous machine
4.	Determination of V and inverted V curves of a synchronous motor
5.	Current -Time characteristics of fuse
6.	IDMT characteristics of non-directional electromechanical overcurrent relay
7.	DMT characteristics of overvoltage relay / undervoltage relay
8.	Realization of various characteristics of Microcontroller based overcurrent relay
9.	Differential Protection
10.	Demonstration of protection of induction motor/AC generator/feeder

Course Outcomes

At the end of the course student will be able to

1.	Comprehend the impact of load on voltage regulation of an alternator.
2.	Appreciate the performance of the synchronous motor as a flexible power factor compensator.
3.	Realize the significance of characteristics of different types of electrical protection relays.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE321.1	3	3					1	3	3			2	2
EEE321.2	3	3					1	3	3			2	2
EEE321.3	3	3					1	3	3			2	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Electrical machinery	P. S. Bhimbra	Khanna Publishers	7th edition, 2011
2.	Fundamentals of Power System Protection	Y. G. Paithankar and S.R. Bhide	PHI Learning Pvt. Ltd.	2nd edition, 2010

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Theory of Alternating Current Machinery	A. S. Langsdorf	McGraw Hill Education Pvt. Ltd.	2nd edition, 1984
2.	Power System Protection and Switchgear	Badri Ram and D. N. Vishwakarma	Tata McGraw Hill Education Pvt. Ltd.	2nd edition, 2017

LINEAR CONTROL SYSTEMS LABORATORY

Course Code	EEE322	**Credits**	1
Hours/Week (L :T:P:S)	0:0:2:0	**CIE Marks**	50
Total Hours	30	**SEE Marks**	50
Exam Hours	3	**Course Type**	PCC

PREREQUISITE: Electrical Circuit Analysis-II

Course Objectives

1.	To develop mathematical models of electrical, mechanical and electromechanical linear systems to study the system dynamics
2.	To compute system transfer function using block diagram reduction and signal flow graph techniques to carry out time domain analysis
3.	To Apply Routh Hurwitz criterion and root locus technique to assess system stability
4.	To Analyze sinusoidal transfer function of physical systems using Bode plot to study the stability
5.	To list various compensators to observe system behavior and also obtain state space analysis

List of Experiments

1.	Introduction to MATLAB and Simulink.
2.	Mathematical modeling of physical system and applying Force Voltage and Force Current analogy using differential equation.
3.	Mathematical modeling of physical system and applying Force Voltage and Force Current analogy in 's' domain.
4.	Transient analysis of an armature-controlled DC motor.
5.	Time response analysis of first order system.
6.	Time response analysis of second order system and finding performance parameters.
7.	Frequency response of RL-RC circuits.
8.	Transient response of RLC circuits.
9.	Root locus and bode plot of a given system.
10.	Lead, lag and lag-lead compensator.
11.	Effect of PD, PI and PID controller on time response of systems.

Course Outcomes

At the end of the course student will be able to

1.	Develop the model of the physical system using Force Voltage and Force Current analogy.
2.	Study the Time response and frequency response of a given circuit.
3.	Study the stability analysis of a given system.
4.	Design of compensators and controllers for a given system.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE322.1	3	3			3		1	3	3				2
EEE322.2	3	3			3		1	3	3				2
EEE322.3	3	3			3		1	3	3				2
EEE322.4	3	3			3		1	3	3				2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Modern Control Engineering	K. Ogata	Pearson Education Asia/ PHI	5th edition,.2010
2.	Control Systems Engineering	J. Nagarath and M.Gopal	New Age International (P) Limited	5th edition-2007

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Modern Control Systems	Richard C. Dorf and Robert H Bishop	Prentice Hall	14th edition, 2021
2.	Control Systems Engineering	Norman S. Nise	Wiley India Pvt. Ltd	7th edition, 2014

Emerging Technology Course (ETC)

I FOR ELECTRICAL ENGINEERS			
Course Code	EEE331	**Credits**	2
Hours/Week (L :T:P:S)	2:0:0:J	**CIE Marks**	50
Total Hours	30	**SEE Marks**	50
Exam Hours	3	**Course Type**	ETC

PREREQUISITE: Numerical Methods and Probability Theory, Power System Analysis - I

Course Objectives

1.	To introduce the basic concepts, tools, and mathematical foundations of Artificial Intelligence and Machine Learning applicable to Electrical Engineering.
2.	To impart knowledge of various machine learning techniques and their application in solving electrical engineering problems.
3.	To develop the ability to design AI-powered electrical engineering systems.

Course Contents

UNIT–1

Introduction to AI and Machine Learning	**10 Hours**

Introduction to Artificial Intelligence, Machine Learning and Deep Learning, Applications of AI in Electrical Engineering, Basics of Supervised and Unsupervised Learning, Introduction to Reinforcement Learning, Fundamentals of Probability and Statistics for AI, Linear Algebra and Optimization Techniques, Overview of Python Programming for AI, AI/ML Libraries and Tools – Scikit-learn, TensorFlow, PyTorch.

UNIT–2

Machine Learning Techniques in Electrical Engineering	**10 Hours**

Supervised Learning – Linear Regression, Logistic Regression, Decision Trees, Random Forest, Support Vector Machines, Ensemble Methods, Clustering Techniques – K-Means Clustering, Hierarchical Clustering, DBSCAN, Dimensionality Reduction – Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Case Studies – Fault Detection in Electrical Grids, Energy Consumption Prediction, Condition Monitoring of Electrical Equipment.

UNIT-3

AI for Electrical Engineering:	**10 Hours**

Case Study:

1. AI Applications in Smart Grids
2. AI-based Motor Control and Power Electronics,
3. AI-powered Automation in Industrial Systems,
4. AI for Embedded Systems

Course Outcomes

At the end of the course student will be able to

1.	Understand the fundamental concepts of AI, ML, and DL, along with essential mathematical foundations and tools used in AI applications relevant to Electrical Engineering.
2.	Apply supervised and unsupervised machine learning techniques for solving electrical engineering problems such as fault detection, energy prediction, and equipment monitoring.
3.	Ability to design and implement AI-driven electrical engineering systems.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE331.1	3	3					1				1		1
EEE331.2	3	3					1				1		1
EEE331.3	3	3					1				1		1

1: Low 2: Medium 3: High

TEXTBOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Artificial Intelligence: A Guide for Thinking Humans	Melanie Mitchell	Farrar, Straus and Giroux	1st edition, 2019
2.	Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer New York, NY	1st edition,2006
REFERENCE BOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Machine Learning and Data Science in the Power Generation Industry	Patrick Bangert	Elsevier	1st edition,2021
E Books / MOOCs/ NPTEL				
1.	https://nptel.ac.in/courses/106102220			
2.	https://www.coursera.org/learn/introduction-to-ai			

Ability Enhancement Courses (AEC)

ENHANCING SELF COMPETENCE

Course Code	**HSS232**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**2:0:0:0**	**Credits**	**02**
Total Teaching Hours	**30:0:0**	**CIE + SEE Marks**	**50+50**
Pre-requisite	**Communicative English**		

Teaching Department: Humanities

Course Objectives

1.	Introspect and learn about oneself
2.	Develop professional writing skills
3.	Acquaint with the various social behaviour and etiquette
4.	Apply the techniques of fundamental communication skills
5.	Develop necessary techniques for formal presentations

Unit - I

Personality Traits	**06 Hours**
Types & Kinds of personality, Ways to Identify Self (SWOT Analysis, Johari Window), Concepts of Self-Management and Self-Motivation	
Effective Communication Skills	**04 Hours**
One-way and Two-way Communication, Interpersonal & Social Skills	

Unit - II

Social Behaviour and Cultural Etiquette	**05 Hours**
Time Management, Personal Grooming, Making Small Talk, Customs & Manners	
Professional Presentation Techniques	**05 Hours**
Formal Presentation, Sensitivity towards multi-cultural workspaces.	

Unit - III

Job-Related Communication	**10 Hours**
Resume & Cover Letter, Formal E-mails, Framing Requests, Greetings, Salutations, Close	

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

1.	Understand the importance of human conduct and various types of communication.
2.	Demonstrate knowledge of theory and competence in office communication.
3.	Be Familiar with the current practices of social behaviour.
4.	Prepare and deliver presentation appropriate for the workplace.

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
HSS232.1		1				2	2		3					
HSS232.2								3	2	1		1		
HSS232.3			2			2	2	2				2		
HSS232.4		3							2	3	2			

1: Low 2: Medium 3: High

REFERENCES:

1.	Adler, R. B., & Elmhorst, J. M. (Year of publication). Communicating at Work: Principles and Practices for Business and the Professions (Edition number). McGraw Hill College.
2.	Covey, S. R. (2013). The 7 Habits of Highly Effective People (Edition number). Great Britain: Simon & Schuster.
3.	Gulati, S. (2010). Corporate Grooming and Etiquette. New Delhi: Rupa Publications India Pvt. Ltd.
4.	Luthans, F. (1998). Organizational Behavior. McGraw Hill International.
5.	Rath, T. (2020). Strengths Finder 2.0. New York: Gallup Press.
6.	Rizvi, M. A. (2007). Effective Technical Communication. New Delhi: Tata McGraw-Hill.
7.	Robbins, S. P. (2016). Organizational Behavior. New Delhi: Prentice Hall.
8.	Carnegie, D. (2019). How to Win Friends and Influence People (Latest Edition). New York: Gallery Books.
9.	Gaur, R. R., Sangal, R., & Bagaria, G. P. (2010). Human Values and Professional Ethics. New Delhi, India: Excel Books.

DEVELOPING PROFESSIONAL SKILLS

Course Code	**HSS231**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**2:0:0:0**	**Credits**	**02**
Total Teaching Hours	**30:0:0**	**CIE + SEE Marks**	**50+50**
Pre-requisite	**Communicative English**		

Teaching Department: Humanities

Course Objectives:

1.	Developing an understanding of one's own strengths, weaknesses, values, and beliefs through exercises and assessments
2.	Enhancing verbal and non-verbal communication skills to express thoughts and feelings clearly, listen actively, and resolve conflicts constructively
3.	Building professional online presence through personal branding
4.	Learning techniques for setting achievable goals, prioritizing tasks, and managing time effectively to enhance productivity and personal fulfilment

UNIT – I

Understanding Personality — **04 Hours**

- Introduction to 16 types of personalities (Myers & Briggs) and their significance in professional growth
- MBTI Self-assessment exercise to identify individual Personality Type and areas for development

Campus Placement: First Impressions — **09 Hours**

- Comprehensive overview of campus placement opportunities and challenges
- Crafting tailored resumes, cover letters, and portfolios for different job applications
- Self-Introductions: Styles and strategies, Self introduction exercise

UNIT – II

Personal Branding and Professional Image — **05 Hours**

- Understanding the importance of personal branding in career advancement
- Developing a strong online presence through LinkedIn, and GitHub

Voicing Perspectives in Interviews and Group Discussions — **05 Hours**

- Exploring various interview formats
- Addressing common interview challenges and handling difficult questions with poise
- Group Discussions, Do’s & Don’ts in Group Discussion, GD practice session

UNIT – III

Goal Setting — **06 Hours**

- Work Ethics and Professionalism
- Setting SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals for ongoing skill development and career advancement

Wrap-Up — **01 Hours**

- Participant feedback collection to assess the effectiveness of the modules

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

1.	Demonstrate an increased awareness of their strengths, weaknesses, values, and beliefs and set a goal for their life

2.	Effectively express their thoughts and feelings verbally and non-verbally, demonstrate active listening skills, and employ constructive conflict resolution techniques in interpersonal interactions in interviews, GD and online platforms
3.	Develop a compelling personal brand and professional image by leveraging online platforms like LinkedIn and GitHub to enhance career prospects.
4.	Create tailored application materials, including resumes and cover letters, and confidently navigate campus placements, interviews, and group discussions.

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
HSS231.1	-	1	-	-	-	2	2	-	3	-	-	-	-	-
HSS231.2	-	-	-	-	-	-	-	3	2	1	-	1	-	-
HSS231.3		1				2		2	3	1				
HSS231.4							2	2	1	2		1		

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Adler, R. B., & Elmhorst, J. M. "Communicating at Work: Principles and Practices for Business and the Professions", Edition number). McGraw Hill College.
2.	Covey, S. R. "The 7 Habits of Highly Effective People", Great Britain: Simon & Schuster, 2013.
3.	Gulati, S. "Corporate Grooming and Etiquette", New Delhi: Rupa Publications India Pvt. Ltd, 2010.
4.	Luthans, F. "Organizational Behavior". McGraw Hill International, 1998.
5.	Rath, T. "Strengths Finder 2.0", New York: Gallup Press, 2020.
6.	Rizvi, M. A. "Effective Technical Communication", New Delhi: Tata McGraw-Hill, 2007.
7.	Robbins, S. P. "Organizational Behavior", New Delhi: Prentice Hall, 2016.
8.	Carnegie, D. "How to Win Friends and Influence People", New York: Gallery Books, 2019.
9.	Gaur, R. R., Sangal, R., & Bagaria, G. P. "Human Values and Professional Ethics", New Delhi, India: Excel Books, 2010.

AUGMENTING EMPLOYABILITY SKILLS

SEMESTER III

Course Code	HSS134		**Credits**	1
CIE Marks**	50		**Hours/Week (L-T-P)**	1-0-0
Total Teaching Hours	15L+0T+0P		**SEE Marks**	50
Exam hours	1.5 hours		**Course Type**	AEC
Stream	All departments		**Integrated Lab**	NO
Course Component				

COURSE OUTCOMES

Students will be able to

1. recognize the importance of employability skills
2. reflect their personality traits through OCEAN
3. identify an area of improvement and invest in developing it
4. analyze the qualities of entrepreneurs

COURSE CONTENTS

MODULE -1: WHAT DO ORGANIZATIONS WANT? (7 Hours)

- Employability Skills-Introduction activity
- Self-reflection Activity: How employable am I?
- Professional Ethics

MODULE -2: QUALITIES OF AN ENTREPRENEUR (8 Hours)

- Case studies: qualities of entrepreneurs
- Social Lab: Talk to people- The life stories of entrepreneurs and presentations
- Self-Assessment: OCEAN test of Personality . Followed by debriefing

1. Cottrell, Stella.(2015) Skills for success : personal development and employability. Macmillan International Higher Education: Red Globe Press
2. Thiel, P., & Masters, B. 1. (2014). Zero to one: notes on startups, or how to build the future. Unabridged. [Westminster, MD], Books on Tape.

ONLINE RESOURCES *

Topic/Title	Link
1. India Skills Report 2022:	https://wheebox.com/assets/pdf/ISR_Report_2022.pdf
2. Human leadership eBook	https://students.aiu.edu/submissions/profiles/resources/onlineBook/u8C3Q3_psychology%20of%20leadership

	%20Charisma.pdf

****COURSE ASSESSMENT METHOD:**
Attendance : 85% for eligibility **LA1: 10 marks **LA2: 10marks **MSE: 30 marks SEE: 50 marks
PEDAGOGY
1. Administration of OCEAN personality test 2. Case studies 3. Group discussions and presentations 4. Interviewing and conversing with entrepreneurs.

*Additional reading materials and online resources will be shared with the learners as required

BUILDING PSYCHOLOGICAL ASSETS

SEMESTER II

Course Code	HSS135		**Credits**	01
CIE Marks**	50 marks		**Hours/Week (L-T-P)**	1-0-0
Total Teaching Hours	15L+0T+0P		**SEE Marks**	-
Exam hours	1.5 hours		**Course Type**	AEC
Stream	All Departments		**Integrated Lab**	NO
Course Component				

COURSE OUTCOMES

Students will be able to

1. recognize failures as pathways to success
2. recognize the markers of a growth mindset in themselves
3. practice simple mindfulness exercises

COURSE CONTENTS

UNIT -1 **9 HOURSE**

- **Pathways to Success**: Introduction to the non-cognitive factors that are precursors to success; Suggested case studies: Sundar Pichai, Indira Nooyi
- **Learning to Fail:** Decoding failures; Why do we fail? ; Failure as an opportunity- Suggested case studies: Steve Jobs- Apple, ISRO-Chandrayaan
- **Growth mindset:** Comparing growth and fixed mindsets; techniques to develop a growth mindset; communication tools for a growth mindset.

UNIT -2- **6 HOURS**

- **Grit and Resilience:** Importance in crafting success; Tools to develop grit and be resilience. Suggested case studies: Narayana Murthy and Infosys; Ratan Tata
- **Self-regulation of Emotions:** The connect between thought, emotions and behaviours; tips to control my emotions; recognizing depression; mindfulness practice.

REFERENCE BOOKS

1. Duckworth, A. (2016). Grit: The power of passion and perseverance. Scribner/Simon C Schuster.
2. Khera, S. (2014) You Can Win: A Step-by-Step Tool for Top Achievers. ACC Black**.**

ONLINE RESOURCES*

Topic/Title	Link
1. TED talk by Angela Duckworth on grit	https://www.youtube.com/watch?v=H14bBuluwB8Ct=1 11s

3. 5 Practices of Highly Resilient People with Dr. Taryn Marie Stejskal:	https://www.youtube.com/watch?v=gIYHQAeOy-w
4. Learning from failure	https://hbr.org/2011/04/strategies-for-learning-from-failure
5. Carol Dweck on Growth Mindset	https://www.youtube.com/watch?v=hiiEeMN7vbQ

****COURSE ASSESSMENT METHOD:**

Attendance : 5 Marks [95% and above- 5 marks; 94%-90%-4 marks; 89%-85%-3 marks; 84%-80%-2 marks; 79%-75%-1 mark] If students have less than 75% attendance , they will not be allowed to attend the end semester exam.
LA1: 15 Marks
LA2: 15Marks
(The average of two LA will be taken)
MSE: 30 Marks

PEDAGOGY

1. Activity based learning
2. Case studies
3. Group discussions and presentations
4. Reflective activities

*Additional Reading materials and online resources will be shared with the learners as required

INNOVATION AND DESIGN THINKING

Course Code:	**MEC131**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P):	**0:0:2:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

To explain the fundamental concept of innovation and design thinking
To discuss the methods of implementing design thinking in the real-world scenario.
To discuss about business process model in industry
To discuss Agile system development and scenario-based prototyping in industry
To discuss daily used product prototypes using design thinking steps

Note: Teaching-Learning Process (General Instructions): These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

a) Lecturer method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
b) Show Video/animation films to explain concepts
c) Encourage collaborative (Group Learning) Learning in the class
d) Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
e) Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
f) Topics will be introduced in multiple representations.
g) Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
h) 8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

List of Modules

1.	**INTRODUCTION** Background of Design Thinking, Perception building, Discussion on day-to-day life problems and design thinking approach. Why is Design Thinking important, Features of Design Thinking, Characteristics of Design Thinking. Discussion about a Product and Process Industry, Service Industry, Invention, Innovation, Creativity (Activity – out of the box thinking), Technology and Design. Qualities of a good design. **03 Hours**
2.	**PROCESS OF DESIGN** Creativity a bridge between Invention and innovation with real time examples and case studies / Scenarios. Preparing for Drawings (Chair Activity). Brand Building Activity. Empathy and Define using 360-degree approach – Fact, Form, Function, Relationship using real time common usage product - Wallet, Shoes, Backpack, Water Bottle. **03 Hours**
3.	**DESIGN THINKING IN INDUSTRY (Part 1)** Design Thinking in Industries, Design Thinking to Business Process Model, **02 Hours**

4.	**DESIGN THINKING IN INDUSTRY (Part 2)** Design Thinking for Agile System Development, Virtual Collaboration, Scenario Based Prototyping **02 Hours**
5.	Ideation and Prototype using 360-degree approach – Fact, Form, Function, Relationship using real time common usage product - Tiffin Box, Spectacles, Walkin Wardrobe, Farm land. Prototype Evaluation of any one of these Products **05 Hours**

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

- Generate and develop design ideas through a different technique
- Identify the significance of Design Thinking to Understand products
- To understand business process model in industry
- To understand Agile system development and scenario-based prototyping in industry
- To create daily used product prototypes using design thinking steps

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓		
↓ Course Outcomes												1	2	3
MEC131.1	-	-	-	-	-	-	2	2	-	-	-	1	1	-
MEC131.2	-	-	-	-	-	-	2	2	-	-	-	1	1	-
MEC131.3	-	-	-	-	-	-	2	2	-	-	-	1	1	-
MEC131.4	-	-	-	-	-	-	-	-	-	3	3	1	1	-
MEC131.5	-	-	-	-	-	-	-	-	-	3	3	1	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage",Harvard Business Press, 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve–Apply", Springer, 2011
4. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.
5. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, SecondEdition, 2011.
6. Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia BusinessSchool Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author),Kevin Bennett (Author).

E Books / MOOCs/ NPTEL

1. www.tutor2u.net/business/presentations/. /productlifecycle/default.html
2. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
3. www.bizfilings.com › Home › Marketing › Product Developmen
4. https://www.mindtools.com/brainstm.html
5. https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit
6. www.vertabelo.com/blog/documentation/reverse-engineering
7. https://support.microsoft.com/en-us/kb/273814

8. https://support.google.com/docs/answer/179740?hl=en
9. https://www.youtube.com/watch?v=2mjSDIBaUlM
10. https://dschool.stanford.edu/.../designresources/.../ModeGuideBOOTCAMP2010L.pdf
11. https://dschool.stanford.edu/use-our-methods/
12. https://www.interactiondesign.org/literature/article/5-stages-in-the-design-thinking-process
13. http://www.creativityatwork.com/design-thinking-strategy-for-innovation/ 49
14. https://www.nngroup.com/articles/design-thinking/ https://designthinkingforeducators.com/design-thinking/
15. www.designthinkingformobility.org/wp-content/.../10/NapkinPitch_Worksheet.pdf
16. Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
17. http://dschool.stanford.edu/dgift/

PYTHON PROGRAMMING

Course Code	EEE131	**Credits**	1
Hours/Week (L :T:P:S)	0:0:2:0	**CIE Marks**	50
Total Hours	30	**SEE Marks**	50
Exam Hours	3	**Course Type**	AEC

PREREQUISITE:

Course Objectives

1.	To write a simple python program with emphasis on syntax and semantics
2.	To write simple programs utilizing Lists, Tuples and Dictionaries.
3.	To write simple program by choosing appropriate conditional operator.
4.	To write simple program consisting of user defined functions.
5.	To study the concept of object oriented programming in python.

Suggested List of Experiments

1.	Study of datatypes, operations, functions and methods related to datatypes.
2.	write a program to find greatest common divisor or HCF of two numbers
3.	write a program to find a factorial of number **n** using recursive function
4.	Write a Python program to generate first '**n**' Fibonacci numbers
5.	Build a program called "**GuessMyNumber**". The computer will generate a random number between 1 and 10. The user types in a number and the computer replies "lower" if the random number is lower than the guess, "higher" if the random number is higher, and "correct!" if the guess is correct. The player can continue guessing until the guess is right.
6.	Write a binary search function which searches an item in a sorted list. The function should return the index of element to be searched in the list.
7.	Write a bubble sort function to sort a given list. Print the original and sorted lists.
8.	Write a program to remove all punctuations like "'!()-[]{};:'''\,<>,/,?,@,#,$,%^&*_~" from the string provided by the user.
9.	Write a python program that accepts a sentence and calculate the number of words, digits, uppercase letters and lowercase letters

Course Outcomes

At the end of the course student will be able to

1.	Demonstrate the ability to write effective Python programs using operators, functions, conditional statements, and switch-case constructs to solve real-world decision-making problems.
2.	Apply the concepts of strings, tuples, dictionaries, and lists along with object-oriented programming principles to design and develop structured and modular Python applications

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE131.1	2	3					1	3	3				
EEE131.2	2	3			3		1	3	3				1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Introduction to Python Programming	Gowrishankar S, Veena A	CRC Press, Taylor & Francis Group	2019
2.	The Fundamentals of Python: First Programs	Kenneth A. Lambert	Cengage Learning	2011

REFERENCE BOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Introduction to Computer Science Using Python	Charles Dierbach	Wiley India Pvt Ltd	1st Edition, 2015

INTERNET OF THINGS

Course Code	EEE132	**Credits**	1
Hours/Week (L :T:P:S)	0:0:2:0	**CIE Marks**	50
Total Hours	30	**SEE Marks**	50
Exam Hours	3	**Course Type**	AEC

PREREQUISITE:

Course Objectives

1.	Assess the genesis and impact of IoT applications, architectures in real world.
2.	Compare different Application protocols for IoT.
3.	Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

Suggested List of Experiments

1.	Design a Digital AC Voltmeter and Ammeter to measure the voltage and current in AC electrical circuits using microcontroller and display the values in LCD display.
2.	Measure the power and energy in electrical circuit using microcontroller and display the values in LCD display
3.	Interfacing temperature and humidity sensor with microcontroller and display the same in the lcd display
4.	Interfacing of microcontroller to Zigbee module
5.	Interfacing of microcontroller to Bluetooth module
6.	Interfacing of microcontroller to GSM module
7.	Interfacing of sensors to Raspberry Pi
8.	Setup a cloud platform to log the data
9.	Log Data using Raspberry Pi and upload to the cloud platform
10.	Design an IOT based system

Course Outcomes

At the end of the course student will be able to

1.	Describe the impact and challenges of IoT networks to understand the architectural models.
2.	Evaluate the role of IoT communication protocols and integrate sensors to implement real-world applications, particularly in industrial environments.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE132.1	2	3					1	3	3				
EEE132.2	2	3					1	3	3				

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry	Pearson Education	1st edition, 2017
2.	Internet of Things	Srinivasa K G	CENGAGE Leaning India	2017

REFERENCE BOOKS				
Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Internet of Things (A Hands-on-Approach)	Vijay Madisetti and Arshdeep Bahga	VPT	1st edition, 2014
2.	Internet of Things: Architecture and Design Principles	Raj Kamal	McGraw Hill Education	2017

SOLDERING PRACTICE

Course Code	EEE133	**Credits**	1
Hours/Week (L :T:P:S)	0:0:2:0	**CIE Marks**	50
Total Hours	30	**SEE Marks**	50
Exam Hours	3	**Course Type**	AEC

PREREQUISITE:

Course Objectives

1.	To understand basics of manual soldering
2.	To identify various types of components and method of soldering
3.	To setup soldering workstation and understand temperature-controlled soldering
4.	To verify soldered PCB by visual inspection and standard test procedures
5.	To understand the necessity of workplace safety

Suggested List of Experiments

1.	Soldering RC filter in tag board and verify the corner frequency
2.	Soldering the IC base
3.	Build OPAMP circuit in general purpose PCB using IC base
4.	PCB trace development using copper wire to build amplifier circuit
5.	Twisted pair development using copper wire
6.	Rework of through hole component using de-soldering pump
7.	Rework of SMD component using temperature controlled soldering station
8.	Use of tweezer to handle SMD component
9.	SMD IC soldering using hot air gun
10.	Inductor winding and verification of inductance value

Course Outcomes

At the end of the course student will be able to

1.	Develop application circuits in general purpose PCB
2.	Apply the skills of handling SMD component for the development and testing of hardware

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE133.1	1	2	3	3			1	3	3	1			2
EEE133.2	1	1	3	3			1	3	3	1			2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	The Basic Soldering Guide Handbook: Learn to Solder Electronics Successfully	Winstanley, A. Antex	CreateSpace Independent Publishing Platform	**2014**
2.	Solders and Soldering: Materials, Design, Production, and Analysis for Reliable Bonding	Manko, H.H	McGraw-Hill	2001

JAPANESE LANGUAGE

Course Code	**HSS136**	**Course Type**	**AEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45+0+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 1-4) **09 Hours**

Greetings, Self-Introduction, Noun, Verb, Present Tense, Past Tense, Numbers, Days, There is～

UNIT - II

(Lessons 5-8) **09 Hours**

Seasons, Nature, Time and Dialogs, Family, Adjective, Hiragana

UNIT - III

(Lessons 9-12) **09 Hours**

Food Items, Conversation, Hobby, 5W1H, Entering School / Company, Can, Want to, Body Parts, Colors

UNIT - IV

(Lessons 13-16) **09 Hours**

Body Features, Japanese Counting System, Katakana, Birth / Death, How to Show the Way

UNIT - V

(Lessons 17-20) **09 Hours**

Dialogs (Going to Restaurant, About Exams), My Day, Future Tense, Order, Success/Failure, Kanji Characters

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 (120) characters.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HSS136.1	-	-	-	-	-	3	-	-	2	1	-	1
HSS136.2	-	-	-	-	-	3	-	-	2	1	-	1
HSS136.3	-	-	-	-	-	3	-	-	2	1	-	1
HSS136.4	-	-	-	-	-	3	-	-	2	1	-	1
HSS136.5	-	-	-	-	-	3	-	-	2	1	-	1

1: Low 2: Medium 3: High

RESEARCH METHODOLOGY

Course Code	**HSS137**	**Course Type**	**AEC**
Teaching Hours/Week (L: T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Respective Department

Course Objectives

1.	Understand Research Formulation and Design
2.	Inculcate the ability to collect Data and its analysis
3.	Understand hypothesis testing.
4.	Comprehend Research Ethics and the art of publishing
5.	Develop Interpretative Skills and write reports

UNIT - I

Research Formulation and Design — **5 Hours**

Motivation and Objectives – Research methods vis-a-vis Methodology. Criteria of good research. Characteristics and limitations of research – Components of research work - Criteria of good research, Research process – Types of Research, Fundamental, Pure or Theoretical Research –Applied Research –Descriptive Research – Evaluation Research –Experimental Research – Survey Research – Qualitative Research – Quantitative Research – Historical Research.

Defining and formulating the research problem, Selecting the problem, Importance of Literature Review, Literature Review - Primary and Secondary sources, reviews, monograph, patents, research databases, Web as a source, Critical literature review, Identifying gap areas from Literature Review, Development of working hypothesis.

Research Design — **4 Hours**

Research Design – definition – essentials and types of research design – errors and types of errors in research design. Research problem: Selecting and analyzing the research problem – problem statement formulation – formulation of hypothesis. Literature review: purpose, sources, and importance - literature review procedure. Objectives: Learning Objectives; Definitions; Formulation of the research objectives.

UNIT - II

Sampling, Data Collection and analysis — **9 Hours**

Types and sources of data – Primary and secondary, Methods of collecting data, Concept of sampling and sampling methods – sampling frame, sample, characteristics of good sample, simple random sampling, purposive sampling, convenience sampling, snowball sampling, classification and tabulation of data, graphical representation of data, graphs and charts – Histograms, frequency polygon and frequency curves, bell shaped curve and its properties.

Statistical Methods for Data Analysis: Applications of Statistics in Research, measures of central tendency and dispersion, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statistical package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT - III

9 Hours

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

UNIT-IV

9 hours

Interpretation and Report Writing
Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports

UNIT-V

9 hours

Research Ethics and Scholarly Publishing - – Ethical issues in research: Code of Ethics in Research – Ethics and Research Process – Importance of Ethics in Research.

Scientific Conduct
Ethics with respect to science and research.
(i) Intellectual honesty and research integrity.
(ii) Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP).
(iii) Redundant publications: duplicate and overlapping publications, salami slicing.
Selective reporting and misrepresentation of data

ICT Tools for Research: Role of computers in research, maintenance of data using software such as Mendeley, Endnote, Tabulation and graphical presentation of research data and software tools.

Web search: Introduction to Internet, use of Internet and WWW, using search engines and advanced search tools.

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

1.	Demonstrate proficiency in research formulation, design, and problem-solving, applying various methodologies and techniques to effectively address research questions and hypotheses.
2.	Acquire competence in collecting, validating, and analyzing data using appropriate methods and statistical tools, enabling them to draw meaningful conclusions and insights from research datasets.
3.	Write a proper research report.
4.	Acquire competency in doing hypothesis testing and perform Chi-square test
5.	Develop a thorough understanding of research ethics and scholarly publishing standards, and effective use of ICT tools.

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
	-	-	-	-	-	-	-	-	-	2	-	3	-	-
	-	-	-	-	-	-	-	-	-	3	-	3	-	-
	-	-	-	-	-	-	-	-	-	3	-	3	-	-
	-	-	-	-	-	-	-	-	2	2	-	2	-	-
					3	2		3		2		1		

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Garg, B. L., Karadia, R., Agarwal, F., & Agarwal, "An introduction to Research Methodology", RBSA Publishers, 2002.
2.	Wadehra, B. L. "Law relating to patents, trademarks, copyright designs and geographical indications", Universal Law Publishing, 2000.
3.	Kothari, C. R. "Research Methodology: Methods and Techniques". New Age International, 1990.

4.	Trochim, W. M. K. "Research Methods: the concise knowledge base", Atomic Dog Publishing, 2005.
5.	Sinha, S. C., & Dhiman, A. K., "Research Methodology", EssEss Publications. (2 volumes), 2002.
6.	Satarkar, S. V. "Intellectual property rights and copyright", EssEss Publications, 2000.
7.	Coley, S. M., & Scheinberg, C. A., "Proposal Writing", Sage Publications, 1990.
8.	Day, R. A. "How to Write and Publish a Scientific Paper", Cambridge University Press, 1992.
9.	Anthony, M., Graziano, A. M., & Raulin, M. L., "Research Methods: A Process of Inquiry". Allyn and Bacon, 2009.

Professional Elective Courses (PEC)

Power Systems Stream

ELECTRICAL ESTIMATION AND COSTING			
Course Code	EEE341	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Power System Analysis - 1			

Course Objectives

1.	To understand the fundamentals of electrical estimation and costing.
2.	To get familiar with the distribution of energy in a building and its wiring strategies.
3.	To understand the commissioning of overhead transmission and distribution systems.
4.	To comprehend the layout of an electrical substation.

Course Contents

UNIT – 1

Fundamentals of Electrical Estimation and Costing	**9 Hours**

Introduction to Estimation and Costing, Electrical Schedule, Catalogues, Market Survey and Source Selection, Recording of Estimates, Determination of Required Quantity of Material, Labour Conditions, Determination of Cost Material and Labour, Contingencies,

Advanced Estimation Practices and Legal Framework: Overhead Charges, Profit, Purchase System, Purchase Enquiry and Selection of Appropriate Purchase Mode, Comparative Statement, Purchase Orders, Payment Of Bills, Tender Form, General Idea about IE Rule, Indian Electricity(IE) Act and IE Rules

UNIT – 2

Wiring Systems and Lighting Circuit Design	**9 Hours**

Introduction, Distribution of energy in a Building, PVC Casing and Capping, Conduit Wiring, Desirabilities of Wiring, Types of cables used in Internal Wiring, Multi Strand Cables, Voltage Grading and Specification of Cables, Main Switch and Distribution Board, Conduits and its accessories and Fittings, Lighting Accessories and Fittings, Types of Fuses, Size of Fuse, Fuse Units, Earthing Conductor

Wiring Design and Load Estimation: General rules for wiring, Design of Lighting Points, Number of Points, Determination of Total Load, Number of Sub –Circuits, Ratings Main Switch and Distribution Board and Size of Conductor, Current Density, Layout.

UNIT - 3

Service Mains and Power Circuit Design	**9 Hours**

Service Mains: Introduction, Types, Estimation of Underground and Overhead Service Connections Design and Estimation of Power Circuits.

Power Circuit Design and Estimation: Introduction, Important Considerations regarding Motor Installation Wiring, Input Power, Input Current to Motors, Rating of Cables, Rating of Fuse, Size of Condit, Distribution Board Main Switch and Starter

UNIT - 4

Overhead Lines	**9 Hours**

Components and Configuration: Cross Arms, Pole Brackets and Clamps, Guys and Stays, Conductors Configuration Spacing and Clearances, Span Lengths, Lightning Arrestors, Phase Plates, Danger Plates, Anti Climbing Devices, Bird Guards, Beads of Jumpers, Muffs.

Installation and Safety : Points to be Considered at the Time of Erection of Overhead Lines, Erection of Supports, Setting of Stays, Fixing of Cross Arms, Fixing of Insulators, Conductor Erection. Repairing and Jointing of Conductors, Dead End Clamps, Positioning of Conductors and Attachment to Insulators, Jumpers, Tee-Offs, Earthing of Transmission Lines, Guarding of Overhead Lines, Clearances of Conductor from Ground, Spacing Between Conductors, Important Specifications.

UNIT - 5

Substation Layout	**9 Hours**

Main Electrical connection, Graphical Symbols for Various Types of Apparatus and Circuit Elements on Substation main Connection Diagram, Single Line Diagram of Typical Substations.
Substation Components and Estimation Essentials: Equipment for Substation, Substation Auxiliaries Supply, Substation Earthing.

Course Outcomes

At the end of the course student will be able to

1.	Describe the preparation of a tender and material procurement procedure.
2.	Determine the lighting system layout for a building and hence estimate the total cost.
3.	Design a layout for distribution of energy in a building indicating wiring and fuses.
4.	List the components of the overhead transmission and distribution system and to estimate its cost.
5.	Develop the single line diagram, earthing layout and estimation of a substation.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE341.1	3	3				2	2					2	
EEE341.2	3	3					2					2	
EEE341.3	3	3					2					2	
EEE341.4	3	3				2	2					2	
EEE341.5	3	3				2	2					2	

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	A Course in Electrical Installation Estimating and Costing	J. B. Gupta	S.K. Kataria & Sons	9th edition, 2017.

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Electrical Estimation and Electrical Wiring Systems	Raghavendra Rao	Sapna Book House,	2014

ADVANCED POWER SYSTEM ANALYSIS AND CONTROL			
Course Code	EEE361	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITES: Power System Analysis-II.

Course Objectives

1.	To perform the load flow analysis of a power system network.
2.	To justify the need for economic operation of the power system.
3.	To introduce the concept of automatic voltage control and automatic load frequency control.

Course Contents

UNIT – 1

Network Topology	**9 Hours**

Basic Concepts of Network Topology: Introduction, Elementary graph theory –oriented graph, tree, co-tree, basic cut-sets, basic loops; Incidence matrices –Element-node, Bus incidence, Branch – path, Basic cut-set, Augmented cut-set, Basic loop and Augmented loop.
Primitive Network and formation of YBUS: Primitive network – admittance form.
Formation of YBUS – by method of inspection, by method of singular transformation
(YBUS = A^T [y] A).

UNIT – 2

Load Flow Study	**9 Hours**

Gauss-Seidel Method: Introduction, Power flow equations, Classification of buses, Data for load flow, Gauss-Seidel Method – Algorithm and flowchart for PQ and PV buses (numerical problem for one iteration only), Acceleration of convergence.
Newton Raphson Method: Algorithm and flowchart for NR method in polar coordinates (numerical problem for one iteration only); Algorithm for Fast Decoupled load flow method; Comparison of Load Flow Methods.

UNIT - 3

Economic Operation of Power System	**9 Hours**

Introduction, Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglecting losses; Iterative techniques.
Economic Dispatch: Economic Dispatch including transmission losses – approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula.
Optimal Power Flow: Problem formulation, constraints applicable, application of OPF and ELD, different methods for determination of OPF.

UNIT - 4

Control Center Operation of Power System	**9 Hours**

Introduction to SCADA, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model.
Automatic Voltage Control: Automatic voltage regulator, automatic load frequency control, AVR control loops of generators, performance of AVR.

UNIT - 5

Control of active- and reactive- power	**9 Hours**

ALFC of single area systems, concept of control area, multi-area systems, POOL operation-two area systems. Generation and absorption of reactive power, relation between voltage, power and reactive power at a node, single machine infinite bus systems, methods of voltage control, sub synchronous

resonance, voltage stability, voltage collapse.

Course Outcomes

At the end of the course student will be able to

1.	Apply graph theory concepts to form bus incidence matrix and hence build YBUS.
2.	Apply, compare and analyse various load flow techniques in a power system.
3.	Compute economic dispatch schedule for a given power system.
4	Appreciate the significance of automatic generation control.
5.	Describe the techniques adopted for control of active and reactive power.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE361.1	3	3					1				1	2	2
EEE361.2	3	3					1				1	2	2
EEE361.3	3	3					1				1	2	2
EEE361.4	3	3					1				1	2	2
EEE361.5	3	3					1				1	2	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Computer Methods in Power System Analysis	Stagg, G. W., and EI-Abiad, A.H.	McGraw Hill International	Student Edition, 1971
2.	Power Generation, Operation and Control	Wood, A.J. and Wollenberg, B.F.	Wiley–Blackwell	2nd edition, 1996.

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Advanced Power System Analysis and Dynamics	Singh. L. P	New Age International Private Limited	6th edition, 2012
2.	Computer Aided Power System Operations and Analysis	Dhar. R. N	McGraw-Hill Education	1982
3.	Computer Techniques and Models in Power Systems	Uma Rao. K.	TechSar Pvt. Ltd	2nd edition, 2014
4	Power System: Operation and Control	Uma Rao, K.	Wiley; WILEY INDIAN	2012
5.	Operation and Control in Power Systems	Murty, P.S.R.	CRC Press	2nd edition, 2011

E Books / MOOCs/ NPTEL

1.	NPTEL Course on Computer Aided Power System Analysis, Prof. Biswarup Das, IIT Roorkee

HIGH VOLTAGE ENGINEERING			
Course Code	EEE241	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITES: Electric Circuit Analysis - 1			

Course Objectives	
1.	To introduce the concept of high voltage technology.
2.	To familiarise with the concepts of HV breakdown phenomena of dielectrics.
3.	To study the methods of generation of HVAC and HVDC voltages and impulse voltage and current.
4.	To introduce the concept of measurement of high voltages.
5.	To study the non-destructive insulation techniques and high voltage tests on electrical apparatus.

Course Contents

UNIT – 1

Network Topology	**9 Hours**

Introduction: Introduction to HV technology, advantages of transmitting electrical power at high voltages, need for generating high voltages in laboratory. Important applications of high voltage.
Breakdown Phenomena: Classification of HV insulating media. Properties of important HV insulating media under each category.
Gaseous dielectrics: Ionizations: primary and secondary ionization processes. Criteria for gaseous insulation breakdown based on Townsend's theory. Limitations of Townsend's theory. Streamer's theory breakdown in non-uniform fields. Corona discharges. Breakdown in electronegative gases. Paschen's law and its significance. Time lags in breakdown.

UNIT – 2

Breakdown Mechanisms	**9 Hours**

Breakdown in Solid Dielectrics: Solid dielectrics: Intrinsic Breakdown, avalanche breakdown, thermal breakdown, and electromechanical breakdown.
Breakdown in Liquid Dielectrics: Liquid dielectrics: Suspended particle theory, electronic Breakdown, cavity breakdown (Bubble's theory).

UNIT - 3

Generation of HV AC and DC Voltage	**9 Hours**

Generation of HVAC Voltage: HV AC-HV transformer; Need for cascade connection and working of transformers units connected in cascade. Series resonant circuit- principle of operation and advantages. Tesla coil.
Generation of HVDC Voltage: HV DC- voltage doubler circuit. Calculation of high voltage regulation, ripple and optimum number of stages for minimum voltage drop, Cock Croft- Walton type high voltage DC set.

UNIT - 4

Generation of Impulse Voltage and Current	**9 Hours**

Introduction to standard lightning and switching impulse voltages. Analysis of single stage impulse generator-expression for output impulse voltage. Multistage impulse generator - working of Marx impulse, rating of impulse generator, components of multistage impulse generator.
Triggering of impulse Generator: Triggering of impulse generator by three electrode gap arrangement. Triggetron gap and oscillograph time sweep circuits. Generation of switching impulse voltage.

UNIT - 5

Measurement of High Voltages	**9 Hours**

Electrostatic voltmeter principle, construction and limitation. Chubb and Fortescue method for HV

AC measurement. Generating voltmeter- Principle, construction. Series resistance microammeter for HV DC measurements. Standard sphere gap measurements of HVAC, HVDC and impulse voltage. **Non-Destructive Insulation Testing Techniques:** Dielectric loss and loss angle measurements using Schering Bridge, Transformer ratio Arms Bridge. Need for discharge detection and PD measurements aspects. Isolators, cables, Insulators, High Voltage Tests on Electrical Apparatus.

Course Outcomes

At the end of the course student will be able to

1.	Describe the basics of HV technology and analyse the breakdown phenomenon to understand the properties of gaseous dielectrics.
2.	Analyse the breakdown mechanisms in solid and liquid dielectrics, high AC and DC voltage generation and compute parameters of voltage doubler circuit.
3.	Describe the generation of impulse voltages and currents needed to test the insulating medium.
4.	Analyse the factors affecting high voltage and current measurement techniques.
5.	Describe the non-destructive insulation testing methods applicable to high voltage apparatus.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	1	**PSO↓**	
↓ Course Outcomes											1	1	2
EEE241.1	3	3					1				1	1	
EEE241.2	3	3					1				1	1	
EEE241.3	3	3					1				1	1	
EEE241.4	3	3					1				1	1	
EEE241.5	3	3					1				1	1	

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	High Voltage Engineering Fundamentals	Kuffel and W.S. Zaengl	Elsevier press	2nd edition,2005.
2.	High Voltage Engineering	M.S.Naidu and Kamaraju-	TMH	4th edition, 2008.
3.	High Voltage Engineering	C.L.Wadhwa	New Age International Private limited,	3rd edition, 2010.

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Extra High Voltage AC Transmission Engineering	Rakosh Das Begamudre	New Academic Science	4th edition,2011.
2.	High Voltage Technology	Alston	Oxford University Press	2008

E Books / MOOCs/ NPTEL

1.	https://mycourses.aalto.fi/course/view.php?id=5252&section=1
2.	http://www.nptel.ac.in/courses/108104048/

FACTS AND HVDC TRANSMISSION			
Course Code	EEE362	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITES: Power System Analysis – II, Power Electronics

Course Objectives

1.	To introduce FACT controllers and its associated power electronic concepts.
2.	To understand the concepts of series and shunt compensation in transmission networks.
3.	To study the various FACT devices and their control strategies.
4.	To know the various aspects of High Voltage DC converters.
5.	To understand control schemes of HVDC converters and the requirements of smoothing reactor

Course Contents

UNIT – 1

Introduction to FACTS and Compensation Techniques	**9 Hours**

Conte Basics of power transmission networks - control of power flow in AC - transmission line, Transmission, interconnection, power flow and dynamic stability consideration of a transmission interconnection, relative importance of controllable parameters. Classification of flexible AC transmission system controllers, Benefits of FACTS Controller – application of FACTS controllers in distribution systems.

Shunt and Series Compensation Techniques: Objectives of Shunt Compensation, Midpoint voltage regulation for line segmentation, End of line voltage support to prevent voltage instability, Objectives of series Compensation, Improvement of Transient stability, Power oscillation damping.

UNIT – 2

Static VAR Compensator (SVC)	**9 Hours**

Introduction to Static VAR Compensator: Methods of controllable VAR generation, Analysis of SVC – Power angle curve with SVC.

Modeling and Control of SVC: Configuration of SVC- FC-TCR, TSC-TCR, SVC Controller – Block diagram of SVC Voltage Controller, Susceptance Regulator, modeling of SVC – applications of SVC.

UNIT - 3

Thyristor and GTO Controlled Series Capacitors and STATCOM	**9 Hours**

Introduction - Basic concepts of controlled series compensation -operation of TCSC - analysis of TCSC-control of TCSC - GTO thyristor controlled series capacitor (GCSC) - mitigation of sub synchronous resonance with TCSC and GCSC - applications of TCSC

Static Synchronous Compensator (STATCOM): Introduction - principle of operation of STATCOM - a simplified analysis of a three phase six pulse STATCOM - analysis of a six pulse VSC using switching functions – multi-pulse converters. Control of type 2 converters - control of type I Converters - multilevel voltage source converters - applications of STATCOM

UNIT - 4

Static Synchronous Series Compensator and Power Flow Controllers	**9 Hours**

SSSC-operation of SSSC , control of power flow – Description, modeling of SSSC, control of SSSC using Type-1 and Type-2 VSC.

Unified and Interline Power Flow Controllers (UPFC & IPFC):

Introduction to Unified Power Flow Controller (UPFC) and Interline Power Flow Controller (IPFC) – Basic operating principles.

UNIT - 5

HVDC Converters	**9 Hours**

DC Power Transmission Technology: Introduction, comparison with AC transmission, application of DC transmission. Introduction to Line commutated converter, choice of converter configuration for any

pulse number, analysis of 6 pulse Graetz bridge converter without overlap, effect of source inductance. Analysis of converter in two and three, and three and four valve conduction modes.

Control of Converters and HVDC link: DC link control principles, converter control characteristics, firing angle control, current and extinction angle control, Starting and stopping of DC link, Power control, Frequency control, Reactive power control, Tap changer control, Emergency control and Telecommunication requirements.

Course Outcomes

At the end of the course student will be able to

1.	Describe the various FACT controllers required for control of active and reactive power flow in a transmission network.
2.	Discuss the Shunt compensation schemes using SVC for the improvement of voltage profile in the transmission system.
3.	Analyse the working of series compensators and STATCOM for voltage and reactive power control
4.	Analyse the various VSC based series compensators and power flow controllers.
5.	Explain the HVDC transmission system and its control strategies.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE362.1	3	3					1				1	2	
EEE362.2	3	3					1				1	2	
EEE362.3	3	3					1				1	2	
EEE362.4	3	3					1				1	2	
EEE362.5	3	3					1				1	2	

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	HVDC Power Transmission Systems	K. R. Padiyar	New Age International	3rd edition, 2017
2.	FACTS Controllers in Power Transmission and Distribution	K.R Padiyar	New Age International	2nd edition, 2016
3.	Direct Current Transmission	E.W.Kimbark	Wiley–Blackwell	1st edition, 1971

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	High Voltage Direct Current Transmission	Arrilaga	Institution of Engineering and Technology;	2nd edition ,1998
2.	HVDC Transmission	S Kamakshaiah and V Kamaraju	McGraw Hill Education	1st edition,2017
3.	Understanding FACTS	Narain G. Hingorani,Laszlo Gyugyi	IEEE Publications, US,	1st edition,1999

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/108107114
2.	https://nptel.ac.in/courses/108106160

ENERGY AUDITING AND DEMAND SIDE MANAGEMENT			
Course Code	EEE242	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Electric Circuit Analysis - I			

Course Objectives	
1.	To provide a comprehensive understanding of global and Indian energy scenarios, energy consumption trends, and energy conservation measures.
2.	To introduce fundamental concepts in energy economic analysis, including financial metrics, payback, depreciation, and taxation.
3.	To understand the fundamentals of energy auditing techniques and measurement tools used for assessing energy use.
4.	To explain electrical system components, power factor correction, and strategies for electrical efficiency optimization.
5.	To expose students to energy-efficient technologies, electricity tariff systems, and demand-side management techniques.

Course Contents	
UNIT – 1	
Introduction	**9 Hours**
Energy situation: World and India, energy consumption, conservation, codes, standards and legislation. **Energy Economic Analysis:**The time value of money concept, developing cash flow models, payback analysis, depreciation, taxes and tax credit- numerical problems.	
UNIT – 2	
Energy Auditing	**9 Hours**
Introduction, elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results.	
UNIT - 3	
Power Factor Improvement	**9 Hours**
The power triangle, motor horsepower, power flow concept, Correction and improvement of power factor, Location of capacitors	
UNIT - 4	
Electrical Equipment and Tariff	**9 Hours**
Energy efficient motors, lighting basics, case examples, good practices in lighting, tariff, types of tariff, numerical problems on tariff	
UNIT - 5	
Introduction to Demand Side Management (DSM)	**9 Hours**
Introduction, benefits, techniques of DSM – time of day pricing, multi-utility power exchange model, time of day models for planning, load management, load priority technique, peak clipping, peak shifting	

Course Outcomes	
At the end of the course student will be able to	
1.	Explain the current energy scenario, energy conservation principles and basic financial tools used in energy economic analysis.
2.	Describe the methodology of energy auditing and interpret energy use profiles and audit results.
3.	Apply the concepts of power triangle and power factor improvement to optimize electrical system performance.
4.	Analyze tariff structures and implement good practices in motor and lighting systems for energy efficiency.
5.	Describe the various Demand Side Management techniques and their role in load management and energy conservation.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
EEE242.1	3	3				2	1				1	2	
EEE242.2	3	3					1				1	2	
EEE242.3	3	3				2	1				1	2	
EEE242.4	3	3					1				1	2	
EEE242.5	3	3					1				1	2	

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Industrial Energy Management And Utilization	Larry Witte, Philip Schmidt David Brown	CRC Press	1st edition, 1987
2.	Fundamentals of Energy Engineering	Albert Thumann	Prentice Hall Inc.	1984

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1..	Handbook on Energy Audit and Environment Management	Y P Abbi	TERI (Tata Energy Research Institute)	2009

E Books / MOOCs/ NPTEL

1.	NPTEL - Basic Principles of Energy Management & Energy Audit By Dr. R. N. Patel & Mr. Akhilesh Kumar Tiwari | Chhattisgarh Swami Vivekanand Technical University (CSVTU)

Power Electronics Stream

POWER SEMICONDUCTOR DEVICES			
Course Code	EEE243	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Analog Circuit Analysis and Design			
Course Objectives			
1.	To understand the principle of operation of MOSFET and IGBT with their characteristics and effect of reverse recovery transients on switching stresses and losses		
2.	To study the construction and features of the emerging power electronic devices		
3.	To Illustrate the importance of gate drive circuits for power devices, design of snubber and heat sink		
Course Contents			
UNIT – 1			
Introduction			**9 Hours**
Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); selection strategy – On-state and switching losses – EMI due to switching – Power diodes – Types, forward and reverse characteristics, switching characteristics – rating			
UNIT – 2			
Power MOSFET			**9 Hours**
Basic structure and operation, I-V Characteristics, On-state operation, Turn-on, turn-off process, Switching characteristics: Turn-on transient, dv/dt capability, Turn-off transient, turn-off time, Switching losses, Safe operating Area, Effect of reverse recovery transients on switching stresses and losses, dv/dt limitations.			
UNIT – 3			
Power IGBT			**9 Hours**
basic structure and operation, i-v characteristics, Latch-up in IGBT, Switching characteristics: turn-on, Turn-off transient, current tailing, Switching losses, Device limits and SOA, Over-current and short-circuit protection of IGBT			
UNIT – 4			
Power Electronics Devices			**9 Hours**
Construction and features of - Phase Controlled thyristors, inverter graded thyristors, ASCR, RCT, SUS, SBS, SCS, GTO, MCT, SIT, IGCT, MTO, ETO, PIC. Comparison of power devices.			
UNIT – 5			
Firing and Protecting Circuits:			**9 Hours**
Necessity of isolation, pulse transformer, optocoupler – Gate driver circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers, Guidance for heat sink selection, heat sink types and design – Mounting types.			
Course Outcomes			
At the end of the course student will be able to			
1.	Analyze characteristics of power semiconductor devices to select an appropriate device for given application		
2.	Summarize the switching and I-V characteristics of MOSFET to know the maximum switching frequency limit		
3.	Analyze the I-V and switching characteristics to summarize dv/dt and di/dt limitations, over current and short circuit protections to ensure safe operation of IGBT		

4.	Describe the construction and features of the emerging power electronic devices
5.	Analyze the importance of gate drive and protection circuits to switch power electronic converters

Course Outcomes Mapping with Program Outcomes and PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
												1	2
EEE243.1	3	3	-	-	-	-	1	-	-	-	1	1	1
EEE243.2	3	3	-	-	-	-	1	-	-	-	1	-	1
EEE243.3	3	3	-	-	-	-	1	-	-	-	1	-	1
EEE243.4	3	3	-	-	-	-	1	-	-	-	1	-	1
EEE243.5	3	3	-	-	-	-	1	-	-	-	1	1	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Power Electronics – Converters, applications and Design	Mohan, Undeland and Robins	John Wiley and Sons, Singapore	1st edition, 2000
2.	Modern Power Electronic Devices: Physics, applications, and reliability	Edited by Francesco Iannuzzo	IET Digital Library	1st edition, 2020
3.	Power Electronics Semiconductor Switches	R.S Ramshaw	Springer	2nd edition 1993

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Power Electronics Circuits, Devices and Applications	Rashid M.H	Prentice Hall India	4th edition, 2017
2.	Power Electronics Circuit Devices and Applications'	B.W Williams	McGraw Hill Higher Education	1st edition, 1992

E Books / MOOCs/ NPTEL

1.	Power semiconductor device: Basics by IEEE Electron Devices Society - https://eds.ieee.org/images/files/Education/power_semiconductor_device_basics.pdf
2.	NPTEL Course on "Semiconductor Devices and Circuits" by SANJIV SAMBANDAN, Department of Instrumentation and Applied Physics, IISc Bangalore
3.	NPTEL Course on "Power Electronics with Wide Band Gap Devices" by Prof. Moumita Das IIT Mandi

SWITCHED MODE POWER CONVERTERS			
Course Code	EEE363	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Power Electronics			
Course Objectives			

Course Contents

UNIT – 1

Introduction	**9 Hours**

Non-Isolated Converters- Review of Buck, Boost and Buck-Boost. Cuk converter, SEPIC Converter Introduction to interleaved converter, principle of operation and analysis of interleaved Buck converter, principle of operation and analysis of interleaved Boost converter

UNIT – 2

Isolated Converters	**9 Hours**

Introduction to isolated converter, transformer models, principle of operation and analysis of fly back converter-continuous and discontinuous current mode of operation, design considerations, Numerical problems, principle of operation and analysis of push-pull converter, design considerations, principle of operation and analysis of half bridge DC-DC converters and full bridge DC-DC converters design considerations, principle of operation and analysis of DAB.

UNIT - 3

Modeling and Control of DC-DC Converter	**9 Hours**

Modeling of DC-DC converters, State space modeling of Buck converter, Obtaining system transfer function, State space averaging technique for buck converter, Buck converter modeling by circuit average method.

UNIT – 4

Closed Loop Control of Power Converters	**9 Hours**

Block diagram of closed loop control of buck converter, Basics of PI controller, Types of converter control mechanism - Voltage mode control, Current mode control, small signal analysis switch transfer function, implementation of voltage mode closed loop control of buck converter.

UNIT – 5

Resonant switch converters and Magnetics	**9 Hours**

Resonant switch converters: Classification of resonant converter, Resonant switch converter – ZCS, ZVS, Resonant dc-link inverter with ZVS.
Magnetics: Design of high frequency Inductor and transformers. Design examples for buck, boost, and flyback converter
.

Course Outcomes

At the end of the course student will be able to

1.	Describe the working principle of interleaved converter and applications
2.	Describe the working principle of various isolated dc-dc converters and design the converter for a given specification.
3.	Develop state space model of DC-DC converter.
4.	Design closed loop control of DC-DC converter
5.	Analyze the performance of different resonant converters to list their advantages in improving the efficiency of SMPC and design of magnetics for DC-DC converter

Course Outcomes Mapping with Program Outcomes and PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2

EEE363.1	3	3	-	-	1	-	-	-	-	-	1	1	1
EEE363.2	3	3	-	-	1	-	-	-	-	-	1	1	1
EEE363.3	3	3	3	2	1	-	-	-	-	-	1	2	1
EEE363.4	3	3	3	2	1	-	-	-	-	-	1	2	1
EEE363.5	3	3	3	2	1	-	-	-	-	-	1	1	1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Fundamentals of Power Electronics	Erickson, R.W. Maksimovic	Springer US	1st edition,2001
2.	Power Electronics,	Daniel W Hart	Tata McGraw Hill	1st edition,2011

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Power Electronics: Essentials & Applications	L Umanand	Wiley	1st edition,2009
2.	Course Material on Switched Mode Power Conversion, ,	V. Ramanarayanan	IISc	September 11, 2009
3.	Switch-Mode Power Supplies Spice Simulations and Practical Designs	Christophe P. Basso	TMH	2nd edition, 2014
4.	Design of Magnetic Components for Switched Mode Power Converters	L Umanand and Bhatt S R	New Age International New Delhi	1st edition,2009

E Books / MOOCs/ NPTEL

1.	NPTEL Course on “Switched Mode Power Conversion” by Prof. V. Ramanarayanan, Prof. L. Umanand, IISc Bangalore
2.	Coursera courses on “Power Electronics Specialization” by Dr. Robert Erickson
3.	https://www.mooc-list.com/course/converter-control-coursera

CONVERTERS FOR SOLAR AND WIND ENERGY			
Course Code	EEE342	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Power Electronics

Course Objectives

1.	To introduce various grid tie inverter concepts, standards and their requirement
2.	To illustrate grid synchronization concepts of power electronics converters
3.	To introduce typical wind turbine grid converter topologies, control structures, requirements and grid codes
4.	To explain the grid synchronization process of three phase converters under distorted grid conditions.
5.	To introduce the various control issues under grid faults.

Course Contents

UNIT – 1

Introduction, Photovoltaic Inverter Structures	**9 Hours**

Introduction: The Grid tie Converter –Grid Integration of WT and PV Systems. International Regulations.

Photovoltaic Inverter Structures: Introduction, Inverter Structures Derived from H-Bridge Topology, Inverter Structures Derived from NPC Topology, Typical PV Inverter Structures, Three-Phase PV Inverters, Control Structures.

UNIT – 2

Grid Synchronization of 1-Phase Power Converters	**9 Hours**

Grid Requirements for PV: Introduction, Response to Abnormal Grid Conditions, Power Quality, Anti-islanding Requirements

Grid Synchronization of Single-Phase Power Converters: Introduction, Grid Synchronization Techniques for Single-Phase Systems, Phase Detection Based on In-Quadrature Signals, PLLs Based on In-Quadrature Signal Generation, PLLs Based on Adaptive Filtering, The SOGI Frequency-Locked Loop.

UNIT - 3

Islanding Detection, Grid Converter Structures for Wind Turbine Systems	**9 Hours**

Islanding Detection: Introduction, Non-detection Zone, Overview of Islanding Detection Methods, Passive Islanding Detection Methods, Active Islanding Detection Methods

Grid Converter Structures for Wind Turbine Systems: Introduction, Configurations, Grid Power Converter Topologies and Control.

UNIT - 4

Grid Requirements for WT Systems	**9 Hours**

Grid Requirements for WT Systems: Introduction, Grid Code Evolution, Frequency and Voltage Deviation under Normal Operation, Active Power Control in Normal Operation, Reactive Power Control in Normal Operation Behavior under Grid Disturbances.

Grid Converter Control for WTS: Introduction, Model of the Converter, AC Voltage and DC Voltage Control, Voltage Oriented Control and Direct Power Control, Stand-alone, Micro-grid, Droop Control and Grid Supporting.

UNIT - 5

Grid Synchronization in 3-Phase Power Converters	**9 Hours**

Grid Synchronization in Three-Phase Power Converters: Introduction, The Three-Phase Voltage Vector under Grid Faults, The Synchronous Reference Frame PLL under Unbalanced and Distorted Grid Conditions.

Control of Grid Converters under Grid Faults: Introduction, Overview of Control Techniques for Grid-Connected Converters under Unbalanced Grid Voltage Conditions, Control Structures for Unbalanced Current Injection, Power Control under Unbalanced Grid Conditions, Flexible Power Control with Current Limitation.

Course Outcomes	
At the end of the course student will be able to	
1.	Summarise the requirements of grid tie inverters used in PV and Wind energy conversion systems.
2.	Analyze the grid requirements and grid synchronization techniques for single phase power converters
3.	Describe the islanding detection methods and typical WT grid converter structures.
4.	Describe the grid requirements for WT grid connection and the grid codes. Analyze grid synchronization of three phase power converters.
5.	Describe the grid converter control structures for WT and the control issue for the case of grid faults.

Course Outcomes Mapping with Program Outcomes and PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE342.1	3	3					1				1		1
EEE342.2	3	3					1				1		1
EEE342.3	3	3					1				1		1
EEE342.4	3	3					1				1		1
EEE342.5	3	3					1				1		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Grid Converters for Photovoltaic and Wind Power Systems	Remus Teodorescu at al	Wiley	1st edition, 2011

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Wind Electrical Systems,	S. N. Bhadra, D. Kastha, and S. Banerjee	Oxford University Press	1st edition, 2009
2.	Power Electronics Hand Book	Rashid .M. H	Academic press	1st edition, 2001

E Books / MOOCs/ NPTEL

1.	NPTEL Course on "DESIGN OF PHOTOVOLTAIC SYSTEMS" by PROF. L. UMANAND Department of Electrical Engineering, IISc Bangalore https://onlinecourses.nptel.ac.in/noc22_ee71/preview

ELECTRICAL DRIVES			
Course Code	EEE364	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Power Electronics, Electrical Machines			

Course Objectives	
1.	To study the basic principle of Industrial Drives, its requirements, its characteristics, selection and understand its steady state, transient behavior
2.	To control the dc motor drives as per the requirements and understand various types of dc drives available
3.	To study the starting and braking of an induction motor drive and use power electronics concepts to control the same..
4.	To understand the use of synchronous motors and BLDC motors in various electrical drives and study the control aspects of the same
5.	To understand the control and application of stepper motor, SRM, and PMSM motor drives.

Course Contents

UNIT – 1	
AN INTRODUCTION TO ELECTRICAL DRIVES AND ITS DYNAMICS	**9 Hours**
Electrical drives. Advantages of electrical drives. Parts of electrical drives, choice of electrical drives, status of dc and ac drives. Dynamics of electrical drives, Fundamental torque equation, speed torque conventions and multi-quadrant operation. Components of load torques, nature and classification of load torques, steady state stability, load equalization, Selection of motor power rating, Classes of motor duty	

UNIT – 2	
DC MOTOR DRIVES	**9 Hours**
Starting and braking of DC shunt motor. Single phase fully controlled rectifier, control of dc separately excited motor, Single-phase half-controlled rectifier control of dc separately excited motor. multi-quadrant operation of dc separately excited motor fed from fully controlled rectifier, chopper- controlled dc drives, chopper control of separately excited dc motor.	

UNIT - 3	
INDUCTION MOTOR DRIVES	**9 Hours**
Starting and Braking of induction Motor drive Stator voltage control variable voltage frequency control from voltage sources, voltage source inverter control, closed loop control, current source inverter control, current regulated voltage source inverter control, rotor resistance control, slip power recovery, speed control of single-phase induction motors.	

UNIT - 4	
SYNCHRONOUS MOTOR DRIVES, BLDC MOTOR DRIVES	**9 Hours**
Operation form fixed frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors. Self-controlled synchronous motor drive employing load commutated thyristor inverter. **BLDC MOTOR DRIVES:** Construction and working principle of BLDC, Types of BLDC, BLDC drives for servo application, BLDC motor drivers, features and applications	

UNIT - 5	
Stepper Motor, SRM and PMSM Drives	**9 Hours**
Stepper Motor drives: drive circuit for stepper motor, **Switched Reluctance Motor:** Operation and control requirements, converter circuit, modes of operation **PMSM Drives:** Types of PMSM, modelling of PMSM, equivalent circuit , PMSM drive system, control techniques in PMSM drives	

Course Outcomes	
At the end of the course student will be able to	
1.	Analyse the transients associated with electrical drives and model the drives for control aspects.
2.	Summarise the use of the DC drives for various applications with proper understanding of the control parameters
3.	Analyse the induction motor drives and their control using power electronic converters
4.	Analyse the synchronous and BLDC motor drives and understand their control aspects in various industrial applications.
5.	Analyse the stepper, SRM and PMSM motor and their control aspects.

Course Outcomes Mapping with Program Outcomes and PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE364.1	3	3	-	-	-	-	1	-	-	-	1	-	-
EEE364.2	3	3	-	-	1	-	1	-	-	-	1	-	1
EEE364.3	3	3	-	-	1	-	1	-	-	-	1	-	2
EEE364.4	3	3	-	-	1	-	1	-	-	-	1	-	2
EEE364.5	3	3	-	-	1	-	1	-	-	-	1	-	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Fundamentals of Electrical Drives	G.K Dubey	Narosa publishing house Chennai	2nd edition 2010

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Electrical Drives	N.K De and P.K. Sen	PHI	1st edition,2009
2.	A First Course On Electric Drives	S.K Pillai	Wiley Eastern Ltd	3rd edition, 2012.
3.	Power Electronics, Devices, Circuits and Industrial Applications	V.R. Moorthi	Oxford University Press	1st edition, 2005

E Books / MOOCs/ NPTEL

1.	NPTEL Course on "Industrial Drives - Power Electronics", Prof. K. Gopakumar, IISc Bangalore https://nptel.ac.in/courses/108108077
2.	Open CourseWare on "Electrical machines and drives" by Dr. ir. Henk Polinder https://ocw.tudelft.nl/courses/electrical-machines-and-drives/?view=lectures

RESONANT AND MULTILEVEL CONVERTERS			
Course Code	EEE365	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Power Electronics

Course Objectives

1.	Understand the working of resonant converter and soft switching bidirectional DC-DC converters
2.	Understand the working principle of various PWM Converters with Auxiliary Switch and explain the resonant DC link inverter.
3.	Analyse the working principle of multi-phase rectifier and understand the application of the converter in reducing the harmonics
4.	Analyse the working principle of Cascaded H- Bridge Multilevel Inverters and diode clamped multilevel inverter.
5.	Analyse the hybrid multilevel inverters and multilevel flying capacitor inverter

Course Contents

UNIT – 1

Resonant Converters, Resonant Transition Phase Modulated Converters	**9 Hours**

Resonant Converters: Review of Basic Resonant Converters, Soft switching principles: ZVS, ZCS, ZVZCS

Resonant Load Converters: Variable frequency series and parallel resonant converters (Resonant Switch Converters (quasi resonant): Half and full wave operations and control.

Resonant Transition Phase Modulated Converters: Reduction of VA ratings, fixed frequency operation and advantageous usages of device and transformer non-idealities;

Soft Switched Bidirectional DC-DC Converters (Dual Active Bridge): Soft-switching under buck mode and boost mode operations with or without active clamp

UNIT – 2

PWM Converters with Auxiliary Switch, ZVT /ZCT PWM Converters	**9 Hours**

Isolated and non-isolated topologies with auxiliary switch ; Auxiliary Resonant Commutated Pole Inverters: ZVT and ZCT concepts used for Inverters; Resonant DC Link Inverters: Forced oscillation of DC Link voltage by auxiliary switch.

UNIT - 3

Multi-pulse rectifier	**9 Hours**

Multi-pulse Diode and SCR Rectifiers, Definition of THD and PF, THD and PF of six-pulse diode rectifier, 12, 18, 24- pulse series-type and separate-type diode rectifiers, Six-pulse and 12-pulse SCR rectifier, Effect of line and leakage inductances, and Phase-Shifting Transformers, Harmonic current cancellation.

UNIT - 4

Cascaded H- Bridge Multilevel Inverters, Diode-Clamped Multilevel Inverters	**9 Hours**

Cascaded H- Bridge Multilevel Inverters: Introduction, Sinusoidal PWM, Space Vector PWM in two level voltage source inverters; H-bridge inverter, multilevel inverter topologies: CHB Inverter with equal dc voltages, H-bridges with unequal dc voltages, Carrier based PWM schemes: Phase shifted multi-carrier modulation, Level shifted multi-carrier modulation, overmodulation of cascaded H-bridges, Control of dc bus voltages of the H-bridges.

Diode-Clamped Multilevel Inverters: Three level inverter: Converter configuration, switching states, Carrier based PWM: Naturally sampled PD PWM, APOD and POD PWM; Space vector modulation: Optimized space vector sequences, modulator for selecting switching states, decomposition method, hexagonal co-ordinate system, optimal space vector position within a switching period; Neutral point voltage control, over modulation of three-level inverter, High-level diode clamped inverters

.

UNIT - 5	
Hybrid Multilevel Inverters	**9 Hours**

Hybridization of Fundamental frequency switching (FFS) and PWM switching inverters: inverter topologies with isolation transformer, PWM switching strategy; Transformerless hybrid inverter: Binary H-bridge multilevel converter, Control of dc bus voltages of different modules.

Multilevel Flying- Capacitor Inverters: Inverter configuration, Modulation scheme.

PWM Current Source Rectifiers and Inverters: Trapezoidal modulation, Selective harmonic Elimination, Space vector modulation, Parallel current source inverters, Single-bridge current source rectifier, Dual-bridge current source rectifier, Power factor control, Active Damping Control.

Course Outcomes

At the end of the course student will be able to

1.	Analyse the resonant converter and explain the working of soft switching bidirectional DC-DC converters
2.	Describe the working principle of various PWM Converters with Auxiliary Switch and explain the resonant DC link inverter.
3.	Analyse the working principle of multi-phase rectifier and understand the application of the converter in reducing the harmonics
4.	Analyse the working principle of Cascaded H- Bridge Multilevel Inverters and diode clamped multilevel inverter.
5.	Analyse the hybrid multilevel inverters and multilevel flying capacitor inverter

Course Outcomes Mapping with Program Outcomes and PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE365.1	3	3					1				2		2
EEE365.2	3	3					1				2		2
EEE365.3	3	3					1				2		2
EEE365.4	3	3					1				2		2
EEE365.5	3	3					1				2		2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Multilevel Inverters: Introduction and Emergent Topologies	Ersan Kabalci	Academic Press Inc	1st edition, 2021
2.	Fundamentals of Multilevel Converters	G. Tulasi Ram Das	BS Publications / BSP Books	1st edition, 2025

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Power Electronics Converters, Applications, and Design,	Ned Mohan et. el	Wiley	3rd edition, 2014
2.	Power Electronics Converters and Regulators	Branko L. Doki ć Branko Blanu š a	Springer (International Publishing, Switzerland)	3rd edition, 2015

E Books / MOOCs/ NPTEL	
1.	NPTEL Course on "High Power Multilevel Converter" by Prof. Anandarup Das, IIT Delhi
2.	NPTEL Course on " Advance Power Electronics" By Prof. Bhim Singh, IIT Delhi
3.	Introduction to Resonant Converters - By Monolithic Power Systems
4.	MOOC Course on "Multilevel Converters for Medium/High-Power Applications" by Maryam Saeedifard Associate Professor at The Georgia Institute of Technology

Microelectronics Stream

LINEAR INTEGRATED CIRCUITS			
Course Code	EEE343	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Analog Circuit Analysis and Design

Course Objectives

1.	To understand the basics of op-amp and demonstrate the use of Op-Amp in signal processing applications
2.	To analyze the non-linear behavior of the Op-Amp and design Op-Amp circuits in open loop and with positive feedback.
3.	To understand the applications of op-amp and 555 timers for waveform generation
4.	To design active filters, A/D, D/A converters and voltage regulator using op-amp

Course Contents

UNIT – 1

Op-Amp Fundamentals	**9 Hours**

(Brief review of differential amplifier, current mirror, active load, level shifter, output stage; ac and dc characteristics). Basic building blocks using Op-Amps. Inverting/Non-inverting VCVS, CCVS and VCCS, Op-Amp with single polarity supply. Understanding datasheet and data sheet parameters. Frequency response of op-amp, frequency and phase response, frequency compensating methods, manufacturer's recommended compensation, op-amp circuit bandwidth, slew rate effects, stray capacitance effects, load capacitance effects, circuit stability precautions.

UNIT – 2

Op-Amp Application	**9 Hours**

Instrumentation amplifier, first order active filters, V/I & I/V converters, comparators,

D to A and A to D Converters

Introduction, basic DAC techniques -weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters -parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

UNIT – 3

Special ICs and Waveform Generators	**9 Hours**

555 Timer circuit – Functional block, characteristics and applications.

Waveform Generator: Phase Shift Oscillators, Colpitts Oscillators, Hartley Oscillator Ramp Generator: Triangle generator, Sawtooth generator Sine wave generator: Requirement for sinusoidal oscillations, Wien-bridge and twin-T oscillators.

UNIT – 4

Frequency Synthesiser and Active Filters	**9 Hours**

Digitally controlled frequency synthesiser: PLL Fundamentals, 566-voltage controlled Oscillator circuit, 565- phase lock loop circuit functioning and applications. PLL synthesizer, Totally digital synthesizer

Active Filters: First and Second order high pass and low pass filters. Band pass filter, Band stop filters. Higher order filters. State variable filter, Universal active filter

UNIT – 5

Voltage Regulators and Power Amplifier	**9 Hours**

Op-Amp Regulators, precision voltage regulator IC Regulators, Fixed Voltage Regulators (78/79, XX).

Power Amplifier: Audio Power Amplifier, Power amplifier classes, Distortion in power amplifier, Class A, Class G, and Class D power amplifier, IC based power amplifier

Course Outcomes

At the end of the course student will be able to

1.	Analyse the fundamental concepts of Op-amp & linear integrated circuit and apply these concepts while designing the practical circuits.
2.	Analyse the applications of op-amp in instrument amplifiers and design A/D & D/A Converters
3.	Design 555 timer-based circuits and op-amp based waveform generators
4.	Analyse PLL and VCO circuits and design op-amp based active filters.
5.	Design op-amp based voltage regulator and analyse power amplifier circuits

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE343.1	3	3	-	-	-	-	1	-	-	-	1	-	-
EEE343.2	3	3	-	-	-	-	1	-	-	-	1	2	2
EEE343.3	3	3	-	-	-	-	1	-	-	-	1	2	2
EEE343.4	3	3	-	-	-	-	1	-	-	-	1	2	2
EEE343.5	3	3	-	-	-	-	1	-	-	-	1	2	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Operational Amplifier and Linear IC's	David A Bell	Oxford University Press-New Delhi.	3rd edition, 2011.
2.	Microelectronic Circuits	Sedra and Smith	Oxford University press	5th edition, 2005.

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Operational Amplifiers and Linear IC's	Ramakanth Gayakwad	Prentice Hall,	4th edition, 2000
2.	Operational amplifiers and Linear Integrated circuits	Stanley William D	Pearson Education.	4th edition, 2001
3.	Operational amplifiers and Linear Integrated circuits	Roy Choudhry,	New Age International	4th edition, 2011.
4.	Audio Power Amplifier Design Handbook	Douglas Self MA	Elsevier	4th edition, 2006,

E Books / MOOCs/ NPTEL

1.	TI Precision Labs - Op Amps
2.	NPTEL course on Op-Amp Practical Applications: Design, Simulation and Implementation by Prof. Hardik Jeetendra Pandya, IISc Bangalore
3.	Linear Integrated Circuits UC Berkeley, Spring 2014 , Prof. Clark Tu-Cuong Nguyen, http://freevideolectures.com

VLSI CIRCUITS AND DESIGN			
Course Code	EEE344	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Electrical Circuit Analysis – II, Analog Circuit Analysis and Design

Course Objectives

1.	To understand the MOS transistor electrical characteristics
2.	To develop the small and large signal models for MOS transistors
3.	To understand the design specific rules in layouts
4.	To appreciate the nMOS and CMOS inverter circuits
5.	To implement the other forms of CMOS logic

Course Contents

UNIT – 1

MOS Transistors	**9 Hours**

Introduction: Introduction to IC Technology, Moore's law, VLSI design flow, Depletion type and Enhancement type MOS transistors.
Electrical Characteristics: MOS system under external bias, structure and operation of MOS transistors, threshold voltage, drain to source current Ids versus Vds relationships, Ids Vs Vgs Characteristics

UNIT – 2

MOS Models	**9 Hours**

Secondary Effects: body effect, channel length modulation, mobility variation, Tunneling, punch through, hot electron effect Drain Induced Barrier Lowering (DIBL)
Models: Large Signal model and Small Signal AC characteristic models

UNIT - 3

Design	**9 Hours**

Layout: Stick Diagrams. Mask Layer, Symbolic diagram.
Layout rules- Lambda based and micron based rules, layout of inverter, gates, flipflops.
Design: Layout Sheet resistance, capacitance layer, inverter delays, rise time, fall time, logical effort and super buffer.

UNIT - 4

Scaling and Inverters	**9 Hours**

Scaling:MOSFET scaling and geometry effects: Introduction, constant field scaling, constant voltage scaling, short channel Effects, narrow channel effects, Comparison of MOSFET parameters due to scaling.
MOS Inverters: Static Characteristics: Voltage transistor characteristics, noise immunity and noise margin, power and area considerations, nMOS inverter static characteristics.

UNIT - 5

CMOS Inverters and Applications	**9 Hours**

CMOS inverters: static characteristics (excluding derivation), latch up problem in CMOS.
Application- Other Forms of CMOS Logic: Pseudo nMOS logic, dynamic CMOS logic, clocked CMOS logic, CMOS domino logic.

Course Outcomes

At the end of the course student will be able to

1.	Derive the electrical characteristics of MOS transistors

2.	Develop the large signal and small signal models for a given MOS transistor
3.	Draw the layout for simple logic circuits
4.	Analyse the (i) effect of scaling in MOS transistors (ii) nMos inverter static characteristics
5.	Implement the CMOS inverter and other forms of CMOS logic circuits

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE344.1	3	3			1		1				1	1	1
EEE344.2	3	3			2		1				1	1	1
EEE3443	3	3			2		1				1	1	1
EEE344.4	3	3					1				1	1	1
EEE344.5	3	3			1		1				1	1	1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	CMOS Integrated Circuit Analysis And Design	Sang Mo Kang, Usuf Leblebici	TATA Mc Graw hill edition,2002	3rd Edition,2002.
2.	Basic VLSI Design	Douglass A Pucknell, Amran Esharaghian	PHI Publication	3rd edition, 2009.

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	CMOS VLSI Design	Neil Weste and David Harris	Addison-Wesley	4th edition,2010.
2.	Modern VLSI design: System on Silicon	Wayne, Wolf	Pearson Education	2nd edition,2005.
3.	Introduction to VLSI Systems	Carver Mead and Lynn Conway	BS Publication	1st edition,1979.

E Books / MOOCs/ NPTEL

1.	NPTEL Course on Digital VLSI Testing by Prof. Santanu Chattopadhyay, IIT Kharagpur
2.	NPTEL Course on CMOS Digital VLSI Design by Prof. Sudeb Dasgupta, IIT Roorkee

DIGITAL CMOS CIRCUITS DESIGN			
Course Code	EEE366	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Applied Digital Logic Design, Electrical Circuit Analysis – I,II, Analog Circuit Analysis and Design

Course Objectives

1.	To understand the basic characteristics of different types of MOS Inverters
2.	To estimate the resistance, capacitance and inductance of CMOS inverter circuits
3.	To realise the combinational and sequential digital circuits using MOS transistors.
4.	To appreciate the CMOS circuit design and its layout
5.	To understand the VLSI design systems

Course Contents

UNIT - 1

Introduction To MOS Inverters	**9 Hours**

MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, MOS Transistor Theory - Introduction MOS Device Design Equations, SPICE Simulation of MOS transistor characteristics, The Complementary CMOS Inverter-DC Characteristics, Static Load MOS Inverters, The Differential Inverter, The Transmission Gate, The Tri State Inverter, Bipolar Devices.

UNIT - 2

Circuit Characterization and Performance Estimation:	**9 Hours**

Introduction, Resistance Estimation Capacitance Estimation, Inductance, Switching Characteristics CMOS-Gate Transistor Sizing, Power Dissipation, Sizing Routing Conductors, Charge Sharing, Design Margining and Reliability. Spice simulation on Power Analysis of CMOS inverter.

UNIT -3

Combinational and sequential Circuits	**9 Hours**

Design of Combinational and Sequential circuits using CMOS logic, SPICE Simulation: Simple Combinational Logic Circuits, Sequential Logic Circuits

UNIT - 4

CMOS Circuit and Logic Design	**9 Hours**

Stick Diagrams & Layouts, MOS Logic Gate Design, Basic Physical Design of Simple Gate, CMOS Logic Structures, Clocking Strategies, I/O Structures

UNIT - 5

Systems Design and Design Method	**9 Hours**

Design Strategies, CMOS Chip Design Options, Design Methods, Design Capture Tools, Design Verification Tools, CMOS Testing - Manufacturing Test Principles, Design Strategies for Test, Chip Level Test Techniques, System Level Test Techniques.

Course Outcomes

At the end of the course student will be able to

1.	Summarise the MOS inverter characteristics
2.	Determine the resistance, inductance and capacitance and switching parameters of CMOS circuits
3.	Design the combinational and sequential digital circuits using CMOS logic.
4.	Construct the CMOS logic circuits and draw its stick diagrams

5.	Design CMOS Chip and perform testing at chip level and system level techniques

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE366.1	3	3			2		1				1		1
EEE366.2	3	3			3		1				1		1
EEE366.3	3	3	3		3		1				1		1
EEE366.4	3	3	3		2		1				1		1
EEE366.5	3	3	3				1				1		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Principles of CMOS VLSI Design	N. Weste and K. Eshranghian	Addison-Wesley Longman Publishing Co., Inc.	2nd edition, 1985
2.	CMOS Circuit Design, Layout and Simulation	Jacob Backer, Harry W. Li and David E. Boyce	Prentice Hall of India	1st edition, 1998.

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	The Design and Analysis of VLSI, Circuits	L.Glaser and D. Dobberpuhl	Addison Wesley	1st edition,1993
2.	Introduction to VLSI Systems	C.Mead and L. Conway	Addison Wesley	1st edition,1979.

E Books / MOOCs/ NPTEL

1.	NPTEl course on Digital IC Design, IIT Madras, By Prof. Janakiraman
2.	NPTEL course on CMOS Digital VLSI Design, IIT Roorkee, Prof. Sudeb Dasgupta

ANALOG CMOS IC DESIGN			
Course Code	EEE345	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Basic Electronics, Semiconductor Physics and Photonics, Analog Circuit Analysis and Design

Course Objectives

1.	To understand the single stage amplifier circuits.
2.	To appreciate the differential amplifier circuits and its operation.
3.	To understand the concept of current mirrors and biasing techniques for CMOS circuits.
4.	To find the frequency response of amplifiers.
5.	To design the operational amplifier circuits.

Course Contents

UNIT – 1

Single-Stage amplifiers	**9 Hours**

Basic concepts, Common-Source Stage, Source Follower, Common- Gate Stage, Cascode Stage, Choice of device models.

UNIT – 2

Differential amplifiers	**9 Hours**

Single ended and differential operations, basic differential pair, Common mode response, Differential pair with MOS loads, Gilbert cell: Passive and Active.

UNIT - 3

Current Mirrors and Biasing Techniques	**9 Hours**

Current Mirrors: Basic current mirrors, Cascode Current mirrors, Active current mirrors, Large and small signal Analysis.
Biasing Techniques: CS, CG, Source Follower biasing.

UNIT - 4

Frequency Response of Amplifiers	**9 Hours**

General considerations, Miller effect, Association of poles with nodes, Common source stage, Source Followers, Common- Gate Stage, Cascode Stage, Differential Pair.

UNIT - 5

Operational amplifiers:	**9 Hours**

Design of: Single stage op amps, Two stage op-amps, Gain boosting, comparison, Common mode feedback, Input range limitations, slew rate.

Course Outcomes

At the end of the course student will be able to

1.	Analyse the single stage amplifier circuits.
2.	Analyse the differential amplifier circuits.
3.	Apply the current mirror and biasing concepts in analog IC design.
4.	Predict the frequency response of amplifier circuits.
5.	Design and implement single stage and two stage Operational amplifier circuits

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	PSO↓ 1	PSO↓ 2
EEE345.1	3	3					1				1	1	
EEE3452	3	3					1				1	1	
EEE345.3	3	3					1				1	1	
EEE345.4	3	3					1				1	1	
EEE345.5	3	3	2				1				1	1	

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Design of Analog CMOS Circuits	Behzad Razavi	Tata Mc-Graw Hill	2nd edition, 2015
2.	CMOS Circuit Design, Layout, and Simulation	R. Jacob Baker, Harry W. Li David E. Boyce	IEEE	1st edition, 1997

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Analysis and Design of Analog Integrated Cir	Paul R. Gray Paul ,J. Hurst Stephen H. Lewis Robert G. Meyer	John Wiley & Sons.	5th edition, 2009
2.	Mohammed Ismail, Terri Fiez	Analog VLSI ation Processing	McGraw-Hill International Editions.	1st edition,1994

E Books / MOOCs/ NPTEL

1.	NPTEL Course on Analog IC Design by Prof. Nagendra Krishnapura, IIT, Madras
2.	NPTEL Course on Analog VLSI Design, IIT Kanpur , Prof. Imon Mondal

VLSI TECHNOLOGY			
Course Code	EEE261	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Chemistry of Energy Storage and Digital Systems

Course Objectives

1.	To understand the Fabrication Process of IC Technology
2.	To understand the concept of conversion of a single crystal of silicon into an IC
3.	To expose the different fabrication steps such as epitaxy, oxidation, chemical vapor deposition, metallization.
4.	To understand the concepts of ion implantation, etching and lithography

Course Contents

UNIT – 1

VLSI Process Integration	**9 Hours**

IC Processing: Introduction, Fundamental Considerations for IC Processing, NMOS IC Technology, CMOS IC Technology, MOS Memory IC Technology, IC Fabrication.
Environment for VLSI technology: clean room and safety requirements, Wafer cleaning process a techniques

UNIT – 2

Processing Techniques	**9 Hours**

Crystal Growth and Wafer Preparation: Introduction, Electronic grade Silicon, Czochralski Crystal Growing, Silicon Shaping, Processing Considerations.
Impurity incorporation: solid-state diffusion modeling and technology, Ion implantation: modeling, technology and damage annealing; Characterization of impurity profiles.
Epitaxy: Introduction , Vapor Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation.

UNIT – 3

Processing Techniques	**9 Hours**

Oxidation: kinetics of silicon dioxide growth for thick, thin and ultra-thin films. Oxidation technologies in VLSI and ULSI; Characterization of oxide films; high K and low K dielectrics for ULSI.
Lithographic techniques: Photolithography techniques for VLSI/ULSI; Mask generation. Chemical Vapour deposition techniques: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films; epitaxial growth of silicon; modeling and technology.

UNIT - 4

Metallizations	**9 Hours**

Dielectric and Polysilicon Film Deposition : Introduction , Deposition Process ,Polysilicon, Silicon Dioxide , Automatic Diffusion Mechanism, Measurement Techniques, Range Theory, Metalization , Metalization Applications ,Metalization Choices , Patterning, Metalization Problems.

UNIT - 5

Fabrication:	**9 Hours**

Topological Design Rules, Masking Sequence and Process flow for nMOS, pMOS, CMOS, BiCMOS, Twin tub process.

Course Outcomes

At the end of the course student will be able to

1.	Explain the basic steps of MOS transistor fabrication.
2.	Describe the processing concepts of Crystal Growth and Wafer Preparation, Impurity incorporation, Epitaxy.
3.	Describe the processing concepts of Oxidation, Lithography and Etching
4.	Describe the process of film deposition and metallization in Chip manufacturing
5.	Appraise the fabrication process of MOS devices.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE261.1	3	2					1				1		
EEE261.2	3	2					1				1		
EEE261.3	3	2					1				1		
EEE261.4	3	2					1				1		
EEE261.5	3	2					1				1		

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	VLSI Technology	S.M.Sze	McGraw Hill Companies Inc.	2nd edition,2017
2.	VLSI Technology	Wai-Kai Chen	CRC press.	1st edition, 2003

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	The Science and Engineering of Microelectronic Fabrication.	Stephena, Campbell,	Oxford University Press	2nd edition,2001
2.	Silicon VLSI Technology: Fundamentals, Practice and Modeling	James D. Plummer, Michael Deal , Peter B. Griffin	Pearson Education India	1st edition, 2009

E Books / MOOCs/ NPTEL

1.	NPTEL course on VLSI Technology, IIT Madras, Dr. Nandita Dasgupta
2.	NPTEL course on Fabrication of Silicon VLSI Circuits using the MOS Technology, IIT Bombay, Prof. A.N.Chandorkar

IT+ AI Stream

MATLAB PROGRAMMING FOR ENGINEERS			
Course Code	EEE346	**Credits**	3
Hours/Week (L :T:P:S)	1:0:4:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Semiconductor Physics, ADLD, ECA-I, ECA-II			

Course Objectives	
1.	To get familiarized with the concept of MATLAB programming for array, matrices, logical operations and conditional statements.
2.	To be acquainted with MATLAB programming for numerical methods to solve differential equations.
3.	To analyse the electrical circuits using MATLAB Simulink.

Course Contents	
UNIT–1	
MATLAB Basics and Programming	**9 Hours**
Getting Started with MATLAB: MATLAB Interactive Sessions, Menus and the Toolbar, Creating and Managing MATLAB Variables, Overwriting Variables, Error Messages, Managing the Workspace, Miscellaneous Commands. **Script Files and Debugging:** Script Files and the Editor/Debugger, MATLAB Help System. **Programming Basics:** Relational and Logical Operators, Conditional Statements (if, if-else, else-if), Loops (for, while), switch Structure, Operator Precedence.	
UNIT–2	
Arrays, Matrices, and Functions	**9 Hours**
Arrays and Matrices: Creating Vectors and Matrices, Matrix Indexing, Colon Operator, Creating Submatrices, Deleting Rows and Columns, Transposing and Concatenating Matrices, Matrix Generators, Special Matrices. **Matrix and Array Operations:** Matrix Arithmetic Operations, Array Arithmetic Operations, Matrix Inverse. **Functions and Files:** Elementary Mathematical Functions, User-defined Functions.	
UNIT-3	
Data Visualization and Plotting	**9 Hours**
2D and 3D Plotting: Introduction to Plots, x-y Plotting Functions, Interactive Plotting, Additional Commands and Plot Types, Subplots. **Advanced Plotting:** Three-Dimensional Plots, Customizing plots (labels, legends, titles), Exporting Plots.	
UNIT–4	
Linear Algebra and Numerical Methods	**9 Hours**
Solving Linear Systems: Matrix Methods for Linear Equations, The Left Division Method, Underdetermined and Overdetermined Systems, General Solution Programs. **Numerical Calculus:** Numerical Integration, Numerical Differentiation, Solving First-Order and Higher-Order Differential Equations.	
UNIT-5	
Simulink and Electrical Simulation	**9 Hours**
Simulink Basics: Introduction to Simulink, Building Simulink Models, First and Second Order System Models, Simulation of RLC Series Circuit (Mathematical Modelling). **Simscape Electrical:** Introduction to Simscape Electrical, Specialized Power System Blocks, Simulation of Electrical Circuits using Simscape, Simulating RLC Circuit using Simscape Blocks.	

Course Outcomes	
At the end of the course student will be able to	
1.	Demonstrate the ability to use MATLAB environment, basic programming constructs, and workspace management tools
2.	Apply matrix operations and user-defined functions in MATLAB for data manipulation and computation
3.	Construct effective 2D and 3D plots to visualize data using MATLAB's plotting tools.
4.	Analyse linear systems and implement numerical methods for solving calculus and differential equations in MATLAB.
5.	Develop Simulink models for dynamic systems and simulate electrical circuits using Simscape Electrical blocks.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE346.1	3	3			3							1	2
EEE346.2	3	3			3							1	2
EEE346.3	3	3			3							1	2
EEE346.4	3	3			3							1	2
EEE346.5	3	3			3							2	3

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Introduction to MATLAB® for Engineers	William J. Palm III	McGraw-Hill.	3rd edition, 2011
2.	An Introduction to MATLAB® Programming and Numerical Methods for Engineers	Timmy Siauw, Alexandre Bayen,	Elsevier Science	1st edition, 2014
3.	Introduction to MATLAB & SIMULINK (A Project Approach)	O. Beucher, M. Weeks	Laxmi Publications Pvt Limited	3rd edition, 2008

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	MATLAB: A Practical Introduction to Programming and Problem Solving	Dorothy C. Attaway, Stormy Attaway	Elsevier Science	3rd edition, 2013

COMPUTATIONAL LINEAR ALGEBRA			
Course Code	EEE262	**Credits**	3
Hours/Week (L:T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Matrix Algebra and Calculus

Course Objectives

1.	To understand the Vectors and Matrices.
2.	To get acquainted with linear mapping, measurements.
3.	To understand the fundamental theorem of linear algebra.
4.	To know the Least squares algorithm for data science.

Course Contents

UNIT–1

Fundamentals of Vectors and Matrices	**9 Hours**

Quantities and Vectors, Matrices and Linear Combinations, Linear Mappings, Functions, Measurements, Compositions, Role of Vectors and Matrices in Data Science, Vector Spaces, Formal Rules, Algebraic Structure, Data Redundancy, Linear Dependence, Basis and Dimensions.

UNIT–2

Vector Spaces and Linear Transformations	**9 Hours**

Fundamental Theorem of Linear Algebra, Vector Spaces of Mappings, Matrix Representations of Mappings, Measurement of Mappings, Orthogonal Matrices and Intrinsic Basis, Applications in Data Representation.

UNIT-3

Singular Value Decomposition and Applications	**9 Hours**

Singular Value Decomposition (SVD), Interpretation of SVD in Linear Mappings, SVD Solution to Linear Algebra Problems, Data Compression and Model Reduction using SVD, Least Squares Problems, Gram-Schmidt Process, QR Decomposition and Solution to Linear Systems, Applications.

UNIT–4

Data Transformation and Matrix Factorizations	**9 Hours**

Gaussian Elimination, Row Echelon Form and Reduced Row Echelon Form, LU Factorization, Computing Inverse of a Matrix, Applications in Solving Systems of Linear Equations.

UNIT–5

Eigenvalue Problems and Data Stability	**9 Hours**

Eigenvalue and Eigenvector Computation, Stability Analysis in Data using Eigenvalues, Computation and Interpretation of SVD in Stability Contexts, Concept of Data Resonance, Advanced Applications of Eigen Decomposition.

Course Outcomes

At the end of the course student will be able to

1.	Explain the basic principles of vectors, matrices, and linear mappings relevant to data science applications.
2.	Apply the concepts of vector spaces and matrix representations to model and analyse data transformations.
3.	Analyse data transformation problems and solve them using SVD, QR decomposition, and least squares methods.
4.	Solve linear systems efficiently using matrix factorization techniques such as Gaussian elimination and LU decomposition.
5.	Evaluate data system stability and resonance through eigenvalue problems and advanced decomposition techniques.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	**PSO ↓**	
												1	2
EEE262.1	3	3					1					-	-
EEE262.2	3	3					1					1	-
EEE262.3	3	3					1					1	-
EEE262.4	3	3					1					1	-
EEE262.5	3	3					1					1	-

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Numerical Linear Algebra	Lloyd N. Trefethen and D. Bau	SIAM	1st edition,1997
2.	Introduction to Linear Algebra	Gilbert Strang	Wellesley-Cambridge Press	6th edition, 2023

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Numerical Analysis: Mathematics of Scientific Computing	D. Kincaid and W. Cheney	Brooks/Cole	2nd edition, 2002

E Books / MOOCs/ NPTEL

1.	Linear algebra for data science by SORIN MITRAN, Department of Mathematics University of North Carolina at Chapel Hill.
2.	Introduction to Linear Algebra by Gilbert Strang, Sixth Edition (2023), ISBN : 978 17331466-7-8

PROBABILITY AND INFORMATION THEORY			
Course Code	EEE263	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Numerical Methods and Probability Theory

Course Objectives

1.	To Understand different methods of information and probabilistic modelling.
2.	To understand the importance of statistical inference in data processing.
3.	To understand the inequality measure of information.

Course Contents

UNIT – 1

Introduction to Information and Probability	**9 Hours**

Information, uncertainty, basic concepts of probability, Markov inequality, limit theorems, source model, motivating examples, a compression problem, Shannon entropy, random hash

UNIT – 2

Randomness, Entropy, and Typical Sets	**9 Hours**

Uncertainty and randomness, total variation distance, generating uniform bits, generating from uniform bits, typical sets, entropy and randomness relationships

UNIT – 3

Hypothesis Testing and Measures of Information	**9 Hours**

Hypothesis testing and estimation, log-likelihood ratio test, Kullback-Leibler divergence, Stein's lemma, information per coin toss, multiple hypothesis testing, mutual information, Fano's inequality

UNIT – 4

Properties of Information Measures	**9 Hours**

Definitions of information measures, chain rule, shape of information functions (boundedness, concavity/convexity, non-negativity), data processing inequality, proof of Fano's inequality, variational formulae, capacity as information radius, proof of Pinsker's inequality, continuity of entropy

UNIT – 5

Information-Theoretic Bounds and Compression	**9 Hours**

Lower bound for source coding, lower bound for Stein's lemma, lower bound for randomness generation, strong converse, lower bound for minmax estimation, variable length source codes, compression limits

Course Outcomes

At the end of the course student will be able to

1.	Explain the fundamental concepts of information, uncertainty, and probabilistic modelling including entropy and compression.
2.	Analyse the relationship between entropy and randomness using concepts like typical sets and random bit generation.
3.	Apply hypothesis testing and statistical inference methods using information measures like KL divergence and mutual information.
4.	Evaluate various information measures and their properties, including inequalities and information radius interpretations.
5.	Design bounds and efficient compression schemes using principles from information theory.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	1	**PSO↓**	
↓ Course Outcomes											1	1	2

EEE2631	3	3					1					-	-
EEE263.2	3	3					1					-	-
EEE263.3	3	3					1					-	-
EEE263.4	3	3					1					1	-
EEE263.5	3	3					1					1	-

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Elements of Information Theory	T. Cover and J. Thomas	Wiley	2nd edition, 2006.
2.	Information Theory: Coding Theorems for Discrete Memoryless Systems	I. Csiszar and J. Korner	Cambridge	2nd edition, 2011.
3.	Information spectrum methods in Information Theory, Stochastic Modelling and Applied Probability series	T S Han	Springer	1st edition, 2010.

MATRIX METHODS IN MACHINE LEARNING			
Course Code	EEE264	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Matrix Algebra and Calculus			
Course Objectives			
1.	To understand the concept of linear dependence matrix, its rank and subspaces.		
2.	To understand the machine learning methods and algorithms through matrix-vector methods and optimization theory.		
3.	To Formulate a wide variety of machine learning problems as optimization models and solve them numerically.		
4.	To understand practical implications of norm choice, regularization, and convexity.		
5.	To Investigate an applied machine topic not explicitly covered in class and produce a research project that explains, analyzes, and discusses the topic.		
Course Contents			
UNIT–1			
Introduction and Overview			**9 Hours**
Block matrices and norms, Linear dependence matrix and rank, Subspaces and linear equations, least squares.			
UNIT–2			
Vector Derivatives and PSD Matrices			**9 Hours**
Vector derivatives and PSD matrices, orthogonality and Gram Schmidt, LS classification and cross validation.			
UNIT-3			
Singular value decomposition			**9 Hours**
Matrix norms and SVD, SVD geometry and PCA, low rank approximation and pseudoinverse, geometry and sensitivity, tradeoffs and regularizations, examples.			
UNIT-4			
Iterative algorithms			**9 Hours**
Iterative methods, proximal algorithm, gradient methods, stochaistic Gradient method.			
UNIT-5			
Machine learning algorithms			**9 Hours**
Max-Margin SVM and Kernels, Dual formulation, neural network on perceptron, convolution neural networks, unsupervised learning and k-means, matrix problems and vectorization.			
Course Outcomes			
At the end of the course student will be able to			
1.	Describe the application of matrix methods for machine learning.		
2.	Apply vector derivatives for machine learning.		
3.	Describe the application of SVD, PCA for machine learning.		
4.	Explain the geometry, sensitivity and regularizations to machine learning.		
5.	Analyse the SVM, kernels, CNN and unsupervised learning methods.		

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE264.1	3	3	-	-	-	-	1	-	-	-	-	-	-
EEE264.2	3	3	-	-	-	-	1	-	-	-	-	2	-
EEE264.3	3	3	-	-	-	-	1	-	-	-	-	2	-
EEE264.4	3	3	-	-	-	-	1	-	-	-	-	2	-
EEE264.5	3	3	-	-	-	-	1	-	-	-	-	2	-

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Matrix Methods in data mining and pattern recognition	Lars Eldén	SIAM	2nd edition, 2019

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Introduction to Applied Linear Algebra	Stephen Boyd, Lieven Vandenberghe	Cambridge University Press	1st edition, 2018

E Books / MOOCs/ NPTEL

1.	https://archive.nptel.ac.in/courses/106/106/106106046/
2.	https://nptel.ac.in/courses/106105174

BASICS OF MACHINE LEARNING WITH PYTHON			
Course Code	EEE347	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Matrix Algebra and Calculus, Complex variables and Transform Techniques, Numerical Methods and Probability Theory			
Course Objectives			
6.	To analyse the given data set.		
7.	To perform Linear and non-linear regression techniques using scikit learn package.		
8.	To perform kNN and DT techniques using scikit learn package.		
9.	To perform Logistic regression and SVM techniques using scikit learn package.		
10.	To perform clustering and Design a recommender system		
Course Contents			
UNIT–1			
Introduction & Regression			**09 Hours**
Basics of Machine Learning, Python for Machine Learning, Supervised vs Unsupervised. Introduction to Regression, Simple Linear Regression, Model Evaluation in Regression Models			
UNIT–2			
Regression			**09 Hours**
Evaluation Metrics in Regression Models, Multiple Linear Regression, Gradient Descent Method, Non-Linear Regression.			
UNIT-3			
Classification			**09 Hours**
Basics of K-Nearest Neighbours, Evaluation Metrics in classification, Decision Trees, Building Decision Trees(DT), Logistic Regression,			
UNIT-4			
Classification			
Logistic regression vs Linear regression, Logistic Regression Training, Support Vector Machine(SVM).			
UNIT-5			
Clustering:			**09 Hours**
Introduction to k-Means, Hierarchical Clustering, DBSCAN			
Recommender Systems			
Content-based Recommender Systems, Collaborative Filtering.			
Course Outcomes			
At the end of the course student will be able to			
6.	Identify the characteristics of datasets and compare the trivial data for various applications		
7.	solve regression problems using linear/non-linear regression analysis techniques for various applications.		
8.	Perform classification using kNN, DT for various applications		
9.	solve classification problem using Logistic regression and SVM for various applications		
10.	Perform clustering analysis and design recommender system for various applications		

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	PSO↓ 1	PSO↓ 2
EEE347.1	2	3	-	-	-	-	-	-	-	-	-		1
EEE347.2	2	3	-	-	3	-	-	-	-	-	-		1
EEE347.3	2	3	-	-	3	-	-	-	-	-	-		1
EEE347.4	2	3	-	-	3	-	-	-	-	-	-		1
EEE347.5	2	3	-	-	3	-	-	-	-	-	-		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	An Introduction to Machine Learning	Rebala, A. Ravi, and S. Churiwala,	Springer International Publishing	1st edition ,2019
2.	An Introduction to Machine Learning	Miroslav Kubat	Springer International Publishing	1st edition ,2015

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Introduction to Machine Learning with Python A Guide for Data Scientists	A. C. Müller and S. Guido	McGraw Hill Education	1st edition ,2016
2.	Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow Concepts, Tools, and Techniques to Build Intelligent Systems	Aurélien Géron	Springer International Publishing	1st edition ,2015

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/106105152
2.	https://www.coursera.org/learn/machine-learning-with-python

ESSENTIALS OF DATA SCIENCE

Course Code:	**AD111**	**Course Type:**	**PCC**
Teaching Hours/Week (L: T:P: S):	**3:0:0:0**	**Credits:**	**3**
Total Teaching Hours:	**45**	**CIE + SEE Marks:**	**50+50**

Teaching Department: ISE, AI&DS, EEE

Course Objectives:

1	To understand the foundations of data science and statistical analysis..
2	To explore data collection, wrangling, and preprocessing techniques.
3	To utilize data mining and data warehousing for effective data management and data analysis.
4	To understand descriptive statistics, regression, and model evaluation techniques.
5	To understand the basic tools for data science and explore through a case study.

UNIT-I

Introduction to Data Science and Preprocessing: Introduction to Data Science – evolution and significance, data science process lifecycle, roles in a data science project, and real-world applications. Introduction to data types and sources, data security, and privacy issues. Ethical considerations – bias, fairness, data ownership, reproducibility. Data Collection Strategies – scraping, APIs, surveys, public datasets. Data Preprocessing – Data Quality, Major Tasks in Data Pre-processing, Data Reduction, Data Transformation and Data Discretization, Data Cleaning and Data Integration. Handling missing values, outlier detection,	**09 Hours**

UNIT-II

Introduction to Data Mining: What is data mining, Challenges, Data Mining Tasks, Phases of data mining Benefits of data mining, What Kinds of Data Can Be Mined, What Kinds of Patterns Can Be Mined, Major Issues in Data Mining. Data Warehousing and On-Line Analytical Processing: Data Warehouse basic concepts, Data Warehouse Modelling - Data Cube and OLAP	**09 Hours**

UNIT-III

Exploratory Data Analysis and Statistical Foundations: Descriptive Statistics – measures of central tendency and dispersion, Symmetry, skewness and kurtosis, correlation and covariance, Inferential Statistics – hypothesis testing, ANOVA, confidence intervals.	**09 Hours**

UNIT-IV

Regression and Predictive Modeling: Introduction to supervised learning, Simple and Multiple Linear Regression, Polynomial Regression, residual analysis, Prediction and decision-making using regression, concepts of underfitting and overfitting. **Model Evaluation and Validation Techniques:** Generalization error, evaluation metrics – MAE, RMSE, R^2, Train/Test Split, Cross-Validation,	**09 Hours**

UNIT-V

Tool boxes for Data Scientists: Fundamental Python libraries for data Scientists, Integrated development environment (IDE), Data operations: Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking, and plotting. **Case Study: Network Analysis:** Graphs, Social Network Analysis, Centrality: Drawing centrality of Graphs, PageRank, Ego-Networks, Community Detection.	**09 Hours**

Mini project walkthrough using end-to-end workflow – data ingestion, analysis, model building, interpretation, and presentation.

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

1	Explain the fundamentals of data science lifecycle and apply it to real-world problems.
2	Apply data preprocessing techniques to enhance data quality, ensuring reliability and accuracy for advanced analytical tasks.
3	Explain the significance of data mining and warehousing in data science applications
4	Apply statistics and other techniques for model building and validate the same.
5	Apply data science tools for data operations and network analysis to effectively analyze complex systems

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes															
CO-1	2														
CO-2	3	3													
CO-3	2	2													
CO-4	2	3													
CO-5	1	3													

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Cathy O'Neil and Rachel Schutt, *Doing Data Science*, O'Reilly, 2015.
2	Joel Grus, *Data Science from Scratch*, 2nd Edition, O'Reilly, 2019.
3	Sanjeev J. Wagh et al., *Fundamentals of Data Science*, CRC Press, 2022.

REFERENCE BOOKS:

1	David Cielen et al., *Introducing Data Science*, Manning Publications, 2016.
2	Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly, 2022.
3	DJ Patil, *Building Data Science Teams*, O'Reilly, 2011.

E Books / MOOCs/ NPTEL

1	https://nptel.ac.in/courses/106106179
2	https://archive.nptel.ac.in/courses/106/106/106106212/
3	https://www.coursera.org/professional-certificates/ibm-data-science

PRINCIPLES OF ARTIFICIAL INTELLIGENCE

Course Code:	**AID212**	**Course Type:**	**PCC**
Teaching Hours/Week (L: T:P: S):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45**	**CIE + SEE Marks:**	**50+50**

AI&DS

Course Objectives:

1	To impart artificial intelligence principles, techniques, and its history.
2	To access the applicability, strength and weakness of the basic knowledge representation
3	To interpret problem solving and learning methods in solving engineering problems.
4	To develop intelligence systems by assembling solutions to concrete computational problems.
5	To Analyze planning and acting strategies in nondeterministic domains, and apply sensor-less planning methods

UNIT-I

Introduction: Evolution of Al, State of Art -Different Types of Artificial Intelligence, Applications of Al-Subfields of Al-Intelligent Agents- Structure of Intelligent Agents- Environments. Problem Solving based on Searching: Introduction to Problem Solving by searching Methods, State Space search, Uninformed Search Methods- Uniform Cost Search	**09 Hours**

UNIT-II

Breadth First Search, Depth First Search-Depth- limited search, Iterative deepening depth-first, Informed Search Methods- Best First Search, A* Search Local Search algorithms: Hill-climbing search, Simulated annealing, Genetic Algorithm	**09 Hours**

UNIT-III

Adversarial Search: Game Trees and Minimax Evaluation, Elementary two-players games: tic-tac-toe, Minimax with Alpha-Beta Pruning. Logic and Reasoning: Introduction to Logic and Reasoning -Propositional Logic-First Order Logic- Inference in First Order Logic- Unification	**09 Hours**

UNIT-IV

Logic and Reasoning: Forward Chaining, Backward Chaining, Resolution. Uncertain Knowledge and Reasoning: Quantifying Uncertainty- Bayes Rule -Bayesian Belief Network- Approximate Inference in Bayesian networks	**09 Hours**

UNIT-V

Planning: Classical planning, Planning as State-space search, Forward search, backward search, Planning graphs, Hierarchical Planning, Planning, and acting in Nondeterministic domains - Sensor-less Planning, Multiagent planning.	**09 Hours**

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

1	Evaluate Artificial Intelligence (AI) methods and describe the foundations.
2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
3	Demonstrate knowledge of reasoning, uncertainty, and knowledge representation for solving real- world problems.
4	Analyze and illustrate how search algorithms play a vital role in problem solving.
5	Identify the need of Planning states.

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	3
CO-1	3	1	3	-	-	-	-	-	2	-	-	1	1	2	-
CO-2	2	2	1	-	1	-	-	-	2	-	-	1	1	3	-
CO-3	2	1	2	-	-	-	-	-	2	-	-	2	1	3	-
CO-4	3	1	2	-	1	-	-	-	2	-	-	2	1	3	-
CO-5	2	2	2	-	1	-	-	-	3	-	-	2	1	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2	Sathish S. Nadig “Principles of Artificial Intelligence”, Himalaya Publishing House, 2023
REFERENCE BOOKS:	
1	Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007.
2	Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008.
3	Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.
4	Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013.
E Books / MOOCs/ NPTEL	
1	https://nptel.ac.in/courses/106102220
2	https://nptel.ac.in/courses/106105077
3	https://nptel.ac.in/courses/112103280
4	https://www.pdfdrive.net/artificial-intelligence-a-modern-approach-3rd-ditione32618455.html.
5	https://www.coursera.org/learn/introduction-to-ai.

Electric Vehicles

ELECTRIC VEHICLE BATTERY CHARGING METHODS AND TOPOLOGIES			
Course Code	EEE244	**Credits**	3
Hours/Week (L: T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Chemistry of energy storage and digital system			

Course Objectives	
1.	To understand the working principle of electric vehicle and basics of battery.
2.	To study the capacity of electric vehicle battery.
3.	To analyse electric vehicle battery charging and discharging behaviours.
4.	To gain insight into battery fast-charging mechanisms and strategies.
5.	To analyse the electric vehicle battery performance.

Course Contents	
UNIT – 1	
Electric Vehicle Batteries and Efficiency	**9 Hours**
Electric Vehicle Operation, Battery Basics, Introduction to Electric Vehicle Batteries, Fuel Cell Technology, Choice of a Battery Type for Electric Vehicles, **Electric Vehicle Battery Efficiency:** Effects of VRLA Battery Formation on Electric Vehicle Performance, Regenerative Braking, Electric Vehicle Body and Frame, Fluids, Lubricants, and Coolants, Effects of Current Density on Battery Formation, Effects of Excessive Heat on Battery Cycle Life, Battery Storage, The Lithium-ion Battery, Traction Battery Pack Design	
UNIT – 2	
Electric Vehicle Battery Capacity	**9 Hours**
Battery Capacity, The Temperature Dependence of Battery Capacity, State of Charge of a VRLA Battery, Capacity Discharge Testing of VRLA Batteries, Battery Capacity Recovery, Definition of NiMH Battery Capacity, Li-ion Battery Capacity, Battery Capacity Tests, Energy Balances for the Electric Vehicle	
UNIT - 3	
Electric Vehicle Battery Charging and Discharging	**9 Hours**
Charging NiMH Batteries, Rate of Charge Effect on Charge Acceptance Efficiency of Traction, Battery Packs, Environmental Influences on Charging, Charging Methods for NiMH Batteries, Charging Technology, Battery Pack Corrective Actions, Definition of NiMH Battery Capacity, Discharge Capacity Behaviour, Discharge Characteristics of Li-ion Battery, Discharge of an Electric Vehicle Battery Pack, Cold-Weather Impact on Electric Vehicle Battery Discharge.	
UNIT - 4	
Electric Vehicle Battery Fast Charging	**9 Hours**
On-board & off-board charging, The Fast-Charging Process, Fast Charging Strategies, The Fast Charger Configuration, Using Equalizing/Levelling Chargers, Inductive Charging—Making Recharging Easier, Range Testing of Electric Vehicles Using Fast Charging, Electric Vehicle Speedometer Calibration. Wireless Charging	
UNIT - 5	
Electric Vehicle Battery Performance	**9 Hours**
The Battery Performance Management System, BPMS Thermal Management System, The BPMS Charging Control, High-Voltage Cabling and Disconnects, Safety in Battery Design, Battery Pack Safety—Electrolyte Spillage and Electric Shock, Charging Technology, Electrical Insulation Breakdown	

Detection, Electrical Vehicle Component Tests, Building Standards, Ventilation.

Course Outcomes

At the end of the course student will be able to

1.	Describe the operation of electric vehicle and battery.
2.	Analyse the capacity of a battery used in electric vehicles.
3.	Analyse the fast charging and discharging behavior of batteries.
4.	Describe the various fast charging methods used in electric vehicle.
5.	Appraise the performance of the battery.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE244.1	3	3					1					1	
EEE244.2	3	3					1					1	
EEE244.3	3	3					1					1	
EEE244.4	3	3					1					1	
EEE244.5	3	3					1					1	

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Electric vehicle battery systems	Sandeep Dhameja	Newnes Publishing	1st edition,2001

AUTONOMOUS AND CONNECTED VEHICLES			
Course Code	EEE265	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: AI for Electrical Engineers

Course Objectives

1.	To understand the technology and advancements in autonomous and connected vehicles.
2.	To study the concept of connected vehicle technologies, opportunities and challenges.
3.	To apply the knowledge of sensor and perception technology in connected and autonomous vehicles.
4.	To explore autonomous vehicle control algorithms and real time decision making.
5.	To analyse the legal, ethical and social aspects of alternative automotive technologies.

Course Contents

UNIT – 1

Introduction to autonomous vehicles and its architecture	**9 Hours**

History and Evolution of Autonomous Vehicles, Key Technologies in Autonomous Vehicles (Sensors, AI, Machine Learning) and Levels of Vehicle Autonomy.
Architecture of autonomous vehicles: System Design and Architecture for Autonomous Vehicles, Safety and Reliability in Autonomous Vehicles, Current Challenges and future trends.

UNIT – 2

Connected vehicle technologies	**9 Hours**

Basics of Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) Communication, Standards and Protocols for Connected Vehicles and Data Security and Privacy in Connected Vehicles.
Connected vehicle opportunities and challenges: Impact of Connectivity on Traffic Management and Control, Smart Transportation and Urban Mobility and Integration of Connected Vehicles with Smart Cities.

UNIT - 3

Sensors and Perception technology	**9 Hours**

Sensors: Overview of Sensors in Autonomous Vehicles (RADAR, LIDAR, Cameras), Data Fusion and Sensor Integration, Object Detection and Classification.
Perception Technologies: Environmental Perception and Mapping, Advanced Driver-Assistance Systems (ADAS) and Challenges in Perception under Various Conditions.

UNIT - 4

Autonomous Vehicles	**9 Hours**

Autonomous Vehicle Control: Path Planning and Navigation, Control Algorithms for Autonomous Driving.
Autonomous Vehicle Decision Making: Real-time Decision Making in Autonomous Vehicles, Interaction with Non-autonomous Traffic, Simulation and Testing of Autonomous Vehicle Systems, Ethical Decision Making in Autonomous Vehicles.

UNIT - 5	
Legal and Ethical aspects	**9 Hours**

Regulatory Framework for Autonomous and Connected Vehicles, Ethical Considerations and Accountability.
Social aspects: Impact on Employment and Society, User Acceptance and Behavioural Aspects, Privacy Issues and Data Governance, Future of Mobility and Societal Transformations.

Course Outcomes

At the end of the course student will be able to

1.	Explain the fundamentals and differentiate the autonomous and connected vehicles.
2.	Analyse the autonomous vehicle architecture and its design.
3.	Evaluate connected vehicle technologies and gain the knowledge of sensors and perception technology
4.	Apply Control and Decision-Making strategies for autonomous vehicles.
5.	Assess Ethical, Legal, and Social Implications of autonomous vehicles

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE265.1	3	3										2	
EEE265.2	3	3										2	
EEE265.3	3	3										2	
EEE265.4	3	3			2							2	2
EEE265.5	3	3				3	3					2	

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Autonomous Vehicles Technologies, Regulations, and Societal Impacts	George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos	Elsevier Publications	1st edition, 2021

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
2.	Guide to Automotive Connectivity and Cybersecurity: Trends, Technologies	Dietmar P.F. Möller, Roland E. Haas	Springer Publications	1st edition,2019

ELECTRIC VEHICLES IN SMART GRID			
Course Code	EEE367	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: AI for Electrical Engineers			

Course Objectives

1.	To understand the fundamentals of Plug in Electric Vehicle technologies.
2.	To understand the threats involved in connecting Electric Vehicle to Smart Grid.
3.	To study the impact of plug-in electric vehicles on the power system.
4.	To study the Plug in Electric Vehicle Load on power system.
5.	To study the response of large-scale EV charging loads.

Course Contents

UNIT – 1

Overview of Plug-in Electric Vehicle Technologies	**9 Hours**

PEV Technologies, PEV Systems, impacts, Smart Charging Infrastructure, Integration of PEVs to Electric Grid Promotional Programs on PEVs.
Wireless Power Transfer (WPT) for Electric Vehicles (EVs): Wireless Energy Transfer Methods, Inductive Coupling Versus Magnetic Resonance Coupling, Modelling the WPT System, WPT for EV Charging, Stationary WPT for EV Charging, Dynamic WPT for EV Charging.

UNIT – 2

Cyber Security of Plug-in Electric Vehicles in Smart Grids	**9 Hours**

Detection Methods, Smart Grids with PEVs, Communication Infrastructure, Communication Standards, Cyber Security Challenges, Data Attacks and Intrusions in PEV Communications, Intrusion Detection Methods, Application to the Detection of Malicious PEV Penetration Level

UNIT - 3

Impact Evaluation of Plug-in Electric Vehicles on Power System	**9 Hours**

Probabilistic PEV Charging Demand, Fast Charging Points, Probabilistic Arrivals, Probabilistic PEV Charging Demand, Probabilistic Grid Impact of Fast Chargers.

UNIT - 4

PEV Load and Its Impact on Static Voltage Stability	**9 Hours**

Modeling of PEV Charging Load, Introduction to Power System Load Characteristics, Modeling of the PEV Charging Load, Effects of Charger Resistances on Load Model Parameters, Newton Raphson Power Flow with PEV Load, Impact of PEV Charging Load on System Static Voltage Stability, Voltage Stability Theory, Static Voltage Stability Analysis, Mitigating PEV Charging Impacts through Voltage Control, Mitigating PEV Charging Impact through Proper Planning

UNIT - 5

Response of Large-Scale EV Charging Loads	**9 Hours**

Introduction Characteristics of EV Charging Loads, Current Related Research of EVs on Frequency Regulation(FR) , EVs' Advantages in FR ,The Current Related Research of FR Based on the Coordination Among EVs, AGC, BESSs Properties of FR Resources ,Traditional FR Resources ,Large-Scale Energy Storage Devices ,EV/BESS FR Resource, Coordinated Control Strategy for EVs/BESSs ,Coordination Principle ,Implementation Method for Coordinated FR, Case Study and Results , Simulation Model and Parameters, Simulations of Power System FR, Asynchronous Response of Small-Scale Charging Facilities to Grid Frequency, Formulation of the Proposed Control Method. Demonstration of coordination, Demonstration of equality

Course Outcomes	
At the end of the course student will be able to	
1.	Discuss Plug in Electric Vehicle technologies and wireless power transfer mechanism in electric vehicles connected to the grid.
2.	Illustrate the cyber security measures to be adopted for Electric Vehicle connected to Grid.
3.	Analyse the impact of plug-in electric vehicles on the power system.
4.	Describe the impact of Plug in Electric Vehicle Load on Static Voltage Stability of the grid.
5.	Describe the impact of large-scale EV charging loads on grid frequency.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE367.1	3	3					1					2	1
EEE367.2	3	3					1					2	1
EEE367.3	3	3					1					2	1
EEE367.4	3	3					1					2	1
EEE367.5	3	3					1					2	1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Plug In Electric Vehicles in Smart Grids Integration Techniques	Sumedha Rajakaruna, Farhad Shahnia and Arindam Ghosh	Springer Verlag, Singapore	1st edition,2015

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Influences of Electric Vehicles on Power System and Key Technologies of Vehicle-to-Grid	Canbing Li, Yijia Cao, YonghongKuang and Bin Zhou	Springer-Verlag Berlin Heidelberg	1st edition,2016
2.	Grid Integration of Electric Vehicles in Open Electricity Markets	Qiuwei Wu	Wiley	1st edition,2013

BATTERY CONTROL AND MONITORING			
Course Code	EEE243	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Chemistry of Energy Storage and Digital Systems

Course Objectives

1.	To introduce the various components of the Battery Management System.
2.	To understand the types and parameters of governing the batteries.
3.	To understand the functionality of Battery Management System.
4.	To estimate the state of charge of the battery.
5.	To identify the various faults occurring in batteries.

Course Contents

UNIT – 1

Battery Management System	**9 Hours**

The Power Module (PM), The battery, The DC/DC converter, load, communication channel, Examples of Battery Management Systems, Comparison of BMS in a low-end and high-end shaver, Comparison of BMS in two types of cellular phones

Basic information on batteries: Battery systems, Definitions Battery design, Battery characteristics, General operational mechanism of batteries. Battery voltage.

UNIT – 2

Lithium-Ion Battery Fundamentals	**9 Hours**

Battery Operation, Battery Construction, Battery Chemistry, Safety Longevity, Performance, Integration.

Measurement of battery parameters: Cell Voltage Measurement, Current Measurement, Current Sensors Current Sense Measurements, Synchronization of Current and Voltage, Temperature Measurement, Measurement Uncertainty and Battery Management, System Performance.

UNIT - 3

Battery Management System Functionality	**9 Hours**

Charging, Strategies, CC/CV Charging Method, Target Voltage Method, Constant Current Method, Thermal Management, Operational Modes

Charge Balancing: Balancing Strategies, Balancing Optimization, Charge Transfer Balancing, Flying Capacitor, Inductive Charge Transfer Balancing, Transformer Charge Balancing, Dissipative Balancing, Balancing Faults

UNIT - 4

State-of-Health Estimation Algorithms	**9 Hours**

State of Health, Mechanisms of Failure, Predictive SOH Models Impedance Detection, Passive Methods, Active Methods, Capacity Estimation, Self-Discharge Detection Parameter Estimation, Dual-Loop System, Remaining Useful Life Estimation

State-of-Charge Estimation Algorithms: Challenges, Definitions, Coulomb counting, SOC Corrections, OCV Measurements, Temperature Compensation, Kalman Filtering, Other observer methods

UNIT – 5	
Fault Detection	**9 Hours**

Overview, Failure Detection, Overcharge/Overvoltage, Over-Temperature, Overcurrent Battery Imbalance/Excessive Self-Discharge, Internal Short Circuit Detection, Detection of Lithium Plating, Venting Detection, Excessive Capacity Loss, Reaction Strategies

Safety considerations: Fire hazard, thermal runaway, electrical hazards and chemical leakage.

Course Outcomes

At the end of the course student will be able to

1	Analyse the various components of the Battery Management System.
2	Analyse the battery structure with emphasis on Lithium-Ion Battery.
3	Measure different battery parameters and analyse the functionality of Battery Management System
4	Detail the need of Charge Balancing and state of charge estimation using various algorithms.
5	Estimate the state of health of the battery and implement the necessary safety precautions.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE243.1	3	3					1					1	1
EEE243.2	3	3					1					1	1
EEE243.3	3	3					1					1	1
EEE243.4	3	3					1					1	1
EEE243.5	3	3					1					1	1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Battery management systems: design by modelling	H. J. Bergveld	University Press Facilities, Eindhoven	1st edition,2002

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
2.	A Systems Approach to Lithium-Ion Battery Management	Phillip Weicker	Artech house	1st edition,2013

FUNDAMENTALS OF AUTOMOTIVE SYSTEMS			
Course Code	EEE348	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Instrumentation and Measurements			

Course Objectives	
1.	To study and analyse various systems used in automotive systems.
2.	To understand the role of sensors and transducers in automotive systems.
3.	To understand the various tools and communication protocols used in automotive systems.
4.	To understand the concepts of lighting and infotainment in automotive systems.
5.	To understand the underlying concepts of Electric and Hybrid Electric Vehicles.

Course Contents	
UNIT – 1	
Introduction of common technology and Engine management systems	**9 Hours**
Engine related systems. Ignition system, Engine management systems, Anti-lock braking systems, Traction control system, Stability Control system. **Engine management systems:** Fuel injection, ignition systems and engine control units.	
UNIT – 2	
Sensors and Actuators	**9 Hours**
Introduction of sensors and transducers Electromagnetic Sensors, Optical sensors, variable resistance type sensors, temperature sensors, Pressure sensors, variable capacitance sensors, Flow sensors, Piezoelectric sensors, Oxygen Sensor, Practical Importance of sensors. **Actuators:** Introduction of Actuators, Actuators operation, Injectors, Exhaust gas recirculation actuators, motors, Solenoids, ABS actuators.	
UNIT - 3	
Diagnostic tools, equipment, techniques and Communication protocols	**9 Hours**
Digital Multimeter, Oscilloscope, Circuit testing, Ignition system tests, Fault and error Codes, OBD II (On board diagnostic –II) **Communication protocols:** Overview of automotive communication protocols, CAN, LIN, Flex Ray, MOST, Ethernet, D2B and DSI, Interfacing techniques and Interfacing with infotainment gadgets, Relevance of Protocols such as TCP/IP for automotive applications, Wireless LAN standards such as Bluetooth, IEEE 802.11x communication protocols for automotive applications.	
UNIT - 4	
Infotainment and Lighting Systems	**9 Hours**
Application of telematics in automotive domain, Global positioning systems (GPS) and General packet radio service (GPRS) **Lighting Systems**: Operation of headlights, taillights, and other vehicle lighting systems.	

UNIT – 5	
Electric , Hybrid Electric Vehicles and Safety Equipment	**9 Hours**

State-of-the Art EVs & HEVs, Comparison of EV Vs IC Engine. EV System: EV Configuration: Fixed & variable gearing, single & multiple motor drive, In-wheel drives EV Parameters: Weight, size, force, energy & performance parameters.

Safety Equipments: Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating airbags, bumper design for safety, Anthropomorphic Test Devices.

Course Outcomes

At the end of the course student will be able to

1.	Describe different technologies used with respect to ignition, fuelling, braking and stability in automotive systems.
2.	Describe different sensors and actuators used in automotive systems.
3.	Use diagnostic tools such as digital multimeter, oscilloscope etc. in detecting the faults in automotive systems.
4.	Illustrate lighting and infotainment used in automotive systems.
5.	Analyse pros and cons between the electric and hybrid electric vehicle.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE348.1	3	3					1						
EEE348.2	3	3					1						
EEE348.3	3	3					1						
EEE348.4	3	3					1						
EEE348.5	3	3					1						

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Navigation and Intelligent Transportation Systems – Progress in Technology	Ronald K Jurgen	Automotive Electronics Series, SAE, USA	1st edition,1998
2.	Understanding Automotive Electronics	William B Ribbens, Norman P. Mansour	Newnes	4th edition,2012

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Automotive Handbook	Bosch	Wiley-Blackwell	11th edition,2022

Embedded Systems

EMBEDDED SYSTEMS WITH ARM			
Course Code	EEE368	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Microcontroller programming with C			
Course Objectives			
1.	To explain the architecture and features of ARM Cortex-M microcontrollers.		
2.	To develop embedded software using register-level and abstraction-layer approaches.		
3.	To configure and interface common peripherals (timers, ADC, UART, SPI, I2C).		
4.	To understand and implement interrupt-driven systems.		
5.	To describe real-time system design concepts and basic RTOS usage.		
Course Contents			
UNIT – 1			
ARM Cortex-M Architecture and Programming Model			**9 Hours**
Overview of ARM microcontroller families and applications, Cortex-M architecture: core registers, stack operation, memory model, Clock and reset systems, Exception and interrupt handling: NVIC, vector table, CMSIS: purpose, layers and coding standards			
UNIT – 2			
Embedded Programming with ARM Toolchain			**9 Hours**
Embedded C programming review, Project setup: startup code, linker script, memory sections Bit manipulation and register-level access, Abstraction layers: CMSIS vs HAL, GPIO configuration and digital I/O applications			
UNIT - 3			
Timers, ADC, and Communication Peripherals			**9 Hours**
Timer modes: basic timer, output compare, PWM. **ADC:** resolution, sampling, triggering methods **UART**: baud rate, data framing, interrupt-driven communication SPI and I2C: clocking, data transfer, use cases Application examples: motor control, sensor interfacing			
UNIT - 4			
Interrupts and Real-Time Behavior			**9 Hours**
NVIC configuration and interrupt priority, Writing and linking ISRs, GPIO and peripheral interrupt sources, Debouncing and ISR best practices, Synchronous vs asynchronous operations Introduction to real-time systems			
UNIT - 5			
Real-Time Systems and Embedded Application Design			**9 Hours**
RTOS basics: tasks, scheduling, context switching, Task states and inter-task communication (queues, semaphores), Time management: delays, periodic tasks, Power-efficient embedded design (low-power modes, clock scaling), Case studies: real-time data acquisition system, IoT node, control system design			
Course Outcomes			
At the end of the course student will be able to			
1.	Explain the architecture, memory structure, and features of ARM Cortex-M microcontrollers to identify their advantages in real-time and low-power embedded		

	applications
2.	Develop embedded firmware using register-level, CMSIS, and HAL-based programming approaches to configure and control ARM microcontroller peripherals effectively
3.	Interface digital and analog peripherals including timers, ADC, UART, SPI, and I2C to design embedded control and communication systems
4.	Implement interrupt handling and peripheral event-driven programming to improve system responsiveness and performance in real-time scenarios
5.	Describe the concepts of real-time operating systems (RTOS) and basic multitasking techniques to design reliable and scalable embedded applications

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE368.1	3	3					1					2	
EEE368.2	3	3	2		2		1					2	
EEE368.3	3	3	2		2		1						2
EEE368.4	3	3			2		1						2
EEE368.5	3	3	2		2		1						2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Embedded Systems: Introduction to the ARM Cortex-M Microcontrollers	Jonathan W. Valvano	CreateSpace Independent Publishing	5th edition, 2012
2.	The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors	Joseph Yiu	Elsevier	3rd edition, 2013

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C	Yifeng Zhu	E-Man Press LLC	3rd edition, 2017

EMBEDDED SYSTEMS FOR IOT APPLICATIONS			
Course Code	EEE246	**Credits**	3
Hours/Week (L :T:P:S)	1:0:4:0	**CIE Marks**	50
Total Hours	15:0:60:0	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Microcontroller programming with C			

Course Objectives	
1.	To understand the architecture of IoT-enabled embedded systems.
2.	To interface and control sensors and actuators using microcontrollers.
3.	To implement embedded communication protocols.
4.	To integrate microcontrollers with Wi-Fi/Bluetooth for IoT applications.
5.	To enable remote monitoring and control through cloud.

Course Contents

UNIT – 1

Introduction to Embedded IoT Systems	**7 Hours**
Overview of IoT and its Applications, IoT Architecture: Perception, Network, and Application Layers, Embedded Systems in IoT, Introduction to IoT-enabled Microcontrollers (ESP32, STM32) Real-Time Operation and Basics of Free RTOS, Power Management in IoT Nodes	

UNIT - 2

Embedded Communication Protocols and Wireless Communication for IoT	**8 Hours**
Serial Communication: UART, SPI, I2C – Overview and Comparison, Wireless Protocols: Wi-Fi and Bluetooth (BLE), Network configuration: SSID, IP, MAC, DHCP, MQTT Protocol: Publish/Subscribe Model, QoS Levels, sending data over HTTP (GET/POST), Mobile App Interfaces for Control, Security in wireless communication (basics) **Cloud Integration** Overview of IoT Cloud Platforms, setting up and Configuration, Connecting ESP32 to platform using Wi-Fi, Data Upload and Visualization, Trigger-based Actions and API Key Management, case studies	

Laboratory Component

Suggested List of Experiments	
1.	Setup 2-wire LCD with microcontroller to display given string
2.	Design a Digital AC Voltmeter and Ammeter to measure the voltage and current in AC electrical circuits using microcontroller and display the values in LCD.
3.	Measure the power and energy in electrical circuit using microcontroller and display the values in LCD
4.	Interfacing temperature and humidity sensor with microcontroller and display the same in the LCD.
5.	Interfacing of microcontroller to Bluetooth module
6.	Interfacing of microcontroller to Wifi module ESP32
7.	Interfacing of microcontroller to GSM module
8.	Setup a cloud platform to log the data
9.	Interfacing of microcontroller to LoRa module

10.	Design an IOT based automation system
ourse Outcomes	
At the end of the course student will be able to	
1.	Analyze and design embedded system architectures for IoT applications by integrating microcontrollers with sensors, actuators, and communication protocols (UART, I2C, SPI) to acquire, process, and control real-world signals.
2.	Interface sensors and actuators with microcontrollers to acquire and control real-world signals and develop and implement IoT solutions by integrating wireless technologies and cloud platforms for remote monitoring, data visualization, and control of smart devices for IoT-based applications**.**

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE246.1	3		3		3		1	3	3	3	2		3
EEE246.2	3		3		3		1	3	3	3	2		3

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	INTERNET OF THINGS (IOT): Architecture and Design Principles	Raj Kamal	McGraw Hill	2nd edition, 2022
2.	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,	Pearson Education (Cisco Press Indian Reprint).	1st edition, 2017

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	INTERNET OF THINGS - A HANDS-ON APPROACH	Arshdeep Bahga	Orient Blackswan Private Limited - New Delhi;	1st edition/ 2015

INDUSTRIAL AUTOMATION AND CONTROL			
Course Code	EEE247	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Applied Digital Logic Design			

Course Objectives	
1.	To introduce the principles and components of industrial automation.
2.	To provide in-depth knowledge of sensors, actuators, and PLCs used in industrial systems.
3.	To understand monitoring and control through SCADA and HMI systems.
4.	To explore communication protocols in industrial networks and their role in automation.
5.	To discuss emerging technologies such as Industry 4.0 and IIoT.

Course Contents	
UNIT – 1	
Introduction to Industrial Automation	**9 Hours**
Definition and Importance of Automation, Types and Levels of Automation (Hard, Soft, Programmable),Overview of Industrial Processes and Control Hierarchies Basic elements: Sensors, Controllers, Actuators, HMI, Communication interfaces Applications: Manufacturing, Packaging, Process Industries, Energy Sector	
UNIT – 2	
Industrial Sensors and Actuators	**9 Hours**
Classification of Sensors and Actuators, Sensors: Temperature, Pressure, Proximity, Optical, Level, Flow, Actuators: Electromechanical (Relays, Contactors, Motors), Pneumatic, Hydraulic, Signal Conditioning and Data Acquisition Basics, Interfacing and Wiring Standards in Industrial Environments	
UNIT – 3	
Programmable Logic Controllers (PLCs)	**9 Hours**
PLC Architecture and Operation, Programming Languages: Ladder Logic, Function Block Diagram (FBD) , Timers, Counters, Comparators, Latching, Sequencing, PLC Selection Criteria and Application Examples, Troubleshooting and Diagnostics	
UNIT – 4	
Industrial Control Strategies	**9 Hours**
Open-loop vs Closed-loop Control, On-Off, Proportional, Integral, Derivative (PID) Control, Motor Control: DOL starter, Soft starters, VFDs Process Automation: Batch vs Continuous Control Control Panel Design Basics	
UNIT – 5	
SCADA, HMI, and Industrial Networks	**9 Hours**
SCADA Architecture and Functions, Remote Terminal Units (RTUs), Data Acquisition Systems Human Machine Interface (HMI): Design, Screens, Alarms, Trends Communication Protocols: MODBUS, Profibus, CAN, Ethernet/IP Overview of Industry 4.0, IIoT (Industrial IoT), and Cybersecurity Challenges	

Course Outcomes	
At the end of the course student will be able to	
1.	Understand the structure and components of industrial automation systems to identify suitable automation solutions for various industrial scenarios**.**
2.	Analyze and select appropriate industrial sensors and actuators to achieve reliable and

	efficient process control.
3.	Develop PLC programs using standard programming languages to implement automation logic in industrial applications.
4.	Apply basic control strategies for motor and process control to maintain system stability and desired performance.
5.	Explain SCADA, HMI systems, and industrial communication protocols to monitor, supervise, and control real-time industrial operations effectively.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE247.1	3						1					2	
EEE247.2	3						1					2	
EEE247.3	3	2			3		1	2	2	2		2	2
EEE247.4	3	2			2		1						2
EEE247.5	3	2	2		3		1						2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Programmable Logic Controllers: Principles and Applications	John W. Webb and Ronald A. Reis	Pearson Education	5th edition, 2009
2.	Industrial Automation and Process Control	Jon Stenerson and John Winfield	Pearson Education	1st edition, 2002

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Programmable Logic controllers	W Bolton	Elsevier newness	6th edition, 2015

AUTOMOTIVE ELECTRONICS

Course Code	EEE369	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Microcontroller programming with C

Course Objectives

1.	To understand various aspects of electronic system in vehicle control
2.	To familiarize with various sensors used in vehicle control.
3.	To comprehend the communication protocol used in vehicle.
4.	To understand concepts of AUTOSAR.
5.	To now the data processing and memory management system.

Course Contents

UNIT – 1

Electrical and Electronic Systems in the Vehicle	**9 Hours**

Overview, Motoronic-engine management system, Electronic diesel control, Lighting technology, electronic stability program, adaptive cruise control, Infotainment System.

UNIT – 2

Automotive Sensors & Measuring Principle	**9 Hours**

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.

UNIT - 3

In Vehicle Networking	**9 Hours**

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

UNIT - 4

AUTOSAR Concepts	**9 Hours**

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

UNIT - 5

Architecture of Electronic Systems & Control Units	**9 Hours**

Basics and Overview, vehicle system architecture. Control units, Operating conditions, Design and data processing. Digital modules in the control unit. Automotive Applications.

Course Outcomes

At the end of the course student will be able to

1.	Describe the function and operation of Automotive Electrical and Electronic subsystems
2.	Discuss the 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.	Explain the architecture & Methodology of AUTOSAR.
5.	Describe automotive data processing and memory system

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**

↓ Course Outcomes												1	2
EEE369.**1**	3	3					1				2		2
EEE369.**2**	3	3					1				2		2
EEE369.**3**	3	3					1				2		2
EEE369.**4**	3	3					1				2		2
EEE369.**5**	3	3					1				2		2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Bosch Automotive Electrics and Automotive Electronics	Robert Bosch	John Wiley & Sons Ltd,	5th edition/2007

DEVICE DRIVERS

Course Code	EEE266	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Introduction to C programming

Course Objectives

1.	To introduce the concept, structure, and functionality of device drivers in embedded and general-purpose operating systems.
2.	To explore Linux kernel architecture and driver development methodology.
3.	To understand programming interfaces for character, block, and network device drivers.
4.	To examine hardware interfacing and interrupt handling using kernel modules.
5.	To develop debugging, testing, and deployment strategies for device drivers.

Course Contents

UNIT – 1

Introduction to Device Drivers and OS Kernel	**9 Hours**

Role of device drivers in operating systems, Types of device drivers: character, block, and network drivers, Kernel vs User space, Kernel architecture: processes, memory, scheduling, Overview of kernel modules and dynamic loading

UNIT – 2

Linux Kernel Modules and Character Device Drivers	**9 Hours**

Writing a basic Linux kernel module, Device file system, Character driver interface, Registering and unregistering character devices, Memory allocation

UNIT - 3

Interrupts and Synchronization	**9 Hours**

IRQs and interrupt handling in Linux, Top halves and bottom halves, Synchronization primitives: mutex, spinlock, semaphore, Race conditions and interrupt safety

UNIT - 4

Block and Network Device Drivers	**9 Hours**

Overview of block devices and I/O scheduling, Writing a simple block device driver, Introduction to network interfaces and net_device structure, Packet transmission and reception in network drivers, Linux networking stack overview

UNIT - 5

Driver Debugging, Testing, and Deployment	**9 Hours**

Debugging tools, Driver testing and validation, Udev rules and driver loading at boot, Kernel versioning and cross-compilation, Case studies

Course Outcomes

At the end of the course student will be able to

1.	Explain the structure and role of device drivers within OS kernel environments to facilitate hardware-software interaction.
2.	Develop character device drivers in Linux to manage peripheral communication at a low level.
3.	Handle interrupts and apply synchronization mechanisms to ensure safe and efficient driver behavior.
4.	Describe the architecture and function of block and network drivers to enable data I/O and networking support.
5.	Employ tools and techniques to debug, test, and deploy device drivers in embedded Linux systems.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
EEE266.1	3	3					1						
EEE266.2	3	3					1						
EEE266.3	3	3					1						
EEE266.4	3	3					1						
EEE266.5	3	3			2		1				1		2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Linux Device Drivers	Jonathan Corbet, Alessandro Rubini, and Greg Kroah-Hartman	Shroff	3rd edition/ 2009

Renewable Energy Systems

SOLAR PHOTOVOLTAIC			
Course Code	EEE349	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Electrical Circuit Analysis - I, Power Electronics			

Course Objectives	
1.	To describe the overall block diagram of a Solar Photovoltaic System and energy estimation.
2.	To interpret the parameters of PV Modules and their connections to form arrays.
3.	To understand the design and economics of Solar PV Systems.
4.	To understand the importance of Charge Controllers, MPPT and Inverters.
5.	To explain types of batteries and their maintenance in Solar PV Systems.

Course Contents	
UNIT – 1	
Solar Photovoltaic System	**9 Hours**
Introduction to renewable energy sources: types, global and national energy scenarios.. **Solar PV System:** Insolation, irradiance of solar energy, power and energy estimation, Standard Test Condition, block diagram representation of solar PV system.	
UNIT – 2	
Solar PV Array	**9 Hours**
Solar Cells and PV modules: Parameters of solar cells, factors affecting electricity generated from a solar cell, solar PV modules, ratings, module parameters, factors affecting electricity generated by a solar PV module, measuring module parameters. **Solar PV arrays:** Solar PV module arrays - connection of modules in series, in parallel and in series and parallel (combination).	
UNIT – 3	
Solar PV System Design	**9 Hours**
Design: Types of solar PV systems: standalone, grid-connected and hybrid. Design methodology for standalone solar PV System, grid-connected PV System, design for Small power application. **Economic aspects of solar PV system:** Introduction, sample payback period, lifecycle costing, introduction to Solar Advisory Model (SAM) software.	
UNIT – 4	
Solar PV charge controller, MPPT and Inverters	**9 Hours**
Solar PV charge controller, MPPT: Need for Balance of System (BoS), charge controllers, Maximum Power Point Tracking (MPPT), types of wires and wire sizing, junction box. **Solar Inverters:** string inverters, microinverters, and hybrid inverters.	
UNIT – 5	
Batteries	**9 Hours**
Types of batteries, parameters of batteries, how to select a battery, connecting batteries together–Series, parallel and mixed combination, estimating number of batteries to be connected in a battery Bank. **Battery maintenance and their applications to solar PV systems:** Testing and Maintenance of Batteries, Fault Detection, Instruments used for Maintenance, Sample Case Study of a Solar PV System, Environmental Considerations of PV Systems.	

Course Outcomes	
At the end of the course student will be able to	
1.	Explain the functional block diagram of a solar PV System and its energy estimation.
2.	Design the PV array for given specification.
3.	Design the standalone and grid connected solar PV system and analyse its economic aspects.
4.	Discuss the role of charge controller, MPPT and Inverters in solar PV systems.
5.	Explain the parameters of batteries and battery management systems.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE349.1	3	3					1				1	1	
EEE349.2	3	3					1				1	1	
EEE349.3	3	3			2		1				1	1	
EEE349.4	3	3					1				1	1	
EEE349.5	3	3					1				1	1	

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers	Chetan Singh Solanki	PHI Learning Publications	1st edition, 2013
2.	Photovoltaic Systems Engineering	Roger A. Messenger and Jerry Ventre	Taylor and Francis Group Publications	3rd edition, 2010

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Solar Energy Engineering: Processes and Systems, Academic Press	Soteris A. Kalogirou	Elsevier	2 nd edition, 2014

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc22_ee71/preview

SMART GRID			
Course Code	EEE370	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Linear Control Systems, Power Electronics, Power System Analysis-I			

Course Objectives	
1.	To understand the evolution, concept and need for Smart Grids compared to conventional grids.
2.	To explore the architecture, standards and communication technologies used in Smart Grids.
3.	To gain knowledge of automation, measurement systems and wide-area applications in Smart Grid environments.
4.	To study the integration of renewable energy sources and storage systems with the grid.
5.	To understand power quality challenges and solutions related to Smart Grid operations.

Course Contents

UNIT–1

Introduction to Smart Grid	**9 Hours**

Role of IoT in Smart Grids, evolution of electric grid, smart grid concept, definition, need of smart grid, characteristics, key drives of the smart grid, functions, opportunities of smart grid, challenges in implementation of smart grid. Smart grid benefits, technical challenges for development of smart grid in India.

Conventional Vs Smart Grid: Difference between conventional and smart grid, concept of resilient, resilience of smart grid functions, self-healing grid, smart grid implementation, present development.

UNIT–2

Smart Grid Architecture	**9 Hours**

Introduction, standards, policies, smart grid control layer and elements, network architectures, power line communications, supervisory control and data acquisition system, advanced metering infrastructure.

Smart Grid Design: The fundamental component of smart grid designs, Transmission Automation, Distribution Automation, and Renewable Integration, Communication Protocols (e.g., IEC 61850, Modbus, ZigBee).

UNIT-3

Distribution Automation Equipment and Management Systems	**9 Hours**

Introduction, Data sources and associated external systems, Modelling and analysis tools, Distribution Management System (DMS), Asset Management using Smart Grid Data Analytics.

Transmission System Operation: Phasor measurement, Wide area applications.

UNIT-4

Renewable Integration	**9 Hours**

Role of renewables in Smart Grid, Integration challenges of solar PV and wind energy, Distributed Energy Resources (DER), Microgrids and their control.

Energy Storage: Energy Storage Systems (ESS), Types and applications, Power Electronics interface for renewable energy and storage.

UNIT-5

Power Quality Management in Smart Grid	**9 Hours**

Power Quality and Electromagnetic Compatibility (EMC) in Smart Grid, relation between voltage quality and EMC, Smart Inverters for Grid Support, Use of AI/ML for Power Quality Prediction and Monitoring.

Power Quality Issues: Power quality issues of grid connected renewable energy sources, causes of

low power quality, issues, challenges and solutions of RES grid integration. Power quality conditioner, power quality monitoring.

Course Outcomes

At the end of the course student will be able to

1.	Describe the evolution, characteristics and functions of Smart Grid.
2.	Explain the architecture, components and communication standards used in Smart Grids.
3.	Analyse automation systems and real-time monitoring tools used in transmission and distribution.
4.	Evaluate renewable integration and energy storage methods used in Smart Grids.
5.	Identify and address power quality issues and propose solutions in a Smart Grid environment.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO ↓**	
↓ Course Outcomes												1	2
EEE370.1	3	3					1				1		1
EEE370.2	3	3					1				1		1
EEE370.3	3	3					1				1		1
EEE370.4	3	3					1				1		1
EEE370.5	3	3					1				1		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Smart Grid - Technology And Applications	Janaka Ekanayake, Kithsiri Liyanage, John	Wiley & Sons	1st edition, 2012
2.	Smart grid fundamentals of design and analysis	James Momoh	Wiley-IEEE Press	1st edition, 2012

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Smart Grids: Infrastructure, Technology and Solutions	Stuart Borlase	CRC Press	1st edition, 2013
2.	Renewable and Efficient Electric Power System	G. Masters	Wiley–IEEE Press	2nd edition, 2013

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc21_ee68/preview

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN RENEWABLE ENERGY			
Course Code	EEE248	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Electrical Circuit Analysis-I, Electrical Power Generation and Utilization, Probability Theory and Numerical Methods			

Course Objectives	
1.	To introduce the fundamentals of artificial intelligence and machine learning techniques.
2.	To explore AI and ML applications in renewable energy forecasting, optimization, and grid integration.
3.	To provide insight into the use of predictive modeling for performance enhancement of renewable systems.
4.	To discuss case studies and real-world applications in solar, wind, and hybrid energy systems.
5.	To equip students with the skills to develop AI-based tools for intelligent renewable energy management.

Course Contents	
UNIT – 1	
Introduction to AI and ML in Renewable Energy	**9 Hours**
Solar, wind, biomass, hydro, and hybrid systems. Introduction to Artificial Intelligence and Machine Learning: definitions, types, tools, and techniques, Relevance of AI/ML in renewable energy, Overview of data-driven decision making Introduction to supervised and unsupervised learning techniques, Case studies on AI applications in energy systems.	
UNIT – 2	
Data Acquisition and Preprocessing	**9 Hours**
Sources of renewable energy data: meteorological, sensor-based, and SCADAsystems, Data preprocessing: cleaning, normalization, transformation, and handling missing data, Feature engineering and selection techniques, Exploratory Data Analysis (EDA) using Python or MATLAB, Time-series data analysis for solar and wind forecasting, Tools: Pandas, NumPy, Scikit-learn, MATLAB.	
UNIT - 3	
Predictive Modelling and Forecasting	**9 Hours**
Machine learning models: Linear regression, Decision trees, Random Forest, Support Vector Machines (SVM), Forecasting techniques for solar radiation and wind speed, Deep learning approaches: Artificial Neural Networks (ANN), LSTM for time series, **Model evaluation:** RMSE, MAE, R^2, and confusion matrix, Real-time load and generation forecasting, Case studies on wind and solar prediction.	
UNIT - 4	
Optimization and Energy Management using AI	**9 Hours**
Optimization techniques: Genetic Algorithms (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Optimal sizing and placement of renewable energy systems,Energy storage and demand-side management using ML models, Smart grid and demand response using AI,	

Hybrid renewable energy systems optimization, Economic dispatch and unit commitment using ML tools.

UNIT - 5

Applications, Challenges, and Future Trends	**9 Hours**

Integration of AI with IoT for renewable energy, Edge AI for distributed energy systems, Cybersecurity challenges in AI-based energy systems, Limitations and ethical considerations of AI in renewable energy, Future trends: federated learning, digital twins, reinforcement learning, Industrial case studies and research directions.

Course Outcomes

At the end of the course student will be able to

1.	Analyse the fundamentals of AI/ML techniques and their relevance to renewable energy systems.
2.	Analyse and preprocess renewable energy data for building predictive models.
3.	Develop machine learning models for forecasting and prediction in solar and wind systems.
4.	Apply AI-based optimization methods for intelligent energy management.
5.	Discuss the real-world challenges and advancements in AI for renewable energy.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE248.1	3	3					1				1		1
EEE248.2	3	3					1				1		1
EEE248.3	3	3					1				1		1
EEE248.4	3	3					1				1		1
EEE248.5	3	3					1				1		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Artificial Intelligence for Renewable Energy Systems	Soteris Kalogirou	Elsevier	1st edition, 2022
2.	Machine Learning and Data Science in the Power Generation Industry	Patrick Bangert	Academic Press	1st edition, 2021

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Renewable Energy Integration: Practical Management of Variability, Uncertainty, and Flexibility in Power Grids	Lawrence E. Jones	Academic Press	2nd edition, 2017
2.	Artificial Intelligence and	Zhenyuan	Springer	1st edition, 2021

	Machine Learning for Energy Systems	Zhang, Chanan Singh		
3.	Hands-On Artificial Intelligence for Renewable Energy Systems	Abhishek Kumar, Abhijeet Singh	BPB Publications	1st edition, 2021
E Books / MOOCs/ NPTEL				
1.	MOOC: Artificial Intelligence: Principles and Techniques- Stanford University (edX / Coursera)			
2.	NPTEL Course: Machine Learning for Engineering and Science Applications – Prof.Balaraman Ravindran, IIT Madras			

HYBRID RENEWABLE ENERGY SYSTEMS			
Course Code	EEE371	**Credits**	3
Hours/Week (L:T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Electrical Circuit Analysis -I, Linear control Systems, Power Electronics			

Course Objectives

1.	To understand the need, classification of hybrid renewable energy systems (HRES).
2.	To explore different combinations of renewable energy sources like solar, wind, biomass, and others.
3.	To learn energy management and control strategies in HRES.
4.	To analyze sizing, modeling, and simulation techniques.
5.	To evaluate grid integration and real-time applications of HRES.

Course Contents

UNIT – 1

Introduction to Hybrid Renewable Energy Systems	**9 Hours**

Need for hybrid systems: limitations of individual renewable energy systems,
types of hybrid energy systems: PV-Wind, PV-Diesel, Wind-Diesel, Biomass-PV,
Classification: Standalone vs Grid-connected systems, benefits and challenges in implementation, component overview: PV modules, wind turbines, diesel generators, biomass gasifiers, controllers, converters, inverters, and storage units, case studies of existing hybrid systems in India and globally.

UNIT – 2

Power Conditioning and Energy Storage	**9 Hours**

Power electronics interface: role of MPPT, DC-DC converters, inverters.
Energy storage technologies: batteries, ultracapacitors, flywheels, hydrogen storage, pumped hydro, compressed air.Battery Management System (BMS), comparison of storage systems for different hybrid setups, load matching and peak shaving techniques, role of smart inverters in Hybrid Renewable Energy Systems.

UNIT - 3

System Design and Control Strategies	**9 Hours**

System architecture and configurations, design considerations and optimization parameters.
Control strategies: centralized, decentralized, and hierarchical control, load forecasting and demand side management, Energy Management Systems (EMS): rule-based, optimization-based, AI-based, simulation tools: HOMER, RETScreen, Matlab/Simulink basics.

UNIT - 4

Modeling, Sizing, and Economic Analysis	**9 Hours**

Mathematical modeling of PV, wind, battery, and other components, sizing methods: intuitive, numerical, and analytical,Levelized Cost of Energy (LCOE), Net Present Cost (NPC), payback period, environmental and economic assessment, case studies with cost and performance comparison, government schemes and subsidies for HRES in India.

UNIT - 5

Grid Integration and Applications	**9 Hours**

Grid-tied hybrid systems: interfacing, synchronization, and protection, islanding detection and prevention, power quality issues in HRES: harmonics, voltage/frequency instability, Microgrids and distributed generation, applications in rural electrification, telecom towers, military, and EV charging stations, emerging trends: IoT, AI in HRES, blockchain for energy transactions.

Course Outcome

At the end of the course student will be able to	
1.	Explain the structure, need and classifications of hybrid renewable energy systems.
2.	Discuss energy storage and power electronic interfaces in hybrid renewable energy systems.
3.	Demonstrate design considerations and control strategies of hybrid systems.
4.	Develop the mathematical model of PV, wind, battery and also estimate their environmental and economic impacts.
5.	Explain integration process of hybrid renewable energy systems with the grid and its applications.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE371.1	3	3					1				1		1
EEE371.2	3	3					1				1		1
EEE371.3	3	3					1				1		1
EEE371.4	3	2				2	1				1		1
EEE371.5	3	2					1				1		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Hybrid Renewable Energy Systems: Modeling, Design, and Applications	Umakanta Sahoo	CRC Press	1st edition ,2021
2.	Renewable Energy Systems	B. H. Khan	McGraw Hill Education	3rd edition ,2018

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Non-Conventional Energy Sources	B. H. Khan	McGraw Hill Education	3rd edition ,2017

E Books / MOOCs/ NPTEL

1.	NPTEL Online Course: *Hybrid Renewable Energy Systems* – Prof. Ashok Jhunjhunwala, IIT Madras https://nptel.ac.in/courses/108106182
2.	Coursera MOOC: *Renewable Energy Systems* – TU Delft https://www.coursera.org/learn/renewable-energy

GRID INTEGRATION OF RENEWABLE ENERGY SOURCES			
Course Code	EEE372	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Electrical Power Generation and Utilization, Power Electronics, Power System Analysis -I

Course Objectives

1.	To understand the principles and challenges of integrating renewable energy systems into the power grid.
2.	To analyse the impact of renewable energy sources (RES) on power system operation and control.
3.	To study grid codes, standards, and power quality issues related to RES integration.
4.	To familiarize students with various RES technologies like solar, wind, and hybrid systems and their interfacing requirements.
5.	To explore modeling, forecasting, and control strategies for RES-based generation.

Course Contents

UNIT – 1

Introduction to Grid Integration of Renewable Energy Systems	**9 Hours**

Overview of Renewable Energy Sources (RES): Solar, Wind, Biomass, Small Hydro, Difference between Conventional and Renewable Generation with respect to Grid, Necessity for Grid Integration: Environmental, Economic, and Technological perspectives, Grid integration challenges: Intermittency, Variability, Dispatchability, Reliability, Overview of Architecture: Centralized vs. Decentralized Generation, Microgrids, Converter topologies: AC/DC, DC/AC, AC/AC and their application in RES interfacing, Case studies on different integration scenarios.

UNIT – 2

Wind and Solar PV System Integration	**9 Hours**

Overview of Renewable Energy Sources (RES): Solar, Wind, Biomass, Small Hydro, Difference between Conventional and Renewable Generation with respect to Grid, Necessity for Grid Integration: Environmental, Economic, and Technological perspectives, Grid integration challenges: Intermittency, Variability, Dispatchability, Reliability, Overview of Architecture: Centralized vs. Decentralized Generation, Microgrids, Converter topologies: AC/DC, DC/AC, AC/AC and their application in RES interfacing, Case studies on different integration scenarios.

UNIT - 3

Standards, Grid Codes and Power Quality	**9 Hours**

Introduction to Grid Codes: IEEE 1547, IEC 61727, Indian standards for DG and RES, Power quality aspects: Voltage dips, surges, sags, THD, flicker, transients, Measurement and monitoring of power quality disturbances in RES, Voltage regulation techniques: Tap changing transformers, FACTS devices, Grid Stability and Frequency regulation in high-RES penetration, Anti-islanding protection: Active and passive methods, Case studies on power quality disturbances due to RES integration.

UNIT - 4	
Energy Storage and Hybrid Systems	**9 Hours**
Need for energy storage in RES-dominated grids: smoothing, load leveling, and peak shaving; types of energy storage systems: electrochemical (batteries, flow batteries), mechanical (flywheels, CAES), and electrical (supercapacitors); hybrid renewable energy systems (HRES): design configurations and optimization, system sizing, and techno-economic analysis for hybrid systems; energy management strategies: rule-based, optimization-based, fuzzy logic, and AI-based; real-time implementation: hardware-in-the-loop simulations and SCADA integration; case studies of remote/rural electrification using hybrid systems.	
UNIT - 5	
Grid Integration Techniques and Control Strategies	**9 Hours**
Basics of microgrids including architecture, control, protection, and operation, control techniques such as primary, secondary, and tertiary control in renewable energy source (RES) grids, forecasting methods including statistical (ARIMA), machine learning (ANN, SVM), and hybrid models, smart grid components such as Advanced Metering Infrastructure (AMI), demand response, and wide area monitoring systems, communication protocols including IEC 61850, Modbus, ZigBee, and LoRaWAN in RES integration, protection schemes in RES grids including adaptive relaying and coordination with conventional protection, and case studies of smart grid-enabled RES integration in developed and developing countries.	

Course Outcomes

At the end of the course student will be able to

1.	Understand the challenges of integrating renewable energy sources into the power grid.
2.	Model and analyze wind and solar systems for grid connectivity.
3.	Apply relevant grid codes and address power quality issues.
4.	Design hybrid systems using appropriate energy storage and control techniques.
5.	Interpret the control strategies and smart grid technologies for efficient integration.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE372.1	3	3					1				1		1
EEE372.2	3	3					1				1		1
EEE3723	3	3					1				1		1
EEE372.4	3	3					1				1		1
EEE372.5	3	3					1				1		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Grid Integration of Wind Energy Conversion System	Siegfried Heier	Wiley	3rd edition, 2014
2.	Grid Integration of Solar Photovoltaic Systems	Majid Jamil, M. Rizwan	CRC Press	1st edition, 2017

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Power Electronics for	Sudipta	Springer	1st edition, 2013

	Renewable and Distributed Energy Systems	Chakraborty et al.		
2.	Renewable Energy Integration: Practical Management of Variability	L. E. Jones	Academic Press	2nd edition, 2017
3.	Smart Grid: Technology and Applications	Janaka Ekanayake et al.	Wiley	1st edition, 2012
E Books / MOOCs/ NPTEL				
1.	NPTEL Course: "Power Electronics for Renewable Energy Systems" – Prof. B.G. Fernandes (IIT Bombay).			
2.	Coursera Course: "Renewable Energy and Grid Integration" – TU Delft			

Signal Processing Stream

DIGITAL IMAGE PROCESSING			
Course Code	EEE373	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Digital Signal Analysis and Processing

Course Objectives

1.	To learn and understand the basics of digital image processing
2.	To learn and understand various image transform used in digital image processing
3.	To learn and understand various image enhancement technique used in digital image processing
4.	To learn and understand various image restoration technique and methods used in digital image processing
5.	To learn and understand various image compression and Segmentation used in digital image processing

Course Contents

UNIT – 1

Introduction to Digital Image Processing	**9 Hours**

Elements of Digital Image Processing system, Visual perception and properties of human eye, Image representation, A simple image model, Some basic relationship between pixels, Image geometry

UNIT – 2

Introduction to Fourier Transform	**9 Hours**

DFT & FFT, Properties of 2D Fourier Transform, Separable Image Transforms –Walsh, Hadamard Transform, Discrete Cosine Transform, Haar Transform

UNIT - 3

Image Enhancement	**9 Hours**

Histogram Modelling, Equalization and modification, Image smoothing, Spatial Filtering, Homomorphic filtering for image enhancement.

UNIT - 4

Filtering	**9 Hours**

Model of Image Degradation/Restoration process, Inverse filtering, Least Mean Square (Wiener) filtering, Constrained least mean square restoration, Singular value decomposition, Recursive filtering.

UNIT - 5

Image Compression Models	**9 Hours**

Lossless compression: Variable length coding, LZW coding, Lossy Compression: Transform coding, Wavelet coding, Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding-Region oriented segmentation and Texture.

Course Outcomes

At the end of the course student will be able to

1.	Discuss the different components of image processing system
2.	Apply various transform techniques for image processing
3.	Describe various image enhancement techniques using processing methods
4.	Demonstrate the filtering and restoration of images(pixels) with examples
5.	Illustrate the various schemes for image representation and edge detection techniques with examples

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	PSO↓ 1	PSO↓ 2
EEE373.1	3	3					1				1		
EEE373.2	3	3					1				1		
EEE373.3	3	3					1				1		
EEE373.4	3	3					1				1		
EEE373.5	3	3					1				1		

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Digital Image Processing	Rafael C Gonzalez, Richard E Woods	Pearson Education	4th edition,2018
2.	Fundamentals of Digital Image Processing	Jain A.K	Pearson.	1st edition,2015

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Image Processing Analysis and Machine Vision	Millman Sonka, Vaclav Hlavac, Roger Boyle, Broos/Colic	Thompson Learning	3rd edition,2007

E Books / MOOCs/ NPTEL

1	Digital Image Processing NPTEL by Prof. Prabir Kumar Biswas, IIT Kharagpur https://youtu.be/CVV0TvNK6pk?si=ejPZM7rWgSSXHIkd

COMPUTER VISION WITH PYTHON			
Course Code	EEE350	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Linear Algebra, Digital Signal Analysis and Processing

Course Objectives

1.	To understand the fundamentals of Computer Vision and Digital Image Processing
2.	To introduce the processes involved image enhancement and restoration.
3.	To facilitate the students to gain understanding color image processing and morphology.
4.	To learn and understand various image restoration technique and methods used in digital image processing

Course Contents

UNIT – 1

Introduction	**9 Hours**

What is computer vision? A brief history. Image Formation: Photometric image formation, The digital camera. Image processing: Point operators, Linear filtering.

UNIT – 2

Image processing	**9 Hours**

More neighborhood operators, Fourier transforms, Pyramids and wavelets, and Geometric transformations.

UNIT - 3

Image Restoration and Reconstruction	**9 Hours**

A model of Image degradation/restoration process, restoration in the presence of noise only, periodic noise reduction by frequency domain filtering.
Fundamentals, Point, Line and edge detection, thresholding (Foundation and Basic global thresholding only), Segmentation by region growing and region splitting & merging.

UNIT - 4

Color Image Processing:	**9 Hours**

Color fundamentals, color models, Pseudocolor image processing, full color image processing, color transformations, color image smoothing and sharpening, Using color in image segmentation, Noise in color images.

UNIT - 5

Morphological Image Processing:	**9 Hours**

Preliminaries, Erosion and Dilation, opening and closing, Hit-or-miss transform, some basic morphological algorithms.
Feature Extraction: Background, Boundary preprocessing (Boundary following and Chain codes only). Image pattern Classification: Background, Patterns and classes, Pattern classification by prototype matching (Minimum distance classifier only).

Course Outcomes

At the end of the course student will be able to

1.	Explain the fundamentals of computer vision and its applications.
2.	Apply the image enhancement techniques for smoothing and sharpening of images.
3.	Compare the different image restoration and segmentation techniques.
4.	Demonstrate the smoothing and sharpening techniques for colored images.
5.	Explain morphological, feature extraction and pattern classification techniques for object recognition.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	PSO↓ 1	PSO↓ 2
EEE350.1	2	3			2		1		2	2	1		1
EEE350.2	3	3			2		1		2	2	1		1
EEE350.3	3	3			2		1		2	2	1		1
EEE350.4	3	3			2		1		2	2	1		1
EEE350.5	3	3			2		1		2	2	1		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Computer Vision: Algorithms and Applications (Texts in Computer Science)	Richard Szeliski	Springer	2011th edition,2010
2.	Digital Image Processing	Rafael C Gonzalez, Richard E Woods	Pearson Education	4th edition,2018

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Computer Vision: A Modern Approach.	David Forsyth and Jean Ponce	Pearson	2nd edition, 2015

E Books / MOOCs/ NPTEL

1. Computer Vision in Python for Beginners (Theory & Projects), Udemy, **https://shorturl.at/msIOu**

APPLICATION OF SIGNAL PROCESSING IN ELECTRICAL ENGINEERING			
Course Code	EEE374	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Linear Algebra and Discrete Mathematics, Digital Signal Analysis and Processing			

Course Objectives	
1.	To understand the concepts of synchrophasors and frequency estimation in power systems.
2.	To explore phasor measurement techniques and the accuracy of instrument transformers.
3.	To understand Phasor Measurement Unit (PMU) architecture and data communication frameworks..
4.	To apply phasor data in power system state estimation and optimal PMU placement.
5.	To understand the role of wide-area measurement systems in system stability and control.

Course Contents	
UNIT – 1	
Phasor Measurement Techniques	**9 Hours**
Basic concepts and definition, Synchrophasors, Frequency and ROCOF, Phasor representations of sinusoids, Phasor estimation of nominal frequency signals, Updating phasor, Phasor estimation at off nominal frequency signals, Frequency estimates from balanced and unbalanced three-phase inputs, Steady-state and Dynamic conditions of power systems.	
UNIT – 2	
Phasor Measurement Units and Phasor Data Concentrators	**9 Hours**
Classical phasor versus dynamic phasor, Basic definition of accuracy indexes, Methods to calculate synchrophasor based on steady-state model, Methods based on a dynamic signal model, Evaluation of frequency and ROCOF, Dynamic behavior of phasor measurement algorithms, International standards for instrument transformers, Accuracy of instrument transformers, Instrument transformers technologies, Transducer impact on PMU accuracy.	
UNIT - 3	
PMU Architecture	**9 Hours**
PMU architecture, Data acquisition system, Synchronization of sources, Communication and data collector, Distributed PMU, Synchrophasor standards, Synchrophasors and IEC 61850, Case study on steady-state testing of PMU in an electrical substation.	
UNIT - 4	
State Estimation and PMUs	**9 Hours**
Formulation of the state estimation problem, State estimation measurement models, Weighted least square, Static state estimation, Bad data detection, State estimation with phasor measurements, linear state estimation, Role and impact of PMU in state estimation, PMU-based transmission and distribution system state estimation, Optimal PMU placement, State estimation applications,	
UNIT - 5	
Wide Area Measurement Systems Applications	**9 Hours**
Voltage stability assessment based on Modal approach and synchrophasor measurements, Adaptive under-frequency load shedding and under-voltage load shedding, Estimation of grid parameters, Structure of WAMS integrated in control and management systems, Software platform for real-time monitoring platform, Monitoring application, Distributed system state estimation, Case study on real-life examples of wide-area measurement systems, Managing oscillations in power systems, Managing disturbances, Constraint relief in transmission and distribution system.	

Course Outcomes	
At the end of the course student will be able to	
1.	Apply synchrophasor concepts and estimate phasors in steady and dynamic conditions.
2.	Compute PMU accuracy using different estimation algorithms and transformer characteristics.
3.	Describe PMU architecture, synchronization methods, and communication protocols..
4.	Apply PMU data in state estimation problems and optimal PMU placement strategies.
5.	Analyze WAMS applications for voltage stability, oscillation damping, and disturbance management.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO ↓**	
↓ Course Outcomes												1	2
EEE374.1	3	3											
EEE374.2	3	3											
EEE374.3	3	3							2	2			1
EEE374.4	3	3							2	2			1
EEE374.5	3	3											

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Phasor Measurement Units and Wide Area Monitoring Systems	Antonello Monti, Carlo Muscas, Ferdinanda Ponci,	Academic Press,	2016
2.	Interconnected Power Systems: WideArea Dynamic Monitoring and Control Applications	Yong Li, Dechang Yang, Fang Liu, Yijia Cao, Christian Rehtanz	Springer	1st edition,2016

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	IEEE Standard for Synchrophasor Data Transfer for Power Systems.	IEEE Power & Energy Society,	IEEE New York	2011

STATISTICAL SIGNAL PROCESSING			
Course Code	EEE375	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Digital Signal Analysis and Processing,

Course Objectives

1.	To understand the fundamental concepts of stationary random processes and their spectral analysis.
2.	To learn parameter estimation techniques and evaluate the efficiency of estimators.
3.	To understand to apply MMSE and LMMSE methods for signal estimation in Gaussian noise environments
4.	To know the design of FIR and IIR Wiener filters, and understand linear prediction methods.
5.	To implement Kalman filters for dynamic system state estimation.

Course Contents

UNIT – 1

Introduction	**9 Hours**

Stationary processes: Strict sense and wide sense stationarity; Correlation and spectral analysis of discrete-time wide sense stationary processes, white noise, response of linear systems to wide-sense stationary inputs, spectral factorization

UNIT – 2

Parameter Estimation	**9 Hours**

Properties of estimators, Minimum Variance Unbiased Estimator (MVUE Cramer -Rao bound, MVUE through Sufficient Statistics, Maximum likelihood estimation- properties. Bayesian estimation- Minimum Mean-square error(MMSE) and Maximum a Posteriori(MAP) estimation

UNIT - 3

Signal Estimation	**9 Hours**

Signal estimation in white Gaussian noise– MMSE, conditional expectation; Linear minimum mean-square error(LMMSE) estimation-–, orthogonality principle and Wiener Hoff equation

UNIT - 4

IIR and FIR Wiener Filter	**9 Hours**

Non-causal IIR wiener filter, Causal IIR Wiener filtering
FIR Wiener filter, linear prediction-forward and backward predictions, Levinson-Durbin Algorithm, application –linear prediction of speech

UNIT - 5

Kalman Filters	**9 Hours**

Gauss -Markov state variable models; innovation and Kalman recursion, steady-state behaviour of Kalman filters

Course Outcomes

At the end of the course student will be able to

1.	Analyze stationary stochastic processes and evaluate system responses using correlation and spectral techniques.
2.	Apply estimation theory to compute parameters using MVUE, MLE, and Bayesian approaches
3.	Apply MMSE and conditional expectation for signal estimation in white Gaussian noise
4.	Analyze and design FIR and IIR Wiener filters
5.	Model dynamic systems and perform state estimation using Kalman filtering techniques

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	PSO↓ 1	PSO↓ 2
EEE375.1	3	3					1				1		
EEE375.2	3	3					1				1		
EEE375.3	3	3					1				1		
EEE375.4	3	3	2				1				1		
EEE375.5	3	3	2				1				1		

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Statistical Digital Signal Processing and Modeling	M. H. Hayes	John Wiley & Sons, Inc	1st edition, 2008

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Fundamentals of Statistical Signal Processing: Estimation Theory,	S. M. Kay	Prentice Hall	1st edition,1993
2.	Statistical and Adaptive Signal Processing	D.G. Manolakis, V.K. Ingle and S.M. Kogon,	McGraw Hill	1st edition,2005

E Books / MOOCs/ NPTEL

1.	Statistical Signal Processing by Prof. Prabin Kumar Bora , IIT Guwahati **https://onlinecourses.nptel.ac.in/noc20_ee53/preview**

SYSTEM IDENTIFICATION			
Course Code	EEE351	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Probability and Numerical Techniques, Digital Signal Analysis and Processing

Course Objectives

1.	Understand the fundamentals and significance of system identification in modeling dynamic systems
2.	Learn various non-parametric and parametric techniques for identifying system models from input-output data.
3.	Use the statistical and probabilistic tools to evaluate and validate identified models.
4.	Identify the algorithms for parameter estimation and recursive identification.
5.	Understand the practical considerations and challenges involved in real-world system identification.

Course Contents

UNIT – 1

Introduction to System Identification	**9 Hours**

System Identification, rules of the game, Algorithm and its evaluation, Stochastic vs. Non-stochastic Formulation
Background: Random Variables and Stochastic Processes, Signals and Systems and Related Topics, Model Parameterization and Prediction

UNIT – 2

Nonparametric Identification	**9 Hours**

Impulse and Step Response, Correlation Methods, Spectral Analysis
Linear Regression: Least Square Estimation, Statistical Analysis of LS Methods, Determining Model Dimension

UNIT - 3

Signals and Parameter Estimation	**9 Hours**

Commonly used Signals: Spectral Properties, Persistent Excitation
Parameter Estimation: Minimizing Prediction Error, Identifiability, Consistency, Biase, Least Squares, Relations between Minimizing the Prediction Error and the MLE, MAP, Convergence and Consistency, Asymptotic Distribution of Parameter Estimates, The Instrumental-Variable Method

UNIT - 4

Estimation Algorithms	**9 Hours**

Computing the Estimates, Recursive Estimation, Kalman Filter Interpretation
Identification in Practice: Aliasing due to Sampling, Closed Loop Data, Model Order Estimation

UNIT - 5

Case Study	**9 Hours**

Identification in the Worst Case, Optimal Algorithms, Optimal Inputs, Robustness Consideration

Course Outcomes

At the end of the course student will be able to

1.	Explain the basic principles and formulations of system identification
2.	Apply non-parametric and parametric techniques to estimate dynamic system model

SYSTEM IDENTIFICATION	
3.	Analyze the performance of estimation algorithms using statistical tools
4.	Develop and implement recursive algorithms for online system identification
5.	Evaluate the impact of sampling, excitation, and noise on model accuracy and robustness

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE351.1	3	3					1						
EEE351.2	3	3					1						
EEE351.3	3	3					1						
EEE351.4	3	3					1						
EEE351.5	3	3					1						

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	System Identification: A Theory for the User	Ljung, Lennart	Prentice Hall	2nd edition, 1998

Instrumentation and Control

ADVANCED CONTROL THEORY			
Course Code	EEE376	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Electrical Circuit-II, Differential equation and Laplace Transform, Linear Control Systems

Course Objectives

1.	To outline the state model and deduce the state equations for LTI systems.
2.	To compute the state transition matrix, the Eigenvalues and Eigenvectors.
3.	To analyse the system for controllability and observability .
4.	To design the controller using pole placement techniques to ensure stability.
5.	To understand the behaviour of nonlinear systems and analyse the phase trajectory.

Course Contents

UNIT – 1

State Variable Analysis & Design	**9 Hours**

Canonical representation and transfer function, linearization of state equations, State space representation using physical variables. State space representation using phase variables and canonical variables, Derivation of transfer function from state model, Solution of state equation.

UNIT – 2

State Matrix and Properties	**9 Hours**

State transition matrix and its properties, computation using Laplace transformation, Cayley Hamilton method (only computation), Eigenvalues, Eigen vectors, generalized Eigenvectors, diagonalization.

UNIT - 3

Controllability and Observability	**9 Hours**

Concept of controllability and observability, methods of determining the same. Pole placement techniques: stability improvements by state feedback, necessary and sufficient conditions for arbitrary pole placement.

UNIT - 4

Nonlinear System	**9 Hours**

Introduction, behaviour of nonlinear system, common physical nonlinearity saturation, friction, backlash, dead zone, relay, multi variable non linearity, Phase plane method, singular points, stability of nonlinear system, limit cycles, construction of phase trajectories by Isocline method and Delta method.

UNIT - 5

Lyapunov's Stability	**9 Hours**

Lyapunov's stability criteria for linear as well as nonlinear systems, stability definitions, theorems, sign definiteness, direct method, second method, Krasovskii's method, variable gradient method and for linear systems for state variable models.

Course Outcomes

At the end of the course student will be able to

1.	Develop various state space models to obtain the transfer function for the LTI system.
2.	Compute state transition matrix to solve the state equation.

3.	Analyse the pole placement techniques to enhance the stability of the system.
4.	Identify the behavior of nonlinear systems & evaluate various methods of stability to understand the system behavior.
5.	Apply Lyapunov criteria to evaluate the Stability of linear and nonlinear systems.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	**PSO↓** 1	2
EEE376.**1**	3	3			1		1				1		1
EEE376.**2**	3	3			1		1			2	1		1
EEE376.**3**	3	3			1		1			2	1		1
EEE376.**4**	3	3			1		1			2	1		1
EEE376.**5**	3	3			1		1			2	1		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Control Systems Engineering	Nagarath and M.Gopal ,	New Age International (P) Limited, Publishers	7th edition, 2021
2.	Digital control & state variable methods	M. Gopal	Tata McGraw Hill	4th edition, 2017

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	State Space Analysis of Control Systems",	Katsuhiko Ogata,	Prentice Hall Inc	1st edition, 1967

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/108103007

DIGITAL CONTROL SYSTEMS AND STATE VARIABLE METHODS			
Course Code	EEE377	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE: Electrical Circuit-II, Differential equation and Laplace Transform, Linear Control Systems

Course Objectives

1.	To understand the basics of digital control systems.
2.	To compute z-transform for discrete time systems.
3.	To understand the design of controller / compensator in time and frequency domain .
4.	To obtain the state space model for the SISO model of discrete time system.

Course Contents

UNIT – 1

Basics of Digital Control	**9 Hours**

Basic digital control system, Mathematical modelling,sampling and reconstruction, Zero order and First order hold circuits, Realisation of digital filters. Relation between transfer function and pulse transfer function, Mapping between s-domain and z-domain.

UNIT – 2

Response Computation	**9 Hours**

Pulse transfer function of different configurations of systems, Modified z-transform, Time Response of discrete time system. Order and Type of a system Steady state error and Static error constants.

UNIT - 3

Design of controller/Compensator in frequency domain	**9 Hours**

Bilinear transformation and sketching of frequency response, Digital P/PI/PID controller design based on frequency response, Digital compensator based on frequency response. Introduction to design and simulation using MATLAB.

UNIT - 4

Design of controller/Compensator based on time response	**9 Hours**

Design of lag, lead and lag-lead compensator using root locus, Design of controllers and compensators by the method of Ragazzini- Dead beat response and deadbeat controller design.

UNIT - 5

Modern control approach to digital control	**9 Hours**

Introduction to State Space, State Space modelling of discrete time SISO system ,Computation of solution of state equation and state transition matrix. Controllability, observability and stabilizability of discrete time systems, Loss of controllability and observability due to sampling. Digital controller and observer design, state feedback , pole placement, full order observer, reduced order observer.

Course Outcomes

At the end of the course student will be able to

1.	Describe the various control blocks and components of digital control systems.
2.	Analyse sampled data systems in z-domain.
3.	Design a digital controller/ compensator in the frequency domain.
4.	Design a digital controller/ compensator in the time domain.
5.	Apply state variable concepts to design controllers for linear discrete time systems.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	PSO↓ 1	PSO↓ 2
EEE377.1	3	3					1						1
EEE377.2	3	3					1			2			1
EEE377.3	3	3			2		1			2			1
EEE377.4	3	3			2		1			2			1
EEE377.5	3	3					1			2			1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Digital control & state variable methods	M. Gopal	Tata McGraw Hill	4th edition, 2017
2.	Discrete-Time Control Systems	Ogata K	Prentice Hall India Learning Private Limited	2nd edition, 2005

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Digital Control Systems	Benjamin C. Kuo	OUP USA	2nd edition, 1995

MEASUREMENT AND DATA ANALYTICS			
Course Code	EEE352	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Instrumentation and Measurements			

Course Objectives	
1.	To provide a foundational understanding of measurement principles and error analysis.
2.	To familiarize students with sensors, data acquisition systems, and signal conditioning techniques.
3.	To introduce the fundamentals of data analytics and statistical techniques.
4.	To enable students to apply data preprocessing, visualization, and basic machine learning to engineering problems.
5.	To explore real-world applications of data analytics in power systems, especially with smart grid technologies and PMUs.

Course Contents	
UNIT – 1	
Fundamentals of Measurement	**9 Hours**
Introduction to measurement systems, Types of errors: systematic, random, gross Accuracy, precision, resolution, sensitivity, Static and dynamic characteristics Calibration and standards Measurement of electrical quantities (V, I, R, power, energy).	
UNIT – 2	
Sensors and Data Acquisition	**9 Hours**
Types of sensors: temperature, displacement, pressure, current, voltage, etc. Signal conditioning: amplification, filtering, isolation. **Data Acquisition Systems (DAQ):** architecture, sampling, A/D and D/A conversion. Digital storage and transmission. Basics of time synchronization (intro to GPS & IEEE 1588).	
UNIT - 3	
Introduction to Data Analytics	**9 Hours**
Data types: structured, unstructured, time-series, Data cleaning and preprocessing techniques. **Descriptive statistics:** mean, median, variance, histograms, Exploratory Data Analysis (EDA) using Python/MATLAB Data visualization tools (Matplotlib, Seaborn, Excel, etc.)	
UNIT - 4	
Statistical Methods and Machine Learning	**9 Hours**
Probability distributions and their applications, Hypothesis testing and confidence intervals Correlation and regression analysis, Introduction to ML: supervised vs unsupervised learning **Applications:** load forecasting, anomaly detection, classification in power systems	
UNIT - 5	
Applications in Power Systems and Industry	**9 Hours**
Smart grid monitoring: role of PMUs and WAMS, Case study: Synchrophasor data analytics State estimation and event detection, Condition monitoring of equipment using sensor data Industry 4.0 and predictive maintenance using analytics.	

Course Outcomes	
At the end of the course student will be able to	
1.	Apply the fundamentals of measurement systems and evaluate errors and uncertainties.
2.	Identify appropriate sensors and design basic signal conditioning circuits and data acquisition setups.
3.	Perform data preprocessing and apply statistical techniques for analysis of engineering data.
4.	Evaluate the data visualization and apply basic machine learning techniques to draw insights from datasets.
5.	Analyse and interpret real-time measurement data for applications in smart grid and industrial monitoring.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO ↓**	
↓ Course Outcomes												1	2
EEE352.1	3	3					1				1		1
EEE352.2	3	3					1				1		1
EEE352.3	3	3					1				1		1
EEE352.4	3	3					1				1		1
EEE352.5	3	3					1				1		1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Applied Statistics and Probability for Engineer	Douglas C. Montgomery, George C. Runger	Wiley	6th edition, 2016
2.	Python for Data Analysis	Wes McKinney	O'Reilly Media.	2012
3.	A Course in Electrical and Electronic Measurements and Instrumentation	A.K. Sawhney	Dhanpat Rai & Co.	19th Revised edition, 2014

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Measurement, Instrumentation, and Sensors Handbook,	John G. Webster, Halit Eren	CRC Press.	2nd edition, 2014

E Books / MOOCs/ NPTEL

1.	NPTEL: *Data Science for Engineers* by Prof. Raghunathan, IIT Madras
2.	NPTEL :Electrical Measurement and Electronic Instruments *by Prof. S. Ghoshal,* NIT Durgapur

BIOMEDICAL INSTRUMENTATION			
Course Code	EEE353	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE: Linear Control Systems, Instrumentation and Measurement			

Course Objectives

1.	To introduce the fundamentals of transducers as applicable to physiology.
2.	To explore the human body parameter measurements setups.
3.	To make the students understand the basic concepts of forensic techniques.
4.	To give basic ideas about how multimedia evidences are useful in crime investigation

Course Contents

UNIT – 1

Physiology and Transducers	**9 Hours**

Cell and its structure, Resting and Action Potential, Nervous system: Functional organization of the nervous system, Structure of nervous system, neurons, synapse, transmitters and neural communication, Cardiovascular system, respiratory system, Basic components of a biomedical system, Transducers, selection criteria, Piezo-electric, ultrasonic transducers,Temperature,measurements,Fiber Optic Temperature Sensors.

UNIT – 2

Electro–Physiological Measurements	**9 Hours**

Electrodes: Limb electrodes, floating electrodes, pre-gelled disposable electrodes, Micro, needle and surface electrodes, Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier. ECG, EEG, EMG, ERG, Lead systems and recording methods, Typical waveforms. Electrical safety in medical environment: shock hazards, leakage current-Instruments For checking safety parameters of Biomedical equipment.

UNIT - 3

Non-electrical Parameter Measurements	**9 Hours**

Measurement of blood pressure, Cardiac output, Heart rate, Heart sound Pulmonary function measurements, spirometer, Photoplethysmography, Body Plethysmography, Blood Gas analysers : pH of blood, measurement of blood pCO2, pO2, finger-tip oximeter, ESR, GSR, measurements, Standard-HL7.

UNIT - 4

Medical Imaging	**9 Hours**

Radiographic and fluoroscopic techniques, X rays, Computer tomography, Mammography, MRI, fMRI, Ultrasonography, Endoscopy, Thermography, Different types of biotelemetry systems and patient monitoring.

UNIT - 5

Assisting and therapeutic equipments	**9 Hours**

Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy,
Heart Lung machine, Audiometers, Dialyzers, Lithotripsy.

Course Outcomes

At the end of the course student will be able to

1.	Explain human physiological systems and the working principles of biomedical transducers.
2.	Describe electrode types and amplification techniques for electro-physiological signal measurements (ECG, EEG, EMG).
3.	Evaluate the principles and applications of various medical imaging modalities and biotelemetry systems.

4.	Describe the operation of therapeutic and assisting biomedical devices like pacemakers, ventilators, and dialysis machines.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
												1	2
EEE353.1	3	2				1	1						1
EEE353.2	3	2				1	1						1
EEE353.3	3	2				1	1						1
EEE353.4	3	2				1	1						1
EEE353.5	3	2				1	1						1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Bio-Medical Instrumentation and Measurements	Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer	Prentice Hall India Learning Private Limited	2nd edition, 2015

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Medical Instrumentation	J.Webster	Wiley India Private Limited	3rd edition, 2007
2.	HandBook of Biomedical instrumentation'	R.S. Khandpur	McGraw Hill	3rd edition, 2024

Quantum Technology

INTRODUCTION TO QUANTUM COMPUTING			
Course Code	EEE249	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE:

Course Objectives

1.	Understand vector spaces, matrices, inner products, and tensor products.
2.	Understand the physical basis of quantum spin and its mathematical representation.
3.	Apply and analyze quantum entanglement, qubit operations, Bell's inequality, and quantum key distribution protocols.
4.	Implement basic quantum gates and analyze their operations.
5.	Evaluate the computational advantages of quantum algorithms over classical counterparts.

Course Contents

UNIT – 1	9 Hours

Introduction to Linear Algebra:

Complex Numbers versus Real Numbers, Vectors, Diagrams of Vectors, Lengths of Vectors, Scalar Multiplication, Vector Addition, Orthogonal Vectors, Multiplying a Bra by a Ket , Bra-Kets and Lengths, Bra-Kets and Orthogonality, Orthonormal Bases, Vectors as Linear Combinations of Basis Vectors, Ordered Bases, Length of Vectors, Matrices, Matrix Computations, Orthogonal and Unitary Matrices, Linear Algebra Toolbox.

UNIT – 2	9 Hours

Spin and Qubits:

The Quantum Clock, Measurements in the Same Direction, Measurements in Different Directions, Measurements, Randomness, Photons and Polarization. Probability, Mathematics of Quantum Spin, Equivalent State Vectors, The Basis associated with a Given Spin Direction, Rotating the Apparatus through 60°, The Mathematical Model for Photon Polarization, The Basis Associated with a Given Polarization Direction, The Polarized Filters Experiments, Qubits, Alice, Bob, and Eve, Probability Amplitudes and Interference - Alice, Bob, Eve, and the BB84 Protocol.

UNIT – 3	9 Hours

Entanglement and Bell's Inequality:

Alice and Bob's Qubits Are Not Entangled, Unentangled Qubits Calculation, Entangled Qubits Calculation, Superluminal Communication, The Standard Basis for Tensor Products, Qubits Entanglement ,Using the CNOT Gate to Entangle Qubits, Entangled Quantum Clocks, Entangled Qubits in Different Bases, Proofs, A Classical Explanation of Entanglement, Bell ' s Inequality, The Answer of Quantum Mechanism, The Classical Answer - Measurement - The Ekert Protocol for Quantum Key Distribution.

UNIT – 4	9 Hours

Classical Logic, Gates, and Circuits & Quantum Gates and Circuits: Logic

Boolean Algebra - Functional Completeness – Gates Circuits - NAND Is a Universal Gate - Gates and Computation - Memory - Reversible Computation - Billiard Ball Computing - Qubits - The CNOT Gate - Quantum Gates, Quantum Gates Acting on One Qbit, Universal Quantum Gates, No Cloning Theorem Quantum Computation versus Classical Computation - The Bell Circuit - Superdense Coding - Quantum Teleportation – Error Correction.

UNIT – 5	9 Hours

Quantum Algorithms & Impact of Quantum Computing:

The Complexity Classes P and NP – Comparsion of Quantum and Classical Algorithms - Query Complexity - Deutsch' s Algorithm - The Kronecker Product of Hadamard Matrices - The Deutsch-Jozsa Algorithm - Simon's Algorithm - Complexity Classes – Quantum Algorithms - Shor's Algorithm, Grover's Algorithm.

Course Outcomes

At the end of the course student will be able to

1.	Understand how to apply Basic Linear Algebra and Vectors in Quantum Computing.
2.	Analyze the concept of Spin and Qubits.
3.	Analyze the concept of Entanglement and Bell's Inequality.
4.	Compare the Reversible Gates with Classical Gates.
5.	Understand Quantum Computing Algorithm and its Impact.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
EEE249.1	3	3	--	--	3	--	2	--	--	--	--	2	2
EEE249.2	3	3	--	--	3	--	2	--	--	--	--	2	2
EEE249.3	3	3	--	--	3	--	2	--	--	--	--	2	2
EEE249.4	3	3	--	--	3	--	2	--	--	--	--	2	2
EEE249.5	3	3	--	--	3	--	2	--	--	--	--	2	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Quantum Computing for Everyone	Chris Bernhardt	The MIT Press	2019
2.	Quantum Computing- A Gentle Introduction	Eleanor Rieffel and Wolfgang Pola	MIT Press	2011

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	An Introduction to Quantum Computing	Phillip Kaye, Raymond Laflamme, Michele Mosca	Oxford University Press, Team Ling	2007

E Books / MOOCs/ NPTEL

1.	https://www.udemy.com/course/qc101-introduction-to-quantum-computing-quantum-physics-for-beginners/
2.	https://nptel.ac.in/courses/106106232

QUANTUM COMMUNICATION			
Course Code	EEE354	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC

PREREQUISITE:

Course Objectives

1.	Understand modulation and demodulation techniques such as quadrature amplitude modulation, heterodyne, and homodyne detection.
2.	Explain the principles of noiseless and noisy channel encoding.
3.	Analyze the phenomenon of quantum entanglement and perform Bell test analyses.
4.	Compare the BB84, E91, BBM92, B92, COW, and DPS QKD protocols.
5.	Understand the principles of free-space, satellite-based, and fiber-optic quantum communication systems.

Course Contents

UNIT – 1	**9 Hours**
Basics of Polarization optics & linear and square-law detectors:	
Basics of Polarization optics: Quarter and half-wave plates - Polarizing beam splitters **Basics of linear and square-law detectors:** Quadrature amplitude modulation- Heterodyne and Homodyne demodulation and linear detectors -Intensity measurements and square law detectors - Photomultipliers, Avalanche Photo diodes	
UNIT – 2	**9 Hours**
Digital communication – information theory (basics)	
Information entropy -Noiseless channel encoding - Noisy channel encoding	
UNIT – 3	**9 Hours**
No cloning theorem	
Quantum Memories -Quantum repeaters -Entanglement and Bell Theorems - Bell Measurements and Tests -Quantum Teleportation protocol -Quantum Dense coding	
UNIT – 4	**9 Hours**
Quantum Key Distribution protocols	
BB84 -E91 -BBM92.-B92 - COW - DPS	
UNIT – 5	**9 Hours**
Quantum Networks and Quantum Internet	
Survey of Hardware Implementations-Free space communications -Satellite based communications - Fibre optics-based communications	

Course Outcomes

At the end of the course student will be able to

1.	Understand and apply the principles of polarization optics and optical detection techniques.
2.	Understand foundational concepts of information theory and digital communication.
3.	Analyze quantum mechanical principles underlying quantum communication systems.
4.	Evaluate quantum key distribution (QKD) protocols for secure communication.
5.	Understand and assess the infrastructure and technologies for quantum networking and the quantum internet.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
EEE354.1	3	3	3		1		2				1	1	1
EEE354.2	3	3	3		1		2				1	1	1
EEE354.3	3	3	3		1		2				1	1	1
EEE354.4	3	3	3		1		2				1	1	1
EEE354.5	3	3	3		1		2				1	1	1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Quantum computation and quantum information	Nielsen and Chuang	Cambridge University Press, Cambridge	2010
2.	Elements of Quantum Computation and Quantum Communication	A Pathak	Boca Raton, CRC Press	2015

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	**Quantum Communications**	Gianfranco Cariolaro	Springer	2015

E Books / MOOCs/ NPTEL

1.	https://archive.nptel.ac.in/courses/115/101/115101092/

QUANTUM SENSING			
Course Code	EEE378	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE:			

Course Objectives	
1.	Explain various types of classical noise such as Johnson noise, telegraph noise, and 1/f (flicker) noise.
2.	Understand the concept of weak continuous measurements and their role in quantum feedback and control.
3.	Describe and differentiate between Fock states, coherent states, and squeezed states of light.
4.	Understand linear detectors and quadrature measurements used in homodyne and heterodyne detection.
5.	Analyze single-photon, entanglement-based, and spin-based quantum sensing technologies.

Course Contents	
UNIT – 1	**8 Hours**
Classical sensing	
Photo detection-Classical noise-Johnson Noise, Telegraph noise, flicker or 1/f noise -Sensitivity of classical measurements -Classical Fisher information -Cramer - Rao bounds (information theory basics may be required here)	
UNIT – 2	**8 Hours**
Quantum measurements	
Projective/orthogonal measurements -Approximate/non-orthogonal measurements-Weak continuous measurements -Error-disturbance relations -Standard quantum limits - Quantum non-demolition measurements	
UNIT – 3	**8 Hours**
States of light	
Fock states -Coherent states-Squeezed states-Tomography -Wigner quasi-probability distribution - P-distribution -Husimi Q function	
UNIT – 4	**8 Hours**
Quantum photo detection	
Square-law detectors, Intensity measurements and Photo-detection-Linear Detectors and Quadrature Measurements	
UNIT – 5	**8 Hours**
Quantum sensing applications	
Quantum Cramer-Rao bounds - Single photon-based sensing applications -Entanglement based sensing applications -Atomic state-based sensing, solid-state spin-based sensing applications (gravimetry, magnetometry)	

Course Outcomes	
At the end of the course student will be able to	
1.	Understand the principles of classical sensing and noise in photodetection systems.
2.	Analyze quantum measurement processes and their fundamental limits.
3.	Understand and characterize quantum states of light.
4.	Explore the theory and implementation of quantum photo-detection techniques.

5.	Evaluate applications of quantum sensing in modern physics and engineering.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
												1	2
EEE378.1	2	2	2	2	2		1				1	2	2
EEE378.2	2	2	2	2	2		1				1	2	2
EEE378.3	2	2	2	2	2		1				1	2	2
EEE378.4	2	2	2	2	2		1				1	2	2
EEE378.5	2	2	2	2	2		1				1	2	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Quantum Measurement and Control,	Howard Wiseman and David Milburn,	Cambridge University Press	(2014)
2.	Quantum Information Science	Manenti R., Motta M.,	1st Edition, Oxford University Press	(2023)

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Quantum Measurement,	Vladimir Braginsky and Farid Ya Khalili,	Cambridge University Press	(1995)

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc23_ph45/preview

QUANTUM MATERIALS			
Course Code	EEE379	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	PEC
PREREQUISITE:			

Course Objectives	
1.	Explain the band structure of solids and distinguish between metals, semiconductors, and insulators.
2.	Understand techniques for magnetic measurements and analyze transport phenomena such as the Hall effect and magnetoresistance.
3.	Describe the Josephson effects and their role in superconducting quantum devices.
4.	Understand the mathematical and physical foundations of topology in condensed matter physics.
5.	Understand bulk crystal growth methods and their importance in developing high-quality quantum materials.

Course Contents	
UNIT – 1	**9 Hours**
Band theory basics	
Metals, Semiconductors and Insulators-Band structure of solids -Survey of semiconducting devices for quantum technologies (electronic, quantum optical devices and principle of operation) -Correlated systems	
UNIT – 2	**9 Hours**
Magnetism	
Para, ferro magnetism basics -Magnetic measurements, hall effect, magnetoresistance -Faraday and Kerr effects	
UNIT – 3	**9 Hours**
Superconductivity & 2D materials	
BCS theory-Ginzburg Landau -Josephson Effect – AC and DC Josephson effects -Survey of superconducting devices for quantum technologies - Graphene and its properties – single and few layers -Transition Metal Dichalcogenides – Electronic and Optical Properties	
UNIT – 4	**9 Hours**
Topological Phases of matter	
Basics of Topology ○ Geometric phases - Berry Phase -Aharonov Bohm effect -Topological phases of matter	
UNIT – 5	**9 Hours**
Survey of material growth techniques	
Molecular beam epitaxy -Chemical vapor deposition, MOVPE -Pulsed laser deposition, etc. -Crystal growth techniques	

Course Outcomes	
At the end of the course student will be able to	
1.	Understand the fundamentals of band theory and material classification based on electronic properties.
2.	Analyze magnetic phenomena and their experimental characterization.
3.	Understand the theory and applications of superconductivity and 2D materials in quantum technologies.
4.	Explore topological phases of matter and the role of geometry and topology in quantum systems.

5.	Evaluate various material growth and fabrication techniques essential for quantum material synthesis.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
												1	2
EEE379.1	2	2	2	2			2				1	1	2
EEE379.2	2	2	2	2			2				1	1	2
EEE379.3	2	2	2	2			2				1	1	2
EEE379.4	2	2	2	2			2				1	1	2
EEE379.5	2	2	2	2			2				1	1	2

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Condensed Matter Physics	M P Marder,	2nd Edition, John Wiley and Sons	2010
2.	Introduction to Superconductivity,	Michael Tinkham,	standard ed., Medtech	2017

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Fundamentals Of Quantum Materials: A Practical Guide To Synthesis And Exploration	Johnpierre Paglione (Nicholas P Butch , Efrain E Rodriguez	World Scientific Publishing Co Pte Ltd	2021

E Books / MOOCs/ NPTEL

1.	https://www.quantech.org.in/courses/quantum-materials-and-devices

Humanities, Social Sciences, and Management Courses (HSMC)

INDIAN KNOWLEDGE SYSTEM AND INDIAN CULTURE

Course Code	**HSS104**	**Course Type**	**HSMC**
Teaching Hours/Week (L:T:P:S)	**2:0:0:0**	**Credits**	**02**
Total Teaching Hours	**30**	**CIE+SEE Marks**	**50+50**

Teaching Department: Humanities

Course Objectives

1.	To provide students with a comprehensive understanding of Indian culture, its knowledge systems, and historical roots, fostering analytical skills to evaluate cultural concepts.
2.	To enhance students' knowledge of India's rich heritage, including its history, engineering technology, architecture, and traditional wisdom, while exploring their relevance to modern living ideals.
3.	To understand the approaches in Indian Traditional Knowledge on Environmental Protection and Sustainable growth
4.	To integrate ancient Indian wisdom with modern scientific paradigms, enabling students to recognize its scientific value and compare it with contemporary knowledge systems.

UNIT – I

Introduction to Indian Knowledge System — **04 Hours**

- **Indian Traditional/Indigenous Knowledge**: Definition, Types, Scope and Importance
- **IKS as a Multidisciplinary Domain**: Philosophy, Science, Technology, Arts and literature
- **Traditional Education System**: Takshashila and Nalanda University; Pedagogical Methods: Gurukula system, Oral traditions, and Experiential learning

Introduction to Indian Civilization and Culture — **06 Hours**

- **Indian Culture**: Definition, Characteristics, Importance, and Scope; Influence of Historical Invasions, Trade, and Colonization on Indian Culture; +Influence of Geography on Indian Cultural Practices
- **Sources of Knowledge on Indian Culture**: Archaeological, Literary, and Traditional Practices
- **Civilization and Technological Advances**: Pre-Harappan and *Saraswathi Civilization,* Sindhu Valley Civilization - Town planning, drainage systems, water conservation, and marine technology
- **Influence of Social and Political Structures** on Cultural Growth and Knowledge Transmission; Concepts of Purusharthas, Varnashrama dharma, Chaturashrama dharma

UNIT – II

Economy, Healthand Environmental Sustainability — **06 Hours**

- **Scientific and Technological Sustainability Practices**: Vedic and Post-Vedic Records, Architectural Principles, Water Harvesting Systems, Agricultural Techniques, and Environmental Sustainability Practices
- **Economic and Industrial Contributions**: IKS's role in Pharmaceuticals, Agriculture, Textiles, Handicrafts, Cosmetics, and Eco-friendly Innovations
- **Holistic Healthcare and Ayurveda**: Origins, Core Philosophy, and Concepts of Tridosha (Vata, Pitta, Kapha); Facets of Yoga, Ayurvedic Healing, Panchakarma, and Rejuvenation Practices
- **Sustainability and Innovation**: Traditional Knowledge (TK) as a Driver in Environmental Conservation and Green Technologies
- **Government Initiatives and Community Empowerment**: Role of TKDL, AYUSH Ministry, and NIF in Preserving and Promoting Traditional Knowledge - Geographical Indications (GI)

Engineering, Science, and Technological Innovations — **06 Hours**

- **Mathematical Innovations**: Contributions of Aryabhata, Brahmagupta, and Bhaskara I & II; Decimal System, Zero, Algebra, Trigonometry, Calculus, and Vedic Mathematics
- **Material Science and Metallurgy**: The Iron Pillar of Delhi, Wootz Steel, Zinc Extraction, and

Laboratory developments

- **Science and Astronomy**: Fundamental Concepts in Matter, Life, and the Universe; Panchabhutas: Ancient Indian Understanding of Natural Elements; Gravity, Celestial mechanics (Sage Agastya's model of the battery)
- **Astronomy and Cosmology**: Vedic Cosmology, timekeeping, planetary models, solar/lunar phenomena, and the velocity of light in ancient texts
- **Technological Insights**: Vimaana Shastra (Aeronautics) and Ancient Indian Theories on Flight and Propulsion

UNIT – III

Cultural Heritage and Artistic Expressions	**08 Hours**

- **Literature and Intellectual Traditions**: Vedas, Upanisads, Puranas, Ramayana Mahabhartha; Classical Literature: Kalidasa, Banabhatta, Tirukkural, Panchatantra, Jataka Tales and Hitopadesha; Dravidian Languages and Literary Heritage – Kannada, Tamil (Sangama), Malayalam, Telugu
- **Ethical and Value-Based Knowledge** in Sacred Texts and Cultural Narratives
- **Art and Architecture**: Indus Valley Artifacts and Symbols; Temple Architecture: Nagara, Dravidian, and Vesara Styles; Folk Art and Craft Traditions
- **Performing Arts and Music**: Classical Dance Forms; Classical Music Traditions; Traditional Theatre; Folk Arts

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

1.	Demonstrate an in-depth understanding of Indian cultural heritage, knowledge systems, and historical developments, with the ability to critically analyze their relevance in contemporary contexts.
2.	Apply insights from ancient Indian wisdom to enhance scientific thinking, ethical decision-making, and sustainable living practices in alignment with modern societal needs.
3.	To adopt sustainable growth approach of the Indian Knowledge System in modern scientific and technological practices.
4.	To integrate ancient Indian wisdom with modern scientific paradigms recognizing its scientific value.

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
HSS104.1	-	-	-	-	-	1	2	1	1	2	1	3	-	-
HSS104.2	-	-	-	-	-	1	2	1	1	2	1	3	-	-
HSS104.3	-	-	-	-	-	-	2	-	1	2	-	3	-	-
HSS104.4	-	-	-	-	-	-	2	-	1	2	-	3	-	-

1: Low 2: Medium 3: High

REFERENCES:

1.	Jha, A., "Traditional Knowledge System in India", Atlantic Publishers, 2002.
2.	Kapoor, K., & Danino, M., "Knowledge Traditions and Practices of India", 2012.
3.	Kapil Kapoor, Michel Danino, "Knowledge Traditions and Practices of India", Medknow Publications and Media.
4.	Jha, R.N., "Science of Consciousness Psychotherapy and Yoga Practices", Delhi: Vidyanidhi Prakashan, 2015.
5.	TEDx Talks. (2015, February 6). Unleashing the Power of Traditional Medicine | Dr. Arvind Singh [Video file]. Retrieved from https://www.youtube.com/watch?v=LZP1StpYEPM

GENDER, DIVERSITY & INCLUSION

Course Code	**HSS103**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**01**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+0**
Pre-requisite			

Teaching Department: Any

Course Objectives:

1.	To provide students with a critical understanding of gender, diversity, and inclusion from a multidisciplinary perspective
2.	To explores key theories, policies, and practices that shape social and workplace environments

Unit - I

Introduction to Gender and Diversity	**07 Hours**

Key concepts- Gender & Sex; Key Theories- Feminism, Queer Theory, & Intersectionality; Gender Identity and Sexual Orientation; Cultural and Historical Perspectives on Gender; Discrimination, Privilege, and Power Structures

Unit - II

Workplace Inclusion & Global Perspectives	**08 Hours**

Diversity in the Workplace; Gender Pay Gap; Inclusive Leadership and Allyship; Unconscious Bias; International Gender and Diversity Policies; LGBTQ+ Rights and Representation

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

1.	Analyze Key Concepts and Theories of Gender and Diversity
2.	Evaluate Workplace and Global Policies for Inclusion

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
HSS103.1		1				2	2		3					
HSS103.2								3	2	1		1		

1: Low 2: Medium 3: High

REFERENCES:

1.	Geetha, V. *Gender: Theorizing feminism*. Kolkatta: Web Impressions, 2009
2.	Chakravarthi, Uma. *Gendering Caste: through a feminist lens*. New Delhi: Sage Publications India Pvt. Ltd, 2018.
3.	Menon, Nivedita. *Seeing like a Feminist*. Gurgaon: Penguin Random House India, 2012.
4.	Butler, Judith. *Gender Trouble: Feminism and the Subversion of Identity*. New York and London: Taylor & Francis and Routledge, 1999.
5.	Berger, John. *Ways of Seeing*. Great Britain: Penguin Books, 1972.
6.	Goffman, Erving. *The Presentation of Self in Everyday Life*. USA: Random House, 1959.
7.	Cranny-Francis, Anne et al., *Gender Studies: Terms and Debates*. New York: Palgrave Macmillan, 2003
8.	Cavallaro, Dani. *The Body for Beginners*. Chennai: Orient Longman, 2001.
9.	Foucault, Michel.*The History of Sexuality Volume 1: An introduction*. New York: Pantheon Books, 1978.
10.	Grogan, Sarah. *Body Image: Understanding body dissatisfaction in men, women and children*. London: Routledge, 1999.

MANAGEMENT, ENTREPRENEURSHIP & IPR

Course Code:	**MGM102**	**Course Type:**	**HSMC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Any

Course Objectives:

1.	To introduce the field of management, task of the manager, importance of planning and types of planning, staff recruitment and selection process.
2.	To discuss the ways in which work is allocation, structure of organizations, modes of communication and need of coordination between the manager and staff
3.	To explain the role and importance of the entrepreneur and their functions in economic development and the concepts of entrepreneurship.
4.	To explain the role of IPR for effective business process.
5.	To explain the role of IT Act.

UNIT-I

Management:	**03 Hours**
Definition, Importance – Nature and Characteristics of Management, Management Functions, Roles of Manager, Levels of Management, Managerial Skills, Management & Administration, Management as a Science, Art &Profession.	
Planning:	**04 Hours**
Nature, Importance and Purpose of Planning, Types of Plans, Steps in Planning, Limitations of Planning, Decision Making – Meaning, Types of Decisions- Steps in Decision Making.	
Organizing and Staffing	**03 Hours**
Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization, Committees – meaning, Types of Committees, Centralization Versus Decentralization of Authority and Responsibility, Span of Control (Definition only), Nature and Importance of Staffing, Process of Selection and Recruitment.	

UNIT-II

Directing and controlling	**04 Hours**
Meaning and Nature of Directing-Leadership Styles, Motivation Theories Communication – Meaning and Importance, Coordination- Meaning and Importance, Techniques of Coordination. Controlling – Meaning, Steps in Controlling	
Social Responsibilities of Business:	**03 Hours**
Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics, and Corporate Governance.	
Institutional Support for Business Enterprises	**03 Hours**
Introduction, Policies & Schemes of Central–Level Institutions, State-Level Institutions	

UNIT-III

Entrepreneurship	**05 Hours**
Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Intrapreneur – An Emerging Class, Comparison between Entrepreneur and Intrapreneur, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship.	
Modern Small Business Enterprises	**05 Hours**
Role of Small-Scale Industries, Concepts and definitions of SSI Enterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Impact of Globalization on SSI, Impact of WTO/GATT on SSIs, Ancillary Industry and Tiny Industry (Definition only).	

UNIT-IV	
Intellectual Property Rights (IPR)	**4 Hours**
Introduction to IPR: Business Perspective, IPR in India – Genesis and Development, International Context, Concept of IP Management, Uses in marketing	
Types of Intellectual Property	**4 Hours**
Patent- Procedure, Licensing and Assignment, Infringement and Penalty, Trademark, Example of Trademarks- Domain name, Geographical Indications, Copyright, Industrial Designs, Class Discussion - Major Court Cases regarding violation of Patents	
UNIT-V	
Basic Tenets of Information Technology Act, 2000	**7 Hours**
IT Act – Introduction, E-Commerce and Legal Provisions, E- Governance, Digital signature and Electronic Signature, Cybercrimes	

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

1.	Describe the field of management, the task of the manager, planning, and steps in decision making.
2.	Discuss the structure of the organization, importance of staffing, leadership styles, modes of communication, techniques of coordination, and importance of managerial control in the business.
3.	Describe the concepts of entrepreneurship and a businessman's social responsibilities towards different groups.
4.	Explain the significance of patents and all its associated issues.
5.	Discuss the different aspects of IT Act 2000.

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**	**3**
	3	-	-	-	-	-	-	2	2	-	3	2	-	1	3
	3	-	-	-	-	-	-	2	2	-	3	2	-	2	3
	3	-	-	-	-	-	-	2	2	-	3	2	-	2	3
	3	-	-	-	-	-	-	2	2	-	3	2	-	2	3
	3	-	-	-	-	-	-	2	2	-	3	2	-	2	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	P. C. Tripathi, P. N. Reddy, "Principles of Management", McGraw Hill, 6th Edition, 2017.
2.	Poornima M. Charanthimath, "Entrepreneurship Development and Small Business Enterprises", Pearson 2nd Edition, 2014.
3.	W.D Stevenson, "Elements of Power System Analysis", 4th edition, TMH, 2001.

REFERENCE BOOKS:

1.	Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 2007.
2.	Harold Koontz, Heinz, Weihrich, "Essentials of Management: An International, Innovation and Leadership perspective", McGraw Hill, 10th Edition, 2016.
3.	Tidd, J., & Bessant, J., "Managing Innovation: Integrating Technological, Market and Organizational Change", Wiley, 2021.
4.	Reddy, G. B., "Intellectual Property Rights and the Law", Gogia Law Agency, 2012.
5.	Wadehra, B. L., "Law relating to Intellectual Property", Universal Law Publishing Co., 2011
6.	Narayanan, P., "IPR", Eastern Law House Private Ltd, 2017.
7.	Myneni, S. R. "Law of Intellectual Property", Asian Law House, 2022.

GLOBALIZATION AND ITS IMPLICATIONS

Course Code	**HSS106**	**Course Type**	**HSMC**
Teaching Hours/Week (L:T:P:S)	**02:0:0:0**	**Credits**	**02**
Total Teaching Hours	**30+0+0**	**CIE + SEE Marks**	**50 + 50**

Teaching Department: Any

Course Objectives:

1.	To introduce students to Globalization
2.	Review the changing manner in which globalization has impacted on the questions of international boundaries and state territory over time and its wider implications for society, business and communications.
3.	Familiarize learners with various debates in contemporary world on the importance and impact of Globalization.
4.	Understand the implications of globalization for the conduct of international trade and communications.

UNIT - I

10 Hours

- Globalization and the 21 st century world
- Globalization and its Implications - Globalization and its Linkages to Geography, Politics, Science, International Business and Communications.
- Multiple Dimensions of Globalization

UNIT - II

10 Hours

- Globalization and Universalization, Internationalization, Westernization, Modernization
- Globalization and Modern Technology- The impact of Digital technology on Globalization;

UNIT - III

10 Hours

- Two relevant Case Studies of Globalization in any of the following areas

a) Social Media and Globalization
b) E-governance and Globalization
c) E-commerce and globalization
d) Modern Science and Globalization

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

1.	Understand the Concept of Globalization
2.	Analyze the Dimensions of Globalization
3.	Examine the Role of Technology in Globalization
4.	Apply Knowledge through Case Studies

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
HSS106.1														
HSS106.2														

HSS106.3														
HSS106.4														

1: Low 2: Medium 3: High

REFERENCE BOOKS

1	Anand, Kewal, (2010) Media, Policy and Globalisation, Swastik Publications: New Delhi
2	Bardhan, Pranab, (2015) Globalisation, Democracy and Corruption an Indian Perspective. London: Frontpage Publications.
3	Bhagwati, Jagdish, (2008) In Defence of Globalisation, Oxford University Press: New Delhi
4	Bremmer, Ian, (2018) Us vs. Them: The Failure of Globalisation. New York: Portfolio.
5	Friedman, Thomas L, (2016) The World is Flat: The Globalised World in the Twenty-First Century. England: Penguin Books.
6	Kumar, Chanchal. L Riamei and Sanju Gupta, (2017) Understanding Global Politics. New Delhi: KW Publishers Pvt Ltd.
7	Livesey, Finbar, (2017) From Global to Local: The Making of Things and the End of Globalisation. United States: Pantheon Books.
8	OECD, (2009) International Migration: The Human Face of Globalisation.
9	Steger, Manfred B, (2017) Globalisation – A Very Short Introduction. England: Oxford University Press.

PROJECT MANAGEMENT FOR PROFESSIONALS			
Course Code	**MGM104**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:J)	**3:0:0:2**	**SEE Marks**	**50**
Total Hours of Pedagogy	**30+0+0+15**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

Course Learning Objectives

1	Understand the concepts of project management from planning to execution and how to apply them in projects.	
2	Prepare the resource, schedule, cost planning for an industrial project.	
3	Identify the risk and its management.	
4	Usage of MS Project as a tool for project management and monitoring.	

Unit -I

Contract Management and schedule Management	**Duration : 6 hrs**

Introduction to Project Management, Project and Project Lifecycle – Process, Phases, Organization, Project Financial Feasibility Methods, Non-numerical Feasibility Methods.

Basic Concepts of Contract Management, Essential elements, Contract Types, Tendering and Proposal Preparation, Key Commercial Terms and Conditions, Bid Evaluation and Contract Award, Contract Administration, Claim Management. Work Breakdown Structures- Creation & Case Study

Approach to schedule management, Charts, Sequencing and Dependency, Network Diagram, Activity Duration, Critical Path Method, Float, Case study, Relationships, Case Study, Precedence Diagramming Method.

Unit -II

Resource Management	**Duration : 6 Hrs**

Resource Allocation and Resource Levelling, Case Study on Schedule Compression, PERT to Predict the Probability of Project Completion.

Project Cost and Quality Management	**Duration : 6 Hrs**

Cost Estimation, Budget and Variance Analysis, Monitoring and Control, Cash Flows, Case Study.
Occupational Health, Safety and Environment, Barriers, Quality Management System – Chart and tools

UNIT-III

Procurement, Subcontracts and Stakeholder Management	**Duration : 6 Hrs**

Supply Chain Management, Logistics and Transportation, Vendor and Inventory Management.
Stakeholder Analysis and Engagement, Project Communication, Dealing with Difficult Stakeholders

Project Risk Management and Project Monitoring	**Duration : 6 Hrs**

Process, Terminology, Identification, Analysis and Response Strategy
Analysis Techniques, Monitor and Control Schedule, Cost, Resources, Quality and risks
Creating schedules, Assigning Resources, Cost, Evaluation, Optimization and Tracking

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

1.	Develop WBS and estimate the resource requirements
2.	Prepare bar charts for work schedule
3.	Analyse the resource management methods
4.	Understand the quality control and safety during construction
5.	Create a project monitoring plan

TEXT BOOKS:

REFERENCE BOOKS Project management institute, Guide to the Project Management Body of Knowledge (PMBOK® Guide), seventh edition/2022.

Web links and Video Lectures (e-Resources):
L&T EduTech LMS Content

PO-CO mapping

Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	1	2	3		2						2	1			
CO 2	1		3		2						2				
CO 3	1	3	2	2	1						1				
CO 4	1	1	3	1		2	1				2	1			
CO 5	1	2	3	1	2	1			1		3	1			

1: Low 2: Medium 3: High

ECONOMICS AND FISCAL MANAGEMENT – AN ENGINEER'S PERSPECTIVE

Course Code	MGM101	Course Type	HSMC
Teaching Hours/Week (L:T:P:S)	3:0:0:0	Credits	03
Total Teaching Hours	45	CIE	50

Teaching Department: Humanities/Any

Course Objectives:

1. To equip engineering students with a foundational understanding of micro and macroeconomic principles relevant to engineering projects.
2. To develop the ability to apply cost analysis, budgeting, and financial planning in technical and infrastructure projects.
3. To bridge the gap between technical feasibility and economic viability in engineering decision-making.
4. To introduce fiscal policies and their impact on engineering enterprises and public infrastructure.
5. To foster interdisciplinary thinking between engineering design and financial management.

Unit - I 08 Hours

Fundamentals of Economics for Engineers

Basic economic concepts: Microeconomics and Macroeconomics, Demand and Supply – Law of Demand, Law of Supply, Factors determining the Demand and Supply

Role of engineers in economic development

Financial Management

Concepts and Meaning – Introduction to Finance; Objectives of Financial Management; Profit Maximization; EVA; Changing Role of Financial Managers.

Unit - II 12Hours

Time value of money

Interest Rate Calculations, Simple Interest, Compound Interest, Effective Rate of Interest

Capital Budgeting (Investment Evaluation Techniques)

Payback Period Method; Present Worth Method; Annual Worth Method; Profitability index method; Estimation of IRR

Unit - III 08 Hours

Cost Classifications (Total Cost, Fixed Cost, Variable Cost, Marginal Cost)

Break Even Analysis (Break Even Pont and Margin of Safety Estimation)

Depreciation: Meaning, Methods of Depreciation Estimation, Estimation of Sunk Cost

Unit - IV 09 Hours

Cost of Capital

Sources of various Types of Capital and Estimation; Cost of Debenture Capital; Cost of Preferential Capital; Cost of Term Loans; Cost of Equity Capital.

Working Capital

Factors influencing Working Capital Requirements

Unit - V 08 Hours

Inventory Management

Techniques of Inventory Management and Control –EOQ, ABC Analysis, Just-in-Time (JIT) System

Fiscal Management and Public Policy

Government budgets: capital vs. revenue expenditure; Taxation policies and their impact on engineering projects; Public-private partnerships (PPP); Infrastructure financing and subsidies

Course Outcomes:

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

1. Analyze economic principles and apply them to real-world engineering problems.
2. Perform cost estimation, benefit-cost analysis, and evaluate financial viability of engineering projects.
3. Prepare and interpret budgets and financial statements relevant to engineering firms and projects.
4. Understand the implications of government fiscal policy on engineering industries.
5. Integrate economic reasoning into project design and management.

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
MG---- - .1	-	-	-	-	-	2	-	-	1	2	2	3	-	-
MG---- - .2	-	-	-	-	-	2	-	-	1	3	2	3	-	-
MG---- - .3						2			1	2		3		
MG---- - .4						2			1	2		3		
MG---- - .5						2			1	2		3		

Reference books:

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.
4. Prasanna Chandra, “Financial Management”, 6th Edition, 2004; Tata McGraw Hill Publishing Company Ltd, New Delhi.
5. "Engineering Economy" by Leland Blank & Anthony Tarquin; McGraw-Hill Education
6. "Managerial Economics and Financial Analysis" by R. Narayanaswamy; PHI Learning

Online Resources and MOOCs

NPTEL Online Courses (by IITs)

1. Economics for Engineers (Prof. Trupti Mishra – IIT Bombay)
2. Financial Management for Managers (Prof. Anurag Singhal – IIT Roorkee)

Coursera / edX

1. Introduction to Financial Accounting – University of Pennsylvania (Coursera)
2. Infrastructure Finance – Delft University of Technology (edX)

Case Studies & Government Reports:

1. World Bank – Infrastructure & Fiscal Policy Reports (Available at worldbank.org)
2. Planning Commission / NITI Aayog Reports (On public-private partnerships (PPP), infrastructure investment, and fiscal planning in India)

OPERATIONS RESEARCH AND PROJECT MANAGEMENT

Course Code:	**MGM103**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Electronics & Communication Engineering

Course Objectives:

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

UNIT-I

Introduction to Linear Programming Problem — **16 Hours**

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.

UNIT-II

Simplex Method and Transportation Problem — **16 Hours**

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.
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.

UNIT-III

Assignment Problem and Network Management — **08 Hours**

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.

Course Outcomes: At the end of the course 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.

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**	**3**
MG1004-1.1	2	3	-	-	-	-	-	1	1	1	-	1			
MG1004-1.2	3	-	-	-	-	-	-	1	1	1	-	1			
MG1004-1.3	3	-	-	-	-	-	-	1	1	1	-	1			
MG1004-1.4	2	3	-	-	-	-	-	1	1	1	-	1			
MG1004-1.5	2	3	-	-	-	-	-	1	1	1	-	1			

1: Low 2: Medium 3: High

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.

E Books / MOOCs/ NPTEL

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

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

Mandetory Non Credit courses (MNC)

ಆಡಳಿತ ಕನ್ನಡ (Kannada for Administration)

Course Code	**HSS105**	**Course Type**	**MNC**
Teaching Hours/Week (L:T:P:S)	**1:0:0:0**	**Credits**	**0**
Total Teaching Hours	**15**	**CIE + SEE Marks**	**50+0**

Teaching Department: Respective Department

Course Objectives:

1.	ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಕನ್ನಡ ನಾಡು,ನುಡಿ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಮೂಲಭೂತ ಸಂರಚನೆಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
2.	ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ತಾಂತ್ರಿಕ ಕನ್ನಡ, ಆಡಳಿತಾತ್ಮಕ ಸಂವಹನ ಮತ್ತು ಆಡಳಿತ ಕನ್ನಡವನ್ನು ಪರಿಚಯಿಸುವುದು.

Unit - I

09 Hours

ಲೇಖನಗಳು:

1. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ: ಹಂಪನಾಗರಾಜಯ್ಯ
2. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ: ಒಂದು ಅಪೂರ್ವಚರಿತ್ರೆ - ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ
3. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ವಿತಾವಿಯ ಆಡಳಿತ ಕನ್ನಡ ಪುಸ್ತಕದಿಂದ ಆಯ್ದ ಲೇಖನ

ಕಾವ್ಯಭಾಗ (ಆಧುನಿಕಪೂರ್ವ)

1. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿಲಕ್ಕಮ್ಮ
2. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ - ಪುರಂದರದಾಸ
3. ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳುಮನವೆ - ಕನಕದಾಸ
4. ತತ್ವಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳಸುಟ್ಟು - ಶಿಶುನಾಳಪಂಥಷರೀಫ
5. ಶಿವಯೋಗಿ: ಬಾಲಲೀಲಾ ಮಹಾಂತ ಶಿವಯೋಗಿ
6. ಜನಪದಗೀತೆ: ಬೀಸುವಪದ, ಬಡವರಿಗೆ ಸಾವ ಕೊಡಬೇಡ

ಕಾವ್ಯಭಾಗ (ಆಧುನಿಕ)

1. ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ: ಡಿ.ವಿ.ಜಿ.
2. ಕುರುಡು ಕಾಂಚಾಣ: ದ.ರಾ.ಬೇಂದ್ರೆ
3. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು
4. ಹೆಂಡತಿಯ ಕಾಗದ: ಕೆ .ಎಸ್. ನರಸಿಂಹಸ್ವಾಮಿ
5. ಮಬ್ಬಿನಿಂದ ಮಬ್ಬಿಗೆ: ಜಿ. ಎಸ್. ಶಿವರುದ್ರಪ್ಪ
6. ಆಮರ ಈ ಮರ: ಚಂದ್ರಶೇಖರ ಕಂಬಾರ
7. ಚೋಮನ ಮಕ್ಕಳ ಹಾಡು: ಸಿದ್ಧಲಿಂಗಯ್ಯ

Unit – II

06 Hours

ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ

1. ಡಾ. ಸ ಎಂ ವಿಶ್ವೇಶ್ವರಯ್ಯ – ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ: ಎ ಎನ್ಮೂರ್ತಿ ರಾವ್
2. ಯುಗಾದಿ: ವಸುಧೇಂದ್ರ
3. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ: ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ:

1. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ: ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ
2. 'ಕ' ಮತ್ತು 'ಬ' ಬರಹ ತಂತ್ರಾಂಶಗಳು ಮತ್ತು ಕನ್ನಡ ಟೈಪಿಂಗ್
3. ಕನ್ನಡ: ಕಂಪ್ಯೂಟರ್ಶಬ್ದಕೋಶ
4. ತಾಂತ್ರಿಕ ಪದಕೋಶ: ತಾಂತ್ರಿಕ ಹಾಗೂ ಪಾರಿಭಾಷಿಕ ಕನ್ನಡ ಪದಗಳು

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

1.	ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು ಹಾಗೂ ಕನ್ನಡ ಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡುನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು ಮತ್ತು ಕನ್ನಡಭಾಷೆಯ ವ್ಯಾಕರಣ ಮತ್ತು ಭಾಷಾ ರಚನೆಯ ನಿಯಮಗಳ ಅರಿವನ್ನು ಮೂಡಿಸುವುದು
2.	ಕನ್ನಡ ಭಾಷಾ ಬರೆಯುವಲ್ಲಿ ಉಂಟಾಗುವ ದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ಪರಿಹಾರವನ್ನು ಅರಿತುಕೊಳ್ಳುವುದು, ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆ ಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವನ್ನು ಮೂಡಿಸುವುದು, ಮತ್ತು ಕನ್ನಡಭಾಷಾ ಅಭ್ಯಾಸದಲ್ಲಿ ಸಾಮಾನ್ಯ ಕನ್ನಡ ಮತ್ತು ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವನ್ನು ಮಾಡಿಕೊಡುವುದು

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
HSS105.1								3			1	1		
HSS105.2								2			1	1		

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	ಸಂಕ್ಷಿಪ್ತ ಕನ್ನಡನಿಗಂಟು (ಪರಿಷ್ಕೃತ), ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್, ಬೆಂಗಳೂರು.
2.	ಆಡಳಿತ ಪದಕೋಶ, ಕನ್ನಡ ಅಭಿವೃದ್ಧಿಪ್ರಾಧಿಕಾರ, ಬೆಂಗಳೂರು.
3.	ಕಾನೂನು ಪದಕೋಶ (ಪರಿಷ್ಕೃತ) ಕನ್ನಡ- ಇಂಗ್ಲಿಷ್, ಕನ್ನಡ ಮತ್ತು ಸಂಸ್ಕೃತಿ ನಿರ್ದೇಶನಾಲಯ, ಬೆಂಗಳೂರು.
4.	ಡಿ.ಎನ್. ಶಂಕರ್ಭಟ್, ಕನ್ನಡವಾಕ್ಯಗಳ ಒಳರಚನೆ, ೨೦೦೬, ಭಾಷಾಪ್ರಕಾಶನ, ಮೈಸೂರು.
5.	ಕನ್ನಡ ಭಾಷಿಕ (ಅವಿಸ್ತರ)- ಪ್ರಬಂಧ ಮತ್ತು ಆಡಳಿತ ಕನ್ನಡ, ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮುಕ್ತ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಮೈಸೂರು.
6.	ಆಡಳಿತ ಕನ್ನಡ, ಎಚ್ಚೆಸ್ಕೆ, ಚೇತನ ಬುಕ್ಹೌಸ್, ಮೈಸೂರು.

BALAKE KANNADA (Communication in Kannada)

Course Code	**HSS105**	**Course Type**	**MNC**
Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**0**
Total Teaching Hours	**15+0+0**	**CIE + SEE Marks**	**50+0**

Teaching Department: Respective Department

Course Objectives:

1.	The course will enable the students to cognize Kannada and communicate in basic Kannada language.
2.	Develop proficiency in conversing daily in Kannada, enriching basic Kannada vocabulary, and acquiring knowledge about Karnataka and its culture

Unit - I

06 Hours

Basic Kannada Grammar

1. Personal Pronouns, Possessive Forms, Interrogative words
2. Possessive forms of nouns, Dubitive question and Relative nouns
3. Qualitative, Quantitative and Colour Adjectives, Numerals
4. Predictive Forms, Locative Case
5. Dative Cases, and Numerals
6. Ordinal numerals and Plural markers
7. Defective / Negative Verbs and Colour Adjectives
8. Permission, Commands, encouraging and Urging words (Imperative words and sentences)
9. Accusative Cases and Potential Forms used in General Communication
10. Helping Verbs “iru and iralla”, Corresponding Future and Negation Verbs
11. Comparative, Relationship, Identification and Negation Words
12. Different types of forms of Tense, Time and Verbs
13. Formation of Past, Future and Present Tense Sentences with Verb Forms
14. Karnataka State and General Information about the State
15. Kannada Language and Literature
16. Do's and Don'ts in Learning a Language

Unit – II

09 Hours

Kannada Language Script Part – 1
Kannada Vocabulary List & Kannada Words in Conversation

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

1.	Understand the parts of speech of Kannada and acquire knowledge of the Kannada script.
2.	Be proficient in conversing daily in Kannada, enriching basic Kannada vocabulary, and gaining knowledge about Karnataka and its culture.

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
HSS105.1								3			1	1		
HSS105.2								2			1	1		

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	English –Kannada Rapidex Dictionary of Spoken Words, S N Raju, Bengaluru
2.	English Kannada Standard Dictionary, D K Bharadwaj, Sankeshwar Printers Pvt Ltd, Bengaluru
3.	ಮಾತಾಡುವ ಕನ್ನಡ, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್, ಬೆಂಗಳೂರು (೨೦೧೬).
4.	ಸಂಕ್ಷಿಪ್ತ ಕನ್ನಡನಿಗಂಟು (ಪರಿಷ್ಕೃತ), ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್, ಬೆಂಗಳೂರು.
5.	ಆಡಳಿತ ಪದಕೋಶ, ಕನ್ನಡ ಅಭಿವೃದ್ಧಿಪ್ರಾಧಿಕಾರ, ಬೆಂಗಳೂರು.
6.	ಕನ್ನಡ ಭಾಷಾಕೈಪಿಡಿ, ಸಂಗಮೇಶ್ವರ ದತ್ತಿಮಠ, ರೂಪರಶ್ಮಿ ಪ್ರಕಾಶನ, ಗುಲ್ಬರ್ಗ, ೧೯೯೫.
7.	ಡಿ.ಎನ್. ಶಂಕರ್ಭಟ್, ಕನ್ನಡ ವಾಕ್ಯಗಳ ಒಳ ರಚನೆ, ೨೦೦೬, ಭಾಷಾ ಪ್ರಕಾಶನ, ಮೈಸೂರು.
8.	ಕಾನೂನು ಪದಕೋಶ (ಪರಿಷ್ಕೃತ) ಕನ್ನಡ- ಇಂಗ್ಲಿಷ್, ಕನ್ನಡ ಮತ್ತು ಸಂಸ್ಕೃತಿ ನಿರ್ದೇಶನಾಲಯ, ಬೆಂಗಳೂರು.

EMPLOYABILITY SKILL DEVELOPMENT

Course Code:	**UCC102**	**Course Type**	**MNC**
Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**0**
Total Teaching Hours	**15+0+0+0**	**CIE + SEE Marks**	**50+00**

Teaching Department: Any

Course Objectives:

1.	To explain the students the necessity of clearing the aptitude tests irrespective of the written test is for jobs or higher education.
2.	To assess the readiness of the students to appear for the aptitude test and assisting them to better it if already ready, else train them.
3.	To evaluate the understanding of the students in answering quantitative multiple-choice questions and guide them to improve it.
4.	To evaluate the preparedness of the students to answer the analytical and logical questions.
5.	To evaluate the quality of the students with regard to their professional language grammar, vocabulary and communication skills.

UNIT-I

Quantitative **06 Hours**

Numbers (Odd, even, H.C.F & L.C.M, Square roots & cube roots, Average, Percentage), Ratios & Proportions, Partnership, Time & work, Pipes & Cistern, Speed, Problems on trains, Problems on boats & streams, Allegation & Mixtures.

UNIT-II

Analytical/ Logical **06 Hours**

Numerical logic (next number in series, odd man out), Coded language, Syllogism, Direction (N-E-W-S), Seating arrangement, Blood relations, Statement & Conclusion

UNIT-III

Verbal **03 Hours**

Vocabulary (root words, prefix, suffix, synonyms, antonyms), One word substitution, Idiom/phrases, Sentence completion, Active & Passive voice, Direct and indirect speech.

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

1.	Analyse and answer the quantitative multiple-choice questions.
2.	Analyse and answer the analytical and logical questions and demonstrate good communication 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	3
UM1003-1.1	3	3	-	-	-	-	-	-	2	2	1	-			
UM1003-1.2	3	3	2	-	-	-	-	-	2	2	1	-			

1: Low 2: Medium 3: High

TEXTBOOKS:

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.

REFERENCE BOOKS:

1.	Bharath Patodi and Aditya Choudhary, "Verbal Ability & Comprehension", Disha Publication, Second edition, 2015.
2.	Shakuntala Devi, "Joy of numbers", Orient Black Swan.
3.	Shakuntala Devi, "More puzzles to puzzle you", Orient Black Swan.

E Books / MOOCs/ NPTEL	
1.	https://www.indiabix.com
2.	https://www.faceprep.in

PROJECT/ INTERNSHIP COURSES

COMMUNITY ENGAGEMENT

Course Code	**UCC101**	**CIE Marks**	**100**
Teaching Hours/Week (L: T: P: S)	**-**	**SEE Marks**	-
Total Hours of Pedagogy	80-90 Hours (During I/II semesters)	**Total Marks**	**100** (Evaluation in I/II/III Semester and grades earned shall be included in IV Semester grade card)
Credits	**2**	**Exam Hours**	**--**

Course objective

This course is meant to provide students an opportunity to be involved in Inter/ Intra Institutional Activities. It enables students to learn about challenges faced by vulnerable households and develop an understanding of local wisdom and lifestyle in a respectful manner. It enables the students to

- Gain an understanding of rural life, Indian culture and ethos and social realities.
- Develop a sense of empathy and bonds of mutuality with the local community.
- Appreciate significant contributions of local communities to Indian society and economy.
- Learn to value the local knowledge and wisdom of the community
- Identify opportunities for contributing to community's socio-economic improvements.

Activities and evaluation: Refer section 11.5.1.1 and Appendix B - 3.2 for details

Course outcomes

1. Experience the working in Inter / Institutional activities
2. Work in teams and communicate efficiently both written and oral.
3. Develop the ability to do work in different activities, which will provide the necessary understanding and contribute to the same and provide a foundation to undergo higher level training in subsequent internships.

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	3
UCC101.1	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**-**
UCC101.2	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**-**
UCC101.3	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**-**
1: Low 2: Medium 3: High															

INTERNSHIP

Course Code:	**UCC201**	**Course Type:**	**UCC**
Teaching Hours/Week (L: T: P: S):	**Minimum 40 hours/week**	**Credits:**	**04**
Total Teaching Hours:	**-**	**CIE + SEE Marks:**	**50+50**

Course Objectives:

1.	This course is meant to provide students an avenue to understand the work environment, ethics and practices in an industry/organization and take up assignments/jobs in the future.

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

1.	Analyse and develop technical solutions for a specific problem that is assigned to them.
2.	Communicate ideas that are developed through brainstorming, presentation and prepare a report.
3.	Understand and inculcate industry practices in their professional career.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO↓**		
													1	**2**	**3**
UCC201.1	3	2	-	-	1	1	-	-	2	3	1	-	1	1	1
UCC201.2	3	2	-	-	1	1	-	-	2	3	1	-	1	1	1
UCC201.3	3	2	-	-	1	1	-	-	2	3	1	-	1	1	1

1: Low 2: Medium 3: High

CAPSTONE PROJECT PHASE I & II

Course Code:	**UCC301 & UCC302**	**Course Type:**	**UCC**
Teaching Hours/Week (L: T: P: S)	**UCC301=0+0+03+0 UCC302=0+0+30+0**	**Credits:**	UCC 301= 0 UCC302 = 10
Total Teaching Hours:	**-**	**CIE + SEE Marks:**	UCC 301= (50+0) & UCC302 = (100+100)

Course Objectives:

1.	To perform effective literature survey, identification of research problem / project idea.
2.	To develop skills of planning to execute the project
3.	To assess the needs and necessity of a project.
4.	To learn time management and documentation.
5.	To expose the students to research aspects like literature review, executing experiments and analysis of results.
6.	To expose the students to research aspects like literature review, executing experiments and analysis of results.

A group of students (not more than 4) is assigned to a guide/project supervisor. The students must do a thorough literature review and come out with a project plan. They are expected submit a project proposal (not more than 10 pages) including project idea, protocols, designs (if any), expected outcome, major requirements, and approximate budget. They shall present the same in a proposal seminar in front of the panel of internal examiners (involving guide) and shall get their proposal approved. The presentation must involve projected timeline of the project execution.

Assessment Details (both CIE and SEE)

CIE procedure: Shall involve project proposal, proposal seminar, continuous evaluation of the project progress by Guide and HOD. Monthly progress is evaluated.

Semester End Examination:

SEE procedure:
i)Single discipline: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department.
ii) Interdisciplinary: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.

SCHEME OF EVALUATION:
Project demonstration, Viva voce
Total marks: 100 Marks

The distribution of marks shall be proportioned based on the type of the project and it is based on fulfilling the following requisites.
The evaluation of students is proposed to be done by internal faculty with active involvement of industrial personnel. The evaluation may be based on following criteria:

- Punctuality and Attendance ¨ Interpersonal relations
- Sense of Responsibility
- Clarity of concepts, principles and procedures

- Self-expression/communication skills
- Report Writing Skills
- Creativity/conceiving new and unusual ideas
- Problem-solving skills

At the end of the project work course students are required to submit a working model of the equipment they have designed and developed or if it is a theoretical or experimental work, they are expected to study a detailed analysis and findings from their work.

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

1.	Use various methods or sources for finding literature and analyze data for relevance and appropriateness to the research project undertaken.
2.	Identify and propose suitable methods of analysis and/or design or develop appropriate experiments to address the specific research objectives.
3.	Apply suitable standardized method/s for experimental design.
4.	Analyze and interpret the research findings and compare with reported results to arrive at suitable conclusions.
5.	Adopt appropriate documentation protocol to organize research findings, learn good laboratory practices and work in a team.

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**	**3**
UCC301/ UCC302.1	-	1	-	-	2	2	3	1	-	-	-	1	1	2	2
UCC301/ UCC302.2	-	1	2	1	1	-	1	2	1	-	1	1	1	2	2
UCC301/ UCC302.3	-	1	2	2	1	-	1	1	1	1	1	1	1	2	2
UCC301/ UCC302.4	1	3	2	2	1	2	2	3	3	3	3	2	1	2	2
UCC301/ UCC302.5	-	1	1	-	1	2	2	3	3	3	3	1	1	2	2

1: Low 2: Medium 3: High

PROFESSIONAL PRACTICE

Course Code:	**UCC401**	**Course Type:**	**UCC**
Teaching Hours/Week (L: T: P: S)	**UCC401=0+0+40+0**	**Credits:**	UCC 401= 14
Total Teaching Hours:	**-**	**CIE + SEE Marks:**	UCC 401= (200+200)

Course Objectives:

1.	To perform effective literature survey, identification of research problem /industry project idea.
2.	To develop research/professional skills of planning to execute the Industry/Research project
3.	To assess the needs and necessity of a research/industry project.
4.	To learn time management and documentation.
5.	To expose the students to research aspects like literature review, executing experiments and analysis of results.

Motivated student who has been selected by Industry/research organization is assigned with a guide/project supervisor at Industry and also at the institution. The student must do a thorough literature review and come out with a project plan. The student is expected to submit a project/research proposal (not more than 10 pages) including project/research idea, protocols, designs (if any), expected outcome, major requirements, and approximate budget. They shall present the same in a proposal seminar in front of the panel consisting of internal and industry examiners (involving guides/supervisors) and shall get their proposal approved. The presentation must involve projected timeline of the project execution.

Assessment Details (Both CIE and SEE) (Refer Appendix B Section 5 for more details)

CIE procedure: Shall involve Industry/Research project proposal, proposal seminar, continuous evaluation of the project progress by Guide/supervisors and HOD. Monthly progress is evaluated and the final CIE marks is awarded out of 200.

Semester End Examination:

SEE procedure:
i)Single discipline: Contribution to the project and the performance of student shall be assessed in semester end examination (SEE) conducted at the department.
ii) Interdisciplinary: Contribution to the project and the performance of student shall be assessed in semester end examination (SEE) conducted by a panel of examiners involving the departments to which the supervisors belong to.

SCHEME OF EVALUATION:
Project demonstration/presentation, Viva voce
Total **SEE marks**: 200 Marks

The distribution of marks shall be proportioned based on the type of the project and it is based on fulfilling the following requisites.
The evaluation of students is proposed to be done by internal faculty with active involvement of industrial personnel. The evaluation may be based on following criteria:

- Punctuality and Attendance ¨ Interpersonal relations
- Sense of Responsibility
- Clarity of concepts, principles and procedures

- Self-expression/communication skills
- Report Writing Skills
- Creativity/conceiving new and unusual ideas
- Problem-solving skills

At the end of the project work course students are required to submit a working model of the prototype they have designed and developed or if it is a theoretical or experimental work, they are expected to present a detailed analysis and findings of their work.

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

1.	Utilization of various methods or sources for finding literature and analyze data for relevance and appropriateness to the research project undertaken.
2.	Identify and propose suitable methods of analysis and/or design or develop appropriate experiments to address the specific research objectives.
3.	Apply suitable standardized method/s for experimental design and perform experimentation.
4.	Analyze and interpret the research findings and compare it with reported results to arrive at suitable conclusions.
5.	Adopt appropriate documentation protocol to organize research findings, learn good industry/research practices and work with a team at industry/research organization.

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**	**3**
UCC401.1	-	1	-	-	2	2	3	1	-	-	-	1	1	2	2
UCC401.2	-	1	2	1	1	-	1	2	1	-	1	1	1	2	2
UCC401.3	-	1	2	2	1	-	1	1	1	1	1	1	1	2	2
UCC401.4	1	3	2	2	1	2	2	3	3	3	3	2	1	2	2
UCC401.5	-	1	1	-	1	2	2	3	3	3	3	1	1	2	2

1: Low 2: Medium 3: High

Open Elective Courses (OEC)

LIST OF OPEN ELECTIVE COURSES

Sl No.	Department	Course Codes	Open Elective Courses
1	AIM	AIM181	Intel Driven Empowering with AI And ML
2	AIM	AIM182	Introduction to AI and ML
3	AIM	AIM183	Exploring Neural Networks: Concepts, Techniques and Practical Applications
4	BTE	BTY181	Bioenergy Engineering
5	BTE	BTY182	Solid Waste Management
6	CHY	CHY281	Corrosion Science
7	CBS	CBS181	Business Management
8	CBS	CBS182	FinTech
9	CBS	CBS183	Business Communication
10	CBS	CBS184	Marketing Management
11	CSE	CSE181	Business Intelligence & Applications
12	CSE	CSE182	Cybersecurity
13	CSE	CSE 183	Principles of Mobile Computing
14	CSE	CSE184	Software Testing
15	CSE	CSE281	Data Structures using C
16	CSE	CSE282	Fundamentals of Internet of Things
17	CSE	CSE283	Object Oriented Programming with Java
18	CIV	CIV181	Introduction to Geoinformatics
19	CIV	CIV182	Sustainability Engineering
20	CIV	CIV183	Disaster Management
21	CIV	CIV184	Environmental Impact Assessment
22	ECE	ECE181	Consumer Electronics
23	ECE	ECE182	Space Technology and Applications
24	ECE	ECE183	Sensors & Actuators
25	ECE	ECE184	PCB Design and Fabrication
26	ECE	ECE281	Introduction to Microcontroller
27	ECE	ECE282	MEMS
28	ECE	ECE283	Communication Systems for Avionics
29	ECE	ECE284	Adhoc Wireless Networks
30	EEE	EEE281	Battery Management System
31	EEE	EEE282	Fundamentals of Biomedical Instrumentation
32	EEE	EEE283	Introduction to Electric Vehicle Technology
33	EEE	EEE284	Fundamentals of PLC and its applications
34	EEE	EEE285	Motors and Motor Control Circuits
35	EEE	EEE286	Non-Conventional Energy sources
36	HSS	HSS181	Elements of Yoga
37	HSS	HSS182	Intellectual Property Rights
38	HSS	HSS183	Introduction to Thenkuthittu Yakshagana
39	HSS	HSS184	National Cadet Corps: Organization, Functions & Capabilities
40	HSS	HSS185	Principles of Physical Education
41	HSS	HU1509-1	Indian Culture – Dance *
42	HSS	HU1510-1	Indian Culture – Music *
43	HSS	HU1511-1	Engineering Ethics *
44	HSS	HU1512-1	Art of Communication and Interpersonal Skills*
45	HSS	HSS281	Common sense and Critical Thinking
46	HSS	HSS282	Linguistics & Language Technology

47	ISE	ISE281	Introduction to Cybersecurity
48	ISE	ISE282	Python Application Programming
49	ISE	ISE283	Software Engineering Practices
50	ISE	ISE284	Web Technologies
51	MAT	MAT304	Graph Theory and its Applications
52	MAT	MAT305	Number Theory
53	MAT	MAT306	Mathematical Modelling
54	MEC	MEC181	Airconditioning and Ventilation System
55	MEC	MEC182	Automotive Engineering
56	MEC	MEC183	Design of Experiments
57	MEC	MEC184	Industrial Pollution Control
58	MEC	MEC185	Integrated Automotive Safety
59	MEC	MEC186	Sustainable Development Goals
60	MGM	MGM181	Engineering Economics
61	MGM	MGM182	Financial Management
62	MGM	MGM183	Management Accounting and Control Systems
63	MGM	MGM184	Operations and Quality Management
64	MGM	MGM185	Taxation for Engineers
65	MGM	MGM186	Working Capital Management
66	PHY	PHY281	Nanotechnology and Materials
67	PHY	PHY282	Optoelectronic Devices and Applications
68	RAI	RAI281	Introduction to Mobile Robots
69	RAI	RAI282	Introduction to Medical Robotics
70	RAI	RAI283	PLC Control of Hydraulic and Pneumatic Circuits
71	RAI	RAI284	Unmanned Aerial Robots
72	AER	AER181	Introduction to Unmanned Aerial Vehicles
73	AER	AER182	Introduction to Aircraft Systems and Instruments
74	AER	AER183	Elements of Aeronautics
75	AER	AER281	Introduction to Space Technology
76	AER	AER282	Introduction to Rockets and Missiles

*** For students admitted under Twinning Program**

INTEL DRIVEN EMPOWERING WITH AI AND ML

Course Code:	**AIM181**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Artificial Intelligence Machine Learning

Course Objectives:

1.	Acquire basic understanding of Artificial Intelligence
2.	Illustrate the application of computer vision and natural language processing
3.	Identify and experience the transition from traditional computer vision to artificial intelligence.
4.	Understanding Natural Language Processing Models
5.	Illustrating Various Chatbots.

Prerequisite	**NIL**

UNIT-I	
Basics of AI and Statistical Data **Basic understanding of Artificial Intelligence**: What is AI? The 3 domains of AI: Statistical Data, Computer Vision, NLP, AI Applications, Sustainable Development Goals, AI Ethics issues- privacy, bias, access to AI. **Non-technical Introduction to AI**: AI Project Cycle-Problem scoping, Data Acquisition, Data Visualization, Decision Trees, Introduction to Neural Networks.	**9 Hours**
UNIT-II	
Basics of AI and Statistical Data **Domain - Fundamentals Hands-on Sessions** **Statistical Data**: Data Import and Processing, Machine Learning Techniques, AI for Data Walkthrough **Computer vision** **Basic Techniques in Computer Vision: -** How do computer see?, How image is represented with numbers (RGB), Thresholding, masking and region of interest, Geometric transformation, resizing and cropping	**9 Hours**
UNIT-III	
From Traditional Computer Vision to Artificial Intelligence: Feature extraction, selecting appropriate features, Pre-processing images, Introduction to K-Nearest neighbor algorithm, Training a simple machine learning algorithm with a few samples, Support Vector Machines Terminologies and Algorithm. **Hands-on Session:** Use Pre-trained model for Image classification, Object detection.	**9 Hours**
UNIT-IV	
Natural Language Processing **Data Collection and Processing for NLP:** Requesting website information with Python, Storing data, Curated data sources, NLP tools, Processing NLP data **Classification for NLP:** Converting data into a bag of words, selecting important words from a list of words using tfidf method, choose a machine learning model using the sklearn library, Data pipelining.	**9 Hours**
UNIT-V	
Creating a Chatbot: Introduction to chatbots, finding your chatbot's specialty, Teach your chatbot to match topics, Get your chatbot to say its first words, Teach and play with your chatbot	**9 Hours**

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

1.	Acquire basic understanding of Artificial Intelligence
2.	Understanding the basics of Machine Learning, Decision Trees and Neural Networks
3.	Illustrate the application of computer vision

4.	Identify and experience the transition from traditional computer vision to artificial intelligence.
5.	Understand the different models used in NLP

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**
AIM181.1	2	1										2		
AIM181.2	2	2										2		
AIM181.3	2	2										2		
AIM181.4	2	2										2		
AIM181.5	2	3										2		

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig
2.	Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili
3.	Artificial Intelligence: Foundations of Computational Agents" by David Poole and Alan Mackworth
4.	Intel AI for Youth

REFERENCE BOOKS:

1.	Prediction Machines: The Simple Economics of Artificial Intelligence" by Ajay Agrawal, Joshua Gans, and Avi Goldfarb
2.	The Hundred-Page Machine Learning Book" by Andriy Burkov

E Books / MOOCs/ NPTEL

1.	https://drive.google.com/drive/folders/1N9XredEQt5XeaATMb2Nb8ahpLpmU5Lrn
2.	https://nptel.ac.in/courses/112103280
3.	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
4.	https://www.coursera.org/learn/ai-for-everyone

INTRODUCTION TO AI AND ML

Course Code:	**AIM182**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Artificial Intelligence Machine Learning

Course Objectives:

1.	Understand the history of AI and machine learning.
2.	Learn principles and algorithms of supervised learning.
3.	Explain various applications of Techniques in association analysis.
4.	Use different unsupervised learning techniques to solve the problem specification.
5.	Understand the methods of parametric and non-parametric methods on real time data analysis and combined learners.

Prerequisite	**NIL**

UNIT-I	
Introduction to AI: what is AI, Acting Humanly: The Turing Test approach, Thinking Humanly: The cognitive modelling approach, thinking rationally: The laws of thought approach, Acting Rationally: The rational agent approach. The state of art **Branches Of Artificial Intelligence:** Machine Learning, Deep Learning, Natural Language Processing, Robotics, Expert Systems, Fuzzy Logic.	**9 Hours**
UNIT-II	
Intelligent Agents: Agents and Environments, Good behavior: The concept of rationality, The nature of environments, properties of task environments, Structure of Agents: Agent Programs, Types of agent programs **Solving Problems by Searching:** Problem solving Agents, well defined problems and solutions, formulating problems, Example problems: Toy problems: Vacuum world, 8-Queen's problem, Real world problem: Airline Route finding problem	**9 Hours**
UNIT-III	
Foundations of Machine Learning What is machine learning? Applications of Machine learning, Understand Data. Types of machine learning: Supervised, Unsupervised, Reinforcement Learning. **Supervised Learning:** **Classification:** Preliminaries; General approach to solving a classification problem; Confusion Matrix, Decision tree induction, how decision tree works, Hunt's algorithm, Design issues, Methods for expressing attribute test conditions, Measures for selecting best fit, Algorithm for decision tree induction	**9 Hours**
UNIT-IV	
Supervised Learning: **Classification: Alternative Techniques** Rule-based classifier: How rule-based classifier works, Rule ordering schemes, Nearest-neighbor classifier: Selecting K value, KNN algorithm, Artificial Neural Networks, Support Vector Machines **Tutorials:** 1. Handling the missing values using orange tool. 2. Visualize: Scatter Plot (for univariate), Scatter Plot Matrix (for multivariate) using orange tool. 3. Iris classification using different algorithm.	**9 Hours**

UNIT-V	
Unsupervised Learning: **Association Analysis:** Problem definition, Frequent item set generation, Apriori principle, Candidate generation and pruning, Rule Generation in Apriori algorithm. **Cluster Analysis:** Different types of clustering: Hierarchical vs partitional, Exclusive vs overlapping, Fuzzy clustering, Complete vs partial. Types of clusters: well separated, Prototype based clusters, Graph based clusters, Density based clusters, Conceptual clusters, K-means clustering algorithm, centroids and objective functions, Choosing initial centroids, time space complexity of K-means, K-means additional issues, Strengths and weakness of k-means, Agglomerative hierarchical clustering, Key issues in hierarchical clustering, Strengths and weaknesses. **Tutorials:** 1. Association analysis using orange tool. 2. Clustering analysis using orange tool. 3. Trying different evaluation matrix using orange tool.	**9 Hours**

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

1.	Understand the fundamentals of Artificial Intelligence including the various branches and its applications.
2.	Analyze the problem-solving approaches using intelligent agents and searching algorithms
3.	Develop a knowledge on foundations of Machine Learning and various types of learning methods.
4.	Apply different classification techniques to classify and understand the given dataset.
5.	Apply the different unsupervised learning techniques to solve the real world problem

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
AIM182.1	2	1										2		2
AIM182.2	2	2										2		2
AIM182.3	2	2	2									2		2
AIM182.4	2	2	2									2		2
AIM182.5	2	3	2									2		2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Stuart Russel and Peter Norvig, "Artificial Intelligence A Modern Approach", Pearson 3rd Edition, 2016.
2.	Ethem Alpaydin, Introduction to Machine Learning, Second Edition, 2004.
3.	Introduction to Data Mining-Pang-NingTan, Michael Steinbach,Vipin Kumar, Pearson Education, 2009.

REFERENCE BOOKS:

1.	T. M. Mitchell, "Machine Learning", McGraw Hill, 1997.
2.	R. O. Duda, P. E. Hart and D. G. Stork Pattern Classification, Wiley Publications, 2001
3.	T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008.
4.	P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012.
5.	K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.
6.	M. Mohri, A. Rostamizadeh, and A. Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.

E Books / MOOCs/ NPTEL

1.	https://drive.google.com/drive/folders/1N9XredEQt5XeaATMb2Nb8ahpLpmU5Lrn

2.	https://nptel.ac.in/courses/112103280
3.	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
4.	https://www.coursera.org/learn/ai-for-everyone

EXPLORING NEURAL NETWORKS: CONCEPTS, TECHNIQUES AND PRACTICAL APPLICATIONS

Course Code:	**AIM281**	**Course Type:**	**OEC**
Teaching Hours/Week (L:T:P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence and Machine Learning

Course Objectives:

1.	Understand the fundamental concepts of neural networks, including perceptrons and artificial neurons.
2.	To gain knowledge of loss functions, activation functions, and their roles in training neural networks.
3.	Learn about how to train neural networks with different optimizers.
4.	Explore techniques to improve neural networks, including regularization methods, weight initialization, and batch normalization.
5.	Understand the architecture and operations of Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), along with their practical applications.

Prerequisite	AM1104-1-Introduction to Machine Learning

UNIT-I	
Acquire – AI fundamentals (Neural Networks) **Introduction to Artificial Neural Networks:** From biological to artificial neurons, Types of Neural Networks, the perceptron, Perceptron Training Rule, Issues with simple perceptron, Multilayer perceptron. Loss Functions: MSE and MAE, Huber Loss, Binary Cross Entropy, Categorical Cross Entropy. Activation Functions and types, Feed forward neural networks, Back propagation algorithm	**9 Hours**
UNIT-II	
Acquire – AI fundamentals (Neural Networks) **Fine tuning neural network hyperparameters:** Number of hidden layers, number of neurons per hidden layer, learning rate, batch size and other hyperparameters. **Training deep neural networks:** Gradient descent, learning rate scheduling, Vanishing Gradient problems Exploding gradient problem, Stochastic gradient descent, Mini-batch stochastic gradient descent	**9 Hours**
UNIT-III	
Acquire – AI fundamentals (Neural Networks) **Optimizers in Deep Learning:** AdaGrad optimizers, AdaDelta optimizers, Nesterov Accelerated Gradient (NAG) optimizers, Avoiding overfitting through regularization, L1 and L2 regularization, Drop-out layers, Weight Initialization Techniques: Glorot and He Initialization, Batch normalization, Gradient clipping, Callbacks: Early Stopping, Reduce Learning Rate, Checkpoint, Transfer Learning.	**9 Hours**
UNIT-IV	
Acquire – Domain Specific Concepts (Neural Networks) **Convolutional Neural Networks:** History of CNN, The convolution operation, motivation, Padding in convolution network, Operation of CNN, Pooling in Convolution network: Max pooling, Average pooling, Global pooling in CNN, Data augmentation, Convolution Layer (grayscale, RGB), Variants of the basic convolution function, Data types:1D, 2D, 3D.	**9 Hours**
UNIT-V	
Sequence modeling: Unfolding computational graphs, Recurrent neural networks,	**9 Hours**

Bidirectional RNNS.
Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications.

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

1.	Understand the concepts of neural networks, including perceptrons, artificial neurons, and the backpropagation algorithm.
2.	Implement and Evaluate Gradient-Based Optimization Techniques.
3.	Analyze and apply various optimization techniques to train neural networks effectively.
4.	Analyze and apply the operations involved in Convolution Neural Networks.
5.	Implement sequence modeling concepts using Recurrent Neural Networks in real-world applications.

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**
AIM281.1	3	2	2	2	1								1	
AIM281.2	3	3	2	2	1								1	
AIM281.3	3	2	2	2	1								3	
AIM281.4	3	2	2	3	2								3	
AIM281.5	3	3	2	2	1								1	

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Hands-on-machine learning with Scikit-Learn, Keras and Tensorflow Concepts, tools and Techniques to build Intelligent Systems, Aurélien Géron, 2nd edition, 2019.
2.	Deep Learning (Adaptive Computation and Machine Learning series), Ian Goodfellow, YoshuaBengio, Aaron Couville-2016

REFERENCE BOOKS:

1.	Fundamentals of deep learning, Nikhil Buduma, Nicholas Locascio, 2017
2.	Deep Learning (Adaptive Computation and Machine Learning series), Ian Goodfellow, YoshuaBengio, Aaron Couville-2016
3.	Introduction to pattern recognition and machine learning, M Narasimha Murthy, Der V Susheela Devi, 2015
4.	Neural Networks Design, M T Hagan, H B Demoth, M Beale, 2002, Thomson Learning, ISBN-10: 0-9717321-1-6/ ISBN-13: 978-0-9717321-1-7

E Books / MOOCs/ NPTEL

1.	deeplearning.net
2.	deeplearning.stanford.edu
3.	deeplearning.cs.toronto.edu
4.	https://www.coursera.org/specializations/deep-learning
5.	Deep Learning, Self-Taught Learning and Unsupervised Feature Learning by Andrew Ng

BIOENERGY ENGINEERING

Course Code:	**BTY181**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: J):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Biotechnology

Course Objectives:

1.	To learn the fundamental concepts of bioenergy, classifications and production technologies.
2.	To learn the concepts of biohydrogen, microbial fuel cell, thermochemical conversion technologies and biopower generation.

UNIT-I

BIOENERGY: RAW MATERIALS — **9 Hours**

Description and classification of Bioenergy; Biofuels, Biopower. Major Biofuels: Biodiesel, Bioethanol, and Biogas (Biomethane), Advanced Renewable fuels: Renewable Diesel, Sustainable Aviation Fuels.

Raw Materials: Biodiesel- oils, Bioethanol/ Biobutanol: Starch and Sugar crops, Lignocellulosic materials. Solid Biofuels-Woody biomass. Biopower / Biogas: Waste residues and co-products- wood residues, animal waste, municipal solid waste. Biomass production for fuel – algal cultures.

UNIT-II

BIOENERGY PRODUCTION — **9 Hours**

Production of Biodiesel, Esterification and Transesterification. Catalysts for biodiesel production, Quality Control Aspects: analysis of biodiesel fuel properties, International and Indian standards.

Production of Bioethanol: Pre-treatment of lignocellulosic raw material, Production using Sugar, Starch and Lignocellulosic raw materials, Solid Biofuels Productions: Briquettes, Pellets. Production of Biogas: Anaerobic Digestion; Types of digesters, Biogas plant models in India, Compressed Biogas (CBG). Basics of production of Advanced Biofuels.

UNIT-III

BIOHYDROGEN — **9 Hours**

Conventional Hydrogen and Biohydrogen Basics, Production Methods: Dark Fermentation, Photobiological Processes and Microbial Electrolysis Cell (MEC), Factors affecting biohydrogen production, Detection and Quantification, Reactors for biohydrogen production, Biohydrogen Advantages, Biohydrogen Applications

UNIT-IV

MICROBIAL FUEL CELLS — **9 Hours**

Conventional Fuel Cells, Microbial Fuel Cells: Working Principles, Fuel Cell Design: Anode & Cathode Compartment, Microbial Cultures, Redox Mediators, Exchange Membrane, Basic Power Calculations, MFC Performance: Factors affecting Power Density, Single vs Two-Chamber Designs, Applications and Advantages and Challenges in MFC.

UNIT-V

THERMO CHEMICAL BIOENERGY — **9 Hours**

Thermochemical processing: planning a thermochemical facility: Incineration, Gasification, Pyrolysis, Torrefaction Technologies, Fuel production through advanced Fischer-Tropsch (F-T) process, Hydrothermal process, Biopower: Biomass-to-Electricity, Benefits and Challenges.

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

1.	Mark the significance of bioenergy and Identify suitable raw materials for production of bioenergy.
2.	Illustrate the production of biofuels from various feed stocks.
3.	Determine the key production process of biohydrogen deploying various methods.
4.	Extend the concepts of microbial fuel cells towards development of specific application.
5.	Understand the concepts of Thermo-chemical technologies and biopower generation.

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	3
BTY181	-	2	-	-	-	-	-	-	1	-	-	-	-	1	-
BTY181	-	2	-	-	-	-	-	-	1	-	-	-	-	1	-
BTY181	-	2	-	-	-	-	-	-	1	-	-	-	-	1	-
BTY181	-	2	-	-	-	-	-	-	1	-	-	-	-	1	-
BTY181	-	2	-	-	-	-	-	-	1	-	-	-	-	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Krushna Prasad Shadangi et al. Bioenergy Engineering, 1st Edition, Elsevier- E Book, Woodhead Publishing India-2023
2.	Seveda, M.S. et al, Advances in Bioenergy Engineering, CRC Press-Routledge, Taylor & Francis-2022
3.	Sterling MacMillan, Bioenergy: Principles, Technology and Applications, Larsen and Keller Education, New York-2017

REFERENCE BOOKS

1.	Manish Srivastava, Neha Srivastava and Rajeev Singh. Bioenergy Research: Basic and Advanced Concepts, Springer Verlag, Singapore-2022
2.	Samir K. Khanal et. al, Bioenergy and Biofuel from Biowastes and Biomass, ASCE Press-Virginia, United States-2010

SOLID WASTE MANAGEMENT

Course Code:	**BTY182**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: J):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Biotechnology

Course Objectives:

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 its Impact and Management — **09 Hours**

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 with reference to sustainable development goals (SDG 3, 6, 11 and 12). Concept of waste reduction, recycling and reuse

UNIT-II

Segregation and Transportation of Solid Waste — **09 Hours**

Waste collection and segregation: Solid waste generation, Onsite handling and segregation of wastes at source - community participation with sustainable practices , 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, sustainable logistics systems

UNIT-III

Solid Waste Processing Techniques — **09 Hours**

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, Microbial consortium and genetically engineered microbes for enhanced biodegradation, Drying and dewatering of wastes

UNIT-IV

Recovery of Resources and Waste Disposal — **09 Hours**

Recovery of Resources: Heat recovery in incineration process,energy recovery and conversion of products from biological processes - Applications of biotechnology, Dumping of solid wastes, Landfills – Types, site selection, preliminary design, operation, case study, Advantages and disadvantages of landfills, Leachate and landfill gases: Collection, bio-covers and bio-filters for treatment, Landfill disposal for waste.

UNIT-V

Solid Waste Management Rules and Planning Issues — **09 Hours**

Legislative trends and impacts: Sustainability frameworks and alignment with SDGS for policy, Major legislations, Government agencies. Municipal Solid Waste Management Act (2000), Hazardous Wastes (Handling and Management) Rules 1989, Biomedical Waste (Handling and Management) Rule (1998), e-Waste (Management and Handling) Rule 2011.

Planning and developing a site for solid waste management, Site Remediation: Assessment and Inspection, Remedial techniques with emphasis to biotechnological approach, Siting guidelines.

Course Outcomes: At the end of the course 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.

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	3
BTY182	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-
BTY182	1	1	-	-	-	1	1	-	1	-	-	-	-	-	-
BTY182	-	2	-	-	-	-	-	-	1	-	-	-	-	-	-
BTY182	-	2	-	-	-	1	1	-	1	-	-	-	-	-	-
BTY182	1	-	-	-	-	-	-	-	1	-	-	1	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

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

REFERENCE BOOKS

1.	Landrefh, R. E. And Rebers, P. A.Lewis, Municipal Solid Wastes-Problems & Solutions, 1997.
2.	Bhide, A. D. and Sundaresan, B. B. Solid Waste Management in Developing Countries, Indian National Scientific Documentation Centre. New Delhi, 2000.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/105103205
2.	https://nptel.ac.in/courses/120108005
3.	https://www.coursera.org/learn/solid-waste-management

CORROSION SCIENCE
(Open elective VI Semester)

Course Code:	**CHY281**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Chemistry

Course Objectives:

1	To know the basic concepts of electrochemistry, and relation to the process of corrosion
2	To understand the different types of corrosion attacking the metal and its preventions
3	To know the different approaches for understanding the corrosion process
4	To understand different corrosion monitoring techniques used in materials' research
5	To identify practices for the prevention and remediation of corrosion

UNIT-I

FUNDAMENTALS OF CORROSION — **9 Hours**

roduction, single electrode potential, decomposition potential, over voltage, hydrogen/oxygen overvoltage; classification of corrosion; electrochemical theory of corrosion; corrosion as a natural process, thermodynamic condition of corrosion; different environmental aspects; Standard electrode potential; factors affecting rate of corrosion: corrosion product, ratio of anodic area/cathodic area, difference in potential of two metals, pH, temperature, hydrogen overvoltage, anodic and cathodic polarization

UNIT-II

TYPES OF CORROSION — **9 Hours**

Galvanic corrosion, EMF and Galvanic series; Crevices corrosion; Filiform corrosion; Pitting corrosion; Uniform corrosion; Atmospheric corrosion; Inter granular corrosion; Selective leaching; Erosion corrosion; Cavitation damage; Stress corrosion; Impingement attack; Inlet tube corrosion; Biocorrosion; Corrosion fatigue; Hydrogen embrittlement

UNIT-III

ELECTRODE KINETICS — **9 Hours**

Equation for corrosion rate, different units of corrosion rate; exchange current density (i_0) and corrosion potential (Ecorr), and their significances; mixed potential theory (MPT) and Evan diagrams, applications of mixed potential theory; importance of exchange current density in MPT, exchange c.d. and polarization; kinetics of activation polarization; derivation of Butler-Volmer (B-V) equation for polarization of an electrode, limiting cases of B-V equations as Tafel's equation; application of Tafel's equation.

UNIT-IV

CORROSION MONITORING TECHNIQUES — **9 Hours**

Weight loss method; experimental set up for electrochemical methods of corrosion study, linear polarization; Tafel's extrapolation method; Electrochemical impedance spectroscopy (EIS) study: basic principle, diagrammatic representations of responses of a resistor, capacitor, and inductor to alternate current (AC) of varying frequency, complex number representation of impedance (along real and imaginary axes), Nyquist plots and its interpretation

UNIT-V

CORROSION PREVENTION METHODS — **9 Hours**

Material selection, design; change of the environments: atmospheric corrosion, control of atmospheric

corrosion; changing medium; inhibitors; cathodic and anodic protection; protective coatings

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

1	Gain knowledge about the basic aspects of corrosion science including corrosion mechanism and factors affecting corrosion rate.
2	Analyze and mitigate various forms of corrosion to ensure material integrity and longevity in engineering applications.
3	Derive and apply kinetic models, to understand and predict the electrochemical kinetics of corrosion processes.
4	Apply various experimental techniques, to measure and analyze corrosion rates and mechanisms.
5	Identify remedial action to reduce corrosion to an acceptable level with respect to the metal and its environment.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓		
↓ Course Outcomes														
CHY281-1.1	3	1												
CHY281-1.2	3	2												
CHY281-1.3	3	3												
CHY281-1.4	2	1												
CHY281-1.5	2	1												

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Corrosion Engineering; Mars G Fontana; 3rd Edition; TATA McGraw-Hill Edition.

REFERENCE BOOKS:

1.	Corrosion; Chamberlian and K. Trethway, Longman scientific and technical published by John Wiley and Sons.
2.	Jones, D.A., Principles and prevention of corrosion, Prentice Hall, New York. (1996).
3.	Nestor Perez, Electrochemistry and Corrosion, Kluwer Academic Publishers, (2001).
4.	Handbook of Batteries, David Linden and Thomas B. Reddy, Third Ed., McGraw Hill Publishers, London (1995).

BUSINESS MANAGEMENT

Course Code:	**CBS181**	**Course Type:**	**OEC**
Teaching Hours (L: T:P: J:SL):	**3:0:0:0:1**	**Credits:**	**3**
Total Teaching Hours:	**45:0:0:0:15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science and Business Systems

Course Objectives:

1	Understand the basic concepts, nature, and scope of management and its functions.
2	Trace the historical evolution and development of management theories and thought.
3	Develop the ability to analyze and apply planning and decision-making techniques in managerial contexts.
4	Explain and assess various organizational structures, delegation techniques, and staffing functions.
5	Examine the processes of directing and controlling in management with a focus on leadership, communication, and motivation theories.

UNIT-I	
Introduction to Management – Definition and Nature of Management, Management as Science, Art, and Profession, Management vs. Administration, Levels and Types of Management, Roles and Skills of Managers.	**9 Hours**
UNIT-II	
Evolution of Management Thoughts: Classical Theories: Scientific Management, Administrative Theory. Behavioral Theories: Hawthorne Studies, Human Relations Movement, Modern Approaches: Systems Theory, Contingency Approach, Contributions of Management Thinkers: Henry Fayol, F.W. Taylor, Elton Mayo.	**9 Hours**
UNIT-III	
Planning and Decision Making: Nature and Importance of Planning, Types of Plans: Strategic, Tactical, Operational, Planning Process and Techniques, Decision Making: Types, Process, and Tools, Management by Objectives (MBO).	**9 Hours**
UNIT-IV	
Organizing and Staffing: Principles of Organizing, Organizational Structures: Functional, Divisional, Matrix, Authority, Responsibility, and Delegation, Departmentation and Span of Control, Staffing: Recruitment, Selection, Training, and Development.	**9 Hours**
UNIT-V	
Directing and Controlling: Directing: Nature, Importance, and Principles, Leadership: Styles and Theories (Trait, Behavioral, Contingency), Motivation: Theories (Maslow, Herzberg, McGregor), Controlling: Process, Types, and Techniques.	**9 Hours**

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

1	Describe fundamental principles, roles, and levels of management and their significance in organizations.
2	Compare and contrast various classical and modern management theories.
3	Apply planning tools and decision-making models in business scenarios.
4	Evaluate the effectiveness of organizational structures and staffing processes in different contexts.
5	Analyze leadership styles, motivational theories, and communication processes to enhance managerial effectiveness.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO↓**

↓ Course Outcomes													
CO-1	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**2**	**3**	**2**
CO-2	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**3**	**2**	**3**
CO-3	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**2**	**3**	**3**	**3**	**3**	**3**
CO-4	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**3**	**2**	**2**
CO-5	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**3**	**3**	**3**	**2**

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	Rao, V. S. P. (2020). Management Principles and Applications. Taxmann Publications, 3rd Edition.
2	Tulsian, P. C., & Pandey, V. (2021). Business Organisation & Management. Pearson Education India.
3	Laasch, O. (2022). Principles of Management (2nd ed.). Sage Publications, 2nd Edition
REFERENCE BOOKS:	
1	Koontz, H., & Weihrich, H. (2012). Essentials of Management. McGraw Hill Education. Ninth Edition
2	Gupta, C. B., & Mathur, S. (2022). Management Principles and Applications. Scholar Tech Press.
E Books / MOOCs/ NPTEL	
1	https://books.google.com/books/about/Taxmann_s_Management_Principles_Applicat.html?id=mTIQEQAAQBAJ
2	https://onlinecourses.swayam2.ac.in/nou25_mg04/preview
3	https://onlinecourses.nptel.ac.in/noc25_mg10/preview
4	https://onlinecourses.swayam2.ac.in/imb25_mg44/preview

FINTECH

Course Code:	**CBS182**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:SL):	**3:0:0:0:1**	**Credits:**	**3**
Total Teaching Hours:	**45:0:0:0:15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science and Business Systems

Course Objectives:

1	To provide a comprehensive understanding of the evolution and transformation of FinTech.
2	To explore the concept of Regulatory Technology (RegTech)
3	To examine key innovations in the FinTech domain
4	To analyze alternative financing models such as peer-to-peer lending, crowdfunding, and their potential to support SMEs and MSMEs.
5	To study the application of Artificial Intelligence and Machine Learning in financial services.

UNIT-I	
Applied fintech for Business - FinTech Evolution, FinTech transformation, Fintech in Banking, Insurance and capital market, FinTech Landscape in India, Latest trends and future of fintech (Theory only)	**9 Hours**
UNIT-II	
RegTech - Evolution of RegTech, Reg Tech Ecosystem -Financial Institutions, Start-ups and Regulators, Regulatory Sandboxes, Smart Regulation. (Theory only)	**9 Hours**
UNIT-III	
FinTech Innovations - Payment's system architecture, Cryptocurrencies- types and application, Blockchain -Technology, Cryptography and application. (Theory only)	**9 Hours**
UNIT-IV	
Alternative Finance – P2P Lending, Crowdfunding and SME /MSME Lending opportunities and challenges. (Theory only)	**9 Hours**
UNIT-V	
Application of AI and ML — Banking, Insurance, Capital market, Real Estate, Wealth Management. Ethical issues in AI and ML (Theory only)	**9 Hours**

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

1	Assess the evolving applications of FinTech across various financial services and critically evaluate their impact on operational efficiency and customer experience.
2	Comprehend the regulatory landscape governing FinTech and apply best practices for ethical, legal, and secure integration within organizational contexts.
3	Investigate emerging technologies and business models within the FinTech ecosystem and analyze their transformative influence on traditional financial systems.
4	Identify, interpret, and evaluate contemporary research and developments in FinTech literature to understand trends, challenges, and future directions.
5	Demonstrate proficiency in leveraging Artificial Intelligence and Machine Learning techniques ethically to areas such as Banking, Insurance, Capital market, Real Estate, and Wealth Management

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
CO-1	-	-	-	-	-	-	-	-	-	3	2	1	2
CO-2	-	-	-	-	-	-	-	-	-	3	2	1	3
CO-3	2	2	2	2	-	-	-	-	-	3	2	2	2
CO-4	1	1	-	-	-	-	-	-	-	3	2	2	3
CO-5	2	2	1	2	3	-	3	-	-	3	2	2	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Fintech Future: The Digital DNA of Finance by Sanjay Phadke SAGE Publications India Pvt Ltd; 1st edition, 2020
2	The Future of Finance: The Impact of FinTech, AI, and Crypto on Financial Services, Henri Arslanian, Fabrice Fischer, Palgrave Macmillan; 1st ed. 2019.
3	Fintech in a Flash: Financial Technology Made by Agustin Rubini, Zaccheus Entertainment; 3rd edition, 2018.

REFERENCE BOOKS:

1	Bank 4.0: Banking everywhere, never at a bank by Brett King, Wiley Publication, 1st edition, 2018.
2	FinTech Revolution in India: Opportunities and Challenges by Ca Dr Brajesh Kumar Jaiswal, Notion Press, 2024, ISBN-13:9798892775274
3	Financial Services Technology: TradFi, Fintech and DeFi 3rd Edition by Randall E. Duran, Cengage Asia; 3rd Edition (November 5, 2024), ISBN-10: 9815244744, ISBN-13: 978-9815244748

E Books / MOOCs/ NPTEL

1	https://onlinecourses.swayam2.ac.in/imb25_mg94/preview
2	https://www.mooc-list.com/course/capstone-course-start-your-fintech-future-coursera
3	https://www.mooc-list.com/course/capstone-course-start-your-fintech-future-coursera

BUSINESS COMMUNICATION

Course Code:	**CBS183**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:SL):	**3:0:0:0:1**	**Credits:**	**3**
Total Teaching Hours:	**45:0:0:0:15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science and Business Systems

Course Objectives:

1	To enable the students to become aware of their communication skills and sensitize them to their potential to become successful communicators.
2	To provide a platform for students to adapt to contemporary communication practices in business.
3	To enable the student to learn the techniques of written communication.
4	To support students to develop their interpersonal communication, technological advancements and importance of social media communication.
5	To provide an opportunity to explore communication challenges through real world business cases

UNIT-I	
Introduction of Communication — Definition, Purpose of communication, Process of communication, Elements of communication, Communication structure in organization, Seven Cs of communication, Types of communication, Cultural sensitivity, Intercultural communication Skills, Communication in current global scenario.	**9 Hours**

UNIT-II	
Verbal Communication –Meaning, Principles of successful oral communication, communicating in a diverse environment, Barriers of Communication, listening as a communication skill, Process of Listening Non-Verbal Communication: Types of Non-verbal communication, communicating with people with disabilities. Written Communication –Purpose of Writing, Principles of Effective writing, 3 x 3 Writing process, Writing Business Letters– Formats & Types.	**9 Hours**

UNIT-III	
Employment Communication– Circulars, Memos, Agenda and Minutes, Resume/CV, Electronic Mail. Report, Elements of report, Types of Reports. Presentation Skills: Meaning, Elements of Presentation, Public Speaking: Meaning, Skills for effective speaking. Business Networking: Meaning, Importance.	**9 Hours**

UNIT-IV	
Business Etiquettes: Basic Business Etiquettes, Meeting Etiquettes, Dining Etiquettes, Social Media Etiquettes. Conflict Management and Negotiation skills: Meaning and characteristics of Conflict, sources of conflict, Verbal skills for communicating in conflict. Negotiation — Meaning, nature, Factors affecting negotiation, stages in negotiation process, Negotiation strategies.	**9 Hours**

UNIT-V

Technological Advancement and Business Communication: Intranet, Internet, Teleconference, Video conference, Blogs, Webinars, Chat rooms. Social Media: Introduction, Classification, Nature and scope, types of social media used for effective communication, using social media how you build business relationships. Lab component: Creating a Blog,	**9 Hours**

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

1	
2	
3	
4	
5	

Course Outcomes Mapping with Program Outcomes & PSO

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Business and Professional Communication Kelly m. Quintanilla Shawn T. Wahl, SAGE South Asia Edition 2017
2	Business Communication: Concepts, cases and applications Chaturvedi P.D and Chaturvedi M., Pearson Education India, 2013, 3rd Edition.

REFERENCE BOOKS:

1	Business Communication Raymond V Lesikar et al McGraw Hill Education; 13th Edition 2017
2	Communicating in Business Williams, Krizan Logan,Merrier Cengage Learning 8th Edition, 2012
3	Business Communication: Process Mary Ellen Guffey Cengage Learning 3rd Edition, 2002
4	Business Communication Lesikar,Flatley, Rentz, Pande TMH 11th Edition, 2011

E Books / MOOCs/ NPTEL

1	https://onlinecourses.swayam2.ac.in/imb25_mg05/preview
2	https://onlinecourses.swayam2.ac.in/imb25_mg41/preview
3	https://onlinecourses.swayam2.ac.in/nou25_cm09/preview
4	https://www.google.co.in/books/edition/_/K5xcDwAAQBAJ?hl=en&gbpv=1&pg=PP1
5	https://archive.org/details/isbn_2901412964721/page/n7/mode/2up

MARKETING MANAGEMENT

Course Code:	**CBS184**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:SL):	**3:0:0:0:1**	**Credits:**	**3**
Total Teaching Hours:	**45:0:0:0:15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science and Business Systems

Course Objectives:

1	To provide scope for developing the marketing skills to solve business problems
2	To develop the students decision making skills pertaining to marketing functions and principles.
3	To familiarize the concepts of market segmentation, positioning strategies, Product life cycle, pricing, and promotion
4	To understand various marketing trends and consumer behaviour practices.
5	To explore the marketing challenges using real-world marketing cases.

UNIT-I	
Introduction to Marketing Management: Definition of Marketing; elements of marketing, Customer needs, wants & demands; Market offerings - Products, Services & Experiences; Analyzing Marketing Environment and Competition — Company's Micro-environment: Company's Macro Environment. Consumer Market & Consumer Buyer Behavior: Consumer behavior meaning and characteristics, Factors affecting Consumer Behavior – Cultural Factors, Social Factors, Personal Factors, Psychological Factors.	**9 Hours**
UNIT-II	
Marketing Mix Meaning, Elements of Marketing Mix - Product - Product Mix - Product Line - Product Life cycle, New Product Development, Branding — Packaging and labeling. Pricing - Methods of Pricing. Physical Distribution - Meaning - Factors affecting Channel Selection - Types of Marketing Channels. Promotion - Meaning and Significance of Promotion.	**9 Hours**
UNIT-III	
Market Segmentation, Targeting & Positioning: Market segmentation –Concept of Market Segmentation, Benefits, Bases for market segmentation.	**9 Hours**
UNIT-IV	
Market Targeting – Meaning, Evaluating Market Segments; Selecting Target Market Segments Positioning for competitive Advantage –Meaning, Positioning Maps, Positioning Strategy, AIDA Model	**9 Hours**
UNIT-V	
Recent trends in Marketing Basic concepts of digital marketing, e-commerce, e-marketing, e-networking, social media marketing. Emerging areas- Neuro Marketing-meaning and features, Sensory Marketing – meaning and features.	**9 Hours**

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

1	Apply marketing concepts to solve business problems for an organization.
2	Analyze marketing functions and principles to aid effective decision making.
3	Assess the market segmentation, positioning strategies, product life cycle, pricing and promotion to achieve competitive advantage.
4	Analyze various marketing trends and its impact on consumer behaviour.
5	Apply theoretical knowledge to real-world scenarios, and suggest solutions to challenges in an organization.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
CO-1	-	-	-	-	-	-	-	2	2	3	2	2	2
CO-2	-	-	-	-	-	-	-	2	2	3	3	2	2
CO-3	-	-	-	-	-	-	-	2	2	3	3	2	2
CO-4	-	-	-	-	-	-	-	2	1	3	3	2	2
CO-5	-	-	-	-	-	-	-	2	2	3	3	3	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Marketing Management: A South Asian Perspective – Kotler, Keller, Koshy&Jha, Pearson Education, 14th Edition, 2014
2	Marketing Management – Text and Cases – Indian Context, Tapan Panda, 2nd Edition Excel Books

REFERENCE BOOKS:

1	Case studies in Marketing - The Indian context, R Srinivasan, Prentice Hall of India Publications, 7th Edition 2018.
2	Marketing Management – Ramaswamy V S &Namakumar S, McGraw Hill, 5th Edition, 2013.
3	Marketing Management – RajanSaxena, Cengage Learning Publications, 4th Edition, 2010.

E Books / MOOCs/ NPTEL

1	https://library.uniq.edu.iq/storage/books/file/kotler_keller_-_marketing_management_14th_edition/1666787488kotler_keller_-_marketing_management_14th_edition.pdf
2	https://onlinecourses.swayam2.ac.in/imb25_mg21/preview
3	https://onlinecourses.swayam2.ac.in/cec25_mg08/preview
4	https://onlinecourses.nptel.ac.in/noc25_mg30/preview

BUSINESS INTELLIGENCE AND APPLICATIONS

Course Code:	**CSE181**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: J:SL)	**3:0:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45:0:0:0:0**	**CIE + SEE Marks**	**50+50**
Prerequisite			

Teaching Department: Computer Science & Engineering

Course Objectives:

1.	Comprehend the need of BI for a business enterprise.
2.	Interpret the OLAP operations.
3.	Identify the types and steps involved in ETL process.
4.	To outline the Need & Significance of data modelling ,metrics ,measures & KPI
5.	To understand the measurement concept to evaluate business performance and build enterprise reports.

UNIT-I **09 Hours**

BUSINESS VIEW OF INFORMATION TECHNOLOGY APPLICATIONS

Business Enterprise Organization, Its Functions, and Core Business Processes; Baldrige Business Excellence Framework; Key Purpose of Using IT in Business; The Connected World: Characteristics of Internet-ready IT Applications; Enterprise Applications (ERP/CRM, etc.) and Bespoke IT Applications; Information Users and Their Requirements; Case Studies **(T1: Ch-1.1 to 1.6)**

TYPES OF DIGITAL DATA

Introduction; Getting into ―GoodLife‖ Database; Getting to Know Structured Data; Getting to Know Unstructured Data; Getting to Know Semi-Structured Data; Difference Between Semi-Structured and Structured Data. **(T1: Ch-2.1 to 2.6)**

UNIT-II **09 Hours**

INTRODUCTION TO OLTP AND OLAP

OLTP (On-Line Transaction Processing); OLAP (On-Line Analytical Processing); Different OLAP Architectures; OLTP and OLAP; Data Models for OLTP and OLAP; Role of OLAP Tools in the BI Architecture; Should OLAP be Performed Directly on Operational Databases? A Peek into the OLAP Operations on Multidimensional Data; Leveraging ERP Data Using Analytics **(T1: Ch-3.1 to 3.9)**

GETTING STARTED WITH BUSINESS INTELLIGENCE

Using Analytical Information for Decision Support; Information Sources Before Dawn of BI? Business Intelligence (BI) Defined; Evolution of BI and Role of DSS, EIS, MIS, and Digital Dashboards; Need for BI at Virtually all Levels; BI for Past, Present, and Future; The BI Value Chain; Introduction to Business Analytics. **(T1: Ch-4.1 to 4.8)**

UNIT-III **09 Hours**

BI DEFINITIONS AND CONCEPTS

BI Component Framework; Who is BI for? BI Users; Business Intelligence Applications; BI Roles and Responsibilities; Best Practices in BI/DW; The Complete BI Professional; Popular BI Tools. **(T1: Ch-5.1 to 5.8)**

BASICS OF DATA INTEGRATION

Need for Data Warehouse; Definition of Data Warehouse; What is a Data Mart? What is Then an ODS? Ralph Kimball‘s Approach vs. W.H. Inmon‘s Approach; Goals of a Data Warehouse; What Constitutes a Data Warehouse? Extract, Transform, Load; What is Data Integration? Data Integration Technologies; Data Quality; Data Profiling. **(T1: Ch-6.1 to 6.12)**

UNIT-IV **09 Hours**

MULTIDIMENSIONAL DATA MODELING

Introduction; Data Modeling Basics; Types of Data Model; Data Modeling Techniques; Fact Table; Dimension Table; Typical Dimensional Models; Dimensional Modeling Life Cycle.

(T1: Ch-7.1 to 7.8)

MEASURES, METRICS, KPIS, AND PERFORMANCE MANAGEMENT

Understanding Measures and Performance; Measurement System Terminology; Navigating a Business Enterprise, Role of Metrics, and Metrics Supply Chain; ―Fact-based Decision Making‖ and KPIs; KPI Usage in Companies; Where Do Business Metrics and KPIs Come From? Connecting the Dots: Measures to Business Decisions and Beyond.

(T1: Ch-8.1 to 8.7)

UNIT-V	**09 Hours**

BASICS OF ENTERPRISE REPORTING

Reporting Perspectives Common to All Levels of Enterprise; Report Standardization and Presentation Practices; Enterprise Reporting Characteristics in OLAP World; Balanced Scorecard; Dashboards; How Do You Create Dashboards? Scorecards vs. Dashboards; The Buzz Behind Analysis. **(T1: Ch-9.1 to 9.8)**

BI ROAD AHEAD

Understanding BI and Mobility; BI and Cloud Computing; Business Intelligence for ERP Systems; Social CRM and BI. **(T1: Ch-10.1 to 10.4)**

Case Study: Analyzing Sales Performance Using the tool Tableau

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

1.	Interpret the business view of information technology applications
2.	Summarize the types of OLAP operation.
3.	Outline the Need & Significance of Data Integration.
4.	Explain the basics of data modelling , metrics , measures & KPI
5.	Identify Key Performance Indicators, Business Metrics, Future of BI, creation of Enterprise Reports.

Course Outcomes Mapping with Program Outcomes & PSO

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Prasad RN, Seema Acharya: Fundamentals of Business Analytics, First Edition, Wiley India Pvt. Ltd.
2.	William H. Inmon: Building the Data Warehouse, 4th Edition, Wiley India Ed.
3.	Infosys Reference Book on Business Intelligence.

REFERENCE BOOKS:

1.	David Loshin: Business Intelligence, First Edition, Elsevier Science, 2003.
2.	Mike Biere: Business Intelligence for the Enterprise, First Edition, IBM Press, 2003.
3.	Larissa T. Moss and Shaku Atre: Business Intelligence Roadmap, Addison-Wesley Professional, 2003.

CYBER SECURITY

Course Code:	**CSE182**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:SL)	**3:0:0:0:1**	**Credits:**	**03**
Total Teaching Hours:	**45:0:0:0:15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science & Engineering

Course Objectives:

1	***Summarize*** Cybercrime and Information Security and cyber offenses.
2	***Explain*** the evolution, trends, and security challenges associated with mobile and wireless devices in the modern computing era
3	***Interpret*** various cybersecurity threats and attack techniques in the digital landscape
4	***Extend*** phishing and identity theft, focusing on their methods, techniques, types and countermeasures.
5	***Identify*** the principles and practices of digital forensics, emphasizing its importance in investigating and combating cybercrime

UNIT-I

Introduction to Cybercrime: Cybercrime: Definition and Origin of the Word Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes **Cyber Offenses: How Criminals Plan Them:** Introduction, How criminals plan the attacks, Social Engineering, Cyber Stalking, Cybercafe & cybercrimes. Botnets: The fuel for cybercrime, Attack Vector, Cloud computing Textbook:1 Chapter 1 (1.1 to 1.5) Textbook:1 Chapter 2 (2.1 to 2.8)	**9 Hours**

UNIT-II

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile devices-Related security Issues , Organizational Security Policies and Measures in Mobile Computing Era Textbook:1 Chapter 3 (3.1 to 3.5, 3.8 to 3.11)	**9 Hours**

UNIT-III

Tools and Methods used in Cybercrime: Introduction, Proxy Servers and Anonymizers , Phishing, Password Cracking, Key Loggers and Spywares, Trojan Horses and Backdoors, Steganography, DoS and DDOS Attacks, SQL Injection, Buffer overflow, Attacks on Wireless networks. Textbook:1 Chapter 4 (4.1 to 4.12)	**9 Hours**

UNIT-IV

Phishing and Identity Theft: Introduction, Phishing- Methods of phishing, Phishing techniques, spear phishing, Types of phishing scams, Phishing toolkits and spy phishing, Phishing countermeasures, Identity Theft- Personally identifiable information(PII), Types of identity theft, Techniques of ID theft, Identity Theft countermeasures, How to Efface your online Identity. Textbook:1 Chapter 5 (5.1. to 5.3)	**9 Hours**

UNIT-V	
Understanding Computer Forensics: Introduction, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network forensic, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics. Textbook:1 Chapter 7 (7.1-7.9, 7.11-7.12, 7.16-7.19)	**9 Hours**

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

1	Explain the concept of cybercrime, its origin, classifications, and the planning of cyber offenses
2	Apply security concepts to analyze threats and implement organizational measures and policies for addressing challenges in the mobile and wireless computing era
3	Apply various cyberattack techniques such as phishing, password cracking, SQL injection, and DoS attacks and understand their impact on network and system security
4	Identify various phishing methods and identity theft tactics and implement appropriate countermeasures to protect personally identifiable information and manage online identity risks
5	Analyze the processes, tools, and challenges involved in digital forensics and evaluate the requirements for setting up a forensic laboratory and maintaining the integrity of digital evidence through proper chain of custody

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	PSO↓ 1	PSO↓ 2
CO-1	2	3	-	-	-	1	1	-	-	-	-	1	-
CO-2	2	3	1	-	1	1	-	-	-	-	-	1	-
CO-3	2	3	-	1	1	-	-	-	-	-	-	1	-
CO-4	2	3	1	-	1	1	1	-	-	-	-	1	-
CO-5	2	3	-	1	1	-	1	-	-	-	-	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Sunit Belapure and Nina Godbole, ―Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives‖, Wiley India Pvt Ltd, ISBN: 978-81-265-21791, 2011, First Edition (Reprinted 2018)

REFERENCE BOOKS:

1	Bill Nelson, Amelia philips , Christopher Steuart,‖ Computer Forensics and Investigations‖ , 6th Edition October 2020.
2	Niranjan Reddy ,‖An Incident-Based Approach to Forensic Investigations Malware forensics In: Practical Cyber Forensics‖ Apress, Berkeley, 2019

E Books / MOOCs/ NPTEL

1	Infosys Springboard: 1. Introduction to Cybersecurity Fundamentals https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01423541261343129631 58/overview 2. Cybersecurity https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01415384656741990467/overview

PRINCIPLES OF MOBILE COMPUTING

Course Code:	**CSE183**	**Course Type:**	OEC
Teaching Hours/Week (L: T:P: J:SL)	**3:0:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45:0:0:0:15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science and Engineering

Course Objectives:

1	Learn and understand the principles of mobile computing technologies
2	Analyze the different applications that mobile computing offers to people, employees, and businesses
3	Demonstrate the traditional and modern network technologies and mobile computing protocols
4	Examine the possible future of mobile computing technologies and applications
5	Design and apply the concepts of Database in building the mobile computing systems

UNIT-I	
Mobile Computing - Brief Overview, Evolution, Classification, Advantages, Mobile Devices And Systems, Architectures: Mobile phones, Digital Music Players, Handheld Pocket Computers, Handheld Devices, Operating Systems, Smart Systems, Limitations of Mobile Devices, Automotive Systems. Security Issues	**09 Hours**
UNIT-II	
GSM — Services and System Architectures, Radio Interfaces, Protocols, Localization, Calling, Handover, General Packet Radio Service, Multiplexing, Modulation, Minimum Shift Key Modulation, Spread Spectrum	**09 Hours**
UNIT-III	
Bluetooth Technology, Wireless Application Protocol (WAP) ,Introduction to CDMA — based Systems, OFDM, Mobile IP.The architecture of Mobile IP ,Working and applications of Mobile IP,Network Layer, Mobile Transport Layer: IP and Mobile IP Network Layers Packet Delivery and Handover Management, Location Management, Registration.	**09 Hours**
UNIT-IV	
Tunneling and Encapsulation, Route Optimization, Dynamic Host Configuration Protocol. Indirect TCP, Snooping TCP, Mobile TCP, Other Methods of TCP — layer Transmission for Mobile Networks, Mobile Agents.	**09 Hours**
UNIT-V	
Databases: Database Hoarding Techniques, Data Caching, Client — Server Computing and Adaptation. Transactional Models, Query Processing, Data Recovery Process, Issues relating to Quality of Service. Data Dissemination And Broadcasting Systems: Communication Asymmetry, Classification of Data – Delivery Mechanisms, Data Dissemination Broadcast Models, Selective Tuning and Indexing Techniques.	**09 Hours**

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

1	Explain the evolution, architecture, classification, and limitations of mobile devices and systems.
2	Describe GSM architecture, radio interfaces, protocols, handover, and packet services like GPRS.

3	Analyze wireless technologies such as Bluetooth, WAP, CDMA, OFDM, Mobile IP, and their functioning across network and transport layers.
4	Evaluate tunneling, encapsulation, route optimization, and TCP transmission methods in mobile networks, including mobile agents.
5	Apply mobile database techniques, including hoarding, caching, data recovery, and broadcasting systems, ensuring Quality of Service (QoS) in mobile environments.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
CO-1	3	2	2	1	2	-	-	-	-	2	2	2	2
CO-2	3	2	2	2	3	-	-	-	-	2	2	2	2
CO-3	3	2	2	3	3	-	-	-	-	3	2	2	2
CO-4	3	2	3	2	3	-	-	-	-	2	2	2	2
CO-5	3	2	2	2	3	-	-	-	-	3	3	2	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Raj Kamal , Mobile Computing, Oxford University Press, 2011
2	Asoke K. Talkukder, Roopa RYavaga, Mobile Computing: Technology, Applications and Service Creation, Tata McGraw Hill, 2011

REFERENCE BOOKS:

1	Reza B_Far, Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, Cambridge University press, 5th Edition,2006

E Books / MOOCs/ NPTEL

1	https://nptel.ac.in/courses/106107148
2	https://nptel.ac.in/courses/106106167
3	https://nptel.ac.in/courses/106105166
4	https://www.edx.org/course/mobile-computing

SOFTWARE TESTING

Course Code:	**CSE184**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:SL)	**3:0:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45:0:0:0:0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science and Engineering

Course Objectives:

1	Understand the fundamental principles and objectives of software testing.
2	Design effective test cases using black-box and white-box testing techniques.
3	Develop test plans and define appropriate testing strategies for software projects.
4	Document and manage defect reports throughout the testing lifecycle.
5	Use an open-source automation tool (e.g., Selenium or JUnit) to create, execute, and evaluate automated test cases.

UNIT-I	
FUNDAMENTALS OF SOFTWARE TESTING: Introduction to Software Testing, Objectives of Testing, Errors, Defects, and Failures, Role of Tester, Testing and Quality, Overview of STLC **SOFTWARE TESTING LIFE CYCLE :** SDLC vs STLC, Different stages in STLC, Document templates generated in different phases of STLC, Types and Levels of Testing, Functional Testing, API Testing, Usability Testing, Exploratory Testing, Ad-hoc Testing. Static Testing**:** Static techniques, Reviews, Walkthroughs.	**9- Hours**
UNIT-II	
BASICS OF TEST DESIGN TECHNIQUES: Various test categories, Specification-Based (Black-Box) Testing Techniques, Structure-Based (White-Box) Testing Techniques, Experience-Based Techniques, Designing test cases using MS-Excel.	**9-Hours**
UNIT-III	
TEST MANAGEMENT: Test Planning and Estimation, Test Documentation (Test Plan, Test Case, Test Summary), Test Metrics and Measurements, Effort estimation, Configuration management, Project progress management. Open-source Tools for test case documentation and test management.	**9-Hours**
UNIT-IV	
DEFECT MANAGEMENT: Test Execution, Logging defects, Defect lifecycle and reporting , Fixing / Closing defects. Open-Source Tools for logging and tracing defects. **TEST DATA MANAGEMENT:** Test Data Management –Overview, Why Test Data Management, Test Data Types, Need for Test Data Setup, Test Data Setup Stages, Test data management Challenges. Creating sample test data using MS-Excel.	**9- Hours**
UNIT-V	
BASICS OF AUTOMATION TESTING : Introduction to Test Automation, Benefits and Limitations of Automation, Overview of Automation Tools: Selenium, JUnit, TestNG, Basics of Writing Test Scripts, Overview on Continuous Integration and Testing in DevOps	**9-Hours**
BASICS OF AUTOMATION TESTING USING SELENIUM: Introduction to Selenium, Using Selenium IDE for automation testing, Using Selenium Web driver for automation testing, Understanding TestNG framework with Selenium Web driver for automation testing, Introduction to Maven automation tool.	

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

1	Understand the fundamental principles, objectives, and types of software testing.
2	Develop test plans and define appropriate testing strategies for software projects.
3	Design effective test cases using black-box and white-box testing techniques.
4	Document, manage, and track defects throughout the software testing life cycle.
5	Apply an open-source automation tool (e.g., Selenium or JUnit) to implement and execute automated test cases.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	PSO↓ 1	PSO↓ 2
CO-1	**3**	**2**										**3**	**2**
CO-2	**3**	**3**	**2**										**3**
CO-3	2	**2**	**3**	**2**								**2**	**3**
CO-4	3	**2**	**2**		**3**								**3**
CO-5	**2**	**2**	**3**		**3**							**2**	**2**
	3	**2**	**3**	**2**	**3**							**2**	**3**

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Panagiotis Leloudas – Introduction to Software Testing: A Practical Guide, Apress, 2023.
2	Paul C. Jorgensen - Software Testing: A Craftsman‟s Approach, 5th Edition, August 15, 2022, by Auerbach Publications.
3	Maurício Aniche – Effective Software Testing, Manning Publications, 2022.
	Boni Garcia- Hands-On Selenium WebDriver with Java-A Deep Dive Into the Development of End-to-End Tests, Published:March 31, 2022, Publisher: O'Reilly Media
4	Eran Kinsbruner- Continuous Testing for DevOps Professionals: A Practical Guide from Industry Experts, edited by Eran Kinsbruner, September 5, 2018.
5	Paul Ammann & Jeff Offutt, "Introduction to Software Testing", 2nd Edition, Cambridge University Press, 2016

REFERENCE BOOKS:

1	Bill Laboon – A Friendly Introduction to Software Testing, 2021
2	Rex Black – Foundations of Software Testing: ISTQB Certification, 4th Edition, Cengage, 2020.

E Books / MOOCs/ NPTEL

1	Coursera - Introduction to Software Testing (University of Minnesota)
2	Software Testing Help – Tutorials & Guides
3	Ministry of Education – ePGPathshala (Software Testing Modules)
4	https://www.softwaretestinghelp.com/selenium-tutorial-1/
5	http://softwaretestingfundamentals.com/software-testing-methods/
6	https://www.tutorialspoint.com/software_testing/software_testing_tutorial.pdf
7	http://docs.seleniumhq.org/docs/
8	http://www.seleniumhq.org/download/

DATA STRUCTURES USING C

Course Code:	**CSE281**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P:J:SL)	**3:0:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45:0:0:0:0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science and Engineering

Course Objectives:

1	Outline the concepts of data structures, types, operations, structures, pointers and implement pointers, structures and pointer to structures
2	Implement linear data structure stack and usage of stacks in various applications.
3	Implement linear data structure Linear Queue, Circular Queue and priority queues
4	Implement the operations of singly linked lists and circular linked lists, doubly linked list and circular doubly lists
5	Identify and differentiate different types of binary trees and binary search trees data structures and also implement them and illustrate threaded binary trees, expression trees, graph representation and techniques of hashing

UNIT-I

INTRODUCTION: Data Structure, Classification (Primitive and non-primitive), data structure operations. **POINTERS, ARRAYS and STRUCTURES:** Definition and Concepts, Accessing variables through pointers, Pointers and functions, Array s in C, Arrays and pointers, Array of pointers. Two dimensional Arrays . Structures Definition and declaration, accessing member of structure, Array of Structures and Pointer to Structure, Programming Example. Dynamic Memory Allocation in C Using memory management functions with programming examples,	**9 Hours**

UNIT-II

LINEAR DATA STRUCTURES – STACKS: Introduction and Definition, Representation of stack: Array and structure representation of stacks, Primitive Operations on stacks, Stack using C **APPLICATIONS OF STACK:.** **Recursion**: Definition, Implementation, Examples on Recursion with tracing: Factorial function, Fibonacci sequence and Tower of Hanoi	**9 Hours**

UNIT-III

LINEAR DATA STRUCTURES – QUEUES: Introduction and Definition, Representation of Queue and primitive operations: Array and Structure representation of queue, Queue using C, various other queue structures: circular queue **LINEAR DATA STRUCTURES-LINKED LIST: S**ingly Linked List and chains, Representing chain in C using dynamic variables ,Inserting and deleting nodes, Other list Operations on singly Linked List, Linked Stack and Queues, Header Nodes	**9 Hours**

UNIT-IV

CIRCULAR LINKED LIST, DOUBLY LINKED LIST AND CIRCULAR DOUBLY LINKED LIST : Representation and different Operations	**9 Hours**

NON LINEAR DATA STRUCTURES – Tree data structures: **Introduction:** Tree definition, Terminology, **Binary Trees:** Definition, Types, Properties, **Representation of Binary Tree**: Array representation, Linked representation, Binary Tree traversals- Preorder, Inorder and postorder.	

UNIT-V

BINARY SEARCH TREE: Definition, Construction- Searching, Insertion operations, deletion process, Traversal examples **EXPRESSION TREE:** Constructing expression tree for a given expression, Traversal on expression tree **Heap data structure** -Definition, Max and Min heap, Heap construction using bottom up approach Balanced trees-Definition, AVL tree and Btree **NON LINEAR DATA STRUCTURES – GRAPHS:** **Representation of graphs**: Definition, types and terminology, Matrix representation, Adjacency list representation.	**9 Hours**

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

1	Demonstrate foundational knowledge of various data structures and effectively utilize pointers to design and implement programs
2	Apply fundamental data structure concepts to design and implement stacks for effective problem solving
3	Apply fundamental concepts of data structures to design and implement queues for solving real-world problems
4	Design and implement singly linked lists, circular linked lists, and doubly linked lists for efficient data organization and manipulation.
5	Acquire knowledge of tree data structures and apply binary trees, binary search trees, advanced trees, graph representations, and hashing techniques in problem solving.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
CO-1	2	2	3									2	2
CO-2	2	2	3									2	2
CO-3	2	2	3									2	2
CO-4	2	2	3									2	2
CO-5	2	2	3									2	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Programming in ANSI C: E Balagurusamy, Eighth edition,TATA McGraw HILL, 2019
2	Data Structures Using C, ISRD Group, Tata McGraw Hill, 2006
3	Seymour Lipschutz, "Data Structures, Schaum"s Outlines", Revised 1st edition, McGraw Hill, 2014

REFERENCE BOOKS:

1	Data Structures using C, Aaron M. Tanenbaum, Yedidyah Langsam &Moshe J. Augenstein, Pearson Education/PHI, 2019

2	Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd edition, Universities Press, 2014.
E Books / MOOCs/ NPTEL	
1	Data Structures Using C, Reema Thareja, 2nd edition, Oxford University Press, 2014
2	Introduction to Data Structures by edx , URL: https://www.edx.org/course/
3	Data structures by Berkley, URL: https://people.eecs.berkeley
4	Advance Data Structures by MIT OCW , URL: https://www.mooclab.club/
5	Data Structure by Harvard Extension School, URL: http://www.extension.harvard.

INTERNET OF THINGS

Course Code:	**CSE282**	**Course Type:**	**OEC**
Teaching Hours/Week (L:T:P:J:SL)	**3:0:0:0:1**	**Credits:**	**03**
Total Teaching Hours:	**45:0:0:0:15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science and Engineering

Course Objectives:

1	To understand the evolution of the Internet of Things (IoT), its networking components, and addressing mechanisms.
2	To classify and analyze various types of sensors and actuators along with their characteristics and functions.
3	To evaluate different IoT processing architectures, including device design and processing topologies.
4	To gain insight into associated IoT technologies such as cloud computing and virtualization.
5	To apply IoT concepts and technologies to real-world case studies in domains like healthcare, vehicular systems, and IoT analytics.

UNIT-I

Basics of Networking: Introduction, Network Types, Layered network models **Emergence of IoT:** Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components	**9-- Hours**

UNIT-II

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.	**9-- Hours**

UNIT-III

IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.	**9--Hours**

UNIT-IV

ASSOCIATED IOT TECHNOLOGIES Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service. **IOT CASE STUDIES** Agricultural IoT – Introduction and Case Studies	**9--Hours**

UNIT-V

IOT CASE STUDIES AND FUTURE TRENDS Vehicular IoT – Introduction Healthcare IoT – Introduction, Case Studies IoT Analytics – Introduction	**9-- Hours**

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

1	Describe the fundamentals of IoT, including its evolution, enabling technologies, and networking components.
2	Identify and classify various sensors and actuators, explaining their characteristics and usage in IoT systems.
3	Demonstrate an understanding of IoT data processing topologies and device selection strategies.
4	Explain associated IoT technologies such as cloud computing, virtualization, and the Sensor-Cloud model.

5	Analyze real-world IoT case studies and articulate current trends and applications in domains such as agriculture, healthcare, and vehicular systems.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
CO1	3	1										3	2
CO2	3	1										3	2
CO3	3	1										3	3
CO4	3	1	2						2	2	1	2	2
CO5	3	1	2						2	2	1	3	3

1: Low 2: Medium 3: High

TEXTBOOKS:

Sudip Misra, Anandarup Mukherjee, Arijit Roy, *Introduction to IoT*, Cambridge University Press, 1st Edition /2021

REFERENCE BOOKS:

S. Misra, C. Roy, and A. Mukherjee, *Introduction to Industrial Internet of Things and Industry 4.0,* CRC Press, 1st Edition/2021.

Vijay Madisetti and Arshdeep Bahga, *Internet of Things (A Hands-on-Approach),* Narosa Publications, 1st Edition/2014.

Francis daCosta, *Rethinking the Internet of Things: A Scalable Approach to Connecting Everything,* Apress Publications, 1st Edition, 2013.

Internet of Things: Applications for Sustainable Development 1st Edition, edited By Niranjan Lal, Shamimul Qamar, Sanyam Agarwal, Ambuj Kumar Agarwal, Sourabh Singh Verma December 19, 2024.

E Books / MOOCs/ NPTEL

https://nptel.ac.in/courses/106105166

https://onlinecourses.nptel.ac.in/noc25_cs44/preview

OBJECT ORIENTED PROGRAMMING WITH JAVA

Course Code:	**CSE283**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T P: J:SL)	**3:0:0:0:1**	**Credits:**	**03**
Total Teaching Hours:	**45:0:0:0:15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science and Engineering

Course Objectives:

1	Learn OOP principles and the basics of Java.
2	Understand and apply Java control statements to control program flow
3	Learn the fundamentals of Java classes.
4	Explore Java inheritance and interfaces.
5	Gain knowledge of type wrappers, autoboxing, and the use of Java‘s Collections Framework for data management.

UNIT-I	
An Overview of Java-The Java Buzzwords, Object-Oriented Programming, Two Paradigms, Abstraction, The Three OOP Principles, A First Simple Program, Entering the Program, Compiling the Program, A Closer Look at the First Sample Program Data Types, Variables, and Arrays -Java Is a Strongly Typed Language, The Primitive Types, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays. Operators--Arithmetic Operators, The Bitwise Operators, Relational Operators	**9 Hours**
UNIT-II	
Operators--Boolean Logical Operators, The Assignment Operator, The? Operator, Operator Precedence, Using Parentheses Control Statements --Java‘s Selection Statements, Iteration Statements, Jump Statements	**9 Hours**
UNIT-III	
Introducing Classes: Class Fundamentals, Declaring Objects, A Closer Look at new, Assigning Object Reference Variables, Introducing Methods, Constructors, Parameterized Constructors, This Keyword, Instance Variable Hiding, Garbage Collection, the finalize () Method, A Stack Class. A Closer Look at Methods and Classes: Overloading Methods, Overloading Constructors, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Introducing Access Control, understanding static, introducing final, Arrays, Exploring the String Class, Using Command-Line Arguments, Varargs: Variable Length Arguments.	**9 Hours**
UNIT-IV	
Inheritance: Inheritance Basics, using super, creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Why Overridden Methods? Using Abstract Classes, Using final with Inheritance, The Object Class. Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces, Defining an Interface, Default Interface Methods, Use static Methods in an Interface.	**9 Hours**
UNIT-V	
Type Wrappers: Character, Boolean, and Numeric type wrappers. Autoboxing: Autoboxing and Methods, Autoboxing / Unboxing occurs in expressions, Autoboxing/Unboxing Boolean and Character values. The Collections Framework: Collections Overview, The Collection Interfaces: the collection interface, the List interface, the Set interface. The Collection Classes: The ArrayList Class, The LinkedList Class, The HashSet Class. Accessing a Collection via an Iterator - Using an Iterator, The For-Each Alternative to Iterators.	**9 Hours**

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

Describe the fundamentals of Java and apply object-oriented concepts to develop basic programs.
Implement decision-making and control flow using Java operators and control statements.
Develop and manage Java classes and data structures using object-oriented features.
Design reusable and modular programs using inheritance and interfaces in Java.
Manage collections of data effectively using type wrappers, autoboxing, and the Java Collections Framework.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
CO-1	3	2	2	1	1	-	-	1	1	-	-	2	2
CO-2	3	3	2	2	1	-	-	1	1	-	-	2	2
CO-3	3	3	3	2	2	-	-	1	1	-	-	2	2
CO-4	3	2	3	2	2	-	-	1	1	-	-	2	2
CO-5	3	3	3	2	3	-	-	1	1	-	-	2	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Java The Complete Reference, Herbert Schildt, Oracle Press, 11th Edition, 2019

REFERENCE BOOKS:

1	Introduction to Java Programming, Y. Daniel Liang, Pearson Education, 6th Edition, 2007
2	Head First Java, Kathy Sierra, Bert Bates, Trisha Gee, O'Reilly Media, Inc., 2022
3	Core Java, Volume I: Fundamentals, Cay S. Horstmann, Addison Wesley, 12th Edition, 2017
4	Java How to Program, Early Objects, Paul Deitel, Harvey Deitel, Pearson College Div, 11th Edition, 2017.

E Books / MOOCs/ NPTEL

1	Introduction to Java, https://infyspringboard.onwingspan.com/web/en/login
2	Programming using Java, https://infyspringboard.onwingspan.com/web/en/login
3	Java Foundation Certification, https://infyspringboard.onwingspan.com/web/en/login
4	Programming in Java, https://onlinecourses.nptel.ac.in/noc22_cs47/preview

INTRODUCTION TO GEOINFORMATICS

Course Code:	**CIV181**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**
Prerequisite	**-**		

Teaching Department: Civil Engineering

Course Objectives:

1.	**Explain** the basic principles of Geoinformatics comprising Remote sensing, Photogrammetry, GPS, GNSS & GIS
2.	**Explain** the stages and techniques of photogrammetry, aerial photo interpretation, visual & digital image processing, enhancement and interpretation
3.	**Explain** and **Appraise** GIS - its components, data structures, process and operation, Map and its projections, components, preparation and overlays
4.	**Explain** the GIS functionality and **Appraise** the significance of GEOINFORMATICS (Photogrammetry, RS, GPS, GNSS & GIS) in real world applications.
5.	To **develop** skills in modern surveying, GPS/GNSS, and GIS functionalities for spatial analysis and virtual GIS applications.

UNIT-I	**09 Hours**

Remote sensing and its principles: Physics of remote sensing, EM spectrum, Blackbody concept, atmospheric windows, spectral response of common earth features.
Platforms & Sensors: Ground based, Air borne and Space borne platforms, Active and Passive Sensors, Photographic sensors, scanners, radiometers, RADAR and thermal infrared, hyper spectral remote sensing, Indian satellites and sensors: capabilities, data products.

UNIT-II	**09 Hours**

Photogrammetry: Basic principles of Aerial photography and Photogrammetry, Flight procedures, Aerial Photo Interpretation and Analysis techniques.
Satellite Image Interpretation and Analysis techniques: Visual & Digital Image interpretation, Interpretation elements, False Colour Composites (FCC).

UNIT-III	**09 Hours**

Digital Image Processing and Analysis: Digital image formats, pre-processing and processing (DIP), image restoration/enhancement procedures, information extraction, pattern recognition concepts, post processing procedures.

UNIT-IV	**09 Hours**

Geographic Information System -concept and spatial models: Fundamentals of GIS, spatial and non-spatial data, vector and raster GIS, GIS Hardware and software, georeferencing, digitization, thematic maps, Overlay Analysis, Operation of GIS, Co-ordinate systems and map projections, Map scale, data display and cartography.

UNIT-V	**09 Hours**

Geoinformatics and Virtual GIS: Modern Surveying and Geoinformatics, GPS & GNSS.
GIS Functionality: Introduction, data acquisition, preliminary data processing, data storage and retrieval, spatial search and analysis, graphics and interaction, Virtual GIS and Real-world applications.

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

1.	**Define** and **explain** the principles of Remote Sensing and **list** various types of platforms, sensors & resolutions in RS with a special reference to Indian satellites and data products.
2.	**Explain** Photogrammetry, its basic principles, elements of photo interpretation, Visual & Digital Image interpretation techniques
3.	**Explain** different stages involved in Digital Image Processing, various image enhancement techniques, **list** and **classify** the digital image formats and the extracted information for various purposes.

4.	**Explain** and **Appraise** GIS - its components, data structures, process and operation, Map and its projections, components, preparation and Overlays.
5.	**Explain** the GIS functionality and **appraise** the significance of GEOINFORMATICS (Photogrammetry, RS, GPS, GNSS & GIS) and Virtual GIS in real world applications.

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	3
CIV181.1	2	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CIV181.2	2	2	-	-	-	-	1	-	-	-	-	-	2	2	-
CIV181.3	2	2	-	-	-	-	1	-	-	-	-	-	2	2	-
CIV181.4	2	2	-	-	-	-	1	-	-	-	-	-	2	2	-
CIV181.5	2	2	-	-	-	-	1	-	-	-	-	-	2	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Anji Reddy, M. (2012) ***Text Book of Remote Sensing and Geographical Information Systems***, Fourth Edition, BS Publication, Hyderabad
2.	Bhatta, Basudeva (2011) ***Remote Sensing and GIS***, 2nd edition, Oxford University Press, N. Delhi
3.	Lillesand, T.M., Kiefer, R.W and Chipman, J.W. (2015) ***Remote sensing and Image Interpretations,*** 7th edition, John Wiley and sons, New Delhi

REFERENCE BOOKS:

1.	Anji Reddy, M. and Hari Shankar, Y. (2006) ***Digital Image Processing***, BS Pub., Hyd.
2.	Bernhardsen, Tor (2002) ***Geographic Information Systems-3rd*** Ed., Wiley India, Delhi
3.	Canada Centre for Remote Sensing **(2011)** ***Fundamentals of Remote sensing-Tutorial***
4.	Chang, Kang-tsung (2008) ***Introduction to Geographic Information Systems*** 4th Ed.,
5.	Korte, George B. (2001), ***The GIS Book***, Onword Press, Thomson Learning Inc.,USA
6.	Kumar, S. (2008) ***Basics of Remote sensing and GIS***Laxmi Publications (P) Ltd., Delhi
7.	Longler, Paul A., Goodchild, Michael F., Maguire, David J., Rhind. David W., (2004) ***Geographic Information Systems and Science*** John Wiley & Sons Ltd., ESRI Press
8.	Sabins, F.L. (1997) ***Remote Sensing: Principles and Interpretation***3rd edn. WH Freeman and Company, New York, 494p.

E Books / MOOCs/ NPTEL

1.	https://www.youtube.com/user/edusat2004
2.	https://eclass.iirs.gov.in/login

SUSTAINABILITY ENGINEERING

Course Code:	**CIV182**	**Course Type:**	**OE**
Teaching Hours/Week (L: T:P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45**	**CIE + SEE Marks:**	**60+40**
Prerequisite	**CIV001**		

Teaching Department: Civil Engineering

Course Objectives: This Course will enable students to:

1.	**Understand** the relevance, the concept and the role of engineers in sustainable development
2.	**Understand** green building concepts, materials, certifications, and sustainable practices through case studies in sustainability engineering.
3.	**Illustrate** Life Cycle Assessment principles for environmental, social, and economic analysis in engineering applications.
4.	**Develop** skills to integrate sustainability principles into engineering design processes, employing sustainable strategies and measuring sustainability effectively.
5.	**Understand and apply** sustainability reporting frameworks like GRI, Dow Jones, and prepare comprehensive sustainability reports.

UNIT-I

Sustainable Development	**09 Hours**

Introduction to Sustainability and its relevance to Engineering, Sustainable development- Need- various agreements and Role of Engineering- Sustainable Development and Engineering Profession. Sustainable Engineering concepts, Goals of Sustainability and their relevance to the disciplines, System Thinking, Life cycle Thinking and circular economy

UNIT- II

Green Building	**09 Hours**

Concept, green building materials, green building certification and rating: green rating for integrated habitat assessment (GRIHA) , leadership in energy and environmental design (LEED) rating, energy efficient buildings, sustainable cities, sustainable transport, sustainable pavements, case studies in sustainability engineering: Green building, sustainable city, sustainable transport system.

UNIT-III

Sustainable Technologies in Engineering	**09 Hours**

Design for sustainability Principles and methodologies, Renewable energy systems and their integration, Sustainable manufacturing processes, Emission regulations, Energy efficient electronic devices and components, Green manufacturing practices and materials, responsible electronic waste management. E-waste management and recycling. Disaster Mitigation strategies. Energy efficient algorithms and software development practices, Green data centres and cloud computing.

UNIT- IV

Fundamentals of Life Cycle Assessment	**09 Hours**

Energy systems, Buildings and the Built Environment, Life cycle inventory, Life Cycle Impact Assessment, Interpretation and presentation of Results, Iterative Nature of LCA, Methodological Choices, LCI Databases and LCA Software's, Strength and Limitations of LCA. Environmental Life Cycle Costing, Social Life Cycle Assessment, Life Cycle Sustainability, **LCA Applications in Engineering:** Environmental Product Declarations and Product Category Rules, Carbon and Water Foot Printing, Water and Energy consumption analysis.
Software component: Open LCA

UNIT-V

Sustainability Reporting:	**09 Hours**

Structure of a sustainability Report, Case Study: Sustainability Report Preparation, sustainable projects in each discipline (real world examples), Identifying challenges and lessons learned.
Case studies on sustainable Engineering Design Process – Sustainable Process Design, Sustainable product design with Artificial Intelligence and Internet of Things.

Course Outcomes: At the end of the course students will

1.	Be proficient in applying sustainable engineering concepts, integrating system and life cycle thinking to address global challenges in the engineering profession.
2.	Adeptly apply green building principles, materials, certifications, and sustainability engineering case studies to contribute effectively to sustainable urban development.
3.	Master Life Cycle Assessment principles for comprehensive engineering analysis, integrating environmental, social, and economic dimensions effectively.
4.	skillfully prepare sustainability reports using GRI standards and Dow Jones Sustainability Index, applying theoretical knowledge to practical case studies for effective reporting.
5.	Adeptly integrate sustainability principles into design, applying life cycle strategies and sustainable procurement criteria through case studies analysis.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes															
CIV182.1	2	1	-	-	-	2	2	1	-	-	-	-	2	3	-
CIV182.2	2	2	3	-	-	2	2	1	-	-	-	-	2	3	-
CIV182.3	1	2	1	-	-	2	3	2	-	-	-	-	1	3	-
CIV182.4	1	1	-	-	-	2	3	1	-	-	-	-	1	3	-
CIV182.5	1	2	3	-	-	2	3	2	-	-	-	-	1	3	2

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Allen, D. T. and Shonnard, D. R., “Sustainability Engineering: Concepts, Design and Case Studies”, Prentice Hall. 2015.
2.	Sreenivasan Sundarrajan, "Sustainable Development: Principles, Frameworks, and Practices", Springer, 2018.
3.	S. S. Bhavikatti, "Sustainable Engineering: Concepts and Applications", I. K. International Publishing House Pvt. Ltd., 2016.
4.	Gaurav Biswas, “Engineering Sustainable Communities: Principles and Practices ", CRC Press, 2019.
5.	Brian W. Edwards, "Green Buildings Pay", TERI Press, 2013.
6.	Sam Kubba, "Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes", Butterworth-Heinemann, 2017.
7.	Bhupendra Kumar Sharma, "Life Cycle Assessment: Theory and Practice", TERI Press, 2017.
8.	R. K. Goel, “Life Cycle Assessment: Principles, Practice and Prospects”, TERI Press, 2017.
9.	Zabihollah Rezaee, "Sustainability Reporting: GRI, Dow Jones Sustainability Index, Analysis and Research", John Wiley & Sons, 2017.

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc24_de01/preview; Strategies for Sustainable Design.
2.	https://onlinecourses.nptel.ac.in/noc24_hs77/preview; Energy Resources, Economics, and Sustainability;

DISASTER MANAGEMENT

Course Code:	**CIV183**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**
Prerequisite	**-**		

Teaching Department: Civil Engineering

Course Objectives:

1.	Understand difference between Disaster, Hazard, Vulnerability, and Risk.
2.	Know the Types, Trends, Causes, Consequences and Control of Disasters
3.	Apprehend Disaster Management Cycle and Framework.
4.	Know the Disaster Management in India
5.	Appreciate Applications of Science and Technology for Disaster Management.

UNIT-I

Understanding Disasters	**08 Hours**

Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

UNIT-II

Types, Trends, Causes, Consequences and Control of Disasters	**10 Hours**

Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters

UNIT-III

Disaster Management Cycle and Framework	**10 Hours**

Disaster Management Cycle and Framework: Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Micro zonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.

UNIT-IV

Disaster Management in India	**08 Hours**

Disaster Management in India: Disaster Profile of India – Mega Disasters of India and Lessons Learnt, Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter-Governmental Agencies.

UNIT-V

Applications of Science and Technology for Disaster Management	**05 Hours**

Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non-Structural Mitigation of Disasters S&T Institutions for Disaster Management in India

Case Studies	**04 Hours**

Study of Recent Disasters (at local, state and national level), Preparation of Disaster Risk Management Plan of an Area or Sector, Role of Engineers in Disaster Management

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

1.	Explain Concepts, Types, Trends, Causes of Disasters
2.	Describe Consequences and Control of Disasters
3.	Explain Disaster Management Cycle and Framework
4.	Explain the lesson learnt from the disasters in India and discuss the financial mechanism, roles and responsibilities of Non-Government and Inter-Governmental Agencies for Disaster management
5.	Describe the Applications of Science and Technology recent disasters, role of engineers for Disaster Management and prepare a report of Disaster Risk Management Plan.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CIV183.1	-	-	-	-	-	3	2	-	-	-	1	2
CIV183.2	-	-	-	-	-	3	2	-	-	-	1	2
CIV183.3	-	-	-	-	-	3	2	-	-	-	1	2
CIV183.4	-	-	-	-	-	3	2	-	-	-	1	2
CIV183.5	-	-	-	-	-	3	2	-	-	-	1	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Noble, L. , "Introduction to environmental impact assessment. A Guide to Principles and Practice", 2nd edition, Oxford University Press, Don Mills, Ontario, 2010.
2.	Larry W. Canter, "Environmental Impact Assessment", McGraw Hill Inc. Singapore, 1996.

REFERENCE BOOKS:

1.	Morris and Therivel, "Methods of Environmental Impact Assessment", 3rd edition. New York, NY: Routledge, 2009.
2.	Hanna, K. S., "Environmental impact assessment", Practice and Participation. 2nd edition. Oxford, University Press, Don Mills, Ontario, 2009.

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/120108004/
2.	http://nptel.ac.in/courses/120108004/module3/lecture3.pdf

ENVIRONMENTAL IMPACT ASSESSMENT

Course Code:	**CIV184**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CV001**		

Teaching Department: Civil Engineering

Course Objectives:

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 **09 Hours**

Concepts of EIA, EIA methodologies (Adhoc, Network Analysis, Checklists, Map overlays, Matrix method), Screening and scoping, Rapid EIA and Comprehensive EIA.

UNIT-II

09 Hours

General Framework for Environmental Impact Assessment, EIA Specialized areas like environmental health impact assessment, Environmental risk analysis.

UNIT-III

09 Hours

Baseline data study, Prediction, and assessment of impacts on physical, biological, and socio-economic environment.

UNIT-IV

09 Hours

Legislative and environmental clearance procedures in India, Public participation, Resettlement, and rehabilitation.

UNIT-V

09 Hours

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.

Course Outcomes: At the end of the course 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 Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CIV184.1	1	1	-	-	-	2	3	2	-	-	-	-
CIV184.2	1	1	-	-	-	2	3	2	-	-	-	-

CIV184.3	1	1	-	-	-	2	3	2	-	-	-	-
CIV184.4	1	1	-	-	-	2	3	2	-	3	-	-
CIV184.5	1	1	-	3	-	2	3	2	-	-	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Noble, L., "Introduction to environmental impact assessment. A Guide to Principles and Practice", 2nd edition, Oxford University Press, Don Mills, Ontario, 2010.
2.	Larry W. Canter, "Environmental Impact Assessment", McGraw Hill Inc. Singapore, 1996.

REFERENCE BOOKS:

1.	Morris and Therivel, "Methods of Environmental Impact Assessment", 3rd edition. New York, NY: Routledge, 2009.
2.	Hanna, K. S., "Environmental impact assessment. Practice and Participation". 2nd edition. Oxford, University Press, Don Mills, Ontario, 2009.

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/120108004/
2.	http://nptel.ac.in/courses/120108004/module3/lecture3.pdf

CONSUMER ELECTRONICS

Course Code:	**ECE181**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:S):	**3-0-0-0-1**	**Credits:**	**03**
Total Teaching Hours:	**45Hrs**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics and Communication Engineering

Course Objectives:

1	To provide basic knowledge on sound and transducers
2	To provide basic knowledge on different display units and camera
3	To understand the recording process and storage mechanism
4	To provide basic knowledge on communication and broadcasting
5	To understand the working of various electronic gadgets

UNIT-I

Sound: **9 Hours**

Definition and properties of sound, Transducers: Micro Phone – characteristics and types, and Loudspeakers – characteristics and types, Enclosures and baffles, mono-stereo, audio amplifiers-characteristics, Synthesizers.

UNIT-II

Vision: **9 Hours**

Displays-LED, LCD, PLASMA, Camera: basic principle, CCTV Camera.

UNIT-III

Recording and Playback: **9 Hours**

Audio recording methods-magnetic recording, optical recording, digital recording, erasing methods, optical discs- recording and playback, Film projector, Theatre Sound, HiFi system.

UNIT-IV

Communications and Broadcasting **9 Hours**

Modulation: AM, FM PCM, Radio transmitters, Radio receivers - Tuned radio frequency receiver and Superheterodyne receiver. Fiber optics, Radio and TV broadcasting. Cellular communication: digital cellular phone, establishing a call.

UNIT-V

Machines **9 Hours**

Fax machine, Xerox machine, electronic Calculator, Microwave ovens, Washing Machines, A/C and refrigeration, ATM, Auto Electronics, Industrial Electronics and Robotics, Electronics in health / Medicine.

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

CO1	Identify and describe the basics of sound and transducers.
CO2	Analyze the working principles of display units and CCTV camera.
CO3	Analyze the working basic working of Recording, storage devices
CO4	Analyze the working basics of communication and broadcasting
CO5	Describe the basic working of commonly used electronic gadgets

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
CO-1	1	-	-	-	-	1	-	-	-	-	2		
CO-2	1	-	-	-	-	1	-	-	-	-	2		
CO-3	1	-	-	-	-	1	-	-	-	-	2		
CO-4	1	-	-	-	-	1	-	-	-	-	2		
CO-5	1	-	-	-	-	1	-	-	-	-	2		

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Consumer Electronics Anand Khanna publications 2011
2	Consumer Electronics Bali S. P. Pearson Education 2010

REFERENCE BOOKS:	
1	Modern Television Engineering Gulati R. R. Wiley Eastern. 2015
E Books / MOOCs/ NPTEL	

SPACE TECHNOLOGY AND APPLICATIONS

Course Code:	**ECE182**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:S):	**3:0:0:0-1**	**Credits:**	**03**
Total Teaching Hours:	**45 Hrs**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics and Communication Engineering

Course Objectives:

1	Understand the general laws governing satellite orbits and their parameters.
2	Discuss the effect of the space environment on satellite signal propagation.
3	Illustrate various segments employed in satellite and ground stations.
4	Explain the satellite launch in space and its applications in remote sensing.
5	Discuss the different communication systems used for satellite access.

UNIT-I

Satellite communications: **9 Hours**

Introduction, Kepler's laws, definitions, orbital element, apogee and perigee heights, orbit perturbations, inclined orbits.
T1: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9

UNIT-II

Space environment: **9 Hours**

Earth's Atmosphere, Ionosphere and Meteorological effects on space systems, signal propagation, Transmission losses in space environment.
T1: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6

UNIT-III

Satellite Technology: Space segment: **9 Hours**

Working, stages, Fuel, payload protection, Navigation, guidance and control, Reliability, launching into outer space and launch bases, types of launch vehicles, Ground segment: Digital DBS TV, DBS-TV System Design, Master Control Station, Community Antenna TV System, Transmit-Receive Earth Stations.
T1:Chapter7: 7.1-7.8 T1:Chapter8:8.1- 8.5. R3: 2, 4

UNIT-IV

Remote Sensing: **9 Hours**

Introduction, Remote Sensing System: Remote sensors, Platforms, Data products generation, Data Analysis, Indian Remote Sensing Programme and Applications.
T3:Chapter 3: 1.1, 1.2, 1.3, 1.6.

UNIT-V

Satellite Access: **9 Hours**

Introduction, Single Access, Pre-assigned FDMA, Demand-Assigned FDMA, Spade system. Advanced space systems: Satellite mobile services, VSAT, Radarsat, orbital communication, Global Positioning Satellite System (GPS).
T1: Chapter 14:14.1-14.5, Chapter17:17.1-17.6

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

CO1	Describe the fundamental principles of Satellite communication systems.
CO2	Understand the Propagation impairments of satellite links.
CO3	Discuss the satellite launch mechanism and various segments employed in satellite and ground stations.
CO4	Describe the remote sensing fundamentals and their applications.
CO5	Discuss the different communication systems used for satellite access and satellite services.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
CO-1	3	2	2	-	1	-	-	-	-	-	-	3	1
CO-2	-	3	-	-	2	1	-	-	-	-	-	3	1
CO-3	3	-	-	1	-	1	3	-	-	-	-	3	1
CO-4	-	-	-	-	-	1	3	-	-	-	-	3	1
CO-5	-	-	-	-	-	3	3	2	-	-	-	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Satellite Communications Dennis Roddy McGraw Hill 2006
2	Satellite Communications Timothy Pratt, Jeremy Allnutt Wiley-Blackwell 2020
3	Fundamentals of Remote Sensing George Joseph Universities press 2017

REFERENCE BOOKS:

1	Rocket Propulsion K Ramamurthy McMillan Publishers India Ltd 2010
2	Remote Sensing and Applications B C Pande VIVA Books pvt ltd 2009
3	Sensors systems and next-generation satellites Meynart Roland SPIE Publication
4	Space Environment Thyagarajan ISRO Hand Book Publication

E Books / MOOCs/ NPTEL

1	https://nptel.ac.in/courses/101106046

SENSORS AND ACTUATORS

Course Code:	**ECE183**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:S):	**3:0:0:0-1**	**Credits:**	**03**
Total Teaching Hours:	**45 Hrs**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics and Communication Engineering

Course Objectives:

1	Understand the principles and classification of sensors and actuators.
2	Learn the work, characteristics, and applications of different types of sensors and actuators.
3	Develop the ability to select appropriate sensors and actuators for specific applications.
4	To be able to know about the Standards for Smart Sensor Interface
5	Gain knowledge on signal conditioning and interfacing techniques.

UNIT-I

Introduction: **9 Hours**

What are Sensors/Transducers, Principles, Classification, Characteristics, Environmental Parameters, Electrical Characterization, Mechanical and Thermal characterization, Optical characterization, Chemical/biological characterization
T1:Chapter1: 1.1-1.6

UNIT-II

Mechanical and electro-mechanical sensors: **9 Hours**

Introduction, Resistive potentiometer, strain gauge, inductive sensors, capacitive sensors, Ultrasonic sensors.Thermal Sensors: Introduction, Gas thermometric sensors, Nuclear Thermometer, Resistance change type thermometric sensors, Thermal radiation sensors, Heat flux sensors
T1:Chapter2: 2.1-2.4.1,2.4.2,2.5.1,2.5.4,2.5,6,2.7
T1:Chapter3: 3.1,3.2,3.7,3.9,3.12,3.17

UNIT-III

Actuators: **9 Hours**

Actuation systems, Pneumatic and hydraulic systems, Mechanical actuation systems, kinetic chains, Cams, gears, Ratchet and Pawl, Belt and chain drives, Bearings, Electrical actuation systems, Mechanical switches, solid state switches, solenoids, direct current motors, and stepper motors.
T2:Chapter 7: 7.1,7.2, T2:Chapter 8:8.1-8.8, Chapter 9:9.1-9.7

UNIT-IV

Input/Output systems: **9 Hours**

Interfacing, Input/output addressing, Interface requirement, Peripheral interface adapters, serial communications interface, and examples of interfacing.
Text 2: Chapter 13:13.1-13.6

UNIT-V

Closed loop controllers: **9 Hours**

Continuous and discrete control processes, two-step mode, proportional mode, derivative control, integral control, PID controller, Digital controller, Adaptive controller.
T2Chapter 22: 22.1-22.8,22.12

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

CO1	Gain knowledge of sensors, their classification, and characterization methods
CO2	Get familiar with Mechanical, Electromechanical, and thermal sensors.
CO3	Understand actuation systems and their different types.
CO4	Understand the input/output systems to interface sensors and actuators to a system.

CO5	Get exposure to the closed loop controllers such as PID, Digital and Adaptive controller.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
CO-1	2	2	-	-	-		-	-	-	-	-	2	-
CO-2	2	2	-	-	-		-	-	-	-	-	2	-
CO-3	2	3	2	2	-	2	-	-	-	-	-	2	2
CO-4	2	3	2	2	-	2	-	-	-	-	-	2	2
CO-5	2	3	2	2	-	2	-	-	-	-	-	2	2

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	Sensors and Transducer D.Patranabis PHI 2nd edition/2013
2	Mechatronics Electronic control systems in mechanical and electrical engineering William Bolton Pearson 6th edition/2015
REFERENCE BOOKS:	
1	Sensors and Actuators: Engineering System Instrumentation Clarence W. de Silva CRC Press
2	Measurement Systems: Application and Design Ernest O. Doebelin and Dhanesh N. Manik McGraw-Hill
3	Introduction to Mechatronics and Measurement Systems David G. Alciatore and Michael B. Histand McGraw-Hill
E Books / MOOCs/ NPTEL	
1	https://onlinecourses.nptel.ac.in/noc21_ee32/preview

PCB DESIGN AND FABRICATION

Course Code:	**ECE184**	**Course Type:**	**OEC**
Teaching Hours/Week (L:T:P:J:SL):	**1-1-2-0-0**	**Credits:**	**3**
Total Teaching Hours:	**15(L)+15(T)+15(P)**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics and Communication Engineering

Course Objectives:

1	To create systematic approach of schematic design using CAD tool
2	To understand the Electronic CAD tool usage in PCB layout
3	To create artwork of any given schematic and layout design
4	Understand the fabrication process involved in PCB design

UNIT-I

Introduction to Electronic components : **05 Hours**

Different types of Electronics components, Representation of Electronics circuits in a schematic circuit, Symbols and footprints of Electronics components in KiCAD, Through hole components and SMD/SMT components

UNIT-II

PCB design rules and fundamentals **05 Hours**

Basic terminologies in PCB , Thou and Mils unit , PCB track width and length, computation of track resistance, Basic routing rules, through PAD design consideration, SMD PAD design consideration, Via in PCB, Single and Double layer PCB manufacturing process

UNIT-III

Multilayer PCB **05 Hours**

PCB physical Stack, different layers in PCB, 4-layer PCB stack, 6-layer PCB stack, Different types of Via in Multilayer PCB – Buried via, stacked via, Micro via etc, PCB manufacturing process of multilayer PCB

List of Experiments
15(T) +(15)P

1	Introduction to PCB design tool: building a schematic circuit and layout,
2	Exploring the PCB design tool by creating new components, using existing components and footprint, simulation features, Active & Passive Components
3	Designing a PCB layout in a single layer with constraints such as board area, track width, packages, via etc
4	Creating a double layer PCB for a given schematic circuit
5	Creating and using different component package types
6	Designing a PCB having custom symbol and footprint on double/single layer
7	Creating negative film for single layer PCB
8	Creating negative film for double layer PCB
9	Managing the gerber file for developing the different fabrication layer
10	Drill bit selection using gerber file on a CNC machine for Single layer PCB fabrication
11	Fabrication of single and double layer PCB on a copper clad board using hatching/engraving technique

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

1	Apply PCB terminology in schematic design for any given circuit
2	Apply PCB layout rules in designing any given schematic in a single or double layer
3	Create footprint for any electronic component with required specification in datasheet
4	Manage Gerber files for fabricating the multilayer PCB
5	Fabricate single layer PCB with required specification using chemical or CNC etching technique

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO**

↓ Course Outcomes												1	2
CO-1	3	1	1	1	3			1	2		1	3	
CO-2	3	1	1		3			1	2		1	3	
CO-3	3	1	1		3			1	2		1	3	
CO-4	3	1	1		3			1	2		1	3	
CO-5	3	1	1		3			1	2		1	3	

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	Peter Dalmaris, “Kicad Like a Pro”, Tech Exploration, 2011
REFERENCE BOOKS:	
1	David L. Jones, “PCB Design Tutorials”, Alternate zone, 2004.
E Books / MOOCs/ NPTEL	
1	www.alternatezone.com

INTRODUCTION TO MICROCONTROLLER

Course Code:	**ECE281**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:S):	**3:0:0:0-1**	**Credits:**	**03**
Total Teaching Hours:	**45 Hrs**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics and Communication Engineering

Course Objectives:

1	Understand the architecture, hardware components, and memory organization of the 8051 microcontroller.
2	Learn data transfer techniques, addressing modes, and perform logical and arithmetic operations through assembly programming.
3	Develop embedded C programs for I/O control, timers, and logic operations using the 8051 microcontroller.
4	Implement serial communication and interrupt handling using 8051 programming in C.
5	Interface the 8051 microcontroller with external devices such as LCDs, keyboards, motors, and write application-level code.

UNIT-I

The 8051 Architecture: **9 Hours**

8051 Microcontroller Hardware, Input/Output Pins, External Memory.
Moving Data:Addressing Modes,External data moves, Code Memory data moves, PUSH and POP Instructions, Data Exchanges. Example Programs.
T1: Chapter 3- 3.1 to 3.3,Chapter 5- 5.l to 5.5

UNIT-II

Logical Operations **9 Hours**

Byte level logical operations, Bit level logical operations, Rotate and swap operations.
Arithmetic Operations: Incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic, Example Programs.
T1: Chapter 6: 6-6.1 to 6.3,Chapter 7 – 7.2 to 7.7

UNIT-III

8051 Programming in C: **9 Hours**

Data types and time delays in 8051C, I/O programming, logic operations,
8051 Timer programming in C: Programming 8051 timers, counter ,Examples of Timer programming in C.
T2: Ch apter 7-7.1 to 7.3,Chapter 9:9.1 , 9.3

UNIT-IV

8051 Serial Communication: **9 Hours**

Basics of serial Communication, 8051 connections to RS 232, Serial communication Programming, . Programming examples in C. Interrupts Programming: 8051 Interrupts, Programming timer interrupts, Interrupt priority
T2: Chapter 10-10.1 to 10.2,10.4 to 10.5, Chapter 11-11.1,11.2,11.5

UNIT-V

8051 Interfacing and Applications: **9 Hours**

Interfacing 8051 to LCD, keyboard, stepper motor and DC motor interfacing. Programming in C.
T2: Chapter 12- 12.1 to 12.2,Chapter 17-17.2 to 17.3

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

CO1	Interpret the architecture and addressing modes of 8051 microcontroller
CO2	Program 8051 microcontroller in assembly and C for various embedded system applications.
CO3	Using KEIL IDE, programming 8051 microcontroller in assembly and C.
CO4	Apply embedded C for programming 8051 microcontroller for serial communications and interrupts.
CO5	Interface 8051microcontroller with different peripheral devices.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												2	1
CO-1	3											2	1
CO-2	3	2	1		3							2	1
CO-3	3	2	2		3							2	1
CO-4	3	2	2		3							2	1
CO-5	3	2	2		3							2	1

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	The 8051 Microcontroller Kenneth Ayala Thomson Delmar Learning 3rd Edition
2	The 8051 Microcontroller and embedded systems – using assembly and C Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay Prentice Hall India, Pearson 2006
REFERENCE BOOKS:	
1	Programming and Customizing the 8051 Micro-controller Myke Predko Tata McGraw-Hill 2007
2	Embedded System design Frank Vahid& Tony Pearson Education. 2002
E Books / MOOCs/ NPTEL	
1	Introduction to Microcontrollers & Microprocessors https://nptel.ac.in/courses/117104072

MEMS

Course Code:	**ECE282**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:S):	**3:0:0:0-1**	**Credits:**	**03**
Total Teaching Hours:	**45 Hrs**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics and Communication Engineering

Course Objectives:

1	To understand the fundamental principles and applications of miniaturization, microfabrication, and smart materials in the context of microsystems and MEMS.
2	To provide students with foundational knowledge and understanding of micro sensors, actuators, smart materials, and their integration into microsystems for various engineering and biomedical application
3	To provide students with a comprehensive understanding of micromachining technologies, including silicon-based microfabrication processes such as thin film deposition, lithography, and etching.
4	To equip students with the knowledge of integrating microsystems with microelectronics, including packaging techniques and real-world applications through case studies.
5	To introduce students to MEMS structures and their applications in industrial and automotive systems, focusing on design methodology, sensing and actuation techniques, and system integration.

UNIT-I

Introduction	**9 Hours**
Why Miniaturization? Microsystems versus MEMS, why microfabrication? Smart Materials, Structures and systems, Integrated Microsystems-Micromechanical Structures, Microsensors, Micro actuators, Applications of smart Materials and Micro Systems T1 - Chapter 1.- 1.1,1.2,1.3,1.4,1.5-1.5.1,1.5.2,1.5.3,1.6	

UNIT-II

Micro Sensors, Actuators, Systems and Smart Materials	**9 Hours**
An Overview-Silicon Capacitive Accelerometer, Piezoresistive Pressure Sensor, Conductometric Gas Sensor, Magnetic Micro relay, Portable Blood Analyzer, Piezoelectric Inkjet Print Head, Smart Materials and Systems. T1 - Chapter 2.- 2.1, 2.2, 2.3, 2.5, 2.6,2.7,2.9	

UNIT-III

Micromachining Technologies	**9 Hours**
Silicon as a Material for Micromachining, Thin Film Deposition, lithography, Etching, Silicon Micromachining, Advanced Process for Microfabrication. T1- Chapter 3.- 3.1, 3.2, 3.3, 3.4, 3.5, 3.7	

UNIT-IV

Integration of Micro and Smart Systems	**9 Hours**
Integration of Microsystems and Microelectronics, Microsystems Packaging, Case studies of Integrated Microsystems T1-: Chapter 8.- 8.1, 8.2, 8.3,	

UNIT-V

MEMS Structures and Systems in Industrial and Automotive Applications	**9 Hours**
General Design methodology, Techniques for sensing and actuation, Passive micromachined Mechanical structures, Sensors and Analysis systems, Actuators and Actuated Microsystems T2- Chapter4.-4.1,4.2,4.3,4.4,4.5	

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

CO1	Identify and describe the basic components and applications of integrated microsystems, including microstructures, microsensors, and micro actuators.
CO2	Analyse the working principles and applications of micro sensors, actuators, and smart material-based systems used in modern technologies.
CO3	Describe a silicon-based micromachining process flow involving thin film deposition, photolithography, and etching steps for a specified microstructure.
CO4	Analyze integration strategies and packaging methods for smart microsystem applications using relevant case studies
CO5	Identify and Compare MEMS-based sensors and actuators used in industrial and automotive applications based on their design and functional principles.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
CO-1	3	1										2	
CO-2	3	3		2								2	
CO-3	3	2		2	2							2	
CO-4	2	3	2	2	2							2	
CO-5	3	2		2	2							2	

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Micro and Smart Systems G.K.Ananthasuresh,K.J.Vinoy,S.Gopalakrishnan,K.N.Bhat,V.K.Aatre John Wiley and Sons Reprint Edition,2014
2	"An Introduction to Microelectromechanical Systems Engineering" Nadim Maluf, Kirt Williams 2rd Edition 2004

REFERENCE BOOKS:

1	"Microsystem Design", Stephen D. Senturia, Kluar Publishers, 2001.

E Books / MOOCs/ NPTEL

1	Fabrication Techniques for MEMS based Sensors https://onlinecourses.nptel.ac.in/noc23_ee109/preview?
2	Micro and Smart Systems https://archive.nptel.ac.in/content/syllabus_pdf/112108092.pdf?utm_source

COMMUNICATION SYSTEMS FOR AVIONICS

Course Code:	**ECE283**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:S):	**3:0:0:0-1**	**Credits:**	**03**
Total Teaching Hours:	**45 Hrs**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics and Communication Engineering

Course Objectives:

1	Understand the significance, role, and environmental considerations of avionics in modern aircraft.
2	Explain the operation and functionality of various surveillance systems used in air traffic control.
3	Illustrate the working of airborne communication systems and their hardware components.
4	Analyze onboard communication protocols and digital data bus standards used in aircraft systems.
5	Evaluate the principles and performance of navigation systems and UAV avionics.

UNIT-I

Introduction to Avionics: **9 Hours**

Importance and role of avionics, avionic environment, Choice of Units
T1 - Chapter 1.- 1.1,1.2,

UNIT-II

Surveillance Systems **9 Hours**

Air traffic control, Primary radar, Secondary radar, Replies, Various system modes, error checking, Transponders of ATCCRB & Mode S, Collision avoidance, Lightning detection, Weather radar.
T2 - Chapter 5.-5.1-5.18

UNIT-III

Airborne Communications Systems: **9 Hours**

VHF AM Communications, VHF Communications hardware, High frequency communications, ACARS, SELCAL, Digital Communications and Networking, VHF Digital communications, Data link Modes. Text 2: Ch 6.1 to 6.10
T2: Chapter 6 - 6.1, 6.2, 6.3, 6.4, 6.5,6.6,6.7,6.8,6.9,6.10

UNIT-IV

Onboard Communications: **9 Hours**

Microphones, Digital communications, Transmission lines, Digital data bus systems ARINC 426, MIL STD 1553, ARINC 629, Commercial standard digital bus, Fiber optic communication.
T2: Chapter 7 - 7.1, 7.2, 7.3, 7.4, 7.5,7.6,7.7,7.8,7.9,7.10,7.11

UNIT-V

Navigation System: **9 Hours**

Introduction and Basic Principles, Inertial Navigation, Aided IN system and Kalman Filters, Attitude Heading Reference System, GPS Global Positioning System, Terrain Reference System.Unmanned Air Vehicles: Importance of Unmanned air vehicles, UAV avionics.
T1: Chapter 6 - 6.1, 6.2, 6.3, 6.4, 6.5,6.6, Chapter 10-10.1,10.2,10.3

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

CO1	Describe the importance, applications, and environmental conditions of avionics systems.
CO2	Demonstrate the working of surveillance systems like radar, transponders, and weather detection equipment.
CO3	Interpret communication technologies including VHF, HF, ACARS, SELCAL, and digital data links.
CO4	Analyze onboard communication protocols such as ARINC 426, MIL-STD-1553, and fiber optic systems.
CO5	Evaluate navigation techniques and avionics systems used in UAVs.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
												1	2
CO-1		2	1				2	2			3	2	
CO-2		2	1				2	2				2	
CO-3							2	2				2	
CO-4							2	2			3	**2**	
CO-5		2	1				2	2			3	2	

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	Introduction to Avionics Collinson RPG Springer 4th/2023
2	Principles of Avionics Albert Helfrick Avionics Communications Inc 9th/2015
REFERENCE BOOKS:	
1	Civil avionics systems Moir, I. and Sea bridge AIAA Education series 2nd edition/ 2013
E Books / MOOCs/ NPTEL	
1	Avionics and Aircraft system Fundamentals https://www.coursera.org/learn/avionics-aircraft-systems-fundamentals

ADHOC WIRELESS NETWORKS

Course Code:	**ECE284**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P: J:S):	**3:0:0:0-1**	**Credits:**	**03**
Total Teaching Hours:	**45 Hrs**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics and Communication Engineering

Course Objectives:

1	To introduce the fundamentals, architecture, and challenges of ad-hoc wireless networks.
2	To understand the design issues, goals, and functioning of MAC protocols for ad-hoc networks.
3	To study various routing protocols and their classification for efficient data communication.
4	To explore multicast routing techniques and their architectural models in ad-hoc wireless networks.
5	To analyze transport layer solutions, security challenges, and energy management techniques in ad-hoc networks

UNIT-I

Introduction — **9 Hours**

Ad-hoc Wireless Networks Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet.MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols.
Chapter 5.1, 5.2, 5.3, 6.1, 6.2,

UNIT-II

Routing: — **9 Hours**

Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols. Table Driven Routing Protocols; On-Demand Routing Protocols.
Chapter 7.1, 7.2, 7.3, 7.4, 7.5

UNIT-III

Multicast Routing: — **9 Hours**

Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols.
Chapter 8.1, 8.2, 8.3, 8.4, 8.5

UNIT-IV

Transport Layer and Security Protocols — **9 Hours**

Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions.
Chapter 9.1, 9.2, 9.3, 9.4, 9.5

UNIT-V

Energy Management in Ad-hoc Wireless Networks: — **9 Hours**

Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes, Transmission Management Schemes.
Chapter 11.1, 11.2, 11.3, 11.4, 11.5

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

CO1	Explain the characteristics, applications, and issues of ad-hoc wireless networks.
CO2	Analyze and compare MAC protocols based on design goals and performance metrics.
CO3	Evaluate different routing protocols and select appropriate strategies for various network scenarios.
CO4	Illustrate multicast routing operations and classify multicast routing protocols.
CO5	Identify and apply suitable transport, security, and energy management techniques for optimizing

	ad-hoc network performance.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
CO-1	2	2	1	-	1	-	-	-	-	1	-	-	1
CO-2	2	3	2	2	2	-	-	-	1	1	1	-	2
CO-3	3	3	3	2	2	-	-	-	1	1	1	-	3
CO-4	2	2	2	2	2	-	-	-	1	1	1	-	2
CO-5	2	3	2	2	2	1	1	1	1	1	1	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1	AdHoc Wireless Networks " C. Siva Ram Murthy and B. S. Manoj Pearson Education 2nd Edition, 2011

REFERENCE BOOKS:

1	Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
2	Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.

E Books / MOOCs/ NPTEL

1	WIRELESS AD HOC AND SENSOR NETWORKS https://archive.nptel.ac.in/courses/106/105/106105160/

BATTERY MANAGEMENT SYSTEM			
Course Code	EEE281	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	OEC

PREREQUISITE:

Course Objectives

1.	To familiarize various concepts of BMS
2.	To understand functional blocks of BMS
3.	To study design steps of BMS
4.	To introduce hardware implementation of BMS

Course Contents

UNIT – 1	**9 Hours**

Battery System

Introduction, Cells, Batteries, and Packs, Resistance, Li-Ion Cells, Formats, Chemistry, Safety, Safe Operating Area, Efficiency, Aging, Modeling, Unequal Voltages in Series Strings, Li-Ion BMSs, BMS Definition, Li-Ion BMS Functions, Custom Versus Off-the-Shelf, Li-Ion Batteries, SOC, DOD, and Capacity, Balance and Balancing, SOH

UNIT – 2	**9 Hours**

BMS Options

Functionality, CCCV Chargers, Regulators, Meters, Monitors, Balancers, Protectors, Functionality Comparison, Technology, Simple (Analog), Sophisticated (Digital), Technology Comparison, Topology, Centralized, Modular Master-Slave, Distributed, Topology Comparison

UNIT – 3	**9 Hours**

BMS Functions

Measurement, Voltage, Temperature, Current, Management, Protection, Thermal Management, Balancing, Redistribution, Distributed Charging, Evaluation, State of Charge and Depth of Discharge, Capacity, Resistance, State of Health (SOH), External Communications, Dedicated Analog Wire, Dedicated Digital Wire, Data Link, Logging and Telemetry, Off-the-Shelf BMSs, Cell Manufacturers' BMSs, Comparison

UNIT – 4	**9 Hours**

Custom BMS Design

Using BMS ASICs , BMS ASIC Comparison, Analog BMS Design, Analog Regulator, Analog Monitor, Analog Balancer, Analog Protector, Ready-Made, Digital BMS Designs, ATMEL's BMS Processor, Elithion's BMS Chip Set, National Semiconductors' Complete BMS, Peter Perkin's Open Source BMS, Texas Instruments' bq29330/bq20z90, Texas Instruments' bq78PL114/bq76PL102, Custom Digital BMS Design, Voltage and Temperature Measurement, Current Measurement, Evaluation, Communications, Optimization, Switching, Logging, Cell Interface, Non-distributed, Distributed, Distributed Charging

UNIT – 5	9 Hours

Deploying a BMS

Installing, Battery Pack Design, BMS Connections to Pack, BMS Connections to System, Configuring, Cell Configuration, Pack Configuration, System Configuration, Testing, Troubleshooting, Grounding, Shielding, Filtering, Wire Routing

Course Outcomes

At the end of the course student will be able to

1.	Identify process to implement BMS
2.	Describe various communication protocol involved in BMS
3.	Illustrate functionality of BMS
4.	Apply concepts of BMS using application specific IC
5.	Analyse the hardware implementation aspects of BMS

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
EEE281.1	1	3	-	-			1				
EEE281.2	1	3	-	-			1				
EEE281.3	1	2	3	-			1				
EEE281.4	1	2	2	3			1				
EEE281.5	1	3	-	-			1				

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Battery Management Systems for Large Lithium-Ion Battery Packs	Davide Andrea	ARTECH HOUSE	2010

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Battery Management Algorithm for Electric Vehicles	Rui Xiong	Springer	2019
2.	Battery Management Systems of Electric and Hybrid Electric Vehicles	Nicolae Tudoroiu	MDPI	2021

FUNDAMENTALS OF BIO MEDICAL INSTRUMENTATION			
Course Code	EEE282	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	OEC

PREREQUISITE: Linear Control System, Instrumentation and Measurement

Course Objectives

1.	To introduce the origin and characteristics of biopotentials
2.	To enable students to understand standard electrode configurations
3.	To impart knowledge about the design and functioning of bio-amplifiers
4.	To provide a foundational understanding of biochemical sensors and clinical laboratory instruments

Course Contents

UNIT – 1

Bio Potential Electrodes	**9 Hours**

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

UNIT – 2

Electrode Configurations	**8 Hours**

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG, ERG and EOG – unipolar and bipolar mode.

UNIT - 3

Bio Amplifier	**9 Hours**

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

UNIT - 4

Measurement of Non-Electrical Parameter	**9 Hours**

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT - 5

Bio-Chemical Measurement	**9 Hours**

Biochemical sensors - pH, pO2 and pCo2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

Course Outcomes

At the end of the course student will be able to

1.	Comprehend the origin and propagation of biopotentials and analyze various electrode types, their interfaces, and the challenges in biopotential signal recording.
2.	Identify and interpret biosignal characteristics and electrode configurations used in ECG, EEG, EMG, ERG, and EOG recordings
3.	Design and evaluate different types of bio-amplifiers and filters with an understanding of isolation techniques and noise reduction in biopotential signal acquisition.
4.	Explain and compare different techniques used for measuring physiological parameters such as temperature, respiration, pulse rate, blood pressure, blood flow, and cardiac outpu

5.	Describe the knowledge of biochemical sensors and analyzers used in clinical diagnostics, including their operating principles and simplified schematic representations.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
Code.1	3	2					1						
Code.2	3	2		2			1						
Code.3	3	2		2			1						1
Code.4	3	2		2			1						1
Code.5	3	2		2			1						1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Medical Instrumentation	J.Webster	John Wiley&Sons	1995

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Introduction to Biomedical Equipment Technology	Joseph J. Carr and John M. Brown	Pearson Education	2004
2.	HandBookofBio-Medical instrumentation'	R.S. Khandpur	Tata McGraw Hill Publishing Co Ltd.	2003

INTRODUCTION TO ELECTRIC VEHICLE TECHNOLOGY			
Course Code	EEE283	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	OEC

PREREQUISITE:

Course 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

Course Contents

UNIT – 1	**9 Hours**
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.	
UNIT – 2	**9 Hours**
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 train).	
UNIT – 3	**9 Hours**
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, Supercapacitors.	
UNIT – 4	**9 Hours**
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.	
UNIT – 5	**9 Hours**
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.	

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
EEE283.1	2	3	-				1				
EEE283.2	1	2	3				1				
EEE283.3	1	2	3				1				
EEE283.4	1	2	3				1				
EEE283.5	1	2	2				1				

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Husain	CRC Press	2003.
2.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design	M. Ehsani, Y. Gao, S.Gay and Ali Emadi	CRC Press	2005

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles	Sheldon S. Williamson	Springer	2013
2.	Electric Vehicle Technology	C.C. Chan and K.T. Chau	OXFORD University	2001
3.	Hybrid Electric Vehicles Principles And Applications with Practical Perspectives	Chris Mi, M. Abul Masrur, David Wenzhong Gao	Wiley Publication	2001

E Books / MOOCs/ NPTEL

1.	Introduction to Mechanics | Coursera
2.	Electric Vehicles - Part 1 - Course (nptel.ac.in)
3.	NPTEL: Electrical Engineering - Introduction to Hybrid and Electric Vehicles
4.	Hybrid Vehicles (edX) | MOOC List (mooc-list.com)
5.	Electric Cars: Technology | My MOOC (my-mooc.com)

FUNDAMENTALS OF PLC AND ITS APPLICATIONS			
Course Code	EEE284	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	OEC

PREREQUISITE:

Course Objectives

1.	To understand main parts and their functions, basic sequence of operation of PLC.
2.	To study the different programming languages and fundamental wiring diagrams.
3.	To explain the functions of PLC counter instructions, applying combinations of counters and timers to control systems.
4.	To explain the basic operation of PLC closed-loop control system, various forms of mechanical sequencers and their operations
5.	To discuss the operation of various processes, structures of control systems and the method of communication between different industrial processes

Course Contents

UNIT – 1	**9 Hours**
Programmable Logic Controllers	
Introduction, Parts of a PLC, Principles of Operation, PLC Size and Application	
PLC Hardware Components	
The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing Unit (CPU), Memory Design, Memory Types, Programming Terminal Devices, Human Machine Interface (HMIs).	
UNIT – 2	**9 Hours**
Basic Programming Language	
Ladder diagrams, Ladder conventions, Logic functions with timing diagram, latching, multiple outputs, entering programs, Functional blocks, Program examples, instruction list, branch codes, programming examples, Sequential functions charts, branching and convergence, actions, Structured Text, conditional and iteration statements	
Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs	
Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors, Output Control Devices, Seal-In Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Writing a Ladder Logic Program Directly from a Narrative Description.	
UNIT – 3	**9 Hours**
Programming Timers	
Introduction, Necessity of Energy Storage and Methods of Energy Storage (Classification and brief description using block diagram representation)	
Programming Counters	
Counter Instructions, Up-Counter, Down-Counter, Cascading Counters, Incremental Encoder-Counter Applications, Combining Counter and Timer Functions.	
UNIT – 4	**9 Hours**
Program Control Instructions	
Master Control Reset Instruction, Jump Instruction, Subroutine Functions, Immediate Input and Immediate Output Instructions, Forcing External I/O Addresses, Safety Circuitry, Selectable Timed Interrupt, Fault Routine, Temporary End Instruction, Suspend Instruction.	
Data Manipulation Instructions	
Data Manipulation, Data Transfer Operations, Data Compare Instructions, Data Manipulation Programs, Numerical Data I/O Interfaces, Closed-Loop Control.	

Math Instructions

Math Instructions, Addition Instruction, Subtraction Instruction, Multiplication Instruction, Division Instruction, Other Word-Level Math Instructions, File Arithmetic Operations

UNIT – 5	**9 Hours**

Sequencer and Shift Register Instructions

Mechanical Sequencers, Sequencer Instructions, Sequencer Programs, Bit Shift Registers, Word Shift Operations.

Process Control, Network Systems, and SCADA

Types of Processes, Structure of Control Systems, On/Off Control, PID Control, Motion Control, Data Communications, Supervisory Control and Data Acquisition (SCADA).

Course Outcomes

At the end of the course student will be able to

1.	Identify main parts, functions of PLC and describe basic circuitry for I/O modules to select PLC for desired application
2.	Apply suitable logic using various programming languages to achieve specific control mechanism for a given application
3.	Identify timer/counter resources of a PLC to design control logic for interfaced device.
4.	Interpret data manipulation and math instructions as they apply to a PLC program
5.	Develop programs that use shift registers and explain functions of control elements of a closed loop control system

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
EEE284.1	3	-	-				1				1
EEE284.2	1	3	-				1				1
EEE284.3	1	2	3				1				1
EEE284.4	1	2	3				1				1
EEE284.5	1	2	3				1				1

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Programming Logic Controllers	Frank Petruzella		5th Edition
2.	Programmable Logic controllers	W Bolton	Elsevier-newness	6th edition, 2015.

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Programmable logic controllers - principles and applications	John W Webb, Ronald A Reis	Pearson education	5th edition, 2009
2.	Programmable Controller Theory and Implementations	L. A Bryan, E. A Bryan		2nd edition, 2003
3.	Solar Energy: Principles Collection and Storage	S. P. Sukhumi, J. K. Nayak	McGraw-Hill Education (India)	3rd edition, 2009

E Books / MOOCs/ NPTEL

1.	https://library.automationdirect.com/category/product/programmable-control/

2.	https://www.coursera.org/lecture/intelligent-machining/programmable-logic-controllers-plc-fGz3r
3.	https://www.udemy.com/course/plc-programming-from-scratch/

MOTORS AND MOTOR CONTROL CIRCUITS			
Course Code	EEE285	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	OEC
PREREQUISITE:			
Course Objectives			
1.	Study architecture of induction motor and synchronous motor		
2.	Understanding control of AC motor		
3.	Study principle of operation of different dc motors		
4.	Understand the different types of control techniques		
5.	Study different sensors and their role in control of a motor		

Course Contents	
UNIT – 1	**9 Hours**
AC Motor Designs	
Introduction, Three phase AC motor architecture, Torque speed curve, wound rotor, Synchronous motors Single phase AC motors, split phase motor, capacitor start and shaded pole motors, Universal and gear motors, AC Motor Specifications, Specifying an AC motor for an application.	
UNIT – 2	**9 Hours**
AC Motor Control:	
AC motor Enclosures, AC motor control components, Manual motor starting systems, Direct On Line Starter, semi-automatic star delta starter, fully automatic star delta starter, control circuit for sequence operation of two motors	
UNIT – 3	**9 Hours**
DC Motors	
DC motor principle of operation, Brushed DC motors, shunt, series and compound wound motors, Brushless DC motors, driving a brushless DC motor, Commutation, Specifying a DC motor	
UNIT – 4	**9 Hours**
DC Motor Control and Stepper Motors	
Stepper motor principles of operation, Illustrative example of a stepper motor drive, stepper motor specification and operation, commercial stepper motor drive chips and packages, Direction Controller-H Bridge, Speed Controller: Pulse Width Modulation (PWM), Armature Controller: Variable resistance, DC vs.AC motors	
UNIT – 5	**9 Hours**
Sensors	
Unipolar Hall Effect Switches, Omnipolar Hall Effect Switches, Latched Hall Effect Switches, Current Sensors: Shunt resistor, Current-sensing transformer, Hall effect current sensor, Speed/position sensors: Quadrature encoder, Hall effect tachometer, Back EMF/Sensorless control method, BLDC motor control with Hall sensor, Block diagram approach of BLDC Fan and Motor Control	

Course Outcomes	
At the end of the course student will be able to	
1.	Demonstrate an understanding of the general principles of AC Motor.
2.	Describe the basic principles of AC motor controls which includes starters, contactors, and control relays
3.	Demonstrate an understanding of the general principles of DC Motor.
4.	Describe the basic principles of DC motor controls which includes starters, contactors, and control relays
5.	Design the sensor setup in order to give feedback to a control circuit

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
EEE285.1	3	-	-	-	-	-	1				
EEE285.2	2	3	3	-	-	2	1				
EEE285.3	3	-	-	-	-	-	1				
EEE285.4	2	3	3	-	-	2	1				
EEE285.5	2	3	3	-	-	2	1				

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Control of electrical machines	S. K. Bhattacharya Birjindersingh	New Age International.	
2.	Electrical Motor Controls	Gary J. Rockis & Glen A. Mazura		5th Edition

REFERENCE BOOKS

Sl. No	Textbook Title	Author /s	Publisher	Edition / Year of publication
1.	Industrial Motor Control	Stephen L. Herman		Delmar Publishers, Inc., latest Edition

E Books / MOOCs/ NPTEL

1.	https://www.coursera.org/learn/motors-circuits-design
2.	http://ww1.microchip.com/downloads/en/appnotes/00894a.pdf

NON-CONVENTIONAL ENERGY SOURCES			
Course Code	EEE286	**Credits**	3
Hours/Week (L :T:P:S)	3:0:0:0	**CIE Marks**	50
Total Hours	45	**SEE Marks**	50
Exam Hours	3	**Course Type**	OEC

PREREQUISITE:

Course Objectives

1.	To understand the principle of extraction of energy from conventional, nonconventional sources
2.	To understand the working principle and applications of solar based thermal, electrical and PV systems.
3.	To justify the usage of energy storage techniques and understand the process of design and implement wind based energy conversion systems.
4.	To understand the process of design and implement biomass based energy conversion systems

Course Contents

UNIT – 1	**9 Hours**

Energy Sources

Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Classification of Energy Resources, Conventional Energy Resources- Availability and their Limitations, Non-Conventional Energy Resources- Classification, Advantages, Limitations, Comparison of Conventional and Non-Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario

Solar Energy Basics

Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems), Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer

UNIT – 2	**9 Hours**

Solar Thermal Systems

Principle of Conversion of Solar Radiation into Heat, Solar Water Heaters (Flat Plate Collectors), Solar Cookers – Box type, Concentrating dish type, Solar driers, Solar Still, Solar Furnaces, Solar Green House.

Solar Electric Systems

Solar Thermal Electric Power Generation, Solar Pond and Concentrating Solar Collector (Parabolic Trough, Parabolic Dish, Central Tower Collector), Advantages and Disadvantages; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems- stand-alone and grid connected, Applications- Street lighting, Domestic lighting and Solar Water pumping systems.

UNIT – 3	**9 Hours**

Energy Storage

Introduction, Necessity of Energy Storage and Methods of Energy Storage (Classification and brief description using block diagram representation)

Wind Energy

Introduction, Wind and its Properties, History of Wind Energy Wind Energy Scenario – World and India. Basic principles of WECS, Classification, Parts of a WECS,
Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS. Wind site selection consideration, Advantages and Disadvantages of WECS.

UNIT – 4	**9 Hours**

Biomass Energy

Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, Factors affecting biogas generation, types of biogas plants- KVIC and Janata model, Biomass program in India

UNIT – 5	**9 Hours**

Energy From Ocean

Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plant, Estimation of Energy – Single basin and Double basin type TPP (no derivations, Simple numerical problems), Advantages and Limitation of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle), Hybrid cycle, Site-selection criteria, Biofouling, Advantages & Limitation of OTEC

Emerging Technologies

Fuel Cell, Small Hydro Resources, Hydrogen Energy and Wave Energy (Principle of Energy generation using block diagrams, advantages and limitations)

Course Outcomes

At the end of the course student will be able to

1.	Describe non-conventional energy sources and solar radiation geometry to estimate and measure solar radiation.
2.	Apply the principle of solar radiation into heat to understand the operation of solar thermal and solar electric systems.
3.	Describe energy storage methods and wind–energy conversion systems to understand the factors influencing power generation.
4.	Review the biomass conversion technologies to design biomass-based energy systems.
5.	Describe tidal, ocean thermal and fuel cell energy conversion systems to understand emerging non-conventional energy technologies.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
EEE286.1	2	3	-	-	-	1	2	1			
EEE286.2	2	3	-	-	-	1	2	1			
EEE286.3	2	3	-	-	-	1	2	1			
EEE286.4	2	3	-	-	-	1	2	1			
EEE286.5	2	3	-	-	-	1	2	1			

1: Low 2: Medium 3: High

TEXTBOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Rai G. D	Non-Conventional Sources of Energy	Khanna Publishers, New Delhi	4th Edition2007

REFERENCE BOOKS

Sl. No	**Textbook Title**	**Author /s**	**Publisher**	**Edition / Year of publication**
1.	Fundamentals of Renewable Energy Systems	Mukherjee D. and Chakrabarti, S	New Age International Publishers	2005

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/108108078

ELEMENTS OF YOGA

Course Code:	**HSS181**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**2:0:2:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Understand the basic philosophy and origin of Yoga.
2.	Learn about the benefits of Yoga for physical and mental well-being.
3.	Practice basic yogic postures (asanas) and breathing techniques (pranayama) for health improvement.
4.	Develop an awareness of mindfulness, stress management, and self-discipline through Yoga.
5	Encourage a healthy, balanced lifestyle suitable for engineering students to handle academic and life challenges.

UNIT-I

Introduction to Yoga	**09 hours**

Theory: Origin and history of Yoga. Definition, meaning, and importance of Yoga. Branches of Yoga (Jnana, Bhakti, Karma, Raja Yoga). Benefits of Yoga for students' life – focus, discipline, and health.
Practical: Nada Yoga – AAA, UUU, MMM (OMKAR) chanting. Yoga Prayer and Sankalpa. Loosening exercises.

UNIT-II

Yogic Lifestyle and Ethics	**09 Hours**

Theory: Introduction to Astanga Yoga: Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana, Samadhi. Yogic concept of health and diseases (Panchakosha Viveka). Yogic lifestyle: Ahara (diet), Vihara (routine), Aachara (conduct), Vichara (thought).
Practical: Surya Namaskar (Sun Salutations). Introduction to basic standing asanas – Tadasana, Vrikshasana, Trikonasana.

UNIT-III

Personality Development through Yoga	**09 hours**

Theory: Yoga for physical, mental, and emotional balance. Guidelines for improving concentration, memory, and stamina. Yogic practices for flexibility and endurance.
Practical: Flexibility exercises. Yogasanas: Bhujangasana, Shalabhasana, Shavasana.

UNIT-IV

Pranayama and Breathing Control	**09 hours**

Theory: Importance of breath in Yoga – physiology and benefits. Introduction to Pranayama – Nadi Shuddhi, Bhramari. Rules and precautions for Pranayama.
Practical: Anuloma-Viloma, Suryabhedana, Chandrabhedana. Kapalabhati (basic practice).

UNIT-V

Meditation and Relaxation	**09 hours**

Theory: Mind-body connection and the role of meditation. Introduction to Dhyana (Meditation) and mindfulness. Stress management and relaxation techniques.
Practical: Guided Meditation (10 mins daily). Yoga Nidra (Relaxation). Shanti Path (Peace Chanting).

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

1.	Explain the fundamentals of Yoga and its relevance in modern life.
2.	Demonstrate basic Yoga asanas for physical fitness and flexibility.
3.	Practice Pranayama and meditation techniques to enhance concentration and reduce stress.
4.	Apply yogic concepts to improve their personal and academic life.
5.	Promote self-awareness and a positive attitude through regular yogic practices.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓		
↓ Course Outcomes												1	2	3
HSS181.1	0	0	0	0	0	0	0	2	1	0	0	1	0	0
HSS181.2	0	0	0	0	0	1	1	2	2	0	0	2	0	0
HSS181.3	0	0	0	0	0	2	1	3	2	1	0	1	0	0
HSS181.4	0	0	0	0	0	2	2	3	2	0	0	1	0	0
HSS181.5	0	0	0	0	0	2	2	3	2	0	0	2	0	0

1: Low 2: Medium 3: High

TEXTBOOKS & REFERENCE BOOKS:

1.	"Yoga: The Science of Holistic Living". Author: Swami Vivekananda Kendra Publisher: Vivekananda Kendra Prakashan. A simple guide to Yoga's basic philosophy, practices, and health benefits. Ideal for students to understand the holistic benefits of Yoga.
2.	"Light on Yoga". Author: B.K.S. Iyengar Publisher: HarperCollins India. Classic text with detailed descriptions and illustrations of over 200 postures. Useful for practical sessions with step-by-step guidance.
3.	Science of Yoga: Understand the Anatomy and Physiology to Perfect Your Practice Author: Ann Swanson Publisher: DK Publishing. Visual guide linking Yoga postures with scientific explanations. Helps engineering students relate to body mechanics and physiology.
4.	"Introduction to Yoga". Author: Swami Vivekananda Publisher: Advaita Ashrama. Focus on philosophical and spiritual aspects of Yoga.. Encourages students to see Yoga as a way of life.

INTELLECTUAL PROPERTY RIGHTS

Course Code	**HSS182**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45+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.
4	Acquire Knowledge of National and International Trade Agreements and Agencies functioning in relation to intellectual property rights.
5	To acquire a general understanding of patenting procedures and licensing

UNIT-I — **09 Hours**

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.

UNIT-II — **09 Hours**

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, 2017

UNIT-III — **09 Hours**

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.)

UNIT-IV — **09 Hours**

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

UNIT-V	09 Hours

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)

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

1	Have a General understanding of the Intellectual Property Rights.
2	Aware of different forms of intellectual property rights, national and international IPR related legislations.
3	Know 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	Aware of National and International Trade Agreements and Agencies functioning in relation to intellectual property rights
5	Familiar with procedures, licensing, technology transfer and other legal provisions of patenting and other IP Rights.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**
↓ Course Outcomes													2
HSS182.1			3	2		3			1	2		3	
HSS182.2			3			3		3	1	1		3	
HSS182.3				2		3			1	2		3	
HSS182.4			1	1		3			1	2		3	
HSS182.5			1			3			2	1		3	

1:Low 2:Medium 3: High

REFERENCEMATERIALS

1	BAREACT, Indian Patent Act1970 Acts & Rules, Universal Law Publishing Co.Pvt.Ltd., 2007
2	Kankanala C., Genetic Patent Law & Strategy,1st Edition, Manupatra Information SolutionPvt. Ltd., 2007
3	Subbaram N.R. "Handbook of Indian Patent Law and Practice", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
4	EliWhitney, United States Patent Number: 72X, Cotton Gin, March14, 1794.
5	IntellectualPropertyToday:Volume8,No.5,May2001,
6	WTO and International Tradeby 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 2000
8	Wadehra,B.L. Law relating to patents, trademarks, copyright designs & geographical indications 2 ed. Universal Law Publishing 2000
9	Sinha, Prabhas Chandra Encyclopedia of Intellectual Property Rights,3 Vols.Eastern Book Corporation, 2006.
10	"PracticalApproachtoIntellectualPropertyRights";RachnaSinghPuriandArvindVishwanathan, 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/

INTRODUCTION TO THENKUTHITTU YAKSHAGANA

Course Code	**HSS183**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**2:0:2:0**	**Credits**	**03**
Total Teaching Hours	**45+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Any

Course Objectives:

1.	Gain basic understanding of thenku thittu yakshagana
2.	Perform basic movements of adi thala, yeka thala and asta thala.
3.	Perform basic movements of rupaka thala, trivude thala and jampe thala.
4	Perform rangasthala pravesha and yerupada steps.
5	Understand speech/dialogue, rhythm, entry and improvisation skills.

UNIT - I

Introduction	**8 Hours**

Yakshagana: Meaning and features, Origin and development, Difference between thenkuthittu and badaguthittu yakshagana. A brief introduction to thenkuthittu yakshagana.
Sabha lakshana in tenkuthittu.

UNIT-II

Thalas	**9 Hours**

Aadi thala, yeka thala, kore thala and asta thala with biditha and mukthya, Practice

UNIT - III

Thalas	**9 Hours**

Rupaka Thala, Trivide Thala, nidhaana and twaritha jampe thala with biditha and mukthaya, Practice

UNIT-IV

Rangasthala pravesha	**9 Hours**

Digina practice, Rangasthala pravesha steps and erupada ettugade steps., Revision of all Thalas.

UNIT – V

Yakshagana prasanga practice	**10 Hours**

Abhinaya and presentation

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

1.	Demonstrate a comprehensive understanding of Yakshagana, including its cultural significance, historical evolution, and the distinctions between Thenkuthittu and Badaguthittu styles, thereby fostering a deeper appreciation for this traditional art form.
2.	Develop proficiency in executing traditional Yakshagana rhythms and expressions, empowering them to actively participate and contribute to the preservation and promotion of Yakshagana heritage.
3.	Attain proficiency in executing certain thalas with precision, enhancing their ability to interpret and convey the essence of traditional compositions.
4.	Develop agility, coordination, and stage presence, enabling them to perform with confidence and grace on various Yakshagana platforms, while the comprehensive revision of all thalas will consolidate their understanding and execution of Yakshagana rhythmic structures.
5.	Demonstrate refined proficiency in Yakshagana Prasanga Practice, exhibiting adeptness in abhinaya (expressive gestures) and captivating presentation skills, enriching their ability to convey narratives with authenticity and artistic flair.

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
HSS183.1	-	-	-	-	-	-	-	-	3	3	-	-	-	-
HSS183.2	-	-	-	-	-	-	-	-	3	3	-	-	-	-
HSS183.3	-	-	-	-	-	-	-	-	3	3	-	-	-	-
HSS183.4	-	-	-	-	-	-	-	-	3	3	-	-	-	-
HSS183.5	-	-	-	-	-	-	-	-	3	3	-	-	-	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Sathish Madivala, “Yaksha Naatyanjali Thenkuthittu- Sampadaka”, Karkala.
2.	Yakshagna Shikshana Patya Pustaka- Prathamika vibhaga, Karnatka Patya pusthaka sangha-Bengaluru.
3.	Dr. Ramananda Banari, “Arthayana: Yakshagana Talamaddale Arthagarike: Ondu Vishleshane”.
4.	Dr. M. Prabhakara Joshi, “Koralara: Yakshagana Vimarsha Sankalana”.
5.	Vaagartha Gawrava: (Dr. Joshi Abhinandana Guchaha): Ga. Na. Bhat

NATIONAL CADET CORPS: ORGANIZATION, FUNCTIONS AND CAPABILITIES

Course Code:	**HSS184**	**Course Type**	**OEC**
Teaching Hours/Week (L: T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Chemistry

Course Objectives:

1	To create evolved youth, who will be equipped to contribute in the development of the nation.
2	To understand and develop life skills, soft skills and to improve the emotional quotient of the student.
3	To inculcate spirit of adventure, undertake adventure activities, to hone leadership qualities and risk-taking abilities.
4	To impart basic military training, to develop awareness about the defence forces and expose learners to military ethos/values.
5	To provide conducive environment to motivate young Indians to choose the Armed Forces as a career.

UNIT-I

NCC: Aims, Objectives and Organization	**09 Hours**

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.

UNIT -II

Personality Development	**09 Hours**

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.

UNIT-III

Naval Communication and Seamanship	**09 Hours**

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.

UNIT- IV

Disaster management and environmental awareness	**09 Hours**

Disaster Management- Organization, Types of Disasters, Essential Services, Assistance, Civil Defence organization. Adventure Activities.
Do's and Don'ts, Fire services and Firefighting, Environmental Awareness and Conservation.

UNIT-V

Naval Orientation	**09 Hours**

Naval Orientation- Armed Forces and Navy Capsule, EEZ Maritime Security & ICG. Border & Coastal Areas: Security setup and Boarder/Coastal management in the area.
Types and Functions of Indian Naval Ships. Functions of each department of a Ship. Naval Customs and Traditions. Modes of Entry in Defence forces.
Border and Coastal areas: Security Challenges & role of cadets in Border management

Course Outcomes: At the end of the course students 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 a sense of discipline, improve bearing, smartness, turnout, and develop the quality of immediate and implicit obedience of orders.
3	Acquaint, expose & provide knowledge about the Navy and to acquire information about the Naval activities, service subjects, and important battles.
4	Know about the various types of natural disasters.
5	Understand individual responsibilities and role in meeting the security challenges on

	Border/Coastal areas.

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
HSS184.1						H	H	L						
HSS184.2						H	H							
HSS184.3									L					
HSS184.4						H	H							
HSS184.5						H	H							

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1. Cadets Handbook, R.K. Guptha, Ramesh Publishing House, New Delhi.

PRINCIPLES OF PHYSICAL EDUCATION

Course Code	**HSS185**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Physical Education

Course Objectives:

1.	Express understanding of constitution of sports organizations
2.	Demonstrate considerate familiarity of various food practices
3.	Grasp understanding of first aid and physical education
4.	Awareness on the importance of exercise
5.	Leadership skills and the rules of different sports

UNIT - I

09 Hours

Physical Education - Concept of Physical Education, meaning and Definition, importance of Physical Education, Aims & Objectives of Physical Education
Physical Fitness - Meaning, definition**,** Physical fitness components and its importance
Exercise – Meaning and Importance
Health Education - Meaning & definition of Health Education, Scope & Importance of Health Education.
Concept of Health - Meaning of Health, Health Definition, Factors Affecting Health, Qualities of Healthy Person. Health Hazards of College Students.

UNIT - II

09 Hours

Training in Sports - Meaning & Principles, Warming Up & Limbering Down
Leadership - Meaning, Qualities of a good leader in Physical Education
Recreation games and its importance
Organization of Sports events and Necessary requirements
Food and Nutrition - Meaning & definition of Food & Nutrition, Nutrients and their Functions - i) Proteins ii) Carbohydrates iii) Fats iv) Vitamins v) Water vi) Minerals
Competition - Introduction, Types of competition, Knock out, League or Round Robin Tournament.

UNIT – III

09 Hours

Posture - Meaning, Definition, types, and its importance
First Aid – Meaning & definition of First Aid, Need and importance of First Aid, The Requisites of First Aid, Scope of First Aid, Qualities of a First Aider, First Aid in Different Cases.
Sports injuries on playing fields – Reasons of sports injuries, PRICE treatment for injuries, basic first aid for strain, sprain, nose bleeds, heatstroke, minor cut or scrape.
Yoga - Meaning and Importance
World Health Organization (WHO) and its importance.

UNIT – IV

09 Hours

Measurements, specification & diagonal distance of various playing fields –Volleyball, Handball, Badminton, Ball Badminton, Basketball, Football, Cricket Pitch, Athletics track and field.
Basic playing skills and Techniques of sports events

Maintenance of sports fields

UNIT – V

09 Hours

History of Physical Education - Olympic games, Modern Olympic games, Olympic Ideals & Objectives, Olympic Symbols, Olympic Flag, Olympic Emblem, Olympic Motto, Olympic Flame, Asian games, Commonwealth games
International Olympic Committee (IOC), Indian Olympic Association (IOA)
Sports awards - Eligibility, Objectives & Criteria

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

1.	Demonstrate knowledge of structure of the world sports organizations
2.	Display understanding of different type of food and nutrition for a healthy diet
3.	Comprehend awareness of first aid and physical education
4.	Elucidate about training and the importance of Physical Education
5.	Aware of leadership skills and the knowledge of various sports

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HSS185.1	-	-	-	-	-	3	-	-	2	1	-	1
HSS185.2	-	-	-	-	-	3	-	-	2	1	-	1
HSS185.3	-	-	-	-	-	3	-	-	2	1	-	1
HSS185.4	-	-	-	-	-	3	-	-	2	1	-	1
HSS185.5	-	-	-	-	-	3	-	-	2	1	-	1

1: Low 2: Medium 3: High

INDIAN CULTURE - YAKSHAGANA

Course Code:	**HU1509-1**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Humanities

Course Objectives:

1.	Gain basic understanding of Thenku Thittu Yakshagana.
2.	Perform basic movements.
3.	Understand speech/dialogue, rhythm, Entry and improvisation skills.
4.	Appreciate folk traditions
5.	To train the students for Abhinaya

Introduction

Yakshagana is a traditional theatre, developed in Dakshina Kannada, Udupi, Uttara Kannada, Shimoga and western parts of Chikmagalur districts, in the state of Karnataka and in Kasaragod district in Kerala that combines dance, music, dialogue, costume, make-up, and stage techniques with a unique style and form. It is sometimes simply called "Aata" or āṭa (meaning "the play"). This theatre style is mainly found in coastal regions of Karnataka. Towards the south from Dakshina Kannada to Kasaragod of Tulu Nadu region, the form of Yakshagana is called Thenku thittu and towards the north from Udupi up to Uttara Kannada it is called Badagu thittu.. Yakshagana is traditionally presented from dusk to dawn. Its stories are drawn from Ramayana, Mahabharata, Bhagavata and other epics from both Hindu, Jain and other ancient Indic traditions.

The course is designed in a progressive method. The content and the steps are listed below:

- Introduction: The first step deals with a brief introduction of the Thenku Thittu Yakshagana and the differences between Thenku and Badagu Thittu.
- Basic movement: The next step is to teach the basic movements of Thenku Thittu Yakshagana.
- Pravesha: The entry of different characters will be different and there are several variations in the entries. This will be taught to students.
- 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.

Need Analysis and Justification

The target public is

a) Faculty of Nitte (Deemed to be University)
b) Non-teaching staff of Nitte (Deemed to be University).
c) Students of Nitte (Deemed to be University)

There is an enthusiasm in people to learn Yakshagana. Since, at present, there is no institution/university providing such a course, Nitte DU can spearhead the Certificate/Value Added Course in Yakshagana

Course Activities

Teaching can take place in two languages either English or Kannada, depending on the audience. The total classes can be roughly classified into 80% practical, 20% theory and the rest of it is practice and performance. The course plan is:

Class - 1st, 2nd : Thenku Thitttu Yakshagana - An Introduction
Class - 3rd : Dhingina
Class - 4th : Revision
Class - 5th : Dhingina, kitataka, tarikita kitataka
Class - 6th and 7th : Practice

Class - 8th : Dhingina, kitataka front and back+turning
Class - 9th : Movements
Class - 9th : Pravesha steps
Class - 10th :Pravesha nade in full form
Class - 11th and 12th : Revision
Class - 13th : Eripada, ettugade, eripada steps
Class – 14th -20th : Practice and Assessment
Class – 21th to 35th : Tala introduction. Slow talas and Yakshagana Prasanga practice (Abhinaya+ Presentation)

Course Duration

The planned duration of the course is 32 hours. Each class will take place for two hours (120 minutes), so 16 classes. 3 extra classes may be taken if required.

Activity	Duration (Hours)
Regular Classes	32 (16 classes)
Backup classes	6 (3 Classes)
Mid Term Exam	1
Final Test	(Performance)

Course completion requirements

The student is said to be qualified only if he/she gets a minimum of 40 out of 100. The categorization of the assessment and scores are given in the table below.

Assessment Type	Maximum Score
Assignment	10
Midterm exam 1	20
Midterm exam 2	20
SEE	50
Total	100

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

1.	To get the knowledge about origin of Yakshagana
2.	Will be able to perform basic movements of Thenku Thittu
3.	Will be able to demonstrate sample Yakshagana Prasanga
4.	Will be versed with the basics of the Yakshagana art form

Suggested Reading/Resources

Dr.Ramananda Banari, “Arthayana: Yakshagana Talamaddale Arthagarike: Ondu Vishleshane”
Dr. M. Prabhakara Joshi, “Koralara: Yakshagana Vimarsha Sankalana”.
Ga. Na. Bhat, “Vaagartha Gawrava:(Dr. Joshi Abhinandana Guchaha)”.

INDIAN CULTURE - MUSIC

Course Code:	**HU1510-1**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: S):	**2:0:2:0**	**Credits:**	**03**
Total Teaching Hours:	**26+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Humanities

Course Objectives:

1.	To understand various aspects of Indian Folklore Music
2.	To comprehend some forms of popular Indian Music
3.	To be aware of major contributors of Indian Music
4.	To recognize the basic dimensions of Indian classical music
5.	To enhance knowledge about Indian culture

UNIT-I

20 Hours

Discussion on historical overview, growth of various music form and royal patronage, discussion on various classifications – classic (Hindustani and Carnatic), folk music and its regional diversities and forms (Bihu, Bauls, Bhangra, Dandiya, Ganasangeet, Uttarakhandi, Lavani, popular Kawwali, Rabindra sangeet, Rajasthani)

UNIT-II

20 Hours

Modern music forms (Indian popular music – filmy music, rock and metal music, dance music, western music, Dasa Sahitya, Musicians – both vocalist and instrumentalists,

UNIT-III

12 Hours

Eminent contributions and scholars of Indian music, various forms of musical instruments, basic dimensions of music – raga, laya, bhava and tala.

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

1.	Understand Indian Folklore Music
2.	Know some forms of popular Indian Music
3.	Recognize major contributors of Indian Music
4.	Identify various popular music in Indian context

ENGINEERING ETHICS

Course Code:	**HU1511-1**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T: P)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

UNIT-I	**09 Hours**
Why professional ethics – what is a profession, engineering and professionalism, two models of professionalism, three types of ethics or morality, negative face of engineering ethics, positive face of engineering cases, case studies. **Responsibility in engineering** – introduction, engineering standards, the standard of care, blame-responsibility and causation, liability, design standards, the range of standards of practice, the problem of many hands, impediments to responsible action,	
UNIT-II	**09 Hours**
Professionalism and code of ethics – introduction, is engineering a profession, codes of ethics **Understanding ethical problems** **Ethical problem solving techniques** **Risk, safety and accidents**	
UNIT-III	**09 Hours**
The social and value dimensions of technology – thinking about technology and society, technological optimism and technological pessimism, computer technology: privacy and social policy, how shall we design, ethical issues in design.	
UNIT-IV	**09 Hours**
Engineers in organization – introduction, professional responsibilities, professional rights, whistleblowing, **Engineers and environment** – introduction, environmental codes, the progressive attitude towards environment, going beyond law, respect for nature, should engineers have environmental obligations?	
UNIT-V	**09 Hours**
Trust and reliability – introduction, honesty, forms of dishonesty, why is dishonesty wrong, dishonesty on campus, dishonesty in engineering research and testing, confidentiality, intellectual property, expert witnessing, informing the public, conflicts of interest. Doing the right thing Codes of ethics of Professional Engineering Societies.	

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

1.	Describe the importance of engineering ethics and the responsibility in engineering
2.	Know about the code of ethics, ethical problems and methods to solve such problems.
3.	Evaluate the value and social dimensions of technology.

4.	Evaluate the role of engineers in organization and their role in safeguarding environment.
5.	Discuss the impact of trust and reliability and know the codes of ethics of professional engineering societies.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
	-	-	-	-	-	3	-	3	1	1	-	-
	-	-	-	-	-	3	-	3	1	1	-	-
	-	-	-	-	-	3	-	3	1	1	-	-
	-	-	-	-	-	3	-	3	1	1	-	-
	-	-	-	-	-	3	-	3	1	1	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Charles E Harris, Michael S. Pritchard & Michael J. Rabins, Engineering Ethics – Concepts and Cases, Fourth Edition, WADSWORTH CENGAGE Learning, 2009, ISBN-13: 978-0-495-50279-1 ISBN-10: 0-495-50279-0
2.	Charles B. Fledderman, Engineering Ethics, Fourth Edition, Pearson, 2012, ISBN-13: 978-0-13-214521-3 (alk. paper) ISBN-10: 0-13-214521-9 (alk. paper)

REFERENCE BOOKS:

1.	
2.	

ART OF COMMUNICATION AND INTERPERSONAL SKILLS

Course Code	**HU1512-1**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Objectives:

1.	Understand effective communication and interpersonal skills
2.	Develop active listening skills and foster meaningful conversations
3.	Enhance verbal and non-verbal communication skills
4.	Comprehend professional communication techniques
5.	Cultivate writing skills

Unit - I

Foundations of Communication and Interpersonal Skills Importance of effective communication in personal and professional contexts; Elements of communication: sender, receiver, message, channel, feedback; Communication models and theories	8
Types of Communication Verbal Communication - Language selection and tone in communication, developing clarity and precision in verbal expression, Active listening skills and techniques, Overcoming barriers to effective verbal communication Nonverbal Communication - Understanding the role of nonverbal cues (body language, facial expressions, gestures), Interpreting and using nonverbal communication effectively, Cultural variations in nonverbal communication, Nonverbal cues in building rapport and trust	8

Unit - II

Interpersonal Skills and Relationship Building Building Rapport and Trust, developing strong relationships through effective communication, Strategies for building rapport and trust, Empathy and emotional intelligence in interpersonal interactions, Building trust in diverse cultural contexts	8
Active Listening and Feedback Enhancing active listening skills, Providing and receiving constructive feedback, Empathetic listening techniques, Nonverbal cues in active listening, Conflict Resolution and Negotiation, Understanding conflict and its impact on relationships, Conflict resolution strategies and techniques, Effective negotiation skills, Mediation and compromise in conflict resolution	8

Unit - III

Advanced Communication Strategies Effective communication in meetings, presentations, and interviews, Cross-cultural communication considerations, Written Communication - Emails, Crafting clear and concise written messages Punctuation and formatting in written communication, Writing reports effectively, Proofreading and editing techniques, Effective use of digital tools (email, social media, video conferencing), Managing online presence and digital etiquette, Avoiding communication pitfalls in the digital age.	8

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

1.	Understand the fundamental concepts and principles of effective communication.
2.	Recognize and overcome barriers to effective communication.
3.	Apply appropriate verbal and nonverbal communication techniques to convey messages clearly and confidently.
4.	Develop active listening skills and demonstrate empathy in interpersonal interactions.
5.	Demonstrate proficiency in written communication, including grammar, clarity, and formatting.

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
HU1512-1.1						3	3	1						
HU1512-1.2						3	3							
HU1512-1.3									1					
HU1512-1.4										2	3			
HU1512-1.5										2	3			

1: Low 2: Medium 3: High

REFERENCES:

1.	Kaul, A. (2015). Effective Business Communication. New Delhi, India: PHI Learning.
2.	Sharma, M. K. (2013). The Art of Effective Communication. New Delhi, India: Excel Books.
3.	Raman, M., & Singh, P. (2012). Interpersonal Skills: Everyday Business Skills. New Delhi, India: Macmillan Publishers India Ltd.
4.	Kumar, S., & Lata, P. (2016). Communication Skills. New Delhi, India: Oxford University Press.
5.	Jaganathan, B. (2014). Effective Communication Skills. New Delhi, India: Pearson Education India.

COMMON SENSE AND CRITICAL THINKING

Course Code	**HSS281**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45+0+0+0**	**CIE + SEE Marks**	**50+50**
Pre-requisite	**Communicative English**		

Teaching Department: Humanities

Course 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 behaviour
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	**05 Hours**
The Terms: Common Sense, Commonsensical Consensus, and Critical Thinking. Unsettling Commonsensical Consensus. Role of Language in Common Sense and Critical Thinking.	
Emotional Intelligence	**04 Hours**
Nature, Function and Types; Emotion, Intelligence and Creativity; Growth and Development of Emotional Intelligence. (Case Studies- Tomiya, Pig and Bitch, Cookies)	

UNIT - II

Manners and Etiquettes	**05 Hours**
What is Etiquette? Work Place Etiquette, Workplace Readiness Skills, Physical and Psychological Working Conditions.	
Workplace:	**04 Hours**
Significance of Cross Cultural Understanding; Cultural Sensitivity, Impact of Social Media, Self-Representation	

UNIT - III

Social Media and its Impacts	**05 Hours**
Emergence of Social Media, Impact on Gender and Self Representation, Regulatory and Liberatory aspects of Social Media, Offline Norms and Online Behaviour.	
Gender Perspectives:	**04 Hours**
Gender and Sex, Genderization, Homogeneity and Heterosexuality, Gender Expressions, Gender schooling	

UNIT - IV

Body	**05 Hours**
Representation of Body, Commodification, Gender Perspectives of Body	
Panopticism:	**04 Hours**
Ways of Seeing, Discipline and Punishment, ISA and RSA	

UNIT - V

Writing	**05 Hours**
Types of Writing, Note Taking Methods, Plagiarism	
Reading	**04 Hours**
Styles of Reading, Types of Reading, Scanning, Skimming	

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 behaviour
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

Program Outcomes→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HSS281.1	-	3	-	-	-	-	-	-	3	3	-	3
HSS281.2	-	2	-	-	-	-	-	3	2	3	-	2
HSS281.3	-	3	-	-	-	-	-	-	2	2	-	3
HSS281.4	-	3	-	-	-	-	-	-	2	2	-	3
HSS281.5	-	2	-	-	-	-	-	-	3	3	-	2

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Geetha.V. Gender. Kolkatta: Web Impressions, 2009.
2.	Bailey, Jane, et al. "Negotiating with Gender Stereotypes On Social Networking Sites: From "Bicycle Face" to Facebook." Journal of Communication Enquiry 37.2 (2013): 91-112.
3.	Barry, Peter. "Beginning Theory". New Delhi: Viva Books, 2010.
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, 2003.
6.	Gauntlett, David. "Media, Gender and Identity: An Introduction". London: Routledge, 2008
7.	Pilcher, Jane, and Imelda Whelehan. "50 Key Concepts in Gender Studies". London: Sage, 2004. 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 (2004): 199-215.Web.

E-RESOURCES:

1.	http://www.cyberpsychology.eu/view.php?cisloclanku=2009061501/ >.
2.	http://www.surveillance-and-society.org/articles2(2)/webcams.pdf
3.	http://eprints.rclis.org/19790/>.

LINGUISTICS AND LANGUAGE TECHNOLOGY

Course Code	**HSS282**	**Course Type**	**OEC**
Teaching Hours/Week (L:T:P:S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**
Pre-requisite	**Communicative English**		

Teaching Department: Humanities

Course Objectives:

1.	Introspect about the consciousness in one's language
2.	Learn pronunciation and how the process helps to communicate effectively.
3.	Build contextual speech and writing with the pedagogy in sentence structure.
4.	Improve skill of applying language to enunciate words.
5.	Progress on the speech aspects by understanding the acquisition of Second Language.

Unit - I	
Introduction to Linguistics Broad understanding of Linguistics, Language and characteristic features, Scientific Language, Levels of Linguistic Analysis (Phonetics, Phonology, Morphology, Syntax and Semantics); Approach to Linguistics (Traditional, Structural and Cognitive).	9
Unit - II	
Phonology Perspectives in Linguistics, Phonemes, Allophones, Phonemic Analysis.	9
Unit - III	
Morphology Morphology and Morphemes, Word building process, Morphological Analysis.	9
Unit - IV	
Syntax Constituent structure (Simple Sentence, Noun Phrase, Verb Phrase, Prepositional Phrase, Adjective Phrase, Adverb Phrase, Structure Rules), Tree Diagrams, Case	12
Unit - V	
Sociolinguistics & Psycholinguistics, Artificial Intelligence Notion of Language Variety, Languages in Contact, Language and Mind, Error Analysis.	6

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

1.	Understand the importance of language and its facets.
2.	Demonstrate knowledge of sounds and competence in process of word building.
3.	Evolve to reason the constituent parts of a sentence.
4.	Understand the techniques of how 'meaning' is applied.
5.	Analyze errors in day-to-day-conversations and how language is related to society.

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
HSS282.1		1			1	1			1			2		
HSS282.2			2						2	2				
HSS282.3	2	3		3					3	2				
HSS282.4					2				1	2				
HSS282.5		2				2	1					1		

1: Low 2: Medium 3: High

REFERENCES:

1.	Akmaijan, A., Dimers, R. A., & Harnish, R. M. (1979). Linguistics: An Introduction to Language and Communication. London: MIT Press.
2.	Chomsky, N. (1968). Language in Mind. New York: Harcourt Brace Jovanovich.
3.	Fabb, N. (1994). Sentence Structure. London: Routledge.
4.	Hockett, C. (1955). A Course in Modern Linguistics. New York: Macmillan.
5.	O'Grady, W., Dobrovolsky, O. M., & Aronoff, M. (1991). Contemporary Linguistics: An Introduction. New York: St. Martin's Press.
6.	Pride, J. B., & Holmes, J. (1972). Sociolinguistics. Harmondsworth: Penguin.
7.	Richards, J. C. (1974). Error Analysis: Perspectives in Second Language Acquisition. London: Longman.
8.	Salkie, R. (1990). The Chomsky Update: Linguistics and Politics. London: Unwin Hyman Ltd.
9.	Sinclair, J. M. C. H., & Coulthard, R. M. (1975). Towards an Analysis of Discourse. Oxford: OUP.
10.	Thomas, L. (1993). Beginning Syntax. Oxford: Blackwell.
11.	Verma, S. K., & Krishnaswamy, N. (1989). Modern Linguistics: An Introduction. New Delhi: OUP.
12.	Wekker, H., & Haegeman, L. (1985). A Modern Course in English Syntax. Kent: Croom Helm.

INTRODUCTION TO CYBER SECURITY

Course Code:	ISE281	Course Type	OEC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	45	CIE + SEE Marks	50+50

Teaching Department: Information Science & Engineering

Course Objectives:

1	Define the area of cybercrime and forensics and to understand the security threat
2	Explain the motive and causes for cybercrime, detection, and handling.
3	Investigate Areas affected by cybercrime.
4	Illustrate tools used in cyber forensic

UNIT-I

Introduction to Cyber Security	08 Hours

Concepts of Cyber Security, Formal Methods of Security Validation, CIA framework-Confidentiality, Integrity and Authenticity, Threat modelling, Domains of cyber security

UNIT-II

Attacks and Threats	08 Hours

Security attacks, Security services, Security Mechanisms, Fundamental security design principles, Types of Cyber Threat.

UNIT-III

Tools and methods used in Cybercrimes	08 Hours

Proxy Servers and Anonymizers, Intruders and Hackers, Insider threats, Cybercrimes. Introduction to Phishing, Identity Theft (ID Theft).

UNIT-IV

Network Threats	09 Hours

Network Threats: Active/ Passive – Interference – Interception –Impersonation – Worms –Virus – Spam's – Ad ware - Spy ware – Trojans and covert channels –Backdoors – Bots – IP, Spoofing - ARP spoofing - Session Hijacking

UNIT-V

Understanding Computer Forensics	12 Hours

Introduction, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics.

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

1	Comprehend the Cybercrime and its origin
2	Analyse Security Threat Management and understand the security elements.
3	Apply tools and methods used in Cyber crimes
4	Analyse Phishing and ID Theft
5	Comprehend Digital Forensics

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
CO-1	2	-	-	-	-	1	3	-	-	-	-
CO-2	-	3	-	1	-	2	-	2	-	-	-
CO-3	-	3	2	-	-	-	-	-	-	-	-
CO-4	2	-	-	-	-	2	-	-	-	-	-

CO-5	-	-	-	-	-	-	3	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	William Stallings, “Cryptography and Network Security: Principles and Practice”, Pearson Education, 2006.
2	Swiderski, Frank and Syndex, “Threat Modeling”, Microsoft Press, 2004.
3	Sunit Belapure and Nina Godbole, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley India Pvt Ltd, ISBN: 978-81-265-21791, Publish Date 2013.
REFERENCE BOOKS:	
1	Thomas J. Mowbray, “Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions”, John Wiley & Sons, Inc, ISBN: 978 -1-118 -84965 -1, 2014.
2	James Graham, Ryan Olson, Rick Howard, “Cyber Security Essentials", CRC Press, 15-Dec 2010. Anti- Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw-Hill.

PYTHON APPLICATION PROGRAMMING

Course Code:	ISE282	Course Type	OEC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	45	CIE + SEE Marks	50+50

Teaching Department: Information Science & Engineering

Course Objectives:

1	Construct Python programs using data types and looping.
2	Design object-oriented Python programs using classes and objects.
3	Design useful stand-alone and CGI applications in Python

UNIT-I

Functions	09 Hours

Functions: Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions

UNIT-II

Classes and OOP	09 Hours

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

UNIT-III

Lists, Tuples and dictionaries	09 Hours

Lists and tuples: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; Dictionaries: dictionary literals, adding and removing keys, accessing, and replacing values; traversing dictionaries,

UNIT-IV

File handling and Essential Python Libraries	09 Hours

File Handling: Reading From Text Files, Writing to Text Files, Working with Excel Sheets ,CSV, PDF, Word
Working with SciPy, NumPy, Matplotlib, Pandas

UNIT-V

Creating GUI	09 Hours

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.

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

1	Demonstrate the basics of Python programming like data types and looping
2	Apply the basic data structures in solving the problems
3	Experiment with usage of functions in a given problem
4	Develop Objects by creating classes and apply object-oriented features
5	Develop applications in Python using File Programming &User Interface

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
CO-1	2	-	-	-	2	-	-	-	-	-	3
CO-2	2	-	-	-	2	-	-	-	-	-	3
CO-3	2	-	-	-	2	-	-	-	-	1	3
CO-4	2	-	-	-	2	-	-	-	-	-	3
CO-5	2	-	-	-	2	-	-	-	-	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1 Kenneth A. Lambert, "The Fundamentals of Python: First Programs", 2011, Cengage Learning, ISBN: 978-1111822705.

SOFTWARE ENGINEERING PRACTICES

Course Code:	ISE283	Course Type	OEC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	45	CIE + SEE Marks	50+50

Teaching Department: Information Science & Engineering

Course Objectives:

1.	Outline software engineering principles and activities involved in building large software programs.
2.	Explain the importance of architectural decisions in designing the software.
3.	Describe the process of Agile project development.
4.	Recognize the importance of software testing and describe the intricacies involved in software evolution.
5.	Identify several project planning and estimation techniques and explain the importance of software quality.

UNIT-I

Introduction and Need for software Processes	09 Hours

Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Case Studies.
Software Processes
Models: Waterfall Model, Incremental Model and Spiral Model; Process activities

UNIT-II

Requirements Engineering	09 Hours

Functional and non-functional requirements, Requirements engineering processes, Requirements Elicitation and Analysis, Requirements specification, Software requirements document, Requirements validation & management.

UNIT-III

System Models and Architectural Design	09 Hours

Context models, Interaction models, Structural models, Behavioral models.
Architectural Design: Architectural design decisions. Architectural Views and patterns, Application architectures.

UNIT-IV

Design and Implementations	09 Hours

Design and implementation, Object oriented Design using UML.
Agile Software Development: Agile methods, Plan-driven and agile development, Extreme Programming, Agile project management.

UNIT-V

Project Management	09 Hours

Project Management: Risk management, Teamwork.
Project Planning: Software pricing, Plan-driven development, Project Scheduling.
Quality Management: Software quality, Reviews and inspections, Software measurement and metrics, Software standards.

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

1	Recognise the basics of software system, component, process and Software Requirement Specification to meet desired needs within realistic constraints and outline the professional and ethical responsibility
2	Describe the waterfall, incremental and iterative models and architectural design in implementing the software
3	Make use of the techniques, skills, modern engineering design tools and agile methods necessary for engineering practice.
4	Describe the methods for maintaining software system.
5	Discuss project planning and management and illustrate the quality of software

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
CO-1	-	3	1	-	-	-	2	-	-	-	-
CO-2	1	3	1	-	-	-	-	-	-	-	-
CO-3	1	1	3	-	-	-	-	-	-	-	-
CO-4	1	3	2	-	-	-	-	-	-	-	-
CO-5	1	2	2	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1 Ian Sommerville, “Software Engineering”, 9th Edition, Pearson Education, 2012.

REFERENCE BOOKS:

1 Roger S. Pressman: “Software Engineering-A Practitioners approach”, 7th Edition, Tata McGraw Hill, 2017.

2 Pankaj Jalote: “An Integrated Approach to Software Engineering”, Wiley, India, 2010.

E Books / MOOCs/ NPTEL

1 http://agilemanifesto.org/

2 http://www.jamesshore.com/Agile-Book/

3 https://www.mooc-list.com/course/uml-class-diagrams-software-engineering-edx

4 https://www.mooc-list.com/course/enterprise-software-lifecycle-management-edx

WEB TECHNOLOGIES

Course Code:	**ISE284**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Information Science & Engineering

Course Objectives:

1.	Illustrate the Semantic Structure of HTML and CSS
2.	Compose forms and tables using HTML and CSS
3.	Design Client-Side programs using JavaScript and Server-Side programs using PHP
4.	Illustrate the Database connectivity using PHP
5.	Examine JavaScript frameworks such as jQuery

UNIT-I

Introduction to HTML — **09 Hours**

HTML tags and simple HTML forms, web site structure, HTML table, background images, colours and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists

UNIT-II

Introduction to CSS — **09 Hours**

Need for CSS, introduction to CSS, basic syntax and structure, using CSS. Formatting using CSS, Positioning using CSS, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

UNIT-III

Client-side Scripting — **09 Hours**

Introduction to JavaScript: JavaScript language – declaring variables, scope of variables functions, event handlers (on click, on submit etc.), Document Object Model, Form validations.

UNIT-IV

PHP — **09 Hours**

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.,

UNIT-V

PHP Databases — **09 Hours**

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.

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

1	Adapt HTML and CSS syntax and semantics to build web pages
2	Construct and visually format tables and forms using HTML and CSS.
3	Experiment with the usage of Event handling and Form validation using JavaScript.
4	Understand the principles of object-oriented development using PHP and Database concepts.
5	Inspect JavaScript frameworks like jQuery which facilitates developers to focus on core features.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11
CO-1	1	2	-	2	-	-	-	-	-	-	1
CO-2	1	-	-	2	-	-	-	-	-	-	1
CO-3	1	2	-	2	3	-	-	-	-	-	1
CO-4	1	2	-	2	3	-	-	-	-	-	1
CO-5	1	-	-	2	3	-	-	-	-	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1st Edition, Pearson Education India. (ISBN:978-9332575271).
E Books / MOOCs/ NPTEL	
1	nptel.ac.in/courses/106105084/11

GRAPH THEORY AND ITS APPLICATIONS

Course Code: MAT304	MAT304	Course Type:	OEC
Teaching Hours/Week (L: T:P):	3:0:0	Credits:	03
Total Teaching Hours:	45+0+0	CIE + SEE Marks:	50+50

Teaching Department: Mathematics

Course Objectives:

1	Understanding graphs and basic terminology.
2	Apply the concept of trees and its properties and Find minimal spanning tree.
3	distinguish between Hamilton and Eulerian graph and Finding the shortest path between two vertices in a graph.
4	Analyze graph properties like matching, planarity and coloring.
5	Calculate and analyze distance -based parameters.

UNIT-I

Introduction to graphs	9 Hours

Graphs and Graph Models: Transformation of configuration model, word graph, Traffic lanes at street intersections, Simple and Multigraphs.
Connected, disconnected Graphs subgraphs and types, Walk, Path and Trail, Common Classes of Graphs: Path, cycle, complete, bipartite graphs, Join and cartesian product of graphs The Degree of a Vertex, Regular Graphs, Degree Sequences,.

UNIT-II

Trees and Connectivity	9 Hours

Bridges, Trees, properties of Trees, The minimum spanning Tree Problems: Prim's and Kruskal's algorithm, The number of minimum spanning trees, Matrix Tree Theorem
Cut vertices, Blocks, connectivity: vertex and edge., Statement of Menger's Theorem, Max Flow-min-cut theorem for network flow problems.

UNIT - III

Traversibility in Graphs and Digraphs	9 Hours

Eulerian graphs, Hamiltonian graphs,: application problems, Konigsberg Bridge problem,
Digraphs and graph models, oriented graph, Hamiltonian digraphs, Eulerian digraphs Tournament, Application Problems-Decision Making problems.
Shortest path algorithm: Dijkstra' algorithm for directed and undirected graphs, travelleing sales man problem, postman problem. 9Hours

UNIT-IV

Matching, planarity and Graph coloring	9 Hours

Matching, maximum, perfect matching, - application problems, Halls theorem, marriage theorem,
Planar graph, properties, Three House and Three Utilities problem, Statement of Euler Identity for planar graphs, Wagner's theorem (statement only)
Graph coloring: Vertex and edge coloring, four color problem, five color theorem Problem of five princes/five palaces, Applications to scheduling problems.

UNIT -V

The distance-based parameters of Graphs	9 Hours

Eccentricity, radius, diameter, center of graph and application problems, Channel assignment problems, radio l-coloring. Radio labeling. Domination number of a graph and its application problems

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

1	Students will achieve command of the fundamental definitions and concepts of graph theory.
2	Implement and apply algorithm such as prim's and Kruskal's algorithm
3	Analyze the similarities and differences between eulerian and Hamiltonian graphs
4	Understand the importance and applications of graph coloring,matching.
5	Recognize the concept of diameter radius and eccentricity of graphs and apply distance baed parameters to real world problems

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3										
2	2	1										
3	2	3										
4	3	2										
5	3	2										

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Chartrand and Zhang, "First Course in Graph Theory", 2012
2	Narsing Deo, "Graph Theory with applications to Engg. and Comp. Sciences", PHI,1974.

REFERENCE BOOKS:

1	F. Harary, "Graph theory", Narosa Publishing House, 1988.
2	D.B.West, "Introduction to Graph Theory", PHI,2001.
3	Discrete Mathematics and its applications", Kenneth H. Rosen, Tata McGraw Hill, V Edition-2003.

E Books / MOOCs/ NPTEL

1	http://diestel-*graph-theory*.com.
2	https://nptel.ac.in/courses/111106102

NUMBER THEORY

Course Code:	**MAT305**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T:P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mathematics

Course Objectives:

1	Understand the divisibility of integers ,study of prime numbers and basic properties of congruences.
2	Study Fermat's little theorem and understand Euler's function.
3	Study the existence of primitive roots and quadratic residues.
4	Study the cryptographic applications in number theory.

UNIT-I

Divisibility	**9 Hours**

Division Algorithm: Definition, Existence and uniqueness proof. Euclid's Algorithm for the Greatest Common Divisor(GCD): apply division algorithm repeatedly to find GCD, Extended Euclidean Algorithm: Relation between gcd(a,b) and integers x and y. Linear Diophantine equation: solving equation $ax + by = c, a, b, c$ are integers, by using extended Euclidean algorithm. Prime numbers: Definition, fundamental theorem on arithmetic.

UNIT-II

The theory of congruences	**9 Hours**

Basic Properties of Congruences: Definition and Notation: Congruence modulo n, Equivalence classes modulo n, Properties, Modular Arithmetic: Arithmetic operations with congruences, Reducing modulo n, Inverses modulo n, Modular exponentiation, Linear Congruences: definition, Conditions for solvability, Review of GCD and divisibility, Chinese remainder theorem with proof, problems.

UNIT - III

Number theoretic functions	**9 Hours**

Fermat's theorem, solving congruences using Fermat's theorem, Wilson's theorem, Compute factorials mod p for small primes, non-prime counterexamples, Euler's Phi function, Calculate $\phi(n)$ for various values, Euler's theorem, Solve modular equations using Euler's theorem.

UNIT-IV

Primitive roots and Quadratic congruences	**9 Hours**

Order of an integer modulo n, primitive roots for primes, Euler's criterion, determine if numbers are quadratic residues modulo a given prime, use Euler's criterion in solving equations like $x^2 \equiv a(modp)$. Legendre symbol and its properties, Evaluate Legendre symbols for various values.

UNIT -V

Cryptography	**9 Hours**

Introduction to public key cryptography, RSA cryptosystem, an application of primitive roots to cryptography

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

1	Use divisibility and Greatest common divisor in Euclidean algorithm. Solve Diophantine equations. Identify prime factorization of an integers.
2	Understand the properties of congruences. Use Chinese reminder theorem to find solution of system of linear congruences
3	Use Fermat's Little Theorem and Wilson's Theorem. Use of Euler's Phi function.
4	Identify primitive roots of an integers. Apply Euler's criterion and Legendre symbols.
5	Code and decode numbers in the RSA cryptosystem.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2										
2	2	2										
3	3	1										
4	3	2										
5	3	2										

1: Low 2: Medium 3: High

TEXTBOOKS:	
1	D. Burton; Elementary Number Theory, McGraw-Hill, 2005
2	Niven, H.S. Zuckerman & H.L. Montgomery, Introduction to the Theory of Numbers, Wiley, 2000.
REFERENCE BOOKS:	
1	H. Davenport, The Higher Arithmetic, Cambridge University Press, 2008.
2	G.A. Jones & J.M. Jones, Elementary Number Theory, Springer UTM, 2007.
3	Thomas Koshy, Elementary Number Theory with Applications, 2nd edition, Elsevier, 2007
4	Fundamentals of Number Theory by William J. LeVeque
E Books / MOOCs/ NPTEL	
1	http://refkol.ro/matek/mathbooks/ro.math.wikia.com%2520wiki%2520Fisiere pdf_incarcate/ Elementary-Number-Theory.pdf
2	https://nptel.ac.in/courses/111104138
3	https://nptel.ac.in/courses/111103020

MATHEMATICAL MODELLING

Course Code:	MAT306	Course Type:	OEC
Teaching Hours/Week (L: T:P):	3:0:0	Credits:	03
Total Teaching Hours:	45+0+0	CIE + SEE Marks:	60+40

Teaching Department: Mathematics

Course Objectives:

- The course covers basic concepts principles and scaling for modeling
- The course elaborately covers Models from ODE and PDE
- The course also covers techniques of modeling using Graph theory and integral equation

UNIT-I

Principles of Modeling — 9 Hours

Mathematical modelling – principles, scientific methods, Dimensional homogeneity and consistency, Abstraction and Scaling, Conservation and Balance, Dimensions and units, dimensional analysis, The Buckingham PI theorem

UNIT-II

Scaling — 9 Hours

Abstraction and scale, Geometrical scaling, Size and function – Birds and flight, hearing and speech, Scale in equations, Taylor formula, algebraic approximation, Numerical approximation, validating model, Fitting curves

UNIT - III

Modelling through differential equations — 9 Hours

Growth and Decay Model, Modeling through 1st order equations, Population dynamics, epidemics, Modeling through second order equations, Planetary motion

UNIT-IV

Modelling through partial differential equations and variations — 9 Hours

Mass balance equations, momentum balance equations, Variational principles, Obtaining PDE through probability generating function, Traffic flow.
Optimization principles and modeling through calculus of variations.

UNIT -V

Modeling through Graph theory and Interal equations — 9 Hours

Situations that can be modeled through graphs, Models using directed graphs, signed graphs, Weighted graphs, Unoriented graphs
Modelling through integral equations.

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

1	Apply Essentials of scaling and dimensional analysis to model different problems
2	Model Engg. Problems using essentials of scaling and dimensional analysis
3	Apply technique differential equations to model engg. problems
4	Apply variational and integral equations to model engg. Problems
5	Model engg. Problems through Graph theory

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2										

2	2	2										
3	3	1										
4	3	2										
5	3	2										

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Mathematical Modelling by J N Kapur, 2nd edition, New Age Pub,2015
2	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition (Reprint), 2016.
3	Principles of Mathematical Modeling, Clive L Dym, Second Edition,Academic press, 2006

AIR CONDITIONING AND VENTILATION SYSTEMS

Course Code:	**MEC181**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**04**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1. Provide students with a foundational understanding of HVAC systems and psychrometric properties of moist air, and analyze various air conditioning processes
2. Comprehensive understanding of thermal comfort and heat transfer principles as they apply to HVAC systems and different types of HVAC systems
3. Equip students with in-depth knowledge of key HVAC components and subsystems, focusing on Air Handling Units (AHUs), Fan Coil Units (FCUs), and various ventilation systems.
4. Explore the types and benefits of natural ventilation and induced ventilation, including design strategies for optimizing airflow around and through buildings
5. Understand Variable Air Volume (VAV) systems, including the different types of VAV boxes

UNIT-I	**09 Hours**

Introduction: HVAC and Basic principles of thermodynamics relevant to HVAC.
Psychrometric of Air Conditioning Processes: Properties of Moist Air, Psychrometric Chart and processes, Psychrometric Analysis, Summer and winter Air conditioning processes.

UNIT-II	**09 Hours**

Thermal Comfort: Thermal comfort factors, Physiological aspects, Body heat balance, Heat flow through Buildings: Basic principles of heat transfer through buildings.
Sensible heat and latent heat. Cooling and Heating Loads in HVAC.
HVAC system Types: Chilled Water System, Air Cooled System, Central Heating System (Boilers, calorifiers, etc), Water Cooled Chiller and Cooling Tower and Chilled Water and Condenser Water Pumps.

UNIT-III	**09 Hours**

Air Handling Units (AHU): Introduction to AHU, working principles, and components such as sensors and actuators. Sequence of operation for Mixed Air VAV AHU and 100% OA AHU.
Fan Coil Units (FCU): Overview of FCU systems and their role in HVAC.
Ventilation systems: Types, Kitchen ventilation system and Car parking ventilation system.

UNIT-IV	**09 Hours**

Natural Ventilation: Types, benefits, Design Strategies for Natural Ventilation, air movement around and through buildings, Orientation for wind, stack effect, **Induced ventilation:** Types, benefits, Design Strategies for Induced Ventilation.

UNIT-V	**09 Hours**

Variable air volume (VAV): Introduction, different types of VAV boxes, Pressure dependent (By-Pass), Pressure Independent, VAV with cooling only, VAV with cooling + reheat coil (Electric/Hydronic), VAV with cooling + Baseboard Heat and Fan powered VAV boxes (Series/Parallel).

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

- Interpret and apply the psychrometric process to analyse summer and winter air conditioning processes.
- Analyze the factors influencing thermal comfort and identify and compare various HVAC system types, along with their components.
- Analyze the design, components, and operation of AHUs, FCUs, and various ventilation systems including kitchen and car parking applications.
- Identify and differentiate between types of natural and induced ventilation and apply design strategies to optimize airflow around and through buildings
- Apply design considerations for pressure-dependent, pressure-independent, and fan-powered VAV configurations.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
MEC181.1	3	2	-	-	-	-	1	-	-	2	-	-	2
MEC181.2	3	2	-	-	-	-	1	-	-	2	-	-	2
MEC181.3	3	2	-	-	1	-	1	-	-	2	-	-	2
MEC181.4	3	2	-	-	2	-	1	-	-	2	-	-	2
MEC181.5	3	2	-	-	2	-	1	-	-	2	-	-	2

1: Low2: Medium 3: High

TEXTBOOKS:

1. Basic Refrigeration and Air Conditioning, Ananthanarayanan P.N, McGraw Hill, 2023
2. A Textbook of Refrigeration and Air Conditioning, R S Khurmi, J K Gupta, S. Chand Limited, 2022

REFERENCE BOOKS:

1. Refrigeration & Airconditioning, C. P. Arora, Tata McGraw Hill, 2017
2. HVAC Handbook, ISHRAE, 2017
3. HVAC Handbook, ASHRAE, 2023

E Books / MOOCs/ NPTEL

1. http://nptelvideos.com/video.php?id=1166
2. https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-me85/

AUTOMOTIVE ENGINEERING

Course Code:	**MEC182**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1. Get an idea on the different components of an engine and its types with lubrication system.
2. Understand the fuel supply system and ignition systems used in automobiles.
3. Demonstrate the working of transmission system.
4. Explain the importance of suspension system, steering geometry and drives in automobiles
5. Know the concept of braking system, tyres and emission control.

UNIT-I	**08 Hours**

Engine Components and Cooling & Lubrication Systems

SI & CI engines, Cylinder arrangements and their relative merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Choice of materials for different engine components, engine positioning, cooling requirements, methods of cooling, thermostat valves, different lubrication arrangements.

UNIT-II	**07 Hours**

Fuel Supply Systems for SI and CI Engines

Fuel mixture requirements for SI engines, types of carburetors, simple carburetor, multi point and single point fuel injection systems, CRDI, fuel transfer pumps: AC Mechanical Pump, SU Electrical Pumps, injectors.

Ignition Systems : Battery Ignition systems, magneto Ignition system, Transistor assisted contacts. Electronic Ignition, Automatic Ignition advance systems, Lighting systems, starting device (Bendix drive)

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-III	**07 Hours**

Power Trains

Clutches - Single plate, multiplate and centrifugal clutches. Gear box: Necessity for gear ratios in transmission, Constant m esh gear box, Synchromesh gear box, principle of automatic transmission, calculation of gear ratios, Types of transmission systems. No numerical.

UNIT-IV	**08 Hours**

Drive to Wheels

Propeller shaft, universal joints, Hotchkiss. and torque tube drives, differential, rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe in & toe out, condition for exact steering, power steering, over steer, under steer & neutral steer, Steering angle sensors, numerical problems.

Suspension and Springs: Requirements, leaf spring, coil spring, Torsion bar suspension systems, independent suspension for front Wheel, Air suspension system. Collective bargaining; Characteristics, Necessity, Forms Safety & Health; Industrial accidents, Safety Quality circle; Meaning, Structure

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-V	**15 Hours**

Brakes
Types of brakes, mechanical, compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, Drum brakes.
Tyres: Desirable tyre properties, Types of tyres.
Automotive Emission: Automotive exhaust emissions, sources and emission control method: EGR, SCR, Emission Standards, Exhaust sensors.
Electric Vehicles.
Pedagogy Chalk and talk method, Power Point Presentation

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

- Describe and demonstrate the layout of an automobile and components of an automobile engine. Explain cooling and lubrication systems.
- Explain and demonstrate the fuel supply and Ignition systems for SI and CI engines.
- Describe and demonstrate the transmission system
- Explain and demonstrate the components of drive to wheel and suspension system, calculate the parameters of steering geometry.
- Describe and demonstrate automotive braking system. Explain types and construction of tyres and wheels. Explain the significance of automotive emissions and its controlling methods

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
MEC182.1	3	1	-	-	-	1	-	2	2	-	1	-	-
MEC182.2	3	1	-	-	-	1	-	-	2	-	1	-	-
MEC182.3	3	1	1	-	-	1	-	-	2	-	1	-	-
MEC182.4	-	2	1	-	-	1	-	-	2	-	1	-	-
MEC182.5	3	1	1	-	-	1	1	1	2	-	1	-	-

1: Low2: Medium 3: High

TEXTBOOKS:

1. S. Srinivasan, "Automotive Mechanics", Tata McGraw Hill, 2003.
2. Kirpal Singh, "Automobile Engineering", Vol I and II, 2013.
3. A. K. Babu, "Automotive Electrical and Electronics", Khanna Publishers, 2nd edition, 2016.

REFERENCE BOOKS:

1. R. B. Gupta, "Automobile Engineering", Satya Prakashan, 4th Edn., 1984 .
2. Naran G, "Automobile Engineering", Khanna Publishers 2002

DESIGN OF EXPERIMENTS

Course Code:	**MEC183**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1. To introduce the fundamental principles of statistical design of experiments.
2. To enable students to develop efficient and reliable experimental designs
3. To analyze and interpret experimental data using statistical tools.
4. To emphasize the importance of experimental planning and optimization.
5. To apply DOE concepts in product design, process optimization, and quality improvement.

UNIT-I	**09 Hours**

Introduction to Design of Experiments

Fundamentals of experimental design, importance of planning experiments, Applications in engineering and research, Basic statistical concepts: mean, variance, standard deviation, confidence intervals, Randomization, replication, and blocking, Introduction to ANOVA

UNIT-II	**09 Hours**

Completely Randomized and Randomized Block Designs

Structure and analysis of Completely Randomized Design (CRD),Randomized Block Design (RBD) – layout, assumptions, analysis, Latin Square Design – layout, analysis, and advantages, Model adequacy checking

UNIT-III	**08 Hours**

Factorial Designs

Introduction to factorial experiments, 2^2 and 2^3 designs: main effects and interaction effects Confounding and aliasing, Analysis and interpretation using ANOVA, Design and analysis of general factorial experiments

UNIT-IV	**09 Hours**

Fractional Factorial Designs and Taguchi Methods

Concept of fractional factorial design, Resolution of designs, Introduction to Taguchi method Orthogonal arrays and signal-to-noise ratio, Case studies in robust design

UNIT-V	**10 Hours**

Response Surface Methodology (RSM) and DOE Software Tools

Introduction to RSM: contour plots, surface plots, Central Composite Design (CCD), Box-Behnken Design (BBD), Optimization using RSM,
Software tools: Python (pyDOE, statsmodels), Industrial case studies

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

- Understand and apply the basic principles of statistical design of experiments.
- Analyze data and perform hypothesis testing using ANOVA
- Design and interpret results from factorial and fractional factorial experiments.
- Apply Taguchi and RSM methods for robust design and process optimization.
- Use statistical software tools for practical implementation of DOE.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
												1	2
MEC183.1	3	2	2	-	2	2	-	-	-	2	1	2	2
MEC183.2	3	3	2	-	2	2	-	-	-	2	1	2	2
MEC183.3	3	3	2	-	3	2	-	-	-	2	1	2	2
MEC183.4	3	2	2	-	3	3	-	-	-	2	1	2	2
MEC183.5	3	3	3	-	3	3	-	-	-	2	1	2	2

1: Low2: Medium 3: High

TEXTBOOKS:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", 10th Edition, Wiley, 2019.

REFERENCE BOOKS:

1. Phillip J. Ross, "Taguchi Techniques for Quality Engineering" , 2nd Edition, Tata McGraw Hill, 2005.
2. Angela Dean, Daniel Voss, Danel Draguljic, "Design and Analysis of Experiments", Springer, 2nd Edition, 2017.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/110/105/110105087/

INDUSTRIAL POLLUTION CONTROL

Course Code:	**MEC184**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

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	**09 Hours**

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.

UNIT-II	**09 Hours**

Meteorology

Meteorology, Wind rose, Lapse rate, plume dispersion studies & Numerical problems.

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-III	**09 Hours**

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

UNIT-IV	**09 Hours**

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.

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-V	**09 Hours**

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
Pedagogy: Chalk and talk method, Power Point Presentation

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

- Identify the various types of pollutants and distinguish between them with regards to Particulate matters and AQI.
- 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
- Explain the Particulates and fly ash separation techniques, compare and Interpret their efficiency
- Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants
- Identify Effects of water, soil, plastics and odor pollution on environmental Pollution and explain the Legal aspects of pollution control.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
MEC184.1	1	-	-	1	-	3	3	2	1	2	3	-	-
MEC184.2	1	2	1	1	3	2	3	1	1	1	2	-	-
MEC184.3	1	2	2	1	1	2	3	1	1	1	1	-	-
MEC184.4	1	1	1	1	1	2	3	1	1	1	2	-	-
MEC184.5	1	-	-	1	-	2	3	1	1	1	3	-	-

1: Low2: Medium 3: High

TEXTBOOKS:

1. "Environmental Pollution Control Engineering", Wiley Eastern Ltd.,
2. Gilbert M Masters, "Introduction to Environmental Engineering & Science", PHI,1995
3. C. S Rao, "Environmental Pollution Control Engineering", New Age Int.

REFERENCE BOOKS:

1. Henry C. Perkins, "Air Pollution", Mc-Graw Hill, 1974.
2. W. L. Faith, "Air Pollution control", John Wiley

E Books / MOOCs/ NPTEL

1. http://nptel.ac.in/courses/105106119/36

INTEGRATED AUTOMOTIVE SAFETY

Course Code:	**MEC185**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1. To provide students with a foundational understanding of the critical need for enhanced road safety and to educate students on the integrated approach to automotive safety, focusing on accident-avoidance strategies and understanding the various factors that contribute to accidents.
2. To introduce students to Advanced Driver Assistance Systems (ADAS), explaining their significance in the context of autonomous driving. Familiarize students with the terminologies, definitions, and the role of ADAS in enhancing vehicle safety and autonomy.
3. To introduce students to the concepts of primary and secondary restraint systems, focusing on the mechanisms involved in mitigating injuries during accidents.
4. To provide a comprehensive understanding of how primary and secondary restraint systems work to protect vehicle occupants.
5. To offer a global overview of automotive safety regulations, including NCAP and regulations specific to India. To educate students on the importance of safety ratings and the regulatory framework that governs automotive safety standards.

UNIT-I	**09 Hours**

Introduction to Automotive Safety:

Introduction to Automotive Safety: Need for increased road safety, definitions involved in automotive safety, driving forces for increased road safety, regulations and consumer tests.

Integrated Automotive safety: Accidence avoidance and factors associated, contributing factors of driver, Vehicle and environment.

Introduction to Active safety systems/ADAS: What is ADAS? Role of ADAS towards Autonomous driving, terminologies, and definitions

Sensors in ADAS: Automotive RADAR, Camera, Ultrasonic Sensor, LIDAR, GNSS-GPS-IMU

UNIT-II	**09 Hours**

Active safety systems:

ADAS and Safety systems 1: Adaptive cruise control, Rear cross traffic Alert, Vehicle exit Alert, front cross traffic alert, forward collision warning, Vehicle turn assistance, blind spot detection, parking assistance systems, Intelligent headlight control system, occupant protection system, pedestrian protection system, Evasive steering Support.

ADAS and Safety systems 2: Traffic sign recognition system, speed limit assist, lane departure warning, 360-degree surrounding view system, driver monitoring system, driver drowsiness detection, emergency brake assist, ABS, cross wind assist.

Testing of ADAS: Overview, Simulation-SIL, HIL, DIL, on track tests

Role of Machine Learning and Deep Learning in ADAS: Overview, Sensors and sensor fusion, ML &DL in ADAS-processors

UNIT-III	**09 Hours**

Passive Safety Systems and Crash Simulations:

Passive Safety: Mitigation of injuries: Introduction to Primary and secondary restraints systems, mechanisms involved. Anthropomorphic Test Devices: Historical background, evolution and current ATDs in use, biomechanics, injury assessments

Crash Simulations: component, sub-system, and system level simulations, optimizing restraint system function, future of Automotive safety.

UNIT-IV	09 Hours

Materials for Automotive safety and its testing:

Materials for Automotive safety and its testing: Metals, Resigns and fabrics: overview, requirements, applications, test methods.

UNIT-V	09 Hours

Automotive Regulations, Functional Safety and Cybersecurity

Regulations and Ratings Overview: Global overview, regulations in automotive safety, NCAP, Regulations and Ratings in India.

Automotive Functional safety ISO 26262: Functional safety, Hazard analysis and risk assessment, ASIL Rankings

Cyber security for Road Vehicles: Cyber security and Automotive context, adaptation of Automotive industry, threats, and vulnerabilities to a vehicle

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

- Summarise the foundational understanding of the critical need for enhanced road safety and able to explain the integrated approach to automotive safety, focusing on accident-avoidance strategies and understanding the various factors that contribute to accidents.
- Explain the Advanced Driver Assistance Systems (ADAS), explaining their significance in the context of autonomous driving. Explain the terminologies, definitions, and the role of ADAS in enhancing vehicle safety and autonomy.
- Describe the concepts of primary and secondary restraint systems, focusing on the mechanisms involved in mitigating injuries during accidents.
- Demonstrate how primary and secondary restraint systems work to protect vehicle occupants.
- Illustrate the automotive safety regulations, including NCAP and regulations specific to India. Explain the importance of safety ratings and the regulatory framework that governs automotive safety standards.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
MEC185-1	3	3	1	3	3	3	3	1	3	-	3	1	1
MEC185-2	3	3	3	3	3	3	3	1	3	1	3	1	1
MEC185-3	3	3	3	3	3	3	3	1	3	1	3	1	1
MEC185-4	3	3	3	3	3	3	3	1	3	1	3	1	1
MEC185-5	1	1	1	1	1	1	3	1	3	1	3	1	1

1: Low2: Medium 3: High

TEXTBOOKS:

1. Vehicle Crash Mechanics by Mathew Huang
2. Vehicle crashworthiness and occupant protection by Paul Du Bois Clifford C. Chou Bahig B. Fileta Tawfik B. Khalil Albert I. King Hikmat F. Mahmood Harold J. Mertz Jac Wismans

3. Advanced Driver Assistance Systems and Autonomous Vehicles by S. Shladover
REFERENCE BOOKS:
1. Integrated Automotive Safety Handbook, SAE International by Ulrich Seiffert, Mark Gonter 2. Automated Driving: Safer and More Efficient Future Driving by Daniel Watzenig and Martin Horn

SUSTAINABLE DEVELOPMENT GOALS

Course Code:	**MEC186**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**
Prerequisite	**Nil**		

Teaching Department: Mechanical Engineering

Course Objectives:

1. To understand the United Nations Sustainable Development Goals and their aims, methodology and perspectives. Analyse the major issues affecting sustainable development and how sustainable development can be achieved in practice.
2. Discuss the global goals including poverty, hunger, health & well-being and education.
3. Discuss the global goals related to gender equality, affordable and clean energy, sustainable cities & communities, and peace, justice & strong institutions.
4. Discuss the global challenges in goals related to work & economic growth, industry, innovation & infrastructure, inequalities, responsible production & consumption.
5. To understand the development within Planetary Boundaries and address the global goals related to clean water, climate, life below water and life on land, and Global Partnerships.

UNIT-I	**09 Hours**
Introduction. The origin, development and idea of the SDGs. History and origins of the Sustainable Development Goals. Definition, Aims, methodology and perspectives Sustainable Development Goals. Millennium Development Goals.	
UNIT-II	**09 Hours**
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.	
UNIT-III	**09 Hours**
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.	
UNIT-IV	**09 Hours**
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.	

UNIT-V	09 Hours

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.

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

- Summarize the UN"s Sustainable Development Goals and how their aims, methodology and perspectives.
- Analyse the major issues affecting sustainable development and how sustainable
- development can be achieved in practice and address the challenges and solutions in global goals related to poverty, hunger, health & well-being and education.
- Address the global challenges in goals related to gender equality, affordable and clean energy, sustainable cities & communities, and peace, justice & strong institutions.
- Address the global challenges in goals related to work & economic growth, industry, innovation & infrastructure, inequalities, responsible production & consumption and Evaluate the implications of overuse of resources, population growth and economic growth.
- Describe the development within Planetary Boundaries and address the global challenges in goals related to clean water, climate, life below water and life on land, and Global Partnerships. 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.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
MEC186.1	1	2	1	1	1	3	3	1	1	1	-	1	-
MEC186.2	2	2	1	1	1	3	3	2	1	1	-	1	-
MEC186.3	3	2	2	1	1	3	3	2	3	1	-	1	-
MEC186.4	3	2	3	1	1	3	3	2	1	1	-	1	-
MEC186.5	1	2	2	1	1	3	3	2	2	2	-	1	-

1: Low2: Medium 3: High

TEXTBOOKS:

1. Sachs, Jeffrey D. "The age of sustainable development" Columbia University Press, 2015
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 2008.

REFERENCE BOOKS:

1. H Elliott, Jennifer, "An introduction to sustainable development", Routledge, 2012.

E Books / MOOCs/ NPTEL

2. https://www.un.org/sustainabledevelopmentgoals.

ENGINEERING ECONOMICS

Course Code:	**MGM181**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1. Explain the fundamental economic concepts.
2. Use simple interest and compound interest to determine compounded and discounted amount.
3. Compare the alternatives using Present Worth, Equivalent Annual Worth and Future Worth methods
4. Compare the alternatives using Internal Rate of Return methods and calculate the depreciated amount of a given assets using Straight line, Declining balance, Double declining g balance, Sum of year digit method and Sinking fund method.
5. Estimate the selling price of given product and prepare balance sheet and profit- loss account for given data of a firm.

UNIT-I	**09 Hours**

Fundamental economic concepts:
Consumer goods, Producer goods, Factors of production, Economy of organization, Demand theory, Law of demand, Exceptions to law of demand, Law of supply, Determinants of supply, Law of increasing returns and law of diminishing returns (No exercises)

UNIT-II	**09 Hours**

Interest:
Rate of interest, Determining rate of interest, Time value of money, Simple interest, Compound interest, Nominal and effective interest rate, Equivalence involving interest, Interest formulae [single payment, uniform series and arithmetic gradient only], problems using interest formulae [discrete compounding only].

UNIT-III	**09 Hours**

Economic Analysis of Alternatives:
Analysis based on: Present Worth [equal life and unequal life situations], Future Worth, Payback Period, Capitalized Worth, Equivalent Annual Worth, Exercises.

UNIT-IV	**09 Hours**

Rate of Returns:
Analysis based on Rate of Return, Exercises, cost of capital concepts
Depreciation:
Causes of depreciation, Depletion, Methods of depreciation [Straight line, Declining balance, Double declining balance, SYD method, Sinking Fund method], Exercises

UNIT-V	**09 Hours**

Estimating and Costing: Components of cost [Material cost, Labour cost, Overhead expenses, Prime cost, Factory cost, Total cost], Determination of selling price of a product, Exercises
Mensuration: Machine shop calculations, Forging shop calculations, Exercises
Financial management: Terminologies used in accounting, Journal and ledger, Profit and loss statement, Balance sheet, Understanding basic financial ratios, Simple exercises.

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

- Explain the fundamental economic concepts. Consumer goods, Producer Goods, Law of Demand, Law of Supply, Law of Returns, Determinants of Returns.
- Apply simple interest and compound interest to determine compounded and discounted amount.
- Compare the alternatives using Present Worth, Equivalent Annual Worth and Future Worth methods
- Compare the alternatives using Internal Rate of Return methods and calculate the depreciated amount of a given assets using Straight line, Declining balance, Double declining g balance, Sum of year digit method and Sinking fund method
- Estimate the selling price of given product and prepare balance sheet and profit- loss account for given data of a firm.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
MGM181.1	3	1	-	-	-	2	2	2	1	2	1	1	-
MGM181.2	2	3	-	-	-	1	-	-	-	-	-	2	-
MGM181.3	2	3	-	-	-	1	-	-	-	-	-	2	-
MGM181.4	2	3	-	-	-	1	2	-	-	-	-	2	-
MGM181.5	2	3	-	-	-	1	2	-	-	-	-	2	-

1: Low2: Medium 3: High

TEXTBOOKS:

1. Engineering Economics, Riggs J.L.,4th edition, Tata McGraw-Hill, 2004
2. Mechanical Estimating and Costing, Banga and Sharma, 16th edition, Khanna Publishers, 2012

REFERENCE BOOKS:

1. Engineering Economy, E Paul Degarmo, Macmillan Publishing, 2001
2. Engineering Economy, Gerald J Thuesen & W J Fabrycky, Prentice Hall of India, 9th ed.
3. Engineering Economics, Tarachand, Nemchand & Bros, 1996
4. Financial Management, I M Pandey, Vikas Publishing House, 2002

FINANCIAL MANAGEMENT

Course Code:	**MGM182**	**Course Type**	OEC
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1. To provide the concepts and foundations of managing finance and meaning of capital budgeting in business enterprises.
2. To equip students with tools and techniques for Firm Value analysis and Working capital management.
3. To provide the students with the knowledge of Long Term Financing and Merger Acquisition/ Restructuring
4. To provide the students with the knowledge of Securities and Portfolio Analysis
5. Financial Statement Analysis
6. To orient students regarding financial management practices in Indian companies and Global enterprises

UNIT-I	**09 Hours**

Introduction: Evolution of Financial Management, Goals, Forms of Business.
Financial Statement Analysis: Ratio analysis, time series analysis, Du pont analysis, funds flow analysis
Risk and Required Return: Risk and return relationship, Business risk, financial risk, and risk in portfolio context, expected rate of return, Capital asset pricing model.

UNIT-II	**09 Hours**

Capital Budgeting: Risk analysis in Capital Budgeting, Cost of Capital – Debt, Preference Equity forms of capital.

Capital Structure and Firm Value: Assumption, Definition and approaches, Modigliani and Miller Mode, Capital Structure decisions – EBIT, EPS analysis, ROI, REI analysis and Cash Flow comparative Analysis.

UNIT-III	**08 Hours**

Working Capital Management: Factors influencing working capital requirement, determination of operating cycle and working capital.

UNIT-IV	**09 Hours**

Long Term Financing: Raising of finance form primary and secondary markets, Valuation of securities, features of convertibility securities and warrants, SEBI guide lines on capital issues, stock market in India, Venture capital, Initial Public Offering.

Merger Acquisition and Restructuring: Reasons, Mechanics, Cost and benefits of a merger, Evolution, terms and purchase of a division, Takeovers, Acquisitions, Portfolio and financial restructuring

UNIT-V	**10 Hours**

Financial Management in Sick Units: Definition of sickness, Causes of sickness, Symptoms of sickness, Prediction of sickness, Revival of a sick unit

International Financial Management: World Monitoring system, Foreign Exchange Markets, International Parity Relationships, International Capital budgeting, Financing Foreign Operations, Raising Foreign Currency Finance, Financing Exports, Documents in International Trade.

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

- Explain the concepts and foundations of managing finance and meaning of capital budgeting in business enterprises.
- Apply the tools and techniques for Firm Value analysis and Working capital management.
- Discuss Long Term Financing and Merger Acquisition/ Restructuring
- Explain the concepts of Securities and Portfolio Analysis and Financial Statement Analysis
- Analyze financial management practices in Indian companies and Global enterprises.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO↓**	
↓ Course Outcomes												1	2
MGM182.1	2	2	2	1	-	-	-	-	-	2	3	2	-
MGM182.2	2	3	2	2	-	-	-	-	-	2	3	2	-
MGM182.3	2	3	2	2	-	-	-	-	-	2	3	2	-
MGM182.4	2	2	2	2	-	-	-	-	-	2	3	2	-
MGM182.5	2	2	1	1	-	-	-	-	-	1	2	1	-

1: Low2: Medium 3: High

TEXTBOOKS:

1. Financial Management Theory and practice – Prasanna Chandra – TMH – ISBN– 007-044501-X, 5th edn.
2. Financial accounting – B.S. Raman – United publication – VoI II

REFERENCE BOOKS:

1. Financial Management Text & Problems – Khan & Jain – TMH – ISBN 0—07-460208-X.
2. Financial management – IM Pandey – Vikas Pub. House – ISBN 0- 7069-5435-1

E Books / MOOCs/ NPTEL

MOOC resource link: https://onlinecourses.nptel.ac.in/noc20_mg51/

MANAGEMENT ACCOUNTING AND CONTROL SYSTEM

Course Code:	MGM183	Course Type	OEC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	45	CIE + SEE Marks	50+50

Teaching Department: Management

Course Objectives:

1.	Apply Cost Accounting concepts and techniques in the decision making process.
2.	Make decisions such as pricing, special order pricing, make-or-buy and elimination of a part of the company or replacement of equipment.
3.	Understand the relevance of different types of costs in the decision making process such as relevant costs, sunk costs or controllable costs.
4.	Understand fundamental concepts in Financial, Cost & Management Accounting.
5.	Develop analytical skills associated with the preparation and interpretation of Financial Statement

UNIT-I

Introduction to Cost and Management Accounting and Marginal Costing	09 Hours

Cost Accounting – Meaning, Objectives and Scope, Management Accounting – Meaning, Objectives and Scope, Tools and Techniques of Management Accounting, Relationship of Cost Accounting, Financial Accounting, Management Accounting and Financial Management, Conflicts in Profit versus Value Maximization Principle, Role of Management Accountant in Decision Making.

UNIT-II

Marginal Costing	09 Hours

Meaning, Advantages, Limitations and Applications. Breakeven Analysis, Cost Volume Profit Analysis, P/V Ratio and its Significance, Margin of Safety, Absorption Costing: System of Profit Reporting and Stock Valuation, Difference between Marginal Costing and Absorption Costing, Income Measurement under Marginal Costing and Absorption Costing. (Practical Problems)

UNIT III

Standard Costing and Budgetary Control	09 Hours

Standard Costing – Definition, Significance and Applications, Various Types of Standards, Installation of Standard Costing System-for Material, Labour, and Overhead. Variance Analysis for Materials, Labour and Overheads, Accounting Treatment of Variances. Benchmarking for Setting of Standards, Variance Reporting to Management. (Practical Problems)

Unit-IV

Budgetary Control	09 Hours

Budget Concept, Manual, Fixed and Flexible Budgets, Preparation and Monitoring of Various Types of Budgets, Budgetary Control System- Advantages, Limitations and Installation. Zero Base Budgeting, Programme and Performance Budgeting. (Practical Problems)

UNIT V

Fund Flow and Cash Flow Statement	04 Hours

Fund Flow Statement Analysis – Definition, Features, Steps for Preparation of Fund Flow Statement.

Cash Flow Statement Analysis	05 Hours

Classification, Preparation of Cash Flow Statement, Uses of Cash Flow statement, Difference between Cash Flow and Fund Flow Statement. (Practical Problems)

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

1.	Describe the Cost Accounting concepts and techniques in the decision making process.
2.	Elucidate the Make decisions such as pricing, special order pricing, make-or-buy and elimination of a part of the company or replacement of equipment.

3.	Apply the relevance of different types of costs in the decision making process such as relevant costs, sunk costs or controllable costs.
4.	Identify fundamental concepts in Financial, Cost & Management Accounting.
5.	Infer the analytical skills associated with the preparation and interpretation of Financial Statement

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
MGM183.1	3	-	-	-	-	1	-	-	1	1	-	1
MGM183.2	3	-	-	-	-	1	-	-	1	1	-	1
MGM183.3	3	-	-	-	-	1	-	-	1	1	-	1
MGM183.4	3	-	-	-	-	1	-	-	1	1	-	1
MGM183.5	3	-	-	-	-	1	-	-	1	1	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	M.Y. Khan and P.K. Jain. “Management Accounting”, McGraw-Hill Education
2.	Robert N. Anthony, “Management Accounting”, Richard Dirwin.
3.	I.M. Pandey , “Management Accounting”, Vikas Publishing House.
4.	Paresh shaw, “Management Accounting”, Oxford University Press.
5.	A. Murthy and S. Gurusamy , “Management Accounting”, McGraw Hill.
6.	NM Singhvi and Ruzbeh J. Bodhanwala, “Management Accounting”, PHI learning Pvt. Ltd.

OPERATIONS AND QUALITY MANAGEMENT

Course Code:	**MGM184**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: Management

Course Objectives:

Define production/operations management. Differentiate between Production and service system and types of production systems Discuss continuous and intermittent production systems with their advantages and disadvantages. Discuss CRM and ERP systems.
Solve problems on fundamentals of statistics and normal distribution. Draw and Analyze variable process control charts and determine process capability.
Discuss Total Quality Management tools and methods. Calculate reliability of series and parallel systems using the information on failure rate and time.
Solve decision-making problems using break even analysis and decision tree methods.
Apply the concepts of Design and System capacity. Solve problems on faculty location using break even analysis and transportation method. Solve problems related to product and process layouts.
Use concepts of replacement theory to solve problems of replacing items that fail gradually and suddenly.

UNIT-I

Production and Operations Management	09 Hours

Introduction, Functions within business organizations, the operation management function, Classification of production systems, Productivity, factors affecting productivity, Introduction to Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP), Philosophy of statistical process control and modeling process quality.

Unit-II

	09 Hours

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)
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, cp – process capability index, cpk, pp – process performance index, summary of process measures. Numerical problems. Concept of Six sigma.
Pedagogy: Chalk and talk method, Power Point Presentation

UNIT III

Quality Concepts and Reliability	09 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.
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.

Unit-IV

Operations Management activities	09 Hours

Decision Making: The decision process, characteristics of operations decisions, use of models - decision making environments. Break even Analysis, Decision trees.
Capacity Planning: Importance of capacity decisions, defining and measuring capacity, determinants of

effective capacity. Design, System an actual capacity. System efficiency and utilization. Determination of Equipment requirement for a single stage production processes. Numerical problems on the above. Facilities location planning: Need for location decisions, nature of locations decisions, general procedure for making locations decisions, Use of Breakeven analysis and Transportation algorithms for making location decisions.

UNIT V

09 Hours

Facilities layout planning: Need for layout decisions. Minimizing material handling cost in process ayout using Load distance analysis, Simple line balancing problems in product layout.

Replacement Theory
Replacement policy for equipment which deteriorates gradually. Replacement of items that fail suddenly.

Pedagogy: Chalk and talk method, Power Point

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

1. Define production/operations management. Differentiate between Production and service system and types of production systems Discuss continuous and intermittent production systems with their advantages and disadvantages. Discuss CRM and ERP systems.
2. Solve problems on fundamentals of statistics and normal distribution. Draw and Analyze variable process control charts and determine process capability.
3. Discuss Total Quality Management tools and methods. Calculate reliability of series and parallel systems using the information on failure rate and time.
4. Solve decision-making problems using break even analysis and decision tree methods. Apply the concepts of Design and System capacity. Solve problems on faculty location using break even analysis and transportation method. Solve problems related to product and process layouts.
5. Use concepts of replacement theory to solve problems of replacing items that fail gradually and suddenly.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
MGM184-1	2	1	-	-	-	-	-	-	-	-	2	-
MGM184-2	2	2	-	-	-	-	-	-	-	-	2	-
MGM184-3	1	1	-	-	-	-	-	-	-	-	2	-
MGM184-4	3	2	-	-	-	-	-	-	-	-	3	-
MGM184-5	1	1	-	-	-	-	-	-	-	-	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

Joseph G Monks, "Production / Operations Management", McGraw Hill Books
William J Stevenson, "Production and Operations Management", Tata McGraw Hill, 8th Edition.
RC Gupta, "Statistical Quality Control", Khanna Publishers, New Delhi, 2005.
N.D. Vohra, "Quantitative Techniques in Management", Tata McGraw Hill, 2015

REFERENCE BOOKS:

E.L. Grant and R.S. Leavenworth, "Statistical Quality Control", 7th edition, McGraw- Hill publisher, 2004.
Prem Kumar Gupta, D S. Hira, "Operations Research", S Chand Publications, New Delhi,

	2nd edition 2008, Prentice Hall.
	W S Messina, "Statistical Quality Control for Manufacturing Managers", Wiley & Sons, Inc. New York, 1987
	Montgomery, Douglas, "Statistical Quality Control", 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ.
	Jerry Banks, "Principles of Quality Control", Wiley & Sons, Inc. New York.

TAXATION FOR ENGINEERS			
Course Code:	MGM185	Course Type	OEC
Teaching Hours/Week (L: T: P: S)	3:0:0:0	Credits	03
Total Teaching Hours	45	CIE + SEE Marks	50+50

Teaching Department: Management

Course Objectives:

To make students understand the overview of Income Tax Law in India.
To make students understand the basic concepts of income tax such as residential status, tax incidence.
To make students understand the income tax provisions involved in determination of income from salary, House property, business and profession, capital gain and other sources.
To help students understand the determination of tax liability Individual assessees.
To make students understand the deductions u/s 80.

UNIT-I	
Basic concepts and Explanation under various Heads of Income	09 Hours
Basic concepts: Assessment Year, Previous Year, Person, Assessee, Income, Charges on Income, Gross Total Income, Capital and Revenue Receipts, Residential status, Connotation of income, Deemed to accrue or arise in India, Incidence of tax, Tax Planning, Tax Evasion, Tax Management. (Problems on Residential Status of Individual assessee)	
UNIT II	
Explanation under various Heads of Income	09 hours
Income from Salary (theory, basic and full-fledged problems on allowances, perquisites and retirement benefits)	
UNIT III	
Income under the head Profit and gains of Business or Professions	09 hours
Income under the head Profit and gains of Business or Professions and its computation - basis - Method of accounting - Scheme of business deductions/ allowance - Deemed profits - maintenance of books, (Problems on computation of Income from Business/ Profession of Individual assessee)	
UNIT-IV	
Income under Capital Gain	09 Hours
Income under Capital Gain: Basis of charge, Transfer of capital asset, inclusion & exclusion from Capital Asset, Capital Gain, Computation of Capital Gains (theory & problems), Exemptions/deductions from capital gains	
UNIT V	
Income from House Property and Other Sources	09 Hours
Income from House Property - Basic problems on House Property Income from Other Sources (theory only) Deductions under section 80C to 80U (No problems - Provisions only)	

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

1. Exhibit an understanding of the Income Tax Law in India.
2. Identify the nature of Incomes and their tax incidence.
3. Demonstrate how to determine the income from salary, house property, business and profession, capital gain.
4. Demonstrate the determination of tax liability of Individual assessees.
5. Exhibit a clear understanding of various provisions of deductions u/s 80.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12

↓ Course Outcomes												
MGM185.1	2	-	-	-	-	1	-	-	1	-	2	1
MGM185.2	2	-	-	-	-	1	-	-	1	-	2	1
MGM185.3	3	-	-	-	-	1	-	-	1	-	2	1
MGM185.4	3	-	-	-	-	1	-	-	1	-	2	1
MGM185.5	3	-	-	-	-	1	-	-	1	-	2	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

Vinod Singhania, "Students Guide to Income Tax", Taxman Publications.
Mehrotra & Goyal, "Direct Tax", Sahitya Bhavan.
Lal & Vashisht, "Direct Tax", Pearson Ed. 28E.
V S Datey, "Indirect Taxes", Taxman Publications.
Vinod Singhania, "Direct Taxes", Taxman Publications.
T N Manoharan, "Students Guide to Income Tax", Snow White.
Kul Bushan, "How to deal with VAT", Pearson Education/PHI, 1/e.
Mahesh Chandra & Shukla , "Income Tax Law & Practice", Pragathi Publications.
Dr.Pillai, "VAT", Jaico Publications.

WORKING CAPITAL MANAGEMENT

Course Code:	**MGM186**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Need of the Course: The course will enable the student to manage activities in the area of working capital in an enterprise and help the students to do advance study in the field of financial-management through detailed analysis of financial statements, liquidity crises, cash optimization, credit analysis etc. The student will learn how to apply sound techniques for managing inventory.

Description of the Course: Every business needs adequate liquid resources in order to maintain day-to-day cash flow. It needs enough cash to pay wages and salaries as they fall due and to pay creditors if it is to keep its workforce and ensure its supplies. Maintaining adequate working capital is not just important in the short-term. Sufficient liquidity must be maintained in order to ensure the survival of the business in the long-term as well. Even a profitable business may fail if it doesn't have adequate cash flow to meet its liabilities as they fall due.

Teaching Department: Management

Course Objectives:

Discuss the importance of working capital management.

Evaluate working capital requirement.

Assess the challenges faced in managing working capital in domestic and international operations.

Plan for financing working capital requirement.

UNIT-I

Working Capital Decisions, Working Capital Management	09 Hours

Working Capital Decisions: Meaning, Concepts, components Importance & types of working Capital.

Working Capital Management: Meaning, objectives, Principles, Importance of adequate working capital & consequences of inadequate working capital, Dangers of excessive working capital, determinants of working capital – operating cycle and Cash cycle. Approaches to determine an appropriate financing mix, Estimation of working capital requirements (problems) important working capital ratios.

UNIT II

Sources of Working Capital	09 hours

Sources of Working Capital: Financing of long term working capital & short term working capital. Factoring - Meaning mechanism, Functions, types, merits & demerits.

UNIT III

Liquidity Management	09 Hours

Liquidity Management: Cash Management - Meaning - Objectives of Cash Management - Nature of Cash - Motives of holding cash - Cash Management planning aspects - Cash Budgets (Problems), Cash Management control aspects - Concentration banking - Lock box system - Playing the float - Cash Management models - William J Baumol Model - Miller-Orr Model (Problems using these models)

UNIT IV

Receivable Management	09 hours

Receivable Management: Definition, Objectives, cost and benefits of receivable. Credit policy & its variables. Types of Credit policy & their merits & demerits, Factors influencing the size of investment in receivables. Control of receivables. Framing optimum credit policy & Average collection period (Problems)

UNIT V

Inventory Management	09 Hours

Meaning of Inventory - Need/Purpose of holding inventory - Benefits of holding inventory - Risk and cost of holding inventory - Management of Inventory - Objectives of Inventory Management - Techniques of Inventory Management - Economic Order Quantity (EOQ) - Determination of Stock levels - ABC analysis - Just in Time (JIT).

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

1. Understand the meaning of working capital
2. Realize the importance of management of working capital in an organization
3. Learn about some key liquidity ratios used to understand more about a business' working capital position
4. Understand various techniques used to manage working capital.
5. Be aware of the techniques of cash, inventory and receivables management.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
MGM186.1	2	-	-	-	-	1	-	-	-	1	2	1

MGM186.2	2	-	-	-	-	1	-	-	-	1	2	1
MGM186.3	2	-	-	-	-	1	-	-	-	1	2	1
MGM186.4	2	-	-	-	-	1	-	-	-	1	2	1
MGM186.5	2	-	-	-	-	1	-	-	-	1	2	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

Sekhar Satya G.V., "Working Capital Management", 1/e; New Delhi: Wiley, 2014.

Bhalla V. K., "Working Capital Management", 1/e; New Delhi: S. Chand Publishing, 2014.

Sagner James S., "Working Capital Management, Applications and Cases", 1/e, New Delhi: Wiley, 2015.

NANO TECHNOLOGY AND MATERIALS
(Open Elective VI-Semester)

Course Code:	**PHY281**	**Course Type**	**Open Elective**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: PHYSICS

Course Objectives:

01	To understand the fundamental properties and advanced synthesis techniques of nanomaterials.
02	To study the structure and applications of carbon-based nanomaterials
03	To get familiar with various characterization methods for nanomaterials.
04	To explore the role of nanomaterials in improving energy storage and conversion technologies.
05	To integrate nanotechnology principles into multidisciplinary engineering applications.

UNIT-I

Introduction to Nanomaterials — **09 Hours**

History of nano science, definition of nano meter, nanomaterials, Nanotechnology, Effect of size reduction on properties, electronic structure of nano materials. Variation of physical properties from bulk to thin films to nanomaterials, Confinement of electron in 0D, 1D, 2D and 3D systems, Surface to Volume Ratio, Synthesis of Nanomaterials: Bottom-Up approach: Sol-gel, Hydrothermal, Top-Down approach- Ball milling technique, Sputtering.

UNIT-II

Nanoforms of Carbon — **09 Hours**

Structure and bonding in Carbon Nano-material: Armchair, Zigzag and chiral patterns. Theory of formation of different structures and growth process of CNT single walled carbon nanotubes and multi walled carbon nano tubes, graphite and diamond. Different types of carbon Nanomaterials: fullerenes, nanofibers, nano discs, nano diamonds, carbon dots, their structure and properties. Properties of Carbon nanomaterials and conventional Carbon materials: Physical, Chemical and Electronic properties. Carbon nanocomposites, types and their applications.

UNIT-III

Characterization of Nanomaterials — **09 Hours**

Basic principles and instrumentations of Electron Microscopy –Scanning Electron Microscope, Transmission Electron Microscope, comparison of SEM and TEM. Basic principles of working of X-ray diffraction, Debye-Scherrer equation (No derivation), numerical on Debye Scherrer equation, Optical Spectroscopy- Instrumentation and application of IR and UV. Differential Scanning Calorimeter (DSC), Differential Thermal Analyzer (DTA), Thermogravimetric Analysis (TGA). Techniques of characterization of size of nano powders/ particles using BET method and laser diffraction.

UNIT-IV

Nanotechnology in Energy storage and conversion — **09 Hours**

Solar cells: First generation, second generation and third generation solar cells: Construction and working of Quantum dot sensitized solar cells. Batteries: Nanotechnology in Lithium-ion battery-working, Requirements of anodic and cathodic materials, classification based on ion storage mechanisms. Fuel Cells: Introduction, construction, working of fuel cells and nanotechnology in hydrogen storage.

UNIT-V

Applications of Nanotechnology — **09 Hours**

Introduction, Significant Impact of Nanotechnology and Nanomaterial on Medicine, Healthcare, Biological, Biochemical, Electronic, Computing, Chemical, Optical, Agriculture and Food Applications, Applications of nano structured thin films, applications of quantum dots.

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

1.	Analyze and distinguish between various methods of nanomaterial synthesis.
2.	Classify various carbon-based nanomaterials based on their structural characteristics
3.	Apply fundamental knowledge of characterization techniques to analyse nanomaterials.
4.	Apply the learning of nanomaterials in improving energy storage and conversion technologies.
5.	Apply nanotechnology concepts into multidisciplinary engineering applications.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
PHY281-1.1	3	2	1					2			1		
PHY281-1.2	3	2	1					2			1		
PHY281-1.3	3	2	1					2			1		
PHY281-1.4	3	2	1					2			1		
PHY281-1.5	3	2	1					2			1		

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	M.S. Ramachandra Rao, Shubra Singh, "Nano science and nano technology", Wiley publishers.

REFERENCE BOOKS:

1.	Charles P. Poole, Jr. Frank J. Owens, "Introduction to Nano Technology", Wiley publishers.
2.	Jermy J Ramsden, "Nanotechnology ", Elsevier publishers.
3.	A.K. Bandyopadhyay, "Nano Materials", New Age publishers.
4.	T Pradeep, "Nano Essentials" TMH.
5.	M. A. Shah, "Nanotechnology the Science of Small", Wiley publishers.
6.	Phani Kumar, "Principles of Nanotechnology", Scitech.
7.	B S Murthy, "Textbook of Nanoscience and Nanotechnology", Universities Press/Springer.

E Books / MOOCs/ NPTEL

1.	https://youtu.be/ebO38bbq0_4
2.	https://youtu.be/0MzIh7wkgMs

OPTOELECTRONIC DEVICES AND APPLICATIONS

(Open Elective Semester-VI)

Course Code:	**PHY282**	**Course Type**	**Open Elective**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**

Teaching Department: PHYSICS

Course Objectives:

1.	To provide comprehensive understanding of the fundamental optical processes in semiconductors and their application in modern display technologies.
2.	To introduce the principles of light propagation in optical fibers, along with their performance characteristics and advantages.
3.	To impart foundational knowledge of laser physics and the importance of laser safety in practical applications.
4.	To introduce the principles of electroluminescence and the operation of various optoelectronic devices, including LEDs, photodiodes, and imaging sensors.
5.	To equip with the knowledge of light modulation techniques and guided wave devices used in optical communication systems.

UNIT-I

Optical processes in Semiconductor & Display devices — **09 Hours**

Optical processes in Semiconductor: Energy bands in solids, Review of semiconductor physics. Elements of optical phenomena in Semiconductors- fundamentals of Fermi-Dirac distribution, direct and indirect band gap semiconductors, generation-recombination mechanisms, absorption and emission processes.

Display devices- cathode ray tube, liquid crystal display, plasma display.

UNIT-II

Optical fibers: — **09 Hours**

Optical fibers- Propagation of radiation in optical fibers, acceptance angle, numerical aperture, Types of fibers, modes of propagation, attenuation, Pulse Dispersion in Optical Fibers, Fiber Bragg Gratings, Erbium-Doped Fiber Amplifiers (EDFAs), Raman Fiber Amplifier (RFA), optical fiber communication system, advantages.

UNIT-III

Lasers — **09 Hours**

Lasers: basic principles, laser action, optical resonator-types, modes and quality factor, Continuous and Pulsed lasers, Solid-State Lasers – Nd: YAG Laser, Semiconductor Lasers, CO_2 Laser, Ultraviolet Lasers: Excimers. Laser Safety.

UNIT – IV

Optical sources and detectors — **09 Hours**

Light emitting diode- Electroluminescence in p-n junction, LED, Heterojunction LED, Surface-Emitting LED and Edge Emitting LED. LED characteristics, efficiency, and responsivity,

Photo detectors- Photo diode, p-i-n photo diode, avalanche photo diode. Photo multiplier tube, Charge Coupled Devices (CCD), CMOS sensors

UNIT-V

Integrated optics and modulators — **09 Hours**

Modulation of light- Analog and digital modulation, Direct modulation – using LED and Semiconductor diode laser (SDL). External modulation – Electro-optic modulators (Pockels effect), Electro-absorption modulators. Acousto-optic modulation. All-optical switches. Optical waveguides: Introduction to wave guides, Guided wave devices-Phase modulator, Mach-Zender interferometer modulator and switch, The optical direction coupler.

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

1.	Analyze and explain the optical behavior of semiconductors and evaluate the working principles of various display devices.
2.	Understand and apply principles of optical fiber communication, including signal propagation, attenuation, and amplification, for effective system design.
3.	Analyze the basic mechanisms of laser action, differentiate between various types of lasers, and apply standard laser safety procedures.
4.	Apply the concepts of optical sources and detectors to analyse the working of various optoelectronic devices.
5.	Analyze the principles and applications of optical modulation and waveguide technologies.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
PHY282-1.1	3	2	1					2			1		
PHY282-1.2	3	2	1					2			1		
PHY282-1.3	3	2	1					2			1		
PHY282-1.4	3	2	1					2			1		
PHY282-1.5	3	2	1					2			1		

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	P. R. Sasikumar, "Photonics – An introduction", PHI Learning Pvt. Ltd., New Delhi, 2012 edition.
2.	Pallab Bhattacharya "Semiconductor Optoelectronic Devices", Prentice Hall of India Pvt., Ltd., New Delhi, 2006.
3.	A. Ghatak & K. Thyagarajan, Optical Electronics, Cambridge University
4.	K. Okamoto, Fundamentals of Optical Waveguides, Academic Press, 2000.

REFERENCE BOOKS:

1.	J. Wilson and J. Haukes, "Optoelectronics- an introduction", Prentice Hall of India.
2.	Jasprit Singh "Optoelectronics- an introduction to Materials and Devices" McGraw Hill.
3.	A. Ghatak and Thyagarajan, "Introduction to optoelectronics", New Age International Publication.

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/115102026/
2.	https://youtu.be/xasZDwgSFiE
3.	https://youtu.be/J6QS_aCT2No
4.	https://archive.nptel.ac.in/courses/108/106/108106181/

INTRODUCTION TO MOBILE ROBOTS

Course Code:	**RAI281**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: J: SL)	**(3:0:0:1)**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**
Prerequisite			

Teaching Department: Robotics & AI

Course Objectives:

This Course will enable students to:

1.	Introduce students to the fundamental concepts of mobile robotics, including various types of mobile robots, their key components, locomotion systems, and wheel configurations.
2.	Teach students how to develop kinematic models for holonomic and nonholonomic mobile robots and understand their implications on robot motion and control.
3.	Study the different types of sensors used in an autonomous mobile robot.
4.	Equip students with the skills necessary to implement localization and mapping techniques, such as SLAM and EKF SLAM
5.	Understand the various algorithms for planning and navigation of the mobile robot.

UNIT-I

09 Hours

Introduction: Introduction to mobile robots and mobile manipulators. Components of a mobile robot. Classification of mobile robots, Types of wheeled Mobile Robots.
Locomotion: Introduction, Key issues for locomotion, Types of land-based mobile robots, wheeled locomotion case studies.
Holonomic and non-holonomic systems, Pseudo Inverse.

UNIT-II

Mobile robot kinematics — **09 Hours**

Introduction, Need of mathematical model, degree of freedom. Differential Kinematics: Representing robot position, forward differential kinematics, Inverse differential kinematics, Degree of manoeuvrability, Types of wheels for mobile robots. Kinematic simulation of a mobile robot. A generalized wheel model, Examples: Differential wheel drive mobile robot, Skid steering wheel drive mobile robot, Omni wheel drive mobile robot, Mecanum wheel drive mobile robot, Tricycle wheel drive mobile robot.

UNIT-III

Perception — **09 Hours**

Sensors for Mobile Robots, Sensor classification, characterizing sensor performance, sensors for mobile robots: Wheel/motor sensors, Heading sensors, Ground-based beacons, Active ranging, Motion/speed sensors, Vision-based sensors.

UNIT-IV

Mobile Robots –Localisation and Mapping: — **09 Hours**

Autonomy for Robots, Building Blocks of Navigation, Challenges of Localization, Noise and Aliasing, Mobile robot localisation: Odometry, Dead reckoning, Map based localisation, Markov Localisation, Kalman Filter. Autonomous map building: SLAM, EKF SLAM.

UNIT-V

Introduction to planning and navigation — **09 Hours**

Competences for Navigation, Path Planning Methods, Graph Construction: Visibility graph, Voronoi diagram, Cell decomposition methods. Graph Search Methods and Algorithms: Deterministic Graph Search, Breadth-first search, Depth-first search, Grass fire, Dijkstra's algorithm. Path Planning- A* Algorithm and Potential Field methods. Obstacle Avoidance: Bug Algorithm.

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

1.	Develop a comprehensive understanding of the different types of mobile robots and their key components, including locomotion systems and wheel configurations
2.	Build kinematic models of holonomic and nonholonomic mobile robots

3.	Apply the different types of sensors used in an autonomous mobile robot.
4.	Acquire skills in implementing localization and mapping techniques for mobile robots, including SLAM and EKF SLAM, and apply various sensor technologies for robot perception to enhance navigation capabilities.
5.	Apply mobile robot navigation competences, including path planning methods, graph construction and search algorithms, and obstacle avoidance techniques, to effectively design and implement autonomous navigation strategies for mobile robots.

Course Outcomes Mapping with Program Outcomes & PSO

PO→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO's**		
↓ CO												**1**	**2**	**3**
CO1	3	2	1	-	-	-	-	-	-	-	-	2	1	1
CO2	3	2	1	-	-	-	-	-	-	-	-	3	1	1
CO3	3	2	1	-	1	-	-	-	-	-	-	3	2	2
CO4	3	2	1	-	1	-	-	-	-	-	-	2	2	2
CO5	3	2	1	-	1	-	-	-	-	-	-	2	2	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	R. Siegwart, I. R. Nourbakhsh, "Introduction to Autonomous Mobile Robots", The MIT Press, 2011.
2.	Peter Corke, "Robotics, Vision and Control: Fundamental Algorithms in MATLAB", Springer Tracts in Advanced Robotics, 2011.
3.	S. M. LaValle, "Planning Algorithms", Cambridge University Press, 2006. (Available online http://planning.cs.uiuc.edu/)

REFERENCE BOOKS:

1.	Thrun, S., Burgard, W., and Fox, D., "Probabilistic Robotics". MIT Press, Cambridge, MA, 2005.
2.	Melgar, E. R., Diez, C. C., "Arduino, and Kinect Projects: Design, Build, Blow Their Minds", 2012.
3.	H. Choset, K. M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki, and S. Thrun, "Principles of Robot Motion: Theory, Algorithms, and Implementations", PHI Ltd., 2005.

E Books / MOOCs/ NPTEL

1.	https://archive.nptel.ac.in/courses/112/106/112106298/
2.	https://www.edx.org/course/autonomous-mobile-robots

INTRODUCTION TO MEDICAL ROBOTICS			
Course Code:	**RAI282**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: J)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite			
Teaching Department: Robotics & AI			

Course Objectives:

1.	Understand the structural and functional requirement of robots for different medical applications and hospital automation
2.	Understand the interoperative sensors and their registrations
3.	Study of robotic subsystems for medical robot
4.	Study the functional and design requirements of robot for different surgical procedures
5.	Study the robot configurations for rehabilitation and assistive robots

UNIT-I

Introduction to medical robotics:	**9 Hours**

Characteristics of medical robotics, advantages of using a robot in a medical procedure, Robots in Surgery, Rehabilitation and Assistive Robotics, Hospital Automation Robotics, Emerging Technologies and Challenges, Robots for Cognitive Rehabilitation and Social Assistance, Robots for Smart Hospitals

Hospital Automation Robotics: Introduction, Robots for Hospital Logistics, Robots for Pharmacy and Drug Management, Robots for Patient Transfer and Care, Robots for High-Throughput Lab Automation, Robots for Diagnosis and Imaging.

UNIT-II

Inter-operative Sensors and Registration:	**9 Hours**

Introduction, Summary of the context and the problem of registration, calibration and tracking, Intra-operative sensors, Imaging sensors, Position sensors, Surface sensors and other sensors, Principles of registration Notations and definitions, Nature of the transformation, Matched information, Similarity metrics, 3D/3D rigid registration.

UNIT-III

Design of Medical Robots:	**9 Hours**

Introduction, Analysis of the gesture, Kinematics of C-Arm, Kinematic and dynamic specifications, Kinematic choices, Design methodologies, Concept selection, Optimization of design parameters, Technological choices, Actuators, Sensors, Material, Security and dependability, Risks reduction in medical robotics, Vision based control, Configurations of the imaging device, Localizers, Tracking of anatomical targets, methods for image processing, Modeling the visual servoing loop and Force Control, Implicit and explicit force control, force control architecture.

UNIT-IV

Surgical Robotics:	**9 Hours**

Introduction, Evolution of Surgical Robots, Neurosurgery and Orthopedics, Robotic Laparoscopy and Flexible Robots for Endoluminal Interventions, Untethered Microrobots, Technologies for Robotic Surgery, Human–Robot Interaction and Levels of Autonomy, Computer-Assisted Intervention: Integrating Imaging and Sensing Surgical Navigation and Control, Micro-Nano Robotics for Surgery.

UNIT-V

Rehabilitation and Assistive Robotics	**9 Hours**

Introduction, Robots for Therapeutic Training, Upper-Limb Rehabilitation Robots, Rehabilitation Robot for Gait Training, Robots for Personal Assistance, Assistive Robots for ADL, Assistive Robots for Human Movement Augmentation, Social Robotics for Cognitive Assistance, Social Robotics for ASD, Social Robotics for Dementia, Prostheses, Human–Robot Interaction for robot control, sensory feedback, rehabilitation assessment.

Course Outcomes: At the end of the course student will be able to	
1.	Differentiate the structural and functional requirement of robots for different medical applications and hospital automation
2.	Define and implement the interoperative sensors and their registrations in medical robots
3.	Design and implement a robotic subsystem for surgical robot
4.	Suggest robot configuration requirements for different surgical procedures
5.	Design and implement the medical robot configuration for rehabilitation and assistive robots

Course Outcomes Mapping with Program Outcomes & PSO

PO→	1	2	3	4	5	6	7	8	9	10	11	PSO↓		
↓ CO												1	2	3
CO1	3	-	1	-	-	-	-	-			-	3		3
CO2	3	-	1	-	-	-	-	-			-	3		3
CO3	3	-	1	-	-	-	-	-			-	3		3
CO4	3	-	1	-	-	-	-	-			-	3		3
CO5	3	-	3	-	-	-	-	-			-	3		3

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	Medical Robotics, Jocelyne Troccaz, Wiley-ISTE, 2013
2.	Medical Robotics, Achim Schweikard, Floris Ernst, Springer, 2015
3.	Medical Robotics-History, Challenges, and Future Directions, Yao Guo, Giulio Dagnino, Guang-Zhong Yang, Springer, 2023
4.	Robot Modeling and Control, Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, Wiley Publishers, 2006

REFERENCE BOOKS:	
1.	Medical robotics- Minimally, Invasive surgery, Paula Gomes, Woodhead, 2012
2.	Medical Robotics, Vanja Bonzovic, I-tech Education publishing Austria, 2008
3.	Medical Robotics, Daniel Faust, Rosen Publishers, 2016

E Books / MOOCs/ NPTEL	
1.	https://www.futurelearn.com/courses/medtech-ai-and-medical-robots
2.	https://web.stanford.edu/class/me328/

PLC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS			
Course Code:	**RAI283**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P:J:S)	**3:0:0:0:1**	**Credits**	**03**
Total Teaching Hours	**45**	**CIE + SEE Marks**	**50+50**
Prerequisite			
Teaching Department: Robotics & AI			

Course Objectives:

1.	To understand the fundamentals of fluid power transmission systems
2.	To design various hydraulic system components.
3.	To design various pneumatic system components.
4.	Learn various types of hydraulic and pneumatic power circuits.
5.	Learn various types of applications in fluid power circuits using PLC.

UNIT-I

Fluid power systems and fundamentals	**04 Hours**
Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, General types of fluids - Properties of hydraulic fluids -Fluid power symbols. Basics of Hydraulics-Applications of Pascal's Law	
Hydraulic system components	**05 Hours**
Sources of Hydraulic Power: Pumping theory - Pump classification - construction and working of pumps - Variable displacement pumps, pump performance. Actuators: Linear hydraulic actuators-Single acting and double acting cylinders, Rotary actuators - Fluid motors.	

UNIT-II

Control Components	**09 Hours**
Direction control valve - Valve terminology - Various center positions. Shuttle valve - check valve - pressure control valve - pressure reducing valve, sequence valve. Flow control valves - Fixed and adjustable Safety valves.	

UNIT-III

Pneumatic system components	**09 Hours**
Pneumatic Components: Properties of air. Compressors. FRL Unit -Air control valves, Quick exhaust valves and pneumatic actuators- cylinders, air motors. Basics of low-cost automation	

UNIT-IV

Fluidics & Pneumatic circuit design	**09 Hours**
Fluidics - Introduction to fluidic devices, simple circuits. Introduction to Electrohydraulic Pneumatic logic circuits, PLC applications in fluid power control, Sequential circuit design for simple applications using classic, cascade, logic with Karnaugh- Veitch Mapping and combinational circuit design methods.	

UNIT-V

Fluid power circuits	**09 Hours**
Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.	

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

1.	Compare the basics of hydraulics to the performance of fluid power systems
2.	Explain the working principle of hydraulic systems including pumps and control components.
3.	Explain the working principle of pneumatic systems and their components.
4.	Design various types of Electrohydraulic and electro pneumatic circuits
5.	Design various types of applications in fluid power circuits using PLC.

Course Outcomes Mapping with Program Outcomes

PO→ / ↓ CO	1	2	3	4	5	6	7	8	9	10	11	PSO↓ 1	2	3
CO1	3	2	3	2	3	-	-	-	-	-	-	3		3
CO2	3	2	3	2	3	-	-	-	-	-	-	3		3
CO3	3	2	3	2	3	-	-	-	-	-	-	3		3
CO4	3	2	3	2	3	-	-	-	-	-	-	3		3
CO5	3	2	3	2	3	-	-	-	-	-	-	3		3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Majumdar S.R., "Pneumatic systems - Principles and maintenance", Tata McGraw Hill, 2008.
2.	Anthony Esposito, "Fluid Power with Applications", Pearson Education 2009.

REFERENCE BOOKS:

1.	Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.
2.	Harry L. Stevart D. B, "Practical guide to fluid power", Taraoeala sons and Port Ltd.Broadey, 2010.
3.	Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 2011.
4.	Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 2011.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/108/105/108105088/
2.	https://plc-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering
3.	http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/COEP_KNOWLEDGE_SEEKERS/labs/exp1/theory.html

UNMANNED AERIAL ROBOTS			
Course Code:	**RAI284**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: J):	**(3:0:0:0)**	**Credits:**	**03**
Total Teaching Hours:	**45+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite			
Teaching Department: Robotics & AI			

Course Objectives:

1.	To introduce students to the fundamentals of unmanned aerial vehicles (UAVs), including their classification, applications, and basic aerodynamic principles that govern their flight performance.
2.	To develop an understanding of aircraft performance parameters and the principles of stability and control, including flight dynamics, control surfaces, and autopilot systems in unmanned and manned aerial vehicles.
3.	To provide students with foundational knowledge of propulsion systems used in air vehicles and an understanding of structural loads, material selection, and construction techniques applicable to aerial platforms.
4.	To familiarize students with various types of payloads used in air vehicles and provide an understanding of control systems required for effective payload integration and operation.
5.	To introduce students to the principles of data-link communication and the design considerations of launch and recovery systems for unmanned aerial vehicles (UAVs).

UNIT-I

The Air Vehicle:	**04 Hours**
Introduction aviation history and overview of UAV systems, classes and missions of UAVs, definitions and terminology, Classification of UAV's, UAV fundamentals, examples of UAV systems-very small, small, medium and large UAV	
Basic Aerodynamics:	**05 Hours**
Basic aerodynamics equations, aircraft polar, the real wing and airplane, induced drag, the boundary layer, flapping wings, total air-vehicle drag	

UNIT-II

Performance:	**05 Hours**
Overview, climbing flight, range and endurance – for propeller-driven aircraft, range- a jet-driven aircraft, guiding flight.	
Stability and Control:	**04 Hours**
Overview, stability, longitudinal, lateral, dynamic stability, aerodynamics control, pitch control, lateral control, autopilots, sensor, controller, actuator, airframe control, inner and outer loops, flight-control classification, overall modes of operation, sensors supporting the autopilot.	

UNIT-III

Fundamentals of Propulsion Systems and Power Sources:	**05 Hours**
Propulsion overview, thrust generation, powered lift, sources of power, the 2-cycle engine, rotary engine, the gas turbine, electric motors, sources of electrical power.	
Structural Loads, Materials, and Construction Techniques:	**03 Hours**
Loads and structures loads, dynamic loads, materials, sandwich construction, skin or reinforcing materials, resin materials, core materials, construction techniques.	

UNIT-IV

Air Vehicle Payloads and Control Systems:	**09 Hours**
Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads.	

UNIT-V

Data-Link Systems and Launch/Recovery Mechanisms:	**09 Hours**
Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems, Recovery Systems, Launch and Recovery Trade-offs	

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

1.	Classify UAVs based on size and mission, understand key UAV systems and terminology, and apply fundamental aerodynamic principles to analyze forces acting on UAVs during flight.
2.	Analyze the performance characteristics of propeller and jet-driven aircraft, evaluate flight stability and control in various modes, and understand the role of sensors and actuators in flight control systems and autopilots.
3.	Explain the principles of thrust generation and evaluate various propulsion systems, as well as identify and analyze structural load types, materials, and construction methods used in air vehicle design.
4.	Identify and differentiate between various payload types such as reconnaissance, surveillance, and weapon systems, and explain the control mechanisms involved in their deployment and operation.
5.	Explain key functions and performance attributes of data-link systems, evaluate trade-offs in data transmission, and analyze various launch and recovery methods for UAVs.

Course Outcomes Mapping with Program Outcomes & PSO

PO→	1	2	3	4	5	6	7	8	9	10	11	PSO's		
↓ CO												1	2	3
CO1	2	2	3	2	2	-	-	-	-	-	-	2	-	2
CO2	2	2	3	2	2	-	-	-	-	-	-	2	-	2
CO3	2	2	3	2	2	-	-	-	-	-	-	2	-	2
CO4	2	2	3	2	2	-	-	-	-	-	-	2	-	2
CO5	2	2	3	2	2	-	-	-	-	-	-	2	-	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Paul Gerin Fahlstrom, Thomas James Gleason, Introduction to UAV Systems, Wiley Publication, 4th Edition,2012.
2.	Landen Rosen, Unmanned Aerial Vehicle, Alpha Editions

REFERENCE BOOKS:

1.	Unmanned Aerial Vehicles: DOD's Acquisition, Alpha Editions
2.	Valavanis, Kimon P, Unmanned Aerial Vehicles, Springer, 2011
3.	Valavanis, K., Vachtsevanos, George J, Handbook of UAVs, Springer, 2015.

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc22_me38/preview

INTRODUCTION TO UNMANNED AERIAL VEHICLES

Course Code:	**AER181**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: J):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Aeronautical Engineering

Course Objectives:

1.	To identify and classify various types of Unmanned Aerial Vehicles
2.	To understand fluid dynamics and airflow over UAV surfaces, analyse lift, drag, and moment forces
3.	To assess UAV performance, understand stability & control systems, and autopilot system
4.	To understand propulsion systems, battery performance, select appropriate materials for components
5.	To apply mission planning principles, navigation and guidance systems, optimize mission profiles

UNIT-I

Introduction	**07 Hours**

Aviation History and Overview of UAV systems, Classes and Missions of UAVs, Definitions and Terminology, UAV fundamentals, Examples of UAV systems-very small, small, Medium and Large UAV

UNIT-II

Aerodynamics	**07 Hours**

The Air Vehicle Basic Aerodynamics: Basic Aerodynamics equations, Aircraft polar, the real wing and Airplane, induced drag, the boundary layer, Flapping wings, Total Air-Vehicle Drag

UNIT-III

Performance and Stability and Control	**12 Hours**

Overview, climbing flight, Range and Endurance – for propeller driven aircraft, range- a jet-driven aircraft, Guiding Flight, Overview, Stability, longitudinal, lateral, dynamic stability, Aerodynamics control, pitch control, lateral control, Autopilots, sensor, controller, actuator, airframe control, inner and outer loops, Flight-Control Classification, Overall Modes of Operation, Sensors Supporting the Autopilot.

UNIT-IV

Propulsion and Materials	**08 Hours**

Overview, Thrust Generation, Powered Lift, Sources of Power, Electric Motors, Sources of Electrical Power, Loads and Structures Loads, Dynamic Loads, Materials, Sandwich Construction, Skin or Reinforcing Materials, Resin Materials, Core Materials, Construction Techniques

UNIT-V

Mission Planning and Control	**11 Hours**

Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads, Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems, Recovery Systems, Launch and Recovery Tradeoffs

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

1.	Describe the types of UAVs and their applications
2.	Describe the aerodynamics of UAV
3.	Describe the stability and control of UAV
4.	Identify suitable Propulsion system, and materials for UAVs
5.	Illustrate the Mission Planning and Control of UAV

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
AER181.1	**3**	**1**	-	-	-	-	-	**3**	**1**	-	-	**2**	**2**
AER181.2	**3**	**1**	-	-	-	-	-	**3**	**1**	-	-	**2**	**2**
AER181.3	**3**	**1**	-	-	-	-	-	**3**	**1**	-	-	**2**	**2**
AER181.4	**3**	**1**	-	-	-	-	-	**3**	**1**	-	-	**2**	**2**
AER181.5	**3**	**1**	-	-	-	-	-	**3**	**1**	-	-	**2**	**2**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Introduction to UAV Systems, by Paul Gerin Fahlstrom, Thomas James Gleason, Wiley Publication, 4th Edition 2012
2.	Unmanned Aerial Vehicle, by Landen Rosen, Alpha Editions, 1st edition, 2015

REFERENCES:

1.	Unmanned Aerial Vehicles, by Valavanis, Kimon P Springer 2011
2.	Handbook of Unmanned Aerial Vehicles by Valavanis, K., Vachtsevanos, George J Springer 2015

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/101/104/101104073/
2.	https://online-learning.tudelft.nl/courses/aircraft-performance-physics-and-simulation/

INTRODUCTION TO AIRCRAFT SYSTEMS AND INSTRUMENTS

Course Code:	**AER182**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: J):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Aeronautical Engineering

Course Objectives:

1.	To impart knowledge of hydraulic and pneumatic systems used in aircraft.
2.	To study the primary functions and components of engine systems.
3.	To provide knowledge of essential auxiliary and flight data systems critical for safe aircraft operation.
4.	To examine various surveillance systems employed in modern aircraft.
5.	To understand the types, functions, and operational principles of various aircraft instruments.

UNIT-I

Aircraft Systems — **09 Hours**

Systems and types - Hydraulic systems - Study of typical workable system - Components - Hydraulic system controllers - Modes of operation - Pneumatic systems - Advantages - Working principle - Typical air pressure system – Brake system - Typical pneumatic power system - Components - Landing gear systems - Classification – Shock absorbers - Retractive mechanism.

UNIT-II

Engine Systems — **09 Hours**

Fuel systems for piston and jet engines - Components of multi engines - Lubricating systems for piston and jet engines - Starting and ignition systems - Typical examples for piston and jet engines.

UNIT-III

Auxiliary and Flight Data Systems — **09 Hours**

Air conditioning system - Pressurization system - Oxygen system - Fire protection system – De-icing and anti-icing systems - Cockpit Voice Recorder (CVR) - Flight Data Recorder (FDR) - Automatic Flight Control System (AFCS) - Electronic Warfare

UNIT-IV

Surveillance Systems — **09 Hours**

Ground Proximity Warning System (GPWS) - Traffic Collision Avoidance System (TCAS) - Aircraft Communication and Reporting System (ACARS) - Aeronautical Telecommunication Network (ATN) - Future Air Navigation System (FANS) - Air Traffic Control Methods

UNIT-V

Aircraft Instruments — **09 Hours**

Flight Instruments and Navigation Instruments – Gyroscope - Accelerometer - Air speed indicators – TAS – EAS - Mach Meter - Altimeter - Principles and operation - Study of various types of engine instruments - Tachometer - Temperature gauge - Pressure gauge - Operation and Principle - Instrument landing system

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

1.	Demonstrate the functioning of various pneumatic and hydraulic systems used in aircraft
2.	Describe the working of different engine systems
3.	Discuss the usage of auxiliary and flight data systems available in aircraft
4.	Understand the need and operation of surveillance systems
5.	Infer the components and construction of various aircraft instruments

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
AER182.1	**2**	-	-	-	-	-	-	-	**2**	**2**	-	-	-
AER182.2	**2**	-	-	-	-	-	-	-	**2**	**2**	-	-	-
AER182.3	**2**	-	-	-	-	-	-	-	**2**	**2**	-	-	-
AER182.4	**2**	-	-	-	-	-	-	-	**2**	**2**	-	-	-
AER182.5	**2**	-	-	-	-	-	-	-	**2**	**2**	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Ian Moir and Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystem Integration" 3rd Edition, Wiley India Pvt Ltd, 2012

2. E. H. J. Pallett and L. F. E. Coombs, "Aircraft Instruments and Integrated Systems", 3rd Edition, Pearson, 1992

3. Lalit Gupta and O. P. Sharma, "Aircraft Systems (Fundamentals of Flight Vol. IV)", Himalayan Books, 2006

REFERENCES:

1. E. H. J. Pallett, "Aircraft Instruments: Principles and Applications", 2nd Edition, Pitman Publishing, 1981

2. William A. Neese, "Aircraft hydraulic systems", 2nd Edition, R. E. Krieger Editorial, 1987

E Books / MOOCs/ NPTEL

1. Avionics and Aircraft Systems: Fundamentals by Lluis Foreman – Coursera

2. Aerospace Engineering: Aircraft Systems and Avionics by Lluis Foreman - Udemy

ELEMENTS OF AERONAUTICS

Course Code:	**AER183**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: J):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Aeronautical Engineering

Course Objectives:

1.	To understand various aircraft configurations, structural components, and materials used in aircraft design.
2.	To describe the fundamental aerodynamic principles governing flight.
3.	To study the components and load-bearing characteristics of aircraft structures.
4.	To understand the basics of aircraft propulsion systems and stability principles.
5.	To describe various aircraft systems and their functions.

UNIT-I

History and aircraft configurations — **09 Hours**

Early development of Airplanes, biplanes and monoplanes, Developments in materials, structures and propulsion over the years, types of flight vehicles, classifications-Components of an airplane and their functions.

UNIT-II

Basics of Flight — **09 Hours**

Structures of the Atmosphere - Temperature, pressure and altitude relationships, Evolution of Aerodynamics forces and moments-center of pressure - aerodynamic center – pressure coefficients, Aerofoils and its nomenclature, speed of sound, Mach number, concepts of aircraft stability and control.

UNIT-III

Basics of Aircraft Structures — **09 Hours**

General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials- V-n diagram and load factor.

UNIT-IV

Basics of Propulsion and Design — **08 Hours**

Introduction to aircraft power plants – classification – principle of operation, Characteristics of piston, turboprop, turbofan and turbo shaft engines, use of propeller and jets for thrust production-Comparative merits and demerits, Principle of operation of rocket, types of rocket and typical applications. Phases of conceptual design of an aircraft.

UNIT-V

Aircraft Systems — **10 Hours**

Hydraulic Systems, Pneumatic Systems, Electrical and Avionics Systems, Fuel Systems, Environmental Control Systems (ECS), Landing Gear and Braking Systems, Fire Protection and Safety Systems, Aircraft Control, Communication, and Navigation System

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

1.	Identify and compare different aircraft configurations and materials based on their applications.
2.	Apply concepts of lift, drag, thrust, and weight to analyze aircraft performance.
3.	Assess structural integrity and material selection for different aircraft designs.
4.	Discuss propulsion mechanisms and stability criteria affecting aircraft performance.

5.	Identify and analyze aircraft systems, including hydraulics, avionics, fuel, and safety mechanisms.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
												1	**2**
AER183.1	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
AER183.2	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
AER183.3	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
AER183.4	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
AER183.5	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	J. D. Anderson, Introduction to Flight, 8th ed. New York, NY, USA: McGraw-Hill, 2022.
2.	S. A. Brandt, Introduction to Aeronautics: A Design Perspective, 2nd ed. AIAA Education Series, 2015.

REFERENCES:

1.	S. A. Brandt, R. J. Stiles, J. J. Bertin, and R. Whitford, Introduction to Aeronautics: A Design Perspective, 2nd ed. AIAA Educational Series, 2015.
2.	L. R. Jenkinson, P. Simpkin, and D. Rhodes, Civil Jet Aircraft Design. London, UK: Arnold Publishers, 1999.
3.	J. Fielding, Introduction to Aircraft Design. Cambridge, UK: Cambridge University Press, 1999.

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc20_ae14/preview
2.	https://www.digimat.in/nptel/courses/video/101101083/L77.html
3.	https://www.digimat.in/nptel/courses/video/101101083/L01.html

INTRODUCTION TO SPACE TECHNOLOGY

Course Code:	**AER281**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: J):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Aeronautical Engineering

Course Objectives:

1.	To understand the basic theory, practices and applications of rocket propulsion
2.	To explain different types of re-entry techniques involved in space missions
3.	To understand the basics of orbital mechanics and different types of maneuvers associated with it
4.	To study the concepts of satellite orbit injection and orbit perturbations
5	To acquire the knowledge on different types of operations involved in the space mission

UNIT-I

Fundamentals of Rocket Propulsion: **09 Hours**

Fundamentals of Aerospace Propulsion, Space Environment, fundamentals of solid propellant rockets, Fundamentals of liquid propellant rockets, Rocket equation, Tsiolkovsky rocket equation, Concepts of Specific Impulse

UNIT-II

Atmospheric Re-entry **09 Hours**

Introduction-Steep Ballistic Re-entry, Ballistic Orbital Re-entry, Skip Re-entry, "Double-Dip" Re-entry, Skip reentry, glide reentry

UNIT-III

Orbital Mechanics and Maneuvers **09 Hours**

Reference Frames and Co-ordinate Systems, Newton law of Gravitation, Kepler Laws, N-body problem, Two-body motion, Trajectory Equation Basic Orbital Elements,
Orbital Maneuvers: Patched Conic Method, Hohmann Transfer, Bielliptical Transfer

UNIT-IV

Satellite Injection and Perturbations **09 Hours**

General aspects of satellite injection – satellite orbit transfer – various cases – orbit deviations due to injection errors – special and general perturbations – Cowell's method and Encke's method – method of variations of orbital elements – general perturbations approach.

UNIT-V

Space Mission Operations **09 Hours**

Supporting Ground Systems Architecture and Team interfaces, Mission phases and Core operations, Command, Planning, Tracking, Telemetry.

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

1.	Use fundamental concepts of rocket propulsion to analyze its applications in space missions.
2.	Explain and compare different re-entry methods used in space missions.
3.	Apply basic orbital mechanics principles to perform and evaluate different types of orbital maneuvers
4.	Analyse and apply the concepts of satellite orbit injection and assess the effects of orbit perturbations
5.	Identify and apply different operational procedures involved in space missions.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	PSO↓	
↓ Course Outcomes												1	2
AER281.1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**2**	**-**	**1**
AER281.2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**1**	**-**	**2**
AER281.3	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**1**	**-**	**2**
AER281.4	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**1**	**-**	**2**
AER281.5	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**1**	**-**	**2**

1: Low 2: Medium 3: High

TEXTBOOKS:

1. W.E. Wiesel, ”Spaceflight Dynamics”, McGraw Hill,2nd edition,2014, ISBN-13: 978-9332901650

2. J.W. Cornelisse, “Rocket Propulsion and Space Dynamics”, J.W. Freeman & Co., Ltd., London, 1982

REFERENCES:

1. Vincet L. Pisacane, “Fundamentals of Space Systems”, Oxford University Press, 2005

2. J. Sellers, “Understanding Space: An Introduction to Astronautics” , McGraw Hill, 2nd edition,2000, ISBN13: 978-0072424683

3. Francis J Hale, “Introduction to Space Flight”, Pearson, 1993, ISBN-13: 978-0134819129

4. Charies D. Brown, “Spacecraft Mission Design”, AIAA education Series, 1998

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/101101079

INTRODUCTION TO ROCKET AND MISSILES

Course Code:	**AER282**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: J):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Aeronautical Engineering

Course Objectives:

1.	To introduction to rockets, missiles and their applications
2.	To understand the aerodynamic forces and moments in rockets and missiles.
3.	To analysis of rocket motion, trajectories, and staging.
4.	To understand vector control, thrust termination, and optimization.
5.	To exploration of materials and testing procedures for rockets.

UNIT-I

Introduction — **09 Hours**

Introduction to rockets and missiles, classification of rockets and missiles, Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles-Applications of Rockets

UNIT-II

Aerodynamics of Rockets and Missiles: — **09 Hours**

Airframe Components of Rockets and Missiles – Forces Acting on a Missile While Passing Through Atmosphere– methods of Describing Aerodynamic Forces and Moments –Lateral Aerodynamic Moment – Lateral Damping Moment and Longitudinal Moment of a Rocket – lift and Drag Forces – Drag Estimation – Body Upwash and Downwash in Missiles

UNIT-III

Motion in Space and Gravitational Field: — **09 Hours**

One Dimensional and Two-Dimensional rocket Motions in Free Space
and Homogeneous Gravitational Fields–description of Vertical, Inclined and Gravity Turn Trajectories–
Determination of range and Altitude Simple Approximations to Burnout Velocity.

UNIT-IV

Staging and Control — **09 Hours**

Rocket Vector Control – Methods – Thrust termination – SITVC – Multistaging of rockets –Vehicle Optimization – Stage Separation Dynamics – Separation Techniques

UNIT-V

Material and Testing — **09 Hours**

Materials Used for Rockets and Missiles: Selection of Materials –Special Requirements of Materials to Perform under Adverse Conditions Rocket Testing: Different types of tests, Test facility and safeguards, Flight testing & post-accident procedure.

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

1.	Classify rockets and missiles and analyze their aerodynamic characteristics.
2.	Evaluate aerodynamic forces, moments, lift, and drag.
3.	Analyze rocket motion, trajectory, and burnout velocity.
4.	Explain staging, vector control, and separation techniques.
5.	Identify suitable materials and understand rocket testing procedures.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
AER282.1	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**2**

	AER282.2	**3**	**3**	**1**	**1**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**-**	**2**
	AER282.3	**3**	**3**	**1**	**1**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**-**	**2**
	AER282.4	**3**	**3**	**1**	**1**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**-**	**2**
	AER282.5	**3**	**3**	**1**	**1**	**2**	**2**	**-**	**2**	**2**	**2**	**2**	**2**	

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	Rocket Propulsion Elements Sutton, GP John Wiley & Sons Inc., New York, 9th Edition, 2017
2.	Rocket Propulsion and Space Dynamics Cornelisse, J.W J.W., Freeman & Co. Ltd., London 1912
3.	Aerospace materials and applications Biliyar N. Bhat American Institute of Aeronautics and Astronautics, Inc., USA 2009
4.	
REFERENCES:	
1.	Gas Turbines and Jet and Rocket Propulsion Mathur, M., and Sharma, R. P Standard Publishers, New Delhi 1991
2.	Materials for Missiles and Spacecraft Parker, E. R McGraw-Hill Book Co. Inc 1982.
3.	
E Books / MOOCs/ NPTEL	
1.	https://nptel.ac.in/courses/101108054
2.	https://ocw.mit.edu/courses/16-512-rocket-propulsion-fall-2005/

AVIONICS SYSTEMS

Course Code:	**AER283**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: J):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**45+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Aeronautical Engineering

Course Objectives:

1.	To describe how avionics and power distribution systems have evolved in aircraft.
2.	To apply basic principles of navigation, surveillance, and electronic flight control systems in aviation.
3.	To explain the working of electronic flight control systems and their subsystems.
4.	To recognize different avionics subsystems and cockpit display technologies used in modern aircraft.
5	To explain how digital systems work and how avionics components are integrated for better aircraft performance.

UNIT-I

Introduction — **09 Hours**

List of Avionics system on-board a modern aircraft, Block diagram of avionics architecture, Need for Avionics in civil and military aircraft.

Power Distribution Systems: Bus Bar, Split Bus Bar System, special purpose cables. Electrical diagram and identification scheme. Circuit controlling devices. Power utilization

UNIT-II

Navigation and Surveillance Systems — **09 Hours**

Introduction to navigation: types, Great Circle and Rhumb Line, Principles of GPS and Satellite Communication, Inertial Navigation System (INS), types of INS and fundamentals of Stabilized and Strap-down Platform. Inertial Measurement Units, Inertial interface system. Importance of Compass swing, VOR and ILS,

Surveillance Systems: Principles of RADARS, Types, Tracking using RADARS

UNIT-III

Electronics Flight Control and Instrument Systems — **09 Hours**

Fly-by-wire system: basic concept and features. Pitch and Roll rate command control and response. Control Laws. Frequency response of a typical FBW actuator. Cooper Harper scale. Redundancy and failure survival. Common mode of failures and effects analysis, Digital Fly by Wire System, Display-units, annunciation, Air Data System

UNIT-IV

Avionics Sub Systems and Electronic Circuits — **09 Hours**

Sub systems: Typical avionics sub systems. Amplifiers, oscillators, aircraft communication system, transmitter, receiver, antenna and its types, Logic Gates

Control and display technologies: CRT, LED, LCD, EL and plasma panel, Touch screen, Direct voice input (DVI)-Civil cockpit and military cockpit: MFDS, HUD, MFK, and HOTAS.

UNIT-V

Digital Systems and Architecture — **09 Hours**

Principles of Digital Systems: Digital Computers, Introduction to Microprocessors (8086), Microcontrollers (8051), Memories and its types

Avionics system architecture – Avionics equipment fit , data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629

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

1.	Comprehend the evolution of Avionics and Power distribution Systems
2.	Use the concepts of Navigation and Surveillance Systems in Aviation
3.	Apply the principles of Electronic Flight Control systems and its Subsystems
4.	Identify And Distinguish Different Avionics Subsystems and Various Display Technologies Used In Flight Cockpits
5.	Examine the principles of Digital Systems and Avionic System Integration

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	**PSO↓**	
↓ Course Outcomes												1	2
AER283.1	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**1**
AER283.2	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**1**	**-**	**2**
AER283.3	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**2**	**-**	**2**
AER283.4	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**2**	**-**	**2**
AER283.5	**3**	**2**	**-**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**2**	**-**	**2**

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	"Introduction to Avionics Systems", RPG Collinson, Springer, 2003
2.	"Aircraft Electrical System", E H J Pallett, Pitman, 3rd Edition, 2015

REFERENCES:

1.	"Principles of Avionics", Albert Helfrick, Avionics Communications Inc., 4th edition, 2007
2.	"Avionics Systems", Middleton, D.H, Longman Group UK Ltd., England, 1989
3.	"Manual of Avionics", Brain Kendal, The English Book House, New Delhi, 3rd Edition, 1993

E Books / MOOCs/ NPTEL

1.	www.udemy.com/course/aerospace-engineering-aircraft-systems-and-avionics/
2.	https://nptel.ac.in/courses/101101079