Regulations and Curriculum for

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

Version 2023.02

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.)

Choice Based Credit System (CBCS)
Effective from AY 2023-24

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 from

Academic Year

2023 – 2024

Curriculum for Acquiring Professional Skills (CAPS)

With Scheme of Teaching & Examination

REGULATIONS: 2023

COMMON TO ALL
B.Tech. DEGREE PROGRAMS
CHOICE BASED CREDIT SYSTEM
(CBCS)

Version 2023.02

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. Electronics Engineering (VLSI Design and Technology)
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	14ENGR22D2
Revision version	2023.02 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 Electronics & Communication Engineering and approved by the Academic Council.
Effective from	09-03-2024
Approvals	• Recommended in the BOS meeting of department of Electronics and Communication Engineering held on 29/09/2023. • Approved in the 56th Academic Council meeting of NITTE (Deemed to be University), held on 23.02.2024 and vide Notification Ref: N(DU)/REG/AC-NMAMIT/2023-24/922 dated 09.03.2024. and Notification Ref: N(DU)/REG/AC-NMAMIT/2023-24/925 dated 09.03.2024.
Program offered at	NMAM Institute of Technology, Off -Campus Centre, Nitte, 574110, Karkala Taluk
Grievance and dispute resolution	All disputes arising from this set of regulations shall be addressed to the Board of Management. The decision of the Board of Management 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

CONTENTS

PREAMBLE

NMAM Institute of Technology (NMAMIT) was established in 1986 and is located at Nitte and off-campus center of NITTE (Deemed to be University), accredited by National Assessment & Accreditation Council (NAAC) with 'A+' grade. NMAMIT is recognized by the All-India Council for Technical Education (AICTE), New Delhi.

The Bachelor of Technology (B. Tech.) Programs focus on Pursuing Excellence, Empowering people, and Partnering in Community Development. Out of fourteen UG Programs i.e., Artificial Intelligence & Machine Learning (AM), Artificial Intelligence & Data Science (AD), Biotechnology (BT), Computer & Communication Engineering (CC), Computer Science & Engineering (CS), Civil Engineering (CV), Electronics & Communication Engineering (EC), Electrical & Electronics Engineering (EE), Information Science & Engineering (IS), Mechanical Engineering (ME), Robotics & Artificial Intelligence (RI), Computer Science & Engineering - Cyber Security (CB), Electronics Engineering - VLSI Design and Technology (VT), and Electronics & Communication - Advanced Communication Technology (AC), all seven eligible UG Programs i.e., BT, CS, CV, EC, EE, IS and ME are accredited by NBA, New Delhi under Tier - I category till 30th June 2025.

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, NMAMIT 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, at NMAMIT, Nitte, it 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 faculty advisor 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 conducted at the NMAM Institute of Technology (NMAMIT), off-campus center of NITTE (Deemed to be University) 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 Governing 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 the NMAMIT, Nitte with effect from its date of approval. This set of Regulations may evolve and get modified or changed through appropriate approvals from the Academic Council / Governing Council from time to time and shall be binding on all stakeholders (The Students, Faculty, Staff of Departments of NMAMIT, Nitte). The decisions of the Academic Council/ Governing Council 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 / NSQF Level at Exit	Unified Credit Level (UCF) at Exit
1	12th Std.	-	4	4
2	First Year B.Tech. Degree	12th Completed (NHEQF /UCF level 4 completed)	5	4.5
3	Second Year B.Tech. Degree	A candidate with a Diploma in the appropriate branch of Engineering /Equivalent Vocational or Technical Program with NHEQF level 5/UCF level 4.5 completed	6	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.

Sr. 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 yrs. Bachelor degree in Vocation / B.Sc. (Engg.) with NCrF level 5.5	**B. Tech (on completion of 160 credits with a minimum CGPA of 5)**	6
	Final yr. of UG Degree with Honours	A candidate with 3 yrs. Bachelor degree in Vocation / B.Sc. (Engg.) with NCrF level 5.5	**B. Tech (Honors)** 178 credits (Additional 18 credits over and above 160 credits in the same discipline	6
	Final yr. of UG Degree with a minor in (Other Discipline).	A candidate with 3 yrs. Bachelor degree in Vocation / B.Sc. (Engg.) with NCrF level 5.5	**B. Tech with Minor** 178 credits. Additional 18 credits over and above 160 credits in other disciplines	6

*** It is mandatory to earn 10 crdits through Internship/Training/ Specialized courses before the award of Qualifications at Exit.**

3.2 Duration of the B. Tech. program

(a) 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.

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

(c) 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.

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

1.	No. of Semesters / Year	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 instruction 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)
2.	Semester Duration	Main semester (Odd, Even) each 20 Weeks; Summer Semester 8 Weeks
3.	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 candidate shall be allowed a maximum duration of eight years from the first semester of admission 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	(BT)
ii)	Computer Science & Engineering	(CS)
iii)	Computer Science & Engineering (Cyber Security)	(CB)
iv)	Civil Engineering	(CV)
v)	Electronics & Communication Engineering	(EC)
vi)	Electronics Engineering (VLSI Design and Technology)	(VT)
vii)	Electronics & Communication (Advanced Communication Technology)	(AC)
viii)	Electrical & Electronics Engineering	(EE)
ix)	Information Science & Engineering	(IS)
x)	Mechanical Engineering	(ME)
xi)	Artificial Intelligence and Machine Learning	(AM)
xii)	Computer and Communication Engineering	(CC)
xiii)	Robotics and Artificial Intelligence	(RI)
xiv)	Artificial Intelligence and Data Science	(AD)
Other teaching departments are –		
i)	Chemistry	(CY)
ii)	Humanities	(HU)
iii)	Management and Social Sciences	(MG)
iv)	Mathematics	(MA)
v)	Physics	(PH)

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 shall be designed for 50 hours of the Teaching-Learning process.
- Three-credit theory courses shall be designed for 40 hours of the Teaching-Learning process.
- Two-credit theory courses shall be designed for 25 hours 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.
- 2-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 3-2-0 hours will be assigned 4.0 credits.
- A laboratory practical course with L-T-P schedule of 0-0-2 hours will be assigned 1.0 credit.
- Calculation of Contact Hours / Week – A Typical Example

  Example:

  An LTP-C of 2-2-2-4 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.

6.1.1 Each course will be identified by a unique Course Code of seven alpha-numerals (two alphabets followed by 5 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 three numerals indicate a running serial number. Each course also has its version to track the revisions carried out in its syllabus over time as represented by the last numerical separated by a hyphen (-). Example: EE1001-1 represents the course offered by EE Dept., Level-1, course serial number is 001 and the version is 1.

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 higher semesters (3rd 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

i) 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).

ii) 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.

iii) 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 limits of minimum (16) and maximum (28) credits.

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 at a later point in time.

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.

(e) **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.

(f) **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

(g) **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.

(h) **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)

(i) **Holistic Education Courses (HEC):** These courses are designed to look into the emotional, social, ethical and academic needs of students in an integrated learning format. It helps in the engagement of all aspects of the learner including body, mind and spirit.

(j) **Vocational Education Courses (VEC):** These courses are designed to prepare students for jobs that are based on manual or practical activities, traditionally non-academic related to a specific trade, occupation or vocation.

(k) **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.

(l) **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.

(m) **University Core Courses (UCC): These are compulsory core courses with common course codes across all the disciplines.**

i. **Project Work (PROJ):** 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. Mini-project and Project work carried out at the parent Institution, or any university / Government recognized organization without affecting the regular class work.

ii. **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

(n) **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 and SEE (If any) 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 the following.
  - Engineering Visualization, Employability Skill Development, Environmental Science, Kannada etc.

(o) **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)	18-23	22
2.	Engineering Science Courses (ESC)	10-15	13
3.	Emerging Technology Courses (ETC)	03-05	03
4.	Programming Language Courses (PLC)	03-05	03
5.	Professional Core Courses (PCC)	52 - 58	55
6.	Professional Elective Courses (PEC)	12-18	15
7.	Open Elective Courses (OEC)	6	6
8.	Humanities, Social Sciences and Management courses (HSMC)	09-15	12
9.	Ability Enhancement Courses (AEC)	9	9
10.	Mandatory Non-credit Courses (MNC)	Non-Credit	0
11.	Holistic Education Courses (HEC)	2	1
12.	Vocational Education Courses (VEC)	1	1
13.	Project Work (PROJ) (UCC)	10-12	10
14.	Internship (INT) (UCC)	8-12	10
15.	Note: **Student can register between 16 to 28 credits per semester**		**160**
	Total minimum Credits to be earned: 160		

i) 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 160.

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 Program structure and suggested Course offerings

I SEMESTER (EC, EE, VT)												
SI No.	**Course and Course code**		**Course Title**	**Teaching Department**	**Teaching hours/Week**			**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE**	**SEE**	**Total Marks**	
					L	**T**	**P**					
1	BSC	MA1001 – 2	Matrix Algebra and Calculus	MAT	4	0	0	3	50	50	100	4
2	BSC	CY1005-1	Chemistry of Energy Storage and Display Devices	CHE	3	0	2	3	50	50	100	4
3	ESC	EE1001-2	Basic Electrical Engineering	EE	2	0	2	3	50	50	100	3
4	ESC	ME1003-2	Elements of Mechanical Engineering	ME	3	0	0	3	50	50	100	3
5	ETC	IS1101-1	Fundamentals of Cyber Security	EC	3	0	0	3	50	50	100	3
6	AEC	CS1651-1	IT Skills	Any Dept.	1	0	2	3	50	50	100	2
7	AEC	BT1651-1	Biology for Engineers	BT	1	0	0	1	50	50	100	1
8	MNC	CV1002-1	Environmental Studies	CV	1	0	0	-	50	-	50	0
9	ESC	ME1004-1	Engineering Visualization	ME	0	0	2	-	50	-	50	1
TOTAL					**18**	**0**	**8**	**19**	**450**	**350**	**800**	**21**

II SEMESTER (EC, EE, VT)													
SI No.	Course and Course code		Course Title	Teaching Department	Teaching hours/Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE	SEE	Total Marks	
					L	T	P					
1	BSC	MA1003-1	Differential Equations and Laplace Transforms	MAT	3	0	0	3	50	50	100	3
2	BSC	PH1006-1	Semiconductor Physics and Photonics	PHY	3	0	2	3	50	50	100	4
3	ESC	EC1001-1	Basic Electronics	EC	3	0	0	3	50	50	100	3
4	PLC	CS1004-1	Introduction to C Programming	EC	3	0	0	3	50	50	100	3
5	ESC	EC1002-2	Applied Digital Logic Design	EC	2	0	2	3	50	50	100	3
6	HSMC	HU1001-1	Technical English	HU	1	0	2	3	50	50	100	2
7	MNC	HU1002-1	Constitution of India	HU	1	0	0	-	50	-	50	0
8	BSC	MA1006-1	Mathematics with MATLAB	MAT	0	0	2	-	50	-	50	1
TOTAL					**16**	**0**	**8**	**18**	**400**	**300**	**700**	**19**

Mandatory Internship-I*								
1.	INT	UC1001-1	Internship – I	Mandatory Intra Institutional Internship of duration (80 - 90 Hours) to be completed during I & II Semesters. *The grades will be included in the IV semester grade card (Refer 11.5.2 for details)	100	--	100	2

III SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	BSC	MA2004-1	Vector Calculus & Transform Techniques	MAT	3	0	0	0	03	50	50	100	3
2.	IPCC	VT2002-1	Electronic Devices and Technology	VT	3	0	2	0	03	50	50	100	4
3.	IPCC	VT2003-1	Digital Logic Design with Verilog	VT	3	0	2	0	03	50	50	100	4
4.	PCC	EC2105-1	Network Theory and Control Systems	EC	3	0	0	0	03	50	50	100	3
5.	PCC	EC2106-1	Signals and Systems	EC	3	0	0	0	03	50	50	100	3
6.	PCC	EC2602-1	Python Programming Lab	EC	0	0	2	0	03	50	50	100	1
7.	HSMC	HU2001-1	Enhancing Self Competence	HU	2	0	0	0	03	50	50	100	2
8.	MNC	HU1003-1	Kannada (Balake / Samskrithika)	HU	1	0	0	0	-	50	-	50	0
9.	HEC	HU1005-1	Essence of Indian Culture	HU	1	0	0	0	-	50	-	50	0
TOTAL					**19**	**0**	**6**	**0**	**21**	**450**	**350**	**800**	**20**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs													
10	MNC	MA1011 – 1	Bridge course – Calculus & Laplace Transforms	MAT	3	0	0	0	3	100	0	100	0

IV SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	BSC	MA2008-1	Probability Theory and Numerical Methods	MAT	3	0	0	0	03	50	50	100	3
2.	IPCC	VT2001-1	Analog Electronic Circuits	VT	3	0	2	0	03	50	50	100	4
3.	IPCC	EC2004-1	Microcontrollers	EC	3	0	2	0	03	50	50	100	4
4.	PCC	EC2102-1	Electromagnetic Wave Theory	EC	3	0	0	0	03	50	50	100	3
5.	PCC	VT2102-1	Microfabrication and MEMS	VT	3	0	0	0	03	50	50	100	3
6.	PCC	EC2601-1	Linear IC Applications Lab	EC	0	0	2	0	03	50	50	100	1
7.	HSMC	HU1004-1	Universal Human Values	HU	1	0	0	0	01	50	50	100	1
8.	AEC	ME1654-1	Innovation and Design Thinking	ME	1	0	0	0	01	50	50	100	1
9.	VEC	ECx5xx-1	Department specific Vocational Education Course	EC	0	0	2	0	03	50	50	100	1
10.	UCC	UC1001-1	Internship – I (Activity based Internship)		Mandatory Intra Institutional Activity based Internship of 2 weeks duration (80 - 90 h) to be completed during the vacations of I & II Semesters. Lateral entry students have to complete the Internship - I during the vacation of III semester					100	-	100	2
TOTAL					**17**	**0**	**8**	**-**	**23**	**550**	**450**	**1000**	**23**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs													
11	MNC	MA1013-1	Bridge course - Probability &Differential Equations	MAT	3	0	0	0	3	100	0	100	0

V SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	IPCC	EC3003-1	Digital Signal Processing	EC	3	0	2	0	3	50	50	100	4
2.	IPCC	VT3002-1	Embedded Systems	VT	3	0	2	0	3	50	50	100	4
3.	PCC	EC3101-1	CMOS VLSI Design	EC	3	0	0	0	3	50	50	100	3
4.	PCC	VT3601-1	VLSI Lab	VT	0	0	2	0	3	50	50	100	1
5.	PEC	VTXXXX-1	Professional Elective-I [Group-1]	VT	3	0	0	0	3	50	50	100	3
6.	HSMC	HU1006-1	Introduction to IPR	Any Dept	1	0	0	0	1	50	50	100	1
7.	AEC	ECx6xx-1	Program Specific Ability Enhancement Course	EC	1	0	2	0	3	50	50	100	2
		HU1010-1	Research Methodology	Any Dept	2	0	0	0					
8.	AEC	HU1007-1	Social Connect & Responsibility	Any Dept	1	0	0	0	1	50	50	100	1
9.	AEC	UM1003-1	Employability Skill Development	EC	1	0	0	0	-	50	-	50	1
TOTAL					**16/ 17**	**0**	**8/6**	**-**	**20**	**450**	**400**	**850**	**20**

VI SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	IPCC	VT3003-1	Scripting Languages for VLSI	VT	3	0	2	0	3	50	50	100	4
2.	PCC	VT3102-1	Semiconductor Packaging and Testing	VT	3	0	0	0	3	50	50	100	3
3.	PCC	EC3603-1	System Verilog Lab	EC	0	0	2	0	3	50	50	100	1
4.	PEC	VTXXXX-1	Professional Elective - II [Group-1]	VT	3	0	0	0	3	50	50	100	3
5.	PEC	ECXXXX-1	Professional Elective - III [Group-2]	VT	3	0	0	0	3	50	50	100	3
6.	OEC	XXX5XX-1	Open Elective –I	Any Dept	3	0	0	0	3	50	50	100	3
7.	HSMC	MG1004-1	Operations Research and Project Management	EC	3	0	0	0	3	50	50	100	3
8.	AEC	HU1008-1	Life Skills for Engineers	Any Dept	1	0	0	0	1	50	50	100	1
TOTAL					**19**	**0**	**4**	**-**	**22**	**400**	**400**	**800**	**21**

VII SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	IPCC	VT3006-1	VLSI Testing and Verification	VT	3	0	2	0	3	50	50	100	4
2.	PCC	VT3602-1	Semiconductor Memory Design Lab	VT	0	0	2	0	3	50	50	100	1
3.	PEC	VTXXXX-1	Professional Elective – IV [Group-1]	VT	3	0	0	0	3	50	50	100	3
4.	PEC	VTXXXX-1	Professional Elective – V [Group-2]	VT	3	0	0	0	3	50	50	100	3
5.	OEC	XXX5XX-1	Open Elective –II	Any Dept	3	0	0	0	3	50	50	100	3
6.	HSMC	MG1003-1	Management & Entrepreneurship	EC	3	0	0	0	3	50	50	100	3
7.	HEC	HU1009-1	Indian Knowledge Systems	Any Dept	1	0	0	0	-	50	-	50	1
8.	UCC	UC3001-1	Major Project Phase I	EC	-	-	4	-	-	100	-	100	2
TOTAL					**16**	**0**	**8**	**-**	**18**	**450**	**300**	**750**	**20**

VIII SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	UCC	UC2001-1	Internship- II (Societal internship and Research/Industry Internship)	Any Dept	Mandatory Societal internship for 2 weeks (80 – 90 h) and Research Internship / Industry Internship of 6 weeks (240 – 270 h) or Research Internship / Industry internship for a total of 8 weeks (320 – 360 h)to be completed in one/two stretches during the vacation periods between IV to VII semesters				3	50	50	100	8
2.	UCC	UC3002-1	Major Project Phase II	EC	Student should carry out project in research institute/industry/intra institute Canter of Excellences. Two contact hours /week for interaction between the project guide and students.				3	100	100	200	8
TOTAL					**-**	**-**	**-**	**-**	**6**	**150**	**150**	**300**	**16**

8.5 Eligibility for submission of Project Work Report

i) 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 **122 credits** and for

Diploma lateral entry students (those who have joined the second year B.Tech.) the same is **88 credits.**

ii) Project work can be carried out as domain-specific /interdisciplinary under the guidance of faculty/ faculty members. They can also opt for an advanced Internship or research Internship in an Industry / Research Institution/Center of excellence.

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

8.6 ELECTIVES

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

ii) 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).

iii) 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) A student who has been admitted to a degree program of the college may be permitted once during the course 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 (160 credits) within the time limits specified by the university.
iii) The student does not have any dues or demands at the College/ University including tuition and other fees as well as library material.
iv) A student availing of temporary withdrawal shall be required to pay such fees and/ or charges as may be fixed by the college until 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)	Quizzes, Tutorials, Assignments, Seminars, etc.	:	10 marks
ii)	Mid-semester Examinations	:	40 marks
CIE for PBL/IPCC Courses			
i)	Project Based Learning (PBL)	:	50 marks
ii)	Mid-semester Examinations	:	40 marks

iii)	Quizzes, Tutorials, Assignments, Seminars, etc.	:	10 marks
60% weightage for theory + 40% weightage for PBL/Practical			

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.

i) **Internship:** Mandatory Internship is in two parts. Internship-I (2 weeks) and Internship-II (8 weeks)

ii) **Internship-I**

- All the students admitted to the 1st semester of engineering programs shall have to undergo Internship-I of 02 weeks (or 80 to 90 hrs duration) during the first year. 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 3rd semester) and the prescribed credit shall be included in the 4th-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 Internship-I**
  a) Students should submit the reports immediately on completion of the Internship to the respective mentors.
  b) The Examination of the internship will be carried out by the mentor.
  c) The Internship-I shall be slated for 100 marks CIE only and will not have SEE.
  d) Internship-I marks are based on CIE marks (25 marks for the first presentation, 25 marks for the second presentation, and 50 marks for the report and final presentation).
  e) A Viva-Voce examination is conducted during I/ II/ III Semesters

(Presentation followed by question-answer session) and the prescribed credit shall be included in the IV semester grade card.

iii) **Internship-II**

- All the students admitted to engineering programs shall have to undergo Internship-II of 08 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 8 weeks Internship involving Innovation / Entrepreneurship/ or short-term (about 2 weeks) societal-related activities and 6 weeks Industry Internship.

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

v) 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/Academic council.

vi) There shall be no re-examination for any course in the credit system. However, students

- who have abstained from attending CIE or SEE without valid reasons ("N" grade), or
- who have failed (F grade) to meet the minimum passing standards prescribed for CIE and/or SEE or
- who have been detained for 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	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.

i) **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.)

ii) **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.

iii) 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.

i) 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.

ii) **Grade "I"**: To a student having attendance ≥85% and CIE ≥70%, in a course, but remained absent from SEE for valid & convincing reasons acceptable to the

College, like:

a) Illness or accident, which disabled him/her from attending SEE.

b) A calamity in the family at the time of SEE required the student to be away from the College.

c) 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.

d) 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.

iii) **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

iv) **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

i) 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.

ii) 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.

iii) 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.

iv) 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.

v) 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.

vi) Summer Semester is optional; it is for the student to make the best use of the opportunity.

vii) A student is permitted to register for a maximum of 16 credits in the Summer /

fast track semester.

viii) A student has to choose those courses which are offered by the Institution in a given summer Semester.

ix) 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

i) 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:

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

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. However, **for submission of B.Tech. Major Project in 8th semester, the student should have completed at least 122 credits.**

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

i) Lateral entry students should complete at least 85% of credits by the end of the 7th semester. However, for **submission of B.Tech. Major Project in 8th semester, the student should have completed at least 88 credits.**

ii) Diploma students should register for mandatory non-credit Mathematics Courses

Bridge Courses (i) Calculus and Laplace Transforms and (ii) Probability and Differential Equations prescribed during III and IV semesters respectively. They shall attend these bridge course classes during the respective semesters to satisfy attendance and CIE requirements.

iii) Completion of Mathematics Courses Bridge Courses (i) Calculus and Laplace Transforms and (ii) Probability and Differential Equations 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.

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

ii) Failure to earn 160 credits (120 for lateral entry students) in 8 years (6 years for lateral entry students) of duration from the year of admission including the duration of temporary withdrawal (leave of absence).

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

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

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

a. The entire process of evaluation shall be made transparent, and the course instructor shall explain to a student why he/she gets whatever grade he/she is awarded, if and when required. A mechanism for 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.

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

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 (160 credits for regular students registered for 4-year degree programs & 120 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 Additional Mathematics I and II 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 are 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 credentia**l. 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. A maximum of 40% credits prescribed for Honors/Minors may be earned through MOOCs/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, in MOOCs (ex: Coursera), there is no proctored examination, 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)

17.3 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 Project/ Mini project

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

17.3.3 Noncompliance of Internship

All the students of B. Tech shall have to undergo mandatory Internship-I and Internship-II for a total of 10 weeks to earn a total of 10 credits in parts during the vacations at the end of the 1/2/3 academic year. The evaluation of Internship shall be during IV and VIII semesters. The internship shall be considered mandatory for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail in that Course and 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 Governing 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.

i) 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 supplementary/Make-up examination such candidates 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

i) 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.

ii) Candidates with W, N, I, X & F grades and who passes the courses in the subsequent/supplementary/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/Supplementary/makeup) henceforth. Students will not be allowed inside the examination hall after the commencement, under any circumstances.

****

APPENDIX - A

Definitions, terminology, and abbreviations

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

2. **BoM**
   a. Refers to Board of Management 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 self-directed 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	16
Tutorials	Scheduled instruction	2:1	32
Supervised Demonstrations / Laboratory sessions / Studio / Workshops / Workplace simulation / Skill Practice Sessions	Scheduled instruction	2:1	32
Supervised Field visits/community visits/Internships	Scheduled instruction	3:1	48
Scheduled self-directed study (individual or group)	Scheduled instruction	2:1	32
Asynchronous E-Learning modules (structured self-directed study	Independent learning	2:1	32
Student Seminar	Independent/small group learning	2:1	32

Project work/dissertation	Independent/small group learning	3:1	48
Internship for credit	Industry placement/ Research Internship	3:1	48

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 POs-COs is mapped to the 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% each

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. CIE 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% of the total syllabus (Unit-1) (15 Teaching hours)				
Descriptive Part-1	2	1	10	10
Descriptive Part-2	2	1	10	10
Mid Sem Exam-2				
40% of the total syllabus (Unit-2) (15 Teaching hours)				
Descriptive Part-1	2	1	10	10
Descriptive Part-1	2	1	10	10
TASKS				
TASK	The task comprises 5 class tests/quizzes/assignments conducted for each unit for a max mark of 10. All tests/quizzes/Assignments are compulsory			10
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% of the total syllabus (Unit-1) (15 Teaching hours)				
Descriptive Part-1	2	1	10	10
Descriptive Part-2	2	1	10	10
Mid Sem Exam-2				
40% of the total syllabus (Unit-2) (15 Teaching hours)				
Descriptive Part-1	2	1	10	10
Descriptive Part-1	2	1	10	10
Task	The task comprises 5 class tests/quizzes/assignments conducted for each unit for a max mark of 10. All tests/quizzes/Assignments are compulsory.			10
Maximum Marks				**50**
60% weightage, converted to 30 marks				
Practical/Project Based Learning (PBL)				
Practical/PBL	Practical/PBL (comprises of implementation of theoretical concepts through projects/problem solving)			**50**
40% weightage, converted to 20 marks				
Maximum Marks [30 (Theory)+ 20 (Practical/PBL)]				**50**

1.2.3 Semester End Evaluation (SEE): 3 Hours Duration

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 marks**
MCQ	Entire Syllabus	10 or 20	All Questions	2 or 1	20
Descriptive	• Unit-1 • 15 teaching hours	3	2	16	32
Descriptive	• Unit-2 • 15 teaching hours	3	2	16	32
Descriptive	• Unit-3 • 10 teaching hours	2	1	16	16
				Maximum Marks	**100**
SEE Marks with 50% Weightage					**50**

1.2.4 CIE & SEE for various types of courses

Sl. No.	Courses		Evaluation scheme			
			CIE (Minimum eligibility marks 40% of Max marks		SEE (Minimum Passing marks 40 % of Max marks)	
			Max Marks	Min eligibility marks required	Max Marks	Minimum passing marks required
1	Integrated Professional Core Course (IPCC)	Theory	30	12	50	20
		Practical	20	08	---	---
		Total	50	20	50	20
2	PCC with PBL component	Theory	30	12	50	20
		PBL component	20	08	--	--
		Total	50	20	50	20
3	PCC/PEC/OEC		50	20	50	20
4	Laboratory		50	20	50	20
5	Drafting		50	20	50	20
6	Mini Project		100	40	---	---
7	Inter/Intra Institutional Internship (2 weeks)		100	40	---	---
8	Industrial/Govt./ NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship (In single or two stretches =Total of 8 weeks)		100	40	100	40
9	Research Internship/ Advanced Industry Internship/Project work		100	40	100	40
10	Seminar		100	40	---	---

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, except in the case of serial no. 06, 07, and 10 shall be reduced to 50 marks and added to CIE marks. 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**

<table>
<tr><th colspan="3">Lab conduction and Record</th><th colspan="3">Lab Internal Assessment</th></tr>
<tr><td colspan="3">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.</td><td colspan="3">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.</td></tr>
<tr><td>Rubrics per experiment</td><td>Marks Distribution</td><td>Remarks</td><td>Rubrics</td><td>Marks distribution</td><td>Remarks</td></tr>
<tr><td>Circuit</td><td>02</td><td rowspan="7">Evaluation of Record write-up to include weightage for submission on time, neatness, etc.</td><td>Write-up</td><td>04</td><td rowspan="7"></td></tr>
<tr><td>Design</td><td>02</td><td>Conduction</td><td>10</td></tr>
<tr><td>Procedure</td><td>02</td><td rowspan="4">Results</td><td rowspan="4">06</td></tr>
<tr><td>Conduction</td><td>06</td></tr>
<tr><td>Viva</td><td>06</td></tr>
<tr><td>Record write-up</td><td>12</td></tr>
<tr><td>Total Marks</td><td>30</td><td>Total Marks</td><td>20</td></tr>
</table>

2.2.5 Split-up of Marks used for continuous Evaluation of laboratory involving experiments with software

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	04
	(ii) Conduction/Execution	10
	(iii) Viva-Voce	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 20 credits of Internship/ Entrepreneurial activities / Project work/ Seminar and Inter/ Intra Institutional Training 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, Seminar activities, etc. This will result in about 800 to 900 hours of total internship and project duration for the B. Tech program.

- To derive the benefits of an internship, it is introduced in two/ three 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 Project work

Sl. No.	Title	Schedule	Duration	Activities	Credits
1	Internship-I	Ongoing First-year academic session/ Summer vacation after 2nd Semester/ vacation during 3rd semester (for lateral entry students	02 weeks	Inter/ Intra Institutional Activities (Evaluation in 4th semester)	02
2	Internship-II	a) Summer vacation after 4th Semester	02-04 weeks	Industrial/Govt./ NGO/ MSME/ Rural Internship/ Innovation / Entrepreneurship/ social internship	---
		b) Summer vacation after 6th Semester	04-06 weeks	Industrial/Govt./ NGO/ MSME/ Rural Internship/ Innovation / Entrepreneurship	
		c) Total of a) and b) at the beginning of the 8th semester	08 weeks	Evaluation in 8th Semester	08
3	Project work	6th Semester	6 hours/week	Mini -Project	02
		8th Semester	16 weeks	Extended Industry Internship /Research Internship/ Project work	10
				Report preparation and writing	
				Seminar	01
Total Credits					**23**

Table-1 states that during the ongoing/ summer vacations after the 2nd Semester, students are required to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation/ innovation /entrepreneurship cell of the institute; participation in conferences/ workshops/ competitions, etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research project within the institutes and Participation in all the activities of Institute's Innovation Council for eg: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos, etc.

During the summer vacation after the 4th/ 6th semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.

3.3 Internship Supervision

i) The internship shall be carried out under the supervision of a faculty mentor. The faculty mentor/guide should,

ii) Serve as a teacher, mentor, trainer, critic, leader, and boss.

iii) Provide sufficient time to guide the interns. (Interns are students or a trainee who does a job to gain work experience)

iv) Play a vital role, along with the Training and Placement Officer, in providing internship opportunities for the students.

v) Exhibit qualities such as leadership, strong communication skills, and patience.

vi) 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).

3.3.1 Each faculty mentor shall supervise the students/Student batches allotted to them. Often, the supervision may be by an external expert. In such cases, the faculty mentor shall jointly guide the student/s without causing miscommunications/embarrassment to either side.

3.3.2 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.

3.3.3 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.

3.3.4 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.

3.3.5 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 Internship-I (Activity based Internship)

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 internship, 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 within the period of the internship. 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 the internship.

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.

3.4.1 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. Activities such as training with higher Institutions or Soft skill training
c. Contribution at incubation/ innovation /entrepreneurship cell of the institute.
d. Learning at Departmental Lab/Tinkering Lab/ Institutional workshop.
e. Working for consultancy/ research projects within the institute.
f. Learning MS Word, Excel, Microsoft equations, MS drawing tools, MS Powerpoint, etc.
g. Coding.
h. Mini projects using commercially available assembled electronic products.
i. Debates, quizzes, and group discussions: On technical topics already studied (both in Kannada and English).
j. Essay competitions: Both in Kannada and English on technical topics already studied.
k. Survey and study of published literature on the assigned topic: Technical paper survey, Preparation of synopsis. Exposure to technical paper publications.
l. Photography.
m. Short film production: Contemporary aspects, technical aspects, etc.
n. Internship in Disaster Management.
o. Solar energy connected activities that help the common man.
p. Working with Smart City Administration.
q. 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).
r. Industrial Safety, Fire Safety, Electrical Safety, Chemical Process Safety, Food Safety, etc.
s. Internship and project work in Indian Knowledge System related Areas/Topics.
t. Industrial visits to Small Scale Industries/ Factories/ Cottage Industries/substation visits etc., and submission of the report.

3.5 Documents to be submitted by Students for Internship Evaluation

3.5.1 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

3.5.2 Internship report

After completion of the Internship, 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 training 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.

Procedure for the Evaluation of Internship-I

a) Students should submit the reports immediately on completion of the Internship to the respective mentors
b) The Examination of the internship will be carried out by the mentor
c) The Internship-I shall be slated for 100 marks CIE only and will not have SEE.
d) Internship-I marks are based on CIE marks (25 marks for the first presentation, 25 marks for the second presentation, and 50 marks for the report and final presentation).
e) A Viva-Voce examination conducted during the I/II/III Semesters (Presentation followed by question-answer session) and the prescribed credit shall be included in the IV semester grade card.

3.5.3 Assessment Rubrics for evaluation of Internship-I (Intra and Inter-Institutional Activities)

Table – B2 Internship-I 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 marks decide the letter	Proposed Document as Evidence	Evaluated by
1	Inter/ Intra Institutional Workshop/ Training.	Excellent	80 to 100	**(i)** Student's Diary and **(ii)** Internship Report along with the	Institute Faculty
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
2	Working for	Excellent	80 to 100		
		Good	60 to 79		

	consultancy/ Research project.	Satisfactory	40 to 59	certificate issued from the relevant authorized Authority	(mentor) together with External Expert, if any.
		Unsatisfactory and fail	< 39		
3	Festival (Technical / Business / Others) Events.	Excellent	80 to 100		
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
4	Contribution in Incubation/ Innovation/ Entrepreneurship Cell.	Excellent	80 to 100		
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
5	Learning at Departmental Lab/Tinkering Lab/Institutional workshop.	Excellent	80 to 100		
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
6	Other than the above five activities	Excellent	80 to 100		
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
Note: The total CIE marks shall be the sum of marks allotted to completed activities by the student.					

3.6 Internship-II: (Societal internship and Research/Industry Internship) (08 weeks) [Scheduled during the intervening period of IV & V semester and VI & VII semester]

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 2 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.

3.6.1 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.

3.6.2 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.

3.6.3 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.

3.6.4 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.

3.6.5 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, 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.

3.6.6 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.**

3.6.7 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.

3.6.7.1 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/

3.6.8 Assessment Rubrics for Innovation / entrepreneurship/ Societal Internship Activities

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/ Societal Internship Activities and Assessment Rubrics
Scheduled during the intervening period of IV & V semester and VI & VII Sem
(Prescribed Period 08 weeks: Credits 08)

Sub Activity Head	**Performance/ Appraisal**	**Assessment Rubrics**	**Proposed Document as Evidence**	**Evaluated by**
(1) Development of new product/ Business Plan/ registration of start-up/societal internship	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	< 39		
(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	< 39		

Note:
(i) The total CIE marks shall be the sum of marks allotted to successfully completed activities by the student.

3.7 Research Internships / Extended Industry Internships

3.7.1 Research Internship /Extended Industry Internship 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.

3.7.2 Research internships and industrial internships 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.

3.7.3 Internships 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.

3.7.4 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.

3.7.5 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.

3.7.6 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).

3.7.7 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.

3.7.8 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,

1. Good Communication skills.
2. Attention to detail.
3. Planning and scheduling.
4. Documentation.
5. Critical thinking.
6. Data collection.
7. Data analysis.
8. Ability to maintain quality, safety, and/or infection control standards.
9. Appreciating and practicing ethical issues.

3.7.9 Responsibilities of an Intern

Interns,

1. 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.
2. Shall engage in literature survey and get an insight of the research work at the initial stages.
3. Shall compile data, sort, file, implement ideas with minimal guidance and assist write papers.
4. 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.
5. Shall attain skills with Microsoft Word Office, Excel, PowerPoint, Outlook, etc.
6. Shall give a mid-term oral presentation to a committee for review and feedback.
7. Shall attend discussions, meetings, symposiums, classroom lectures, etc., to learn new scientific techniques, design experiments, analyze results, and formulate different hypotheses.
8. Shall learn to write reports and be able to correspond independently.
9. Shall manage time effectively.
10. Shall keep a track of the progress of the project.
11. Shall develop integrative thinking.

3.7.10 Research internship Outcomes

1. Generating technical paper/s and publishing in refereed journal/s.
2. Possibility of acquiring intellectual ownership and patent.
3. Build a prototype for an idea on which the research was carried out.
4. File patent/s.
5. Add academic knowledge to the field.
6. Enhanced ability in arranging meetings, presentations, seminars, training, etc.
7. Improved conscientiousness and ethics.

3.7.11 Research internships Benefits

1. 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.
2. Establish professional networks for a future career.
3. Pave the way to join a research team and work alongside leading experts in the field.
4. Introduced to new ideas through interaction with like-minded students and others.
5. Develop research skills and knowledge in a specific area of interest.
6. Provide opportunities for growth, achievement, and personal development.
   Offer an opportunity to publish a research paper that will boost the resume while applying for Post Graduate Studies

4. Evaluation Procedure of UC3001-1 Research Internship /Extended Industry Project/Internship/Project work (16 weeks)

4.1 The students pursuing the course UC3001-1 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.

4.2 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.

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

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

4.5 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.

4.6 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

4.7 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.

4.8 Assessment of CIE marks

4.8.1 **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.

4.8.2 **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.

4.8.3 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.

4.9 Assessment of SEE marks

4.9.1 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.

4.9.2 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.

4.10 Evaluation of research Internship/Extended Industry Internship/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	10
		The clarity in answering the questions related to the	05
		The understanding ability of the questions asked	05
		The confidence in answering the questions asked.	05
		Total Marks	100

NITTE
(Deemed to be University)
NMAM INSTITUTE
OF TECHNOLOGY
Off-Campus Centre, Nitte - 574 110, Karnataka, India

Established under Section 3 of UGC Act 1956
Accredited with ‘A+’ Grade by NAAC

B.Tech. Syllabus

Effective from

Academic Year

2023 – 2024

Curriculum for Acquiring Professional Skills (CAPS)

With Scheme of Teaching & Examination

NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Established under Section 3 of UGC Act 1956
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Off-Campus Centre, Nitte - 574 110, Karnataka, India

Scheme & Syllabus for B. Tech. Electronics Engineering (VLSI Design and Technology)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

2023-24

B. Tech. in Electronics and Communication

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

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

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

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

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

Program Outcomes (POs):
Engineering Graduates will be able to:

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

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

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

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

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

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

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

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

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

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

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

Program Specific Outcomes (PSOs):

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

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

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

B. Tech. in Electronics Engineering
(VLSI Design and Technology)
CREDIT DISTRIBUTION

No.	Course Category	Credit Range	Suggested Credits
1.	Basic Science Courses (BSC)	18-23	22
2.	Engineering Science Courses (ESC)	10-15	13
3.	Emerging Technology Courses (ETC)	03-05	03
4.	Programming Language Courses (PLC)	03-05	03
5.	Professional Core Courses (PCC)	52 - 58	55
6.	Professional Elective Courses (PEC)	12-18	15
7.	Open Elective Courses (OEC)	6	6
8.	Humanities, Social Sciences and Management courses (HSMC)	09-15	12
9.	Ability Enhancement Courses (AEC)	9	9
10.	Mandatory Non-credit Courses (MNC)	Non-Credit	0
11.	Holistic Education Courses (HEC)	2	1
12.	Vocational Education Courses (VEC)	1	1
13.	Project Work (PROJ) (UCC)	10-12	10
14.	Internship (INT) (UCC)	8-12	10
	Note: **Student can register between 16 to 28 credits per semester**		**160**
	Total minimum Credits to be earned: 160		

Course Numbering Scheme

<table>
<tr><th colspan="2">Branch Code</th><th>Course Level</th><th colspan="3">Course Code</th><th>Separator</th><th>Version</th></tr>
<tr><th>Letter</th><th>Letter</th><th>Number</th><th>Number</th><th>Number</th><th>Number</th><th>-</th><th>Number</th></tr>
<tr><td>Branch Code</td><td colspan="7">ME is 2 Letter code for the Department of Mechanical Engineering</td></tr>
<tr><td>Course Level</td><td colspan="7">Course Level is a 1-digit number that can have a value between 1-4 and indicates the prerequisite of a course.
Level-1 courses are basic courses with no courses as pre-requisites
Level-2 course(s) have Level-1 course(s) as prerequisites
Level-3 course(s) have Level-2 course(s) as prerequisites
Level-4 course(s) have Level-3 course(s) as prerequisites</td></tr>
<tr><td>Course Code</td><td colspan="7">Course Code is a 3 Digit number that can have a value between 001-999 and indicates the number assigned to a course based on the following guidelines
001-199 is assigned to Professional Core Courses
001-099 for Integrated Professional Core Courses [4 Credit]
101-199 for Professional Core Theory Courses [3 Credit]
201-499 for Professional Elective Courses
201-299 Electives under Group I
301-399 Electives under Group II
401-499 for future use
501-550 for Open Elective Courses
551 – 599 for Vocational Education Courses
601-650 for Professional Core Lab Courses [1 Credit]
651-699 for Ability Enhancement Courses
701-799 for Courses offered to Honours Program</td></tr>
<tr><td>Separator</td><td colspan="7">“_” is used as a separator between the Course code and the version</td></tr>
<tr><td>Version</td><td colspan="7">Version is a 1-digit number that can have a value between 1-9 and indicates minor revisions of the same course.</td></tr>
</table>

Scheme & Syllabus
(I Year)

B. Tech. (VT): Scheme of Teaching and Examinations 2023-27
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2023 - 24)

I/II SEMESTER (EC, EE, VT)

SI No.	Course and Course code		Course Title	Teaching Department	Teaching hours/Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE	SEE	Total Marks	
					L	T	P					
1	BSC	MA1001 – 2	Matrix Algebra and Calculus	MAT	4	0	0	3	50	50	100	4
2	BSC	CY1005-1	Chemistry of Energy Storage and Display Devices	CHE	3	0	2	3	50	50	100	4
3	ESC	EE1001-2	Basic Electrical Engineering	EE	1	2	2	3	50	50	100	3
4	ESC	ME1003-2	Elements of Mechanical Engineering	ME	3	0	0	3	50	50	100	3
5	ETC	IS1101-1	Fundamentals of Cyber Security	EC	3	0	0	3	50	50	100	3
6	AEC	CS1651-1	IT Skills	CS/ME	1	0	2	3	50	50	100	2
7	AEC	BT1651-1	Biology for Engineers	BT	1	0	0	1	50	50	100	1
8	MNC	CV1002-1	Environmental Studies	CV	1	0	0	-	50	-	50	0
9	ESC	ME1004-1	Engineering Visualization	ME	0	0	2	-	50	-	50	1
TOTAL					**18**	**0**	**8**	**19**	**450**	**350**	**800**	**21**

Note:
BSC: Basic Science Course, **ESC**: Engineering Science Course, **HSMC**: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses, **MNC**: Mandatory Non credited course **UM**: University Mandatory

MATRIX ALGEBRA & CALCULUS

Course Code:	**MA1001 - 2**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: S):	**4:0:0:0**	**Credits:**	**04**
Total Teaching Hours:	**50+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mathematics

Course Objectives:

1. This course will enable the students to master the basic tools of differential calculus, infinite series, elementary linear algebra, partial differentiation, multiple integration and become skilled for solving problems in science and engineering.

UNIT-I

Matrices **10 Hours**

Elementary transformation of a matrix, Echelon form and rank of a matrix. Consistency and solution of system of linear equations; Gauss elimination method and approximate solution by Gauss Seidel method. Eigen values and eigen vectors of square matrices, Rayleigh's power method to find the largest eigen values and eigen vectors of square matrices.

Applications: Network Analysis, Markov Analysis, critical point of a network system, optimum solution.

UNIT-II

Sequences and Series **10 Hours**

Convergence and divergence of infinite series. Tests for convergence of positive term series- comparison test, D-Alembert's ratio test and Cauchy's root test. Power series-Taylor's theorem for a function of single variable with remainder (without proof), expansion of functions into Taylor's and Maclaurin's series.

Applications: Series expansion in communication signals.

UNIT-III

Differential Calculus **10 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 and applications to simple problems.

Applications: Communication signals, Manufacturing of microphones, and Image processing.

UNIT-IV

Partial Differentiation **10 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

(with one subsidiary condition).
Applications: Estimating the critical points and extreme values.

UNIT-V

Multiple Integrals **10 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: Antenna and wave propagation, Calculation of optimum power in electrical circuits, field theory.

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

1.	Solve the system of linear equations and find eigen values and eigen vectors of the given matrix.
2.	Develop the power series of the given function and understand the concept of convergence and divergence of series.
3.	Apply the concept of radius of curvature and mean value theorems.
4.	Learn the concept of partial differentiation of a function with two or more independent variables, apply them to solve engineering problems and examine the given function for its extrema.
5.	Apply the notion of multiple integrals to find areas and volumes.

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
MA1001 - 2.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1001 - 2.2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1001 - 2.3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
MA1001 - 2.4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1001 - 2.5	3	2	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition (Reprint), 2016.
2.	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, 2015.

REFERENCE BOOKS:

1.	G.B. Thomas and R. L. Finney, "Calculus and Analytic geometry", Pearson, 2002.
2.	T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
3.	B. V. Ramana, "Higher Engineering Mathematics", Tata Mc Graw –Hill, New Delhi,2010.

4.	N.P. Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
E Books / MOOCs/ NPTEL	
1.	http://nptel.ac.in/courses/111107108/
2.	https://nptel.ac.in/courses/122101003

CHEMISTRY OF ENERGY STORAGE AND DISPLAY DEVICES

Course Code:	**CY1005-1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Chemistry

Course Objectives:

1.	To enable students to acquire knowledge on principles of chemistry for engineering applications.
2.	To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
3.	To provide students with a solid foundation in analytical reasoning required to solve societal problems.

UNIT-I

Energy Conversion and Storage — 8 Hours

Batteries: Introduction, classification of batteries. Components, construction, working and applications of modern batteries; Na-ion battery, Li-ion battery, and flow battery (Vanadium redox flow battery).

Fuel Cells: Introduction, construction, working and applications of methanol–oxygen and polymer electrolyte membrane (PEM) fuel cell.

Solar Energy: Introduction, importance of solar PV cell, construction and working of solar PV cell, Advantages and disadvantages.

Polymers — 7 Hours

Polymers: Introduction, Molecular weight- Number average, Weight average and numerical problems. Elastomers – Definition, Synthesis, and applications of Butyl rubber and Silicone rubbers. Adhesives- Synthesis and applications of Epoxy resins. Polymer Composites: Introduction, synthesis, properties, and applications of carbon fiber. Conducting polymers– synthesis and conducting mechanism of polyacetylene. Preparation, properties, and commercial applications of graphene oxide.

PCB: Electroless plating – Introduction, Electroless plating of copper in the manufacture of double-sided PCB.

UNIT-II

Electrode System and Sensors — 9 Hours

Electrode System: Introduction, types of electrodes. Reference electrode- Introduction, calomel electrode– construction, working and applications of calomel electrode. Concentration cell– Definition, construction, and Numerical problems. Ion selective electrode – definition, construction, working and applications of glass electrode. Determination of pH using glass electrode.

Sensors: Introduction, working principle and applications of Conductometric sensors, Electro chemical sensors, Thermometric sensors, and Optical sensors.

Corrosion chemistry and Analytical techniques — 6 Hours

Corrosion Chemistry: Introduction, electrochemical theory of corrosion, types of corrosion-differential metal and differential aeration. Corrosion control-galvanization, anodization, and sacrificial anode method. Corrosion Penetration Rate (CPR) – Introduction and numerical problems.

Analytical techniques: Principle and instrumentation of Conductometry; its application in the estimation of weak acid and strong acid. Principle and instrumentation of Potentiometry; its application in the estimation of iron.

UNIT-III

Nanomaterials and Display Systems	**10 Hours**

Nanomaterials: Introduction, size dependent properties of nanomaterials (Surface area, Catalytic, Conducting), preparation of nanomaterials by sol-gel and co-precipitation method with example. Introduction, properties, synthesis, and applications carbon nano tubes.

Display Systems: Liquid crystals (LC's)-Introduction, classification, properties, and application in Liquid Crystal Displays (LCD's). Properties and application of Organic Light Emitting Diodes (OLED's) and Quantum Light emitting diodes (QLED's).

Perovskite Materials: Introduction, properties, and applications in opto-electronic devices.

E-waste Management: Introduction, sources, types, effects of e-waste on environment and human health, methods of disposal, advantages of recycling. Extraction of copper and gold from e-waste.

Suggested List of Experiments

1.	Determination of strength of an acid in Pb-acid battery (Demonstration).
2.	Determination of Total Hardness of a sample of water using disodium salt of EDTA.
3.	Estimation of iron in TMT bar by diphenyl amine/external indicator method.
4.	Synthesis of polyurethane (Demonstration).
5.	Conductometric estimation of strong acid 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).
10.	Colorimetric determination of iron.
11.	Conductometric estimation of a weak acid using standard NaOH solution.
12.	Estimation of Sodium present in soil/effluent sample using flame photometer.
13.	Synthesis of biodiesel (Demonstration).
14.	Synthesis of Iron-oxide Nano particles (Demonstration).

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

1.	Identify the terms processes involved in scientific and engineering and applications.
2.	Explain the phenomena of chemistry to describe the methods of engineering processes.
3.	Solve the problems in chemistry that are pertinent in engineering applications.
4.	Apply the basic concepts of chemistry to explain the chemical properties and processes.
5.	Analyze properties and multi processes associated with chemical substances in disciplinary situations.

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
CY1005-1.1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1005-1.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1005-1.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1005-1.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1005-1.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	P. C. Jain & Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publications, New Delhi, 2015.
2.	R. V. Gadag and Nityananda Shetty, “A Text Book of Engineering Chemistry”, 2nd Edition, I. K. International Publishing house, 2016.
3.	S. S. Dara & S. S. Umare, “A Textbook of Engineering Chemistry”, 12th Edition, S. Chand & Company Ltd., 2011.
REFERENCE BOOKS:	
1.	Baskar, “Wiley Engineering Chemistry”, 2nd Edition, Wiley India Pvt. Ltd, New Delhi, 2013.
2.	Satya Prakash & Manisha Agrawal, “Engineering Chemistry”, Khanna Book Publishing, Delhi.
3.	Bahl & Tuli, “Essentials of Physical Chemistry”, S. Chand Publishing.
4.	Sunita Rattan, “Applied Chemistry”, Kataria.
5.	D. Grour Krishana, “Engineering Chemistry – I”, Vikas Publishing.
6	F. W. Billmeyer, “Text Book of Polymer Science”, John Wiley & Sons, 4th Edition, 1999.
7	G. A. Ozin & A. C. Arsenault, “Nanotechnology A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.
8	Kirby W. Beard, “Linden's Handbook of Batteries”, Fifth Edition, Mc GrawHill, 2019.
9	Takatoshi Tsujimura, “OLED Display Fundamentals and Applications”, Wiley–Blackwell, 2012.
10	MaxLu, Francois Beguin, Elzbieta Frackowiak, “Super capacitors: Materials, Systems, and Applications”, Wiley-VCH;1stedition, 2013.
11	H. Panda, “Handbook on Electroplating with Manufacture of Electro-chemicals”, ASIAPACIFIC BUSINESS PRESS Inc., 2017.
12	Sudharani, “Laboratory manual in Engineering Chemistry”, 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	Mahesh B and Roopa Shree B, “Engineering Chemistry”, Sunstar Publisher, Bengaluru, ISBN978-93-85155-70-3, 2022
15	F. H. Froes,et al., “High Performance Metallic Materials for Cost Sensitive Applications”, John Wiley & Sons, 2010.
16	K. R. Mahadik and L. Satyanarayana, “Instrumental Methods of Analysis”, Nirali Prakashan, 2020.
17	Douglas A. Skoog, F. James Holler, Stanley R. Crouch, “Principles of Instrumental Analysis”, Seventh Edition, Cengage Learning, 2020.
18	V R Gowariker, N V Viswanathan, Jayadev, Sreedhar, “Polymer Science”, NewageInt. Publishers, 4th Edition, 2021.
19	Hari Singh, “Nanostructure materials and nanotechnology”, Nalwa, Academic press, 1st Edition, 2002.
20	O. G. Palanna, “Engineering Chemistry”, Tata McGraw 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

BASIC ELECTRICAL ENGINEERING

Course Code:	**EE1001-2**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: S):	**1:2:2:0**	**Credits:**	**03**
Total Teaching Hours:	**15+30+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	To familiarize the student with the DC circuit analyses.
2.	To analyze single and three-phase AC circuits.
3.	To understand the working principle of electrical machines.
4.	To introduce fundamental concepts in EV, basic converters and special motors, electrical wiring protective devices and safety measures

UNIT-I

Circuit Fundamentals	**04 Hours**

Introduction to DC circuits, Basic nodal and mesh analysis excited by independent DC voltage sources, Power and Energy.

	11 Hours

AC Fundamentals: Generation of sinusoidal voltage, frequency of generated voltage, definition and numerical values of average value, root mean square value, form factor and peak factor of sinusoidally varying voltage and current, phasor representation of alternating quantities.

A.C. Circuits: Analysis of R, L, C, R-L, R-C and R-L-C series. Phasor Diagrams. Real power, reactive power, apparent power and power factor. Three-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of three phase power using two wattmeter.

UNIT-II

DC Machines	**05 Hours**

Faradays Laws, self and mutually induced emfs. Constructional details, Principle of operation of generator and motor, Expression for back emf, Types of dc motors, Characteristic of dc motors (shunt and series motors only) and Applications.

Single-Phase Transformers	**05 Hours**

Necessity of transformer, Principle of operation. Types of Transformers, Emf equation, losses, efficiency, problems on emf equation and efficiency, Autotransformer, Applications.

Induction Motors	**05 Hours**

Concept of rotating magnetic field, Construction and working of a three-phase Induction Motor, Slip and its significance, Torque slip characteristics (qualitative). Necessity of a starter, Principle of operation Single Phase Induction Motor. Applications

UNIT-III	
Electric Vehicles	**06 Hours**
Fundamentals, Block diagram of EV and its components. Motors used in EV – BLDC,Permanent Magnet Synchronous Machine (PMSM) -Working principle **SMPS:** Concept of step up and step-down converter (Basic equation and Block diagram representation), Applications. Block diagram of UPS and applications.	
Domestic Wiring	**04 Hours**
Types of wiring. Two-way and Three-way control of lamp. Elementary discussion on Circuit protective devices: Fuse and Miniature Circuit Breaker (MCB's). **Personal safety measures**: Electric Shock and Precautions against shock. Potential between neutral and ground. Necessity of Earthing, Earthing types- Pipe and Plate earthing.	

Suggested List of Experiments	
1.	Verification of KVL and KCL for DC circuits.
2.	Measurement of current, power and power factor of incandescent lamp, fluorescent lamp, CFL and LED lamp.
3.	Sinusoidal steady state response of R-L, and R-C circuits- impedance calculation and verification
4.	Voltage and Current relationships of three phase star/delta circuits.
5.	Measurement of three-phase power using two wattmeter method
6.	Load test on a single-phase Transformer.
7.	Speed load characteristic of a 3-phase Induction Motor.
8.	Time characteristic of fuse

Demonstration Experiments	
1.	Demonstration of fuse, MCB by creating a fault.
2.	Two-way and Three-way Control of lamp and formation of truth table.
3.	Demonstration of cut out sections of electrical machines (DC machines, Induction machines and Synchronous machines).
4.	Demonstration of EV and its Components.

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

1.	Analyze the DC Circuits using mesh & node methods to compute power and energy.
2.	Analyze voltage & current phasor relationships in single phase & three phase AC circuits to compute circuit parameters.
3.	Describe the fundamentals of electromagnetism, construction, operating principle of DC & Induction motor to study performance characteristics.
4.	Apply principle of single-phase transformer to compute transformer efficiency.

5. Describe fundamental concepts in EV, converters, domestic wiring, protection and safety schemes

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
EE1001-2.1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
EE1001-2.2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
EE1001-2.3	2	3	-	-	-	-	-	-	-	-	-	-	-	-
EE1001-2.4	2	3	-	-	-	-	-	-	-	-	-	-	-	-
EE1001-2.5	2	3	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. S. K. Sahdev, "Basic Electrical Engineering (with Lab Manual)", January 2022
3. Lecture Notes on Basic Electrical Engineering, Department of E&E, NMAMIT, Nitte. (New version)
4. Hughes, Edward, "Electrical Technology", Pearson Education Publications, 10th Edition, 2010.
5. A. Chakarbarti, M. L. Soni and P. V. Gupta, U. S. Bhatnagar, "Power system engineering", Gagan Kanur, Dhanapat Rai and Co Pvt. Ltd, 2013.

REFERENCE BOOKS:

1. Vincent Del Toro, "Electrical Engineering Fundamentals", 2nd Edition, Pearson, 2015.
2. H. Cotton, "Electrical Technology", CBS, 7th Edition, 2005.
3. A. Mittle and V. N. Mittle, "Basic Electrical Engineering", Tata McGraw Hill, 2005.
4. Debashisha Jena, "Basic Electrical Engineering", Wiley India Private Limited, 2012.
5. M.V. Deshpande, "Elements of Power Station Design", 1st edition, PHI learning, 2009.

E Books / MOOCs/ NPTEL

1. http://nptel.ac.in/downloads/108105053/
2. http://www.textbooksonline.tn.nic.in/books/11/stdxi-voc-ema-em-1.pdf
3. Basic Electrical Technology Lectures by Dr. L Umanand Department of Power Electronics Group, CEDT IISC Bangalore available at http://www.nptelvideos.in/2012/11/basic-elerical-technology.html

ELEMENTS OF MECHANICAL ENGINEERING

Course Code:	**ME1003-2**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T: P):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40**	**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, Refrigeration and Airconditioning.
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.

Simple stress and strain

Introduction, stress, strain, Mechanical properties of materials, Linear elasticity, Hook‟s Law and Poisson's ratio, Stress-Strain relation - behavior in Tension for Mild steel and nonferrous metals. Modes of heat transfer, Laws of Thermodynamics, Steam Formation and its application.

Energy Sources and Power Plants:

Basic working principles of Hydel power plant, Thermal power plant, nuclear power plant, Solar power plant, Tidal power plant and Wind power plant.

06 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-II

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.

06 Hours

Mechanical Power Transmission:

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), length of the belt and tensions ratio (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-III

10 Hours

Machine Tool Operations:

Lathe: Principle of working of a center lathe, lathe operations: Turning, facing, knurling, thread cutting, taper turning by swivelling 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. Example of a simple pneumatic/ hydraulic/ electro-pneumatic circuit with function of each component.

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

1. Explain the principles of energy sources, formation of steam and Energy sources. And simple stress and strain.
2. Discuss the working principles of pumps, compressors, and turbines.
3. Explain basic principles of I. C. Engines, Future mobility and Refrigeration, Air conditioning
4. Discuss the basic principles of power transmission and metal joining processes.
5. 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	12	**PSO↓**		
↓ Course Outcomes													1	2	3
ME1003-2.1	3	1	-	-	-	1	-	1	-	1	-	-	-	-	-
ME1003-2.2	3	1	-	-	-	-	-	-	-	1	-	-	-	-	-

FUNDAMENTALS OF CYBER SECURITY

ME1003-2.3	3	2	-	-	-	-	-	-	-	1	-	-	-	-	-
ME1003-2.4	3	2	-	-	-	-	-	-	1	1	-	-	-	-	-
ME1003-2.5	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)

Course Code:	**IS1101-1**	**Course Type:**	**ETC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Information Science & Engineering

Course Objectives:

1.	Define the area of cybercrime and forensics.
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 Cybercrime	**15 Hours**
Cybercrime - Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cyber Crimes. [T1: 1.1-1.5]	
Cyber offenses: How Criminals Plan Them	
How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing. [T1: 2.1-2.8]	
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, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops. [T1: 3.1-3.12]	

UNIT-II

Tools and methods used in Cybercrime	**14 Hours**
Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan-horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. [T1: 4.1-4.12]	
Phishing and Identity Theft	
Introduction to Phishing, Identity Theft (ID Theft). [T1: 5.1-5.3]	

UNIT-III

Understanding Computer Forensics	**11 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. [T1: 7.1-7.19]	

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

1.	Comprehend the Cybercrime and its origin
2.	Analyse the cybercrimes in mobile and wireless devices
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	12	**PSO↓** 1	2	3
IS1101-1.1	2	-	-	-	-	1	-	3	-	-	-	-	-	-	-
IS1101-1.2	-	3	-	1	-	2	-	-	2	-	-	-	-	-	-
IS1101-1.3	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-
IS1101-1.4	2	-	-	-	-	2	-	-	-	-	-	-	-	-	-
IS1101-1.5	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-

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, 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.
3.	Mr. Santosh BJ, Dr. K.V. S.S.S.S. Sairam, Mr. Shubham Kumar, Mr. Chandu Jagan Sekhar M, "Information and Cyber Security", Scientific International Publishing House, ISBN- 978-93-5625-694-1.

IT SKILLS

Course Code:	**CS1651-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P: S):	**1:0:2**	**Credits:**	**02**
Total Teaching Hours:	**13+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science & Engineering

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.	Analyse 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 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 Gaming Applications using Scratch Coding.
2.	Understand the basics of Android Programming.
3.	Design attractive and effective Static Web pages.
4.	Analyse the basic concepts of Cloud.
5.	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CS1651-1.2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CS1651-1.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CS1651-1.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CS1651-1.5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Suman M, Chinmaya Dash, R Sreenivas Rao "Digital Fluency", Himalaya Publishing House Pvt. Ltd., 2021.
2.	Melwyn Amrithraj, 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)

BIOLOGY FOR ENGINEERS

Course Code:	**BT1651-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P):	**1:0:0**	**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
3.	To be updated application of biology in real life scenarios.

UNIT-I

Introduction For Biology for Engineers	**05 Hours**

Why Biology for Engineers? 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	**05 Hours**

Composites in Construction, Termite Mound architecture, Counter current heat exchangers, Design of aeroplane, helicopter and submarine, Information Theory and Biology, SONAR, Medical Devices.

UNIT-III

Real Life Scenarios	**05 Hours**

Recent scenarios in Environment, Agriculture and Medical Technology.

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

1.	Ascertain the importance of Biology to be applied in various engineering streams
2.	Interpret the basics of cell and life processes
3.	Draw inspiration nature in design of machinery and construction
4.	Analyze the significance of mimicry of nature in design of electrical, electronic, and medical devices
5.	Judge knowledge on recent advances in application of biology to Environment, Agriculture and Medical Technology

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
BT1651-1.1	3	-	-	-	-	-	-	-	1	-	-	1
BT1651-1.2	3	-	-	-	-	-	-	-	1	-	-	1
BT1651-1.3	3	3	-	-	-	-	2	-	1	-	-	1
BT1651-1.4	3	3	-	-	-	-	2	-	1	-	-	1
BT1651-1.5	3	3	-	-	-	-	2	-	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

ENVIRONMENTAL STUDIES

Course Code:	**CV1002-1**	**Course Type**	**MNC**
Teaching Hours/Week (L: T: P)	**1:0:0**	**Credits**	**00**
Total Teaching Hours	**15+0+0**	**CIE + SEE Marks**	**50+00**

Teaching Department: Civil Engineering

Course Objectives:

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

UNIT-I

03 Hours

Environment

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

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

Parts of Earth- lithosphere and its role; hydrological cycle

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

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

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

Natural resources — 03 Hours

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

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

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

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

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

Material cycles - Carbon, Nitrogen, and Sulphur cycles.

UNIT-II

Environmental pollution: Definition, harmful effects related to public health — 03 Hours

Water pollution:

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

Land pollution:

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

Air Pollution:
Definition, types, and sources: industry, mining, agriculture, transportation, and effects
Noise pollution:
Definition, sources, mining, industries, rail-roads, aviation, effects and control measures

Energy	**02 Hours**

Different types of energy-
Non-renewable energy; fossil fuels- coal, oil, and natural gas- brief description only. Nuclear energy- nuclear power plants,
Renewable energy: solar energy- Photovoltaic systems for street and domestic lighting, solar water heating-brief description only
Wind energy- definition, merits and demerits, Hydro power- definition, merits, and demerits.
Biomass energy- definition, sources of bioenergy, biogas, biofuels, India's position in renewable energy
Hydrogen as an alternative future source of energy- brief scope, fuel cells.

UNIT-III

Current environmental issues of importance	**04 Hours**

Population growth- Definition, growth rate, effects, remedies Urbanization- Definition, environmental impacts and remedies Global warming and climate change-
Concept of greenhouse effect, sources of greenhouse gases, effects, and remedial measures of greenhouse gases
Acid rain: Definition, causes and effects, control measures. Ozone Depletion: Definition, causes, effects, and control measures.
Environmental Impact Assessment- EIA definition, objectives, and benefits of EIA.

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

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

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
CV1002-1.1	-	2	-	-	-	-	-	2	-	-	-	-	1	-	-
CV1002-1.2	-	-	-	1	-	-	-	-	-	1	-	-	1	-	-
CV1002-1.3	1	-	-		1	-	-	-	-	-	-	-	1	-	-
CV1002-1.4	1	-	-	1	-	-	-	-	-	-	-	-	1	-	-
CV1002-1.5	-	-	3	-	-	-	-	-	-	-	3	-	1	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

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

REFERENCE BOOKS:

1. Balasubramanya, N and Chatwal, Gurdeep R., "Environmental Studies", Himalaya Publishing

	House, Mumbai, 2007.
2.	Barucha, E., “Environmental Studies”, University Grants Commission, New Delhi, 2004.
3.	Bhatia, S. C., “Environmental Chemistry”, CBS Publishers, New Delhi, 2005.
4.	De, A.K. and De, A. K., “Environmental Studies”, 2006.
5.	Keller, Edward A., “Environmental Geology”, CBS Publishers and Distributors, Delhi, 1985.

ENGINEERING VISUALIZATION

Course Code:	**ME1004-1**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T: P):	**0:0:2**	**Credits:**	**01**
Total Teaching Hours:	**26**	**CIE + SEE Marks:**	**50+50**

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 develop the lateral surfaces of solid objects and to draw the isometric projection of simple solids.

UNIT-I

02 Hours

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.

06 Hours

Chapter 2: Projection of plane surface: Triangle, Square, Rectangle, Pentagon, Hexagon and Circle in simple position (Resting on HP with inclination to HP and VP, true length with true inclination only)

UNIT-II

06 Hours

Chapter 3: Projection of Solids: Prisms, Pyramids, Cones and Cylinders in simple position (Resting on HP with inclination to HP and VP, true length with true inclination only)
Orthographic projection of simple machine components using their isometric projection.

UNIT-III

06 Hours

Chapter 4: Development of Lateral surfaces of solids: Right regular Prisms, Pyramids, Cylinders and cones (with single section plane)

06 Hours

Chapter 5: Isometric projection: Isometric scale, Isometric dimensions, to draw Isometric views of simple solids and machine components using their orthographic projections.

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 development of lateral surfaces of standard solid objects. 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**	**12**	**PSO↓**	
↓ Course Outcomes													**1**	**2**
ME1004-1.1	3	1	-	-	-	-	-	-	1	1	-	2	2	1
ME1004-1.2	3	1	-	-	-	-	-	-	1	1	-	2	2	1
ME1004-1.3	3	1	-	-	-	-	-	-	1	1	-	2	2	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	N. D. Bhat & V. M. Panchal, Pramod R. Ingle, “Engineering Drawing”, 53rd Edition, Charotar Publishing House, Gujarat, 2014.
2.	K. R. Gopalakrishna, “Engineering Drawing”, Subhas publishers, Bangalore , 32nd Edition, 2012.

REFERENCE BOOKS

1.	“A Primer on computer aided Engineering Drawing”, VTU, Belgaum, 8thedition, 2011.
2.	Shah, “Engineering Drawing and Computer Graphics”, Pearson, 2010.
3.	Agarwal & Agarwal, “Engineering Graphics”, TMH, Second edition, 2013.
4.	P. S. Gill, “A Text book of Engineering Graphics and Drafting”, 11th Edition, S. K. Kataria & sons, New Delhi, 2009.

B. Tech. (VT): Scheme of Teaching and Examinations 2023-27
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2023 - 24)

I/II SEMESTER (EC, EE, VT)

SI No.	Course and Course code		Course Title	Teaching Department	Teaching hours/Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE	SEE	Total Marks	
					L	T	P					
1	BSC	MA1003-1	Differential Equations and Laplace Transforms	MAT	3	0	0	3	50	50	100	3
2	BSC	PH1006-1	Semiconductor Physics and Photonics	PHY	3	0	2	3	50	50	100	4
3	ESC	EC1001-1	Basic Electronics	EC	3	0	0	3	50	50	100	3
4	PLC	CS1004-1	Introduction to C Programming	EC	3	0	0	3	50	50	100	3
5	ESC	EC1002-2	Applied Digital Logic Design	EC	2	0	2	3	50	50	100	3
6	HSMC	HU1001-1	Technical English	HU	1	0	2	3	50	50	100	2
7	HSMC	HU1002-1	Constitution of India	HU	1	0	0	-	50	-	50	0
8	BSC	MA1006-1	Mathematics with MATLAB	MAT	0	0	2	-	50	-	100	1
TOTAL					**16**	**0**	**8**	**18**	**400**	**300**	**700**	**19**

Note:
BSC: Basic Science Course, **ESC**: Engineering Science Course, **HSMC**: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses, **MNC**: Mandatory Non credited course **UM**: University Mandatory

Mandatory Internship-I*

1.	INT	UC1001-1	Internship – I	Mandatory Intra Institutional Internship of duration (80 - 90 Hours) to be completed during I & II Semesters. *The grades will be included in the IV semester grade card (Refer 11.5.2 for details)	100	--	100	2

DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

Course Code:	**MA1003 - 1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Mathematics

Course Objectives:

1.	This course will enable the students to master the basic tools of Laplace transforms, differential equations, partial differential equations and become skilled for solving problems in science and engineering.

UNIT-I

First Order Ordinary Differential Equations	**08 Hours**

Exact, linear and Bernoulli's differential equations, orthogonal trajectories of cartesian and polar curves. Applications to simple engineering problems. Non-linear differential equations (first order and higher degree) equations solvable for p, equations solvable for y and equations solvable for x, general and singular solutions of Clairaut’s equations.

Applications: Rate of growth or decay, conduction of heat.

Ordinary Differential Equations Of Higher Order	**08 Hours**

Second and higher order linear differential equation with constant coefficients, solution by inverse differential operator, method of variation of parameters, linear differential equation with variable coefficients- Cauchy's linear differential equation. Applications to engineering problems.

Applications: Oscillations of spring.

UNIT-II

Laplace Transforms	**08 Hours**

Definitions, transforms of elementary functions, transforms of derivatives and integrals-properties. Periodic functions, unit step functions and unit impulse functions.

Inverse Laplace Transforms	**08 Hours**

Inverse Transforms and properties, convolution theorem, initial & final value theorems. Applications to engineering problems.

Applications: Signals and systems, Control systems, LR, CR and LCR circuits.

UNIT-III

Partial Differential Equations	**08 Hours**

First and higher order partial differential equations. 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, by Lagrange's Method. Solution of partial differential equations of derivatives involving only one independent variable.

Applications: Propagation of heat or sound, fluid flow, elasticity, electrostatics, electrodynamics, thermodynamics.

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

1.	Solve first order ordinary differential equations.
2.	Solve linear ordinary differential equations of higher order.
3.	Understand the concept of Laplace Transform and apply it to solve engineering problems.
4.	Make use of Laplace transform method to solve linear ordinary differential equations with constant coefficients
5.	Understand the derivation of one dimensional heat and wave equations and solve partial differential equations.

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
MA1003 - 1.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1003 - 1.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1003 - 1.3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1003 - 1.4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1003 - 1.5	3	2	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition (Reprint), 2016.
2.	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, 2015.

REFERENCE BOOKS:

1.	T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
2.	B. V. Ramana, "Higher Engineering Mathematics", Tata Mc Graw –Hill, New Delhi,2010.
3.	N.P. Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
4.	W.E. Boyce and R.C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.
5.	E.A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
6.	G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 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

SEMICONDUCTOR PHYSICS AND PHOTONICS

Course Code:	**PH1006-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L:T:P: S):	**3:0:2:0**	**Credits:**	**04**
Total Teaching Hours:	**40+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Physics

Course Objectives:

1.	To understand the concepts of wave mechanics
2.	To study the concepts of quantum free electron theory.
3.	To understand the fundamentals of semiconductors.
4.	To study the concept of dielectrics.
5.	To understand the principles of lasers and optical fibers

UNIT-I

Wave Mechanics	**10 Hours**

Introduction, Matter waves and de Broglie Hypothesis, de Broglie wavelength and derivation of expression by analogy, Phase Velocity and Group Velocity, Wave Function, Physical significance of a wave function (Born Interpretation), Heisenberg's Uncertainty Principle, Schrodinger wave equation (time dependent and time independent), Eigen functions and Eigen Values, Particle in one dimensional infinite potential well, waveforms and probabilities. Numerical Problems.

Quantum Free electron theory	**05 Hours**

Classical free electron theory and its failures, Quantum Free Electron Theory of Metals - Assumptions, Fermi - Dirac Statistics, Fermi level, Fermi-energy, Fermi factor, Variation of Fermi Factor with Temperature and Energy, Numerical problems.

UNIT-II

Semiconductors	**8 Hours**

Introduction to semiconductors- intrinsic and extrinsic semiconductors - carrier generation, Direct and indirect band gap semiconductors.Fermi level in Intrinsic & Extrinsic Semiconductorand its behavior with temperature, Expression for concentration of electrons in conduction band & holes concentration in valance band (mention of the expression), Electrical conductivity of a semiconductor (derivation), Effect of temperature on conductivity of intrinsic and extrinsic semiconductors, Hall effect **-** theory with derivation for Hall coefficient, carrier concentration, andmobility, applications, Numerical problems.

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

Dielectric materials	**7 Hours**

Dielectrics, Dipoles, Polar and non-polar dielectrics, Dielectric constant, Electric polarization, Polarizability, Electrical Polarization Mechanisms,Electric susceptibility (relation between P, χ and E - no derivation), Internal fields in solids(theory based on one dimensional atomic array), Clausius-Mossotti equation (Derivation), Temperature dependence of polarization, , Frequency dependence of polarization, Dielectric loss (derivation), Dielectric breakdown, Solid, Liquid and Gaseous dielectrics, Application of dielectrics in transformers, Capacitors and Electrical Insulation.

Ferroelectric materials and Piezoelectric materials, properties and applications, Numerical Problems.

UNIT-III

Photonics: Lasers	**05 Hours**

Introduction to lasers, Characteristics of LASER, Interaction of radiation with matter, Einstein's coefficients, Expression for Energy Density and its significance. Requisites of a Laser System. Conditions for Laser action. Principle, Construction and Working of Nd:YAG and Semiconductor laser. Application of Lasers in Defence (Laser range finder), Barcode scanner and Laser Printer. Numerical Problems.

Photonics: Optical Fibers	**05 Hours**

Introduction to optical fibers, 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 in optical fibers, Attenuation Spectrum - Optical Windows. Discussion of Block Diagram of Point-to-Point Communication, Intensity based Fiber Optic Displacement Sensor, Merits and Demerits, Numerical problems.

List of Experiments (Any Ten experiments)

1.	Wavelength of LASER using Diffraction Grating.
2.	Numerical aperture of the given Optical Fiber.
3.	Energy gap of semiconductor by Four Probe Method
4.	Dielectric constant by charging and discharging of a capacitor.
5.	Hall effect
6.	Determination of Fermi Energy of Copper.
7.	Ferroelectric phase transition in Barium titanate
8.	Photo-Diode characteristics
9.	Solar cell characteristics
10.	Photo electric effect – Determination of the work function of the material of the emitter of a photocell.
11.	LED characteristics and determination of Planck's Constant using LEDs.

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

1.	Comprehend various properties of sub-atomic particles on the basis of wave mechanics.
2.	Elucidate the concepts of quantum free electron theory.
3.	Explain and analyze the properties of semiconductors.
4.	Describe and apply the concepts of dielectrics.
5.	Understand the principle, working and applications of lasers & optical fibers.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes															
PH1006-1.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1006-1.2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1006-1.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1006-1.4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1006-1.5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

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:	**EC1001-1**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To familiarize the student with Semiconductor devices like Diodes, Transistors and their applications
2.	To analyze the working of simple electronic circuits involving Op-amps, 555 Timer and Linear Regulator ICs.

3.	To understand the fundamentals of Modern communication system.
4.	To introduce the fundamentals of Embedded Systems

UNIT-I

Diodes and their Applications	**07 Hours**

Semiconductor Diode, Diode Equivalent circuits, Load Line analysis, Half Wave Rectifier, Full wave Bridge Rectifier, capacitor, and choke filter circuit (only qualitative approach). Zener Diode and its use in Voltage Regulation

Transistors and their Applications	**09 Hours**

Bipolar Junction Transistor: Construction and operation, Common Emitter and Common Base Characteristics, DC load line analysis, RC coupled amplifier (frequency response excluded), BJT as a switch, BJT circuit to switch ON/OFF an LED

Field Effect Transistor: Construction and Characteristics of JFET, Transfer Characteristics, Enhancement mode MOSFETs, CMOS Inverter.

UNIT-II

Op-Amp & Linear IC Applications	**11 Hours**

Introduction, Op-Amp Specifications, Differential & Common-Mode operation, Op-Amp applications: Inverting/Non-Inverting Amplifier, Summing, Integrator, Differentiator, Comparator. 555 Timer IC in Astable mode. 78XX series IC Voltage Regulators.

Feedback and Oscillator Circuits	**05 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

UNIT-III

Fundamentals of Communication and Embedded Systems	**08 Hours**

Modern communication system scheme (Block scheme), Information source, Input Transducers, Transmitter, Channels, Receivers, Noise, Fundamentals of Cellular communication.

Embedded system definition, Embedded System v/s General Computing Systems, Classification of Embedded systems, Elements of Embedded systems, Core of Embedded systems, Microprocessor v/s Microcontroller, RISC v/s CISC, Hardware v/s Von Neumann Architecture, Sensors and Actuators with examples

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

1.	Explain the operation of Rectifiers; Design a rectifier circuit, given the specification for output Voltage, PIV, and ripple factor; Design a Zener voltage regulator for the given specification of output voltage and Power;
2.	Explain the construction and operation of Bipolar transistor in CE or CB Mode; Explain the use of BJT in Amplification as well as switching operations; Explain the construction and operation of JFET or MOSFET; Explain the operation of a CMOS Inverter;
3.	List the ideal and practical parameters for an Op-Amp; Define Op-amp Specifications; Explain the use of Op-Amp in Amplification, Summing, Integration, Differentiation

	and comparison; Design an Astable Multivibrator, using 555 Timer IC, for the given frequency and duty cycle;
4.	List the advantages and disadvantage of Negative Feedback; Explain the impact of negative feedback on Amplifier gain, Input and Output Impedance for a Series Voltage Negative feedback; Explain the operation of Op-Amp based RC Phase-shift, Hartley, and Colpitts Oscillator
5.	Explain the scheme of a Modern Communication System; List the differences between a general computing system and Embedded System; Describe the differences between Harvard and Von-Neuman, RISC and CISC system architectures

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ **↓ Course Outcomes**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
EC1001-1.1	3	-	-	-	-	-	-	-	-	-	-	-
EC1001-1.2	3	-	-	-	-	-	-	-	-	-	-	-
EC1001-1.3	3	-	-	-	-	-	-	-	-	-	-	-
EC1001-1.4	3	-	-	-	-	-	-	-	-	-	-	-
EC1001-1.5	3	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", 11th Edition, PHI, 2016
2.	Simon Haykin, "Introduction to Analog and Digital Communications", Wiley Publishers, 2nd Edition, 2019
3.	Theodore Rappaport, "Wireless Communications: Principles and Practice", Pearson, 2nd Edition, 2016
4.	Shibu K V, "Introduction to Embedded Systems", TATA Mc Graw Hill Edu., 2nd Edition, 2016

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#syllabus
5.	https://www.coursera.org/learn/transistor-field-effect-transistor-bipolar-junction-transistor?specialization=semiconductor-devices

INTRODUCTION TO C PROGRAMMING

Course Code:	**CS1004-1**	**Course Type:**	**PLC**

Teaching Hours/Week (L: T: P: S):	**2:0:2**	**Credits:**	**03**
Total Teaching Hours:	**26+0+26**	**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 in problem solving to demonstrate its usage using simple programs.
3.	Apply the concepts of Arrays, User-defined functions and code reusability in problem solving along with parameter passing and returning with the help of user defined functions.
4.	Demonstrate the usage of Strings andStructures
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 DataTypes, 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.,	
Decision Making and Looping:	
The while statement, the do…while statement, the for statement, Jumps in Loops.	

UNIT-II

Arrays	**10 Hours**
Arrays (1-D, 2-D) Initialization and Declaration.	
User-Defined Functions	
Argument Passing – call by value, call by reference, Category of Functions. Managing Command line arguments Examples: Linear Search, Binary Search, Bubble sort, Selection Sort, Trace and Transpose, Matrix Multiplication.	
Strings	
Declaring and Initializing strings, String manipulation functions.	

UNIT-III

Structures	**06 Hours**
Structures and Unions: Usage and nesting, Array of Structures	
Pointers and File Handling:	
Accessing of variables using Pointers, array of pointers Basic file operations: Open, Close, Read, Write, Append and concatenate	

Suggested List of Experiments

PART A	
9.	Write a C program to find the roots of a quadratic equation $ax^2+bx+c=0$
10.	Write a C program to find the sum of all the digits and occurrence of a digit in the number.
11.	Write a C program to find the GCD and LCM of given two numbers using Euclid's method.
12.	Write a C program to print the prime numbers in a given range.
13.	Write a C program to find if a given string is a palindrome or not using string manipulation functions.
14.	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.]
15.	Write a C program to read N integers into an array A and find the sum of elements using pointers.
16.	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 basics of C and the process of problem-solving aspects using algorithmic solution for a given problem. Apply the knowledge of expression solving to evaluate simple expressions and input/output statements to develop a C program.
2.	Develop the C program using control statements such as branching and looping constructs for a given problem.
3.	Apply the knowledge of code re-usability, parameter passing and returning values to develop a maintainable C program using these concepts including arrays and functions.
4.	Identify and describe the use of strings in a C program.
5.	Develop the C program using structures in C

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
CS1004-1.1	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CS1004-1.2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CS1004-1.3	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CS1004-1.4	2	2	3	-	-	-	-	-	-	-	-	-	-	3	-
CS1004-1.5	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	E. Balaguruswamy, "Programming in ANSI C", Tata McGraw Hill, 3rd Edition, 2004.
2.	Jacqueline A. Jones & Keith Harrow, "C Programming with Problem Solving", Pearson,

REFERENCE BOOKS:

1.	Kernighan & Ritchie, "The C Programming (ANSI C)", Prentice Hall; 2ndEdition, 1998.
2.	Rajiv Khanna, "Computer Concepts and C Programming", New Age International Pvt Ltd Publishers, 1st Edition, 2006.
3.	Yashwant Kanetkar, "Let Us C", 5th Edition, BPB Publications, New Delhi, 2004.

E Books / MOOCs/ NPTEL

1.	http://www.lysator.liu.se/c/bwk-tutor.html#introduction
2.	http://www.acm.uiuc.edu/webmonkeys/book/c_guide/
3.	C programming Tutorial by Mark Burgers http://markburgess.org/CTutorial/C-Tut-4.02.pdf
4.	http://nptel.ac.in/courses/106105085/4
5.	https://www.lynda.com/C-training-tutorials/1249-0.html

APPLIED DIGITAL LOGIC DESIGN

Course Code:	**EC1002-2**	**Course Type:**	**ESC**
Teaching Hours/Week (L: T: P)	**2:0:2**	**Credits:**	**03**
Total Teaching Hours:	**25+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand the basics of Number Systems, Logic Gates and Boolean Functions.
2.	To understand simplification of the Boolean Equations using Boolean Algebra, Karnaugh Maps and QM method.
3.	To design combinational Logic Circuits like Adders/Subtractors, Binary Comparators, Decoders, Encoders, and Multiplexers.
4.	To understand the operation of Flip-Flops, Master-Slave Flip-Flops and Conversion of Flip Flops.
5.	To design Shift Registers and Counters.

UNIT-I

Fundamentals of Digital Design	**10 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, Simplification of Boolean Functions using Boolean Algebra, Karnaugh Map and Quine-McCluskey Method, Realization of Boolean functions using Basic Gates and Universal Gates.

UNIT-II

Combinational Logic and Sequential Logic Circuits	**10 Hours**

Introduction to Combinational Logic Circuits, Half/Full Adders/Subtractors, Parallel Adders/Subtractors, Binary Comparators, Decoders, Encoders, Multiplexers.

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.

UNIT-III

Applications of Flip Flops	**05 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.

Suggested List of Experiments

1.	Introduction to Digital Circuit Simulation Software.
2.	Introduction to Basic gates, Universal gates.
3.	Realization of Logic Circuits using Universal gates.
4.	Realization of Combinational Logic Circuits.
5.	Realization of Sequential Logic Circuits.

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

1.	Compare Analog & Digital Signals; Convert the number from one numbering system to another; Analyze Boolean functions.

2. Simplify the logic expressions using Boolean Algebra or K-Map or QM Method; Realize the logic expressions using Basic/Universal Gates.
3. Analyze and Design different Combinational Logic Circuits such as Adders, Subtractors, Binary Comparators, Decoders, Encoders and Multiplexers.
4. Describe the operation of Flip Flops, Mater-Slave Flip Flops and Conversion of Flip Flops.
5. Make use of Flip Flops to design Shift Registers and Synchronous/Asynchronous Counters.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→ **↓ Course Outcomes**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
EC1002-2.1	3	-	-	-	-	-	-	-	-	-	-	-
EC1002-2.2	3	1	1	-	3	-	-	-	3	1	-	-
EC1002-2.3	3	2	1	-	3	-	-	-	3	1	-	-
EC1002-2.4	3	-	-	-	3	-	-	-	3	1	-	-
EC1002-2.5	3	1	1	-	3	-	-	-	3	1	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Morris Mano, “Digital Design”, Prentice Hall of India, 3rd Edition.
2. Donald D. Givone, “Digital Principles and Design”, McGraw Hill, 2002.

REFERENCE BOOKS:

1. John M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2001.
2. D. P. Kothari and J. S Dhillon, “Digital Circuits and Design”, Pearson, 2016.
3. Charles H Roth, “Fundamentals of Logic Design”, Cengage Learning.

E Books / MOOCs/ NPTEL

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

TECHNICAL ENGLISH

Course Code	**HU1001-1**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T:P)	**1:0:2**	**Credits**	**02**
Total Teaching Hours	**13+0+26**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Objectives:

1.	Identify the nuances of Phonetics, Intonation and enhance pronunciation skills
2.	Understand Technical Communication along with the barriers and application of effective Interpersonal Communication Skills
3.	Enhance basic English grammar and essentials of language skills
4.	Improve sentence structure with the help of cohesive devices
5.	Develop spoken and writing skills

UNIT - I

Phonetics & Pronunciation	**8 Hours**

Introduction to Phonetics; Word Stress, Rhythm, and Intonation; Weak Forms and Strong Forms, Role of IPA in past tense and plural forms of words, Awareness of Different Accent

Communication Skills	**8 Hours**

Introduction to Communication, Greeting and Introducing, Making Requests, asking for and Giving Permission, Offering Help. Understanding Telephone Communication, Handling Calls, asking for and Giving Information, Telephone Etiquette

UNIT - II

Language Skills	**15 Hours**

Basic English Grammar, Ability to identify, Analyze, Interpret and Describe the critical ideas, values, and themes through literary works

UNIT - III

Writing Skills	**8 Hours**

Paragraph writing, Refutations, Linkers, Types of Letters

Course Outcomes: At the end of the course student 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 the 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 at command and language proficiency in personal and

	professional life
5.	Develop effective writing skills for incorporating them in different forms of writing

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
HU1001-1.1	1	1	-	-	-	-	-	2	-	2	-	3	-	-
HU1001-1.2	2	-	-	-	-	2	-	-	-	3	-	3	-	-
HU1001-1.3	-	2	-	-	-		3	2	-	3	-	3	-	-
HU1001-1.4	-	2	-	-	-	2	-	-	2	2	-	2	-	-
HU1001-1.5	-	2	-	-	-	2	-	2	1	2	-	2	-	-

1: Low 2: Medium 3: High

TEXT BOOK:

1. Subhashini, A Textbook of English Language & Communication Skills, R Victor et al.

REFERENCE MATERIALS:

1. English Pronunciation Dictionary, Daniel Jones A Remedial English Grammar for Foreign Students, Woods
2. Communication Skills, Sanjay Kumar, Oxford University Press.
3. Exercises in Spoken English Part I - CIEFL, Hyderabad, Oxford University Press.
4. Exercises in Spoken English Part II - CIEFL, Hyderabad, Oxford University Press.
5. Exercises in Spoken English Part III - CIEFL, Hyderabad, Oxford University Press.
6. On Writing Well, William Zinsser
7. Practical English Usage, Swan, Oxford University Press.
8. Study Writing, Liz-Hamp Lyons, Cambridge University Press

E Resources

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

CONSTITUTION OF INDIA

Course Code	**HU1002-1**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T:P)	**1:0:0**	**Credits**	**01**
Total Teaching Hours	**13+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Objectives:

1. Inculcate Social and Political consciousness of the Indian Polity.
2. Understand their Obligations, Responsibilities, Privileges and Rights, Duties, and the Role that they have to play in deciding the Administrative Machinery of the country.
3. Develop National and Patriotic Spirit.
4. Understand the nature and character of relations between union and state governments.
5. Divulge the students about the statutory institutions and policies.

UNIT - I

Evolution of the Indian Constitution	**6 Hours**

1909 Act, 1919 Act, 1935 Govt of India Act, Constituent Assembly: Composition and Functions, Basic structure of Indian Constitution, Fundamental features of the Indian Constitution, Salient Features of Indian Constitution

UNIT - II

Structure of Government	**5 Hours**

Union Government: Legislature; Executive-President, Prime Minister, Council of Ministers; Judiciary, Judicial Review, and activism. State Government: Executive: Governor, Chief Minister, Council of Ministers.

Local Government: Panchayat Raj Institutions, Urban Governance

UNIT - III

Statutory Institutions	**2 Hours**

Elections - Election Commission of India, National Human Rights Commission, National Commission for Women.

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

1. Analyze the legalities and related issues of drafting, adoption, and enforcement of the Indian Constitution as a fundamental law of the nation and the provisions and privileges of Indian Citizenship
2. Understand and judiciously use the fundamental rights, fundamental duties and privileges envisaged in the constitution propagating social harmony and equality and respecting the rights and liberties of other people.
3. Contribute in protecting and preserving the sovereignty and integrity of India and have a compassion to all living creatures, uphold sense of brotherhood ness among all citizens of the nation and promote peace and harmony
4. Respect the Constitutional Institutions and all noble ideals cherished during Indian struggle

	for freedom
5.	Develop a Spirit of belongingness to the country.

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
HU1002-1.1	-	-	-	-	-	-	-	3	-	-	1	1	-	-
HU1002-1.2	-	-	-	-	-	-	-	2	-	-	1	1	-	-
HU1002-1.3	-	-	2	-	-	-	1	2	-	-	1	1	-	-
HU1002-1.4	-	-		-	-	-	-	1	-	-	-	-	-	-
HU1002-1.5	-	-	1	-	-	-	-	3	-	-	1	1	-	-

1: Low 2: Medium 3: High

Reference Materials:

1. Introduction to the Constitution of India; Dr. Durga Das Basu; Twentieth Edition, LexisNexis Butterworths Wadhwa, Nagpur, Haryana, India, Reprint 2011.
2. Introduction to Constitution of India; M.V. Pylee; Fourth Revised Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2005.
3. Introduction to Constitution of India; Brij Kishore Sharma; Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
4. An Introduction to Constitution of India and Professional Ethics; Prof. B R Venkatesh and Merunandan K B; Merugu Publications, Bangalore; Second Edition, 2007.

E Resources

1. *http://nptel.ac.in/courses/109104032/*
2. *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

MATHEMATICS WITH MATLAB

Course Code:	**MA1006-1**	**Course Type**	**BSC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**0+0+26+0**	**CIE Marks**	**50**
Prerequisite	**MA1001-2 /MA1005-1**		

Teaching Department: Mathematics

Course Objectives:

1.	Understand the use of the basic operators, some built-in functions of MATLAB.
2.	Create and work with arrays
3.	Create and display simple plots
4.	Solve by Symbolic and Numerical computation techniques

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 (a) eigenvalues and eigenvectors of a square matrix; (b) largest eigenvalue and the corresponding eigenvector of a square matrix; (c) rank of a square matrix
4	Solution of system of linear equations by Gauss elimination method
5	Solution of system of linear equations by Gauss-Seidel method
6	Taylor's/ Maclaurin's series expansion of a function of single variable.
7	Computation of partial derivatives and Jacobians
8	Evaluation of double/triple integrals with constant/variable limits.
9	Computation of angle between (a) radius vector and tangent ; (b) two curves
10	Solution (with solution curve) of first order ordinary differential equation
11	Solution (with solution curve) of second and higher order linear differential equation with constant coefficients
12	Compute the roots of algebraic or transcendental equation using Regula-Falsi and Newton Raphson's Method.

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

1.	Write and compile simple MATLAB codes. Implement basic operators and conditions and loops effectively.
2.	Construct MATLAB programs gradually for the mathematics concept they are

	studying in theory.
3.	Appreciate the pictorial representation of the mathematics concept.

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**
EC2602-1.1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
EC2602-1.2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
EC2602-1.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-

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 Resources

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

INTERNSHIP-I

Course Code	**UC1001-1**	**CIE Marks**	**100**
Teaching Hours/Week (L: T: P: S)	**-**	**SEE Marks**	-
		Total Marks	**100**
Total Hours of Pedagogy	80-90 Hours (During I/II semesters)		(Evaluation in I/II/III Semester and grades earned shall be included in IV Semester grade card)
Credits	**2**	**Exam Hours**	**--**

Course objective

1. This course is meant to provide students an opportunity to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the institution; contribution at incubation/ innovation /entrepreneurship cell of the institution; participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research projects within the institution and Participation in all the activities of Institute's Innovation Council.

Activities: Refer Appendix B - 3.4 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
UC2001-1.1	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**-**
UC2001-1.2	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**-**
UC2001-1.3	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**-**

1: Low 2: Medium 3: High

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NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Established under Section 3 of UGC Act 1956
Accredited with 'A+' Grade by NAAC

Off-Campus Centre, Nitte - 574 110, Karnataka,India

HOLISTIC COMPONENTS

HUMANITIES

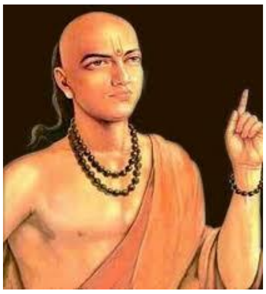
Holistic education is not only about teaching the basic subjects, but it is more about redefining the way a student should be taught. The purpose of holistic language teaching is the development of the learners’ ability to handle both their language oral skills as well as maximizing their life skills. The department contributes to educational life and work spaces that are creative and meaningful. Multidisciplinary and holistic learning is an ancient method used in Indian education system as well as the other parts of the world. This is the reason that such type of education system was advocated by scholars like Kautilya, Banabhatta, Plato, and Aristotle among many others. Holistic approach is essentially a student centered strategy rather than a teacher centered one.

Holistic education through courses allied to Humanities is created within the inclusive connections of social and human experience. A curriculum built around such stages is considered holistic if they involve the practices that integrates language acquisition and fills multiple cognitive demands in interlocking activities that spiral learning. Through the applied learning style of a person--mind, body and spirit students will learn more effectively the nuances of language, responsibilities towards social fabrics and ethics.

The approach strives to make a learner construct his own understanding of the text he/she interacts with and converses with others according his understanding. Intensive experiential and group sessions, a co-created learning ambience and hands-on engagement through real-life cases, field trips and internships to make learning exciting, rigorous and transformative. As a part of the holistic approach and its philosophy, a student is educated beyond core academics providing him/her virtuous and holistic education. This helps the students to discover their individuality and comprehend the significance of life purposefully, creatively, and morally in a complex world. Krishnamurti writes If the unity of life and the oneness of its purpose could be clearly taught to the young, how much brighter would be our hopes for the future! (Krishnamurti, J. 1974).

MATHEMATICS

INDIAN MATHEMATICIANS



It is essential to know about the ancient, medieval and modern time Indian mathematicians and their contribution to Science and Mathematics. Ancient Indian mathematicians have contributed immensely to the field of mathematics. The invention of zero is attributed to Indians and this contribution outweighs all other made by any other nation since it is the basis of the decimal number system, without which no advancement in mathematics would have been possible. The number system used today was invented by Indians and it is still called Indo-Arabic numerals because Indians invented them and the Arab merchants took them to the western world.

Here we are introducing some of the important Indian mathematicians from ancient times.

Aryabhata: (500 A. D.) - Studied at the University of Nalanda, which was considered as a great centre of learning. Aryabhata was a great Indian mathematician. He gave the value of "π" as 3.1416, claiming for the 1st time, that it was approximation. Aryabhata also dealt with other aspects of mathematics and Astronomical calculations, namely Geometry, Mensuration, Square root, Cube root, Progression and Celestial sphere. He presented a method to solve an intermediate equation of certain type that are important in astronomy and computer science.

Bhaskara : (1100 A. D.) - was a great Mathematician and Astrologer. He was the first Mathematician to declare confidently that any term divided by ZERO is infinity and the sum of any term and infinity is infinity. His concept of "Tatkalikagati", which means instantaneous motion, used by astronomers to determine the motion of the planet accurately brought credit to him. He explained the solutions of quadratic and cubic equations. He stated the Rolle's theorems in analysis, the mean value theorem.

Srinivas Ramanujan was an Indian Mathematician who made significant contributions to mathematical analysis, Number theory and continued fractions. He made many important contributions in the field of mathematics with his wonderful and unique knowledge. That's why his birthday is celebrated as Mathematics Day.

PHYSICS

The ancient world had considered Physical Sciences, Chemical Sciences, Earth Sciences, Biological Sciences, Mathematical Sciences etc. as study of nature, which were all studied under the banner of Philosophy. Even today, the philosophers are studying Metaphysics which connects physical attributes to mind. Physics is a branch of science which deals with the study of matter and energy. The Physical Science was a matter of interest for all the civilizations including Vedic era of India dating back to over 3000 years. The physical science in ancient India was majorly restricted to Astronomy and Astrology. It was **Kanada**(600 B.C.) who presented holistic approach of physics, by blending science, philosophy and religion through 'Vaisesika Sutra'. Their essence is the atomic theory of matter. He gave the name 'Paramanu' (Atom), to be the indivisible entity of matter. The idea of chemical change was also put forward by Kanada. Bharadwaja is credited with teaching missile technology. Aryabhata(500 A.D.) was a great astronomer. He was the first to state that the earth is round and it rotates on its own axis, creating day and night. He declared that the moon is dark and shines only because of sunlight. Aryabhatta contributed greatly to the field of science particularly astronomy. Varaha mihira (500 A.D.) studied astrology and astronomy and declared that the earth was spherical. He also proposed that the moon and planets are lustrous not because of their own light but due to sunlight. Bhaskra (1100 A. D.) was a great scientist his concept of "Tatkalikagati", which means instantaneous motion, used by astronomers to determine the motion of the planet accurately brought credit to him. Brahmagupta(598 A.D.) calculated the instantaneous motion of a planet, gave correct equations for parallax, and some information related to the computation of eclipses and is widely regarded as one of the most accomplished of the ancient Indian astronomers.

"If you wish to make an apple pie from scratch, you must first invent the universe."So said astronomer Carl Sagan in an episode of his landmark television series, Cosmos. Embedded in Sagan's memorable quip is a certain holistic understanding of the universe — a notion that the existence of any one thing is intimately tied to the existence of everything else. There are no apple pies without apples; there are no apples without the proper climate for growing apple trees; there is no proper climate for growing apple trees without a planet on which the apple trees can grow — and so on, all the way back to the Big Bang.Pythagoras and his followers held mathematics in an almost holy regard, and they saw numbers as a basic form of matter. According to their view, all things had numbers, and the objects of the universe — including human societies — were arranged in harmonious mathematical relationships with one another.

All sciences were originated from philosophy. Physics was called natural philosophy until the 19th century, but once it was proven to be correct it was no longer philosophy and became a science. Physics is the science of the natural world, more specifically dealing with the matter, energy, space-time, and fundamental forces that govern the physical world. In physics we study a wide range of physical phenomena from subatomic particles to large galaxies of the material universe, and use empirical data and mathematics to find results and conclusions. Physics is also deeply concerned with arriving at knowledge about the ultimate nature of reality. Since we cannot know whether we have discovered everything which would affect our theories of the universe, all such theories are perpetually subject to modification or change. Mathematics is a language and a tool that we use in physics to explain the universe. Quantum physics is a mathematical description that rules the tiny world of atoms and subatomic particles in our universe. Without quantum physics, much of the information technology that we rely on, from microcircuits to lasers, would not exist. Today many scientists argue that metaphysics plays an important role in quantum mechanics at a deeper level; the nature of reality is all mathematical. This could be an example of how metaphysical assumptions can get in the way of our understanding the paradoxical nature of quantum mechanics. But even when quantum mechanics appears a mystical science of metaphysics, it is not metaphysics but productive science.

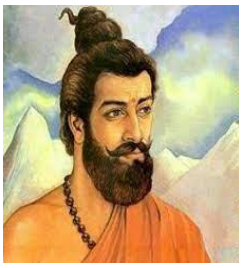
Thus, the Physics though has many branches and uses many other branches of science and philosophy, in the past and the present, its aim is to understand the whole universe which is nothing but matter and energy which is seen or unseen.

CHEMISTRY

ANCIENT SEERS OF INDIA – CHEMISTRY

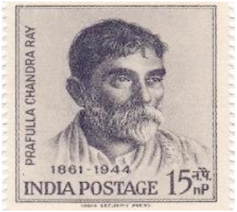
In ancient India, chemistry was called **Rasayan Shastra, Rasa-Vidya, Rasatantra and Rasakriya** all of which roughly mean '***Science of Liquids***'. There also existed chemical laboratories which were called **Rasakriya-nagaram**/**Rasakriya-shala**, which literally mean '***School where liquids are activated***'. Rigveda (earlier than 1500 BCE) mentions many fermented drinks and methods of fermentation, apart from various metals. Soma juice from the stems of the soma plant was considered a divine drink. The Vedic Indians were acquainted with the art of dyeing with certain natural vegetable colouring matters. A type of pottery, now known as 'Painted Grey Ware', is also associated with the Vedic period.

Ancient chemistry in India grew out of the early efforts to develop an elixir; to turn base metals into gold and on metallurgy. Chemical techniques in India can be traced back all the way to the Indus valley or Harappan civilisation (3rd millennium BCE). Pre-Harappan Indians were acquainted with the art of making baked or burnt clay pottery as well as painting the same with two or more colours (by addition of iron oxide, manganese oxide, etc.). Kautilya's Arthashaastra (3rd or 4th century BCE) has a lot of information on prevailing chemical practices. Apart from mines and minerals, it discusses the details of precious stones (pearl, ruby, beryl, etc.); preparation of fermented juices (sugarcane, jaggery, honey, jambu, jackfruit, mango, etc.) and oil extraction.



It is said that **Maharshi Kanada** was the first to propound that the *Parmanu* (atom) was an indestructible particle of matter and that Universe is made up of *Kana*. When matter is divided and sudivided, we reach a stage beyond which no division is possible, the undivisible element of matter is *Parmanu*. Kanada explained that this indivisible, indestructible y cannot be sensed through any human organ.

Nagarjuna (931 A.D.) from Somnath in Gujarat was a chemist/alchemist, who concentrated his efforts in transforming the base metals into gold. His reputation was such that people believed Nagarjuna to be in communion with gods and goddesses who had blessed him with the power of changing base metals into gold and extracting the 'elixir of life'.



Prafulla Chandra Ray (1861-1944), an Indian chemist, is often referred to as the Father of Chemistry in India. He received his BS in 1882 and his PhD in 1887 from University of Edinburgh. In 1896, he announced a major discovery of a new compound, mercurous nitrite.

Today's Science and Technology has been greatly inspired by the contributions of these wise seers. Indians have continued to show their global impact in the Field of Science.

In the 21st century, biochemist **Har Gobind Khorana** won the Nobel Prize (1968) for demonstrating how the nucleotides in nucleic acids control the synthesis of proteins.

Thus, the seers of ancient India have contributed significantly in the development of Modern Chemistry.

BIOTECHNOLOGY

Biology for Engineers

Science deals with matter. It is based on starting from scratch with what a human can observe, test, and rationalize. Ancient sages have worked hard to be seen as the only reliable providers of knowledge to the world. In 1875, the Vymaanika Shaastra, a 4th Century BC text written by Sage Bharadwaj was discovered in a temple in India. It contains 3000 shlokas in 8 chapters which was physically delivered by the ancient Hindu Sage Bharadwaj. The book greatly deals with the operation of ancient vimanas and included information on steering, precautions for long flights, protection of the airships from storms and lightning and how to switch the drive of solar energy or some other form of energy. One of the chapter will reveal the secrets of constructing aeroplanes that cannot be broken or cut, that is indestructible, that is fire resistant. It also deals with the secret of making planes motionless and invisible. It also describes how to defeat the enemy planes etc. as per the Sage Bharadwaj the vimanas were classifies as per the Yugas. During the period of Krita Yuga, Dharma was establishes firmly. The pushpak Vimana which was used by Ravan was an Aerial vehicle. He used this vehicle to kidnap Sita from jungle and took him to his Kingdom Srilanka. Ramayana was during the Treta Yug in which the Vimanas were highly discovered. During this period “Laghima” gave them the power to lighten their vehicle do they can travel freely in the air.

COMPUTER, INFORMATION SCIENCE & ENGINEERING

The Indians (**Aryabhata**, 476 BC - 550 BC) contributed **Zero (0)** to the number system**.** So that numeric system and computing world found an ease in solving numerical problems using computer programs.

Acharya **Pingala** was an ancient Indian mathematician who lived around 300 BCE. He wrote the Chandaḥśāstra, where he analysed **Sanskrit poetry mathematically**. It also contained the first known explanations of **digit zero**, **binary numbers, Fibonacci numbers and Pascal's triangle**.

Baudhayana (8th century BCE) composed the Baudhayana Sulba Sutra, which contains examples of Pythagorean triples, such as: (3,4,5), (5,12,13), (8,15,17), (7,24,25) and (12,35,37) as well as a statement of the Pythagorean theorem for the sides of a square: "The rope which is stretched across the diagonal of a square produces an area double the size of the original square."

In Indian astronomy, the study of **trigonometric functions** flourished in the Gupta period, especially due to **Aryabhata (sixth century CE),** who discovered the **sine function**.

Quadratic equation of the form **$ax^2 + bx + c = 0, a \neq 0$** and is given by $x = (-b \pm \sqrt{}(b^2 - 4ac)) / 2a$. was discovered by **Sridharacharya** in the 11th century.

The largest numbers the Greeks and Romans used were 106. In 5000 BC **Indians used numbers as big as 10^{53}** (10 to the power 53) with specific names. The largest used number today is **Tera 10^{12}**.

Kaṭapayadi numerical notation is an ancient Indian system to depict letters to numbers for easy remembrance of numbers as **words or verses**.

For example: क(Ka)=1 ख(Ka)=2 ग(Ga)=3 घ(Ga)=4 ज्ञ(Gnya)=5 च(Cha)=6 छ(Cha)=7 ज(Ja)=8 झ(Ja)=9 अ(Nya)=0. The modern **Hasing technique in computing system** which is resembling was then being used in the **Indian Katapayadi system**. For example, the hashing number based on Katapayadi system would be as follows for **'Gurudev'**

Gu=Ga(is the consonant)=3, Ru=Ra(is the consonant)=2, De=Da(is the consonant)=8 Va=Va(is the consonant)=4, So Gurudeva = 4823.

In the recent decades, following are the few of the major contributors to the computing world:

1. In 1996 the USB port invented by the **Ajay Bhatt,** an Indian at Intel Oregon which involved low level **programs delt with embedded C Language** to perform flexible IO transfer and opened up an area to use plug-and-play devices efficiently.
2. The Pentium chip invented by **Vinod Dham,** that **made C compiler to speed up the program execution** and do well with **GUI applications (both System and User Level) that are wiritten in C language.**
3. **Amit Singhal** is an Indian who rewrote (search engine in 2001) the **google algorithm** (C language coding embedded with Assembly Language service routins in Windows and Unix/Linux). Then on the Google processes over 40,000 search queries every second on average which translates to over **3.5 billion searches per day** and **1.2 trillion searches per year** worldwide.

Few of the contribution as Auther of CP and Educators of C language:

1. **Yashavant Kanetkar** is an Indian computer science author, known for his varieties of C Programming books.
2. **E. Balagurusamy : An Computer scientist** known for **Programming in ANSI C.**

ELECTRONICS AND COMMUNICATION ENGINEERING

The idea of a holistic approach to engineering design and education has been envisioned to meet the perceived and emerging needs for innovation in the 21st century. Many engineering educators, practicing engineers and engineering students have already recognized the gaps and areas of potential improvements in the knowledge acquisition process implemented in current engineering degree programs when compared to current societal and technological issues and developments.

Society and humanity have progressed drastically over the past few generations. Engineers as a network of professional problem solvers have been heavily involved in these global communities and the engineering profession is evolving from one that focuses on targeted, isolated issues, to one that embraces challenges that incorporate physical, economic, environmental, and humanitarian aspects.

Currently, engineering students are required to take classes on ethics, liberal studies and technology and society courses, however engineering students are not prefaced with the importance of rounding out their education with these topics, and while social issues are discussed, they are not related to engineering specifically. That being said, explicitly linking the technical aspects of engineering to society is paramount in training effective problem solvers for the 21st century. With some exposure to multi-disciplinary, inter-disciplinary and trans-disciplinary approaches to engineering and design, students will be better prepared for their future careers in industry or research fields.

The functional requirements for the perceived solution were determined by the expected outcomes and what students should take away after experiencing the new educational product. Some of them are:

• students will be inspired and driven to seek opportunities in engineering for environmental, social, medical, and human development/poverty issues.

• students will be able to identify the issues that are emerging from new technology, how to mitigate the negative aspects and reduce the amount of impact, while leveraging the positive outcomes.

• students will have respect and knowledge of the importance of ethics and policy matters in the field of engineering and be able to determine between unethical and an ethical situation in a proactive manner.

The courses should overcome the challenges of the current engineering educational system. Approaching the degree from a holistic perspective. The integrated system that fosters collaboration among faculty and students. A new organizational and pedagogical model, which emphasizes knowledge integration and interweaves thematic content threads throughout the curriculum should be proposed.

- Foundations thread (math and science) Key mathematical concepts lay the foundation for understanding the anchoring concepts in courses throughout the ECE curriculum. The foundations thread unpacks mathematics and physics concepts to help students learn fundamentals in ECE topics like circuits, signals and systems, and electromagnetics. The foundations thread champion spearheads the collaboration between the math and ECE departments to introduce and promote the value and utility of mathematics in ECE courses, as well as the importance of mathematical thinking.
- Creativity thread (research, design, and optimization tools) The creativity thread is intended to integrate research and design throughout the undergraduate experience. By showing the impact of research, students will see the practical applications and potential breakthroughs of fundamental ECE concepts. Likewise, exposing students to design at every level of the undergraduate experience allows them to experience the excitement of engineering by applying their foundational knowledge to a tangible product.
- Professional formation thread (communications, cultural adaptability, ethics, leadership, and teamwork) Partnering with faculty and industry leaders to ensure students develop professional skills meaningfully and effectively to enhance student-industry interactions.

ELECTRICAL AND ELECTRONICS ENGINEERING

Agastya Samshita available at Prince's Library of Ujjain in India, dates back to the first millennium BC, contains a detailed description construction of an electric battery/cell along with way to utilize the battery to 'split' water into its constituent gasses. The method of generating electricity using modern battery cell resembles Agastya's method. The materials used by Sage Agastya for generating electricity were an earthen pot, copper plate, copper sulphate, wet saw dust, zinc amalgam. As quoted in Agastya Samhita the open circuit voltage and short circuit current of the prepared cell are 1.138 volts and 23 mA respectively. He articulates 100 earthen pots on water, has the power to change the form of water to oxygen and hydrogen. If hydrogen is contained in an air tight cloth, it can be used in aerodynamics, i.e. it will fly in air. In an iron vessel and in a strong acidic medium, gold or silver nitrate covers copper with a layer of gold or silver. The copper that is covered by gold is called Shatakumbha or artificial gold.

Rao Saheb Krishnaji Vajhe, an engineer from Pune while reading books related to science found the pages of Agastya Samhita with Damodar Tryambak Joshi of Ujjain. Dr. M. C. Sahastrabuddhe, the Head of the Sanskrit Department in Nagpur, when reading Agastya Samhita found the similarity of it with of Daniel Cell. He requested P.P. Hole, the Professor of Engineering at Nagpur to investigate on the same.

On the basis of the descriptions in Agastya Samhita Mr. Hole and his friend started preparing the apparatus for the experiment. While preparing the set up they could not understand the meaning of shikhigreeva and while checking the Sanskrit dictionary, they understood that it meant the neck of a peacock. They went to Maharaja Park and asked the chief when a peacock would die. The chief was very angry and asked them to give in an application. After few days during a conversation with an Ayurveda expert he confirmed that shikhigreeva is copper sulphate, which solved their problem. Thus, a cell was formed and it had an open circuit voltage of 1.38 volts and short circuit current of 23 milli amperes. The results of the experimentation were communicated to Dr. M.C. Sahastryabuddhe. It was exhibited fourth general meeting at the Swadeshi Vigyan Sanshodhan Sanstha, Nagpur on August 7, 1990 to the scholars. It was concluded that the description was of an electric cell

On the basis on Agastya Samhita and other scriptures, Rao Saheb Vajhe, who spent his life in rummaging the Indian scientific scriptures, gave different names to electricity. The six ancient terminologies for electricity are:

- Tadit—produced by friction from leather or silk,
- Saudamini—produced by friction from gems or glass,
- Vidyut— from clouds or steam,
- Shatakoti alias Shatakumbhi—produced from a battery of hundreds of cells,
- Hradini—obtained from storage cells,
- Ashani—the one emanating from a magnetic rod.

MECHANICAL ENGINEERING

Mechanical engineering is one of the oldest disciplines of engineering, which requires the knowledge of mathematics, materials, physics and other engineering technologies. It is concerned with materials, processes and machines and requires the concepts of forces, moments, energy, entropy, work etc. The developments that are visible in all spheres of life have connection to mechanical engineering. Engineering has made a significant contribution in the development of civilizations and contribution of mechanical engineering in areas like construction of large scale structures including for irrigation, architecture, military etc. is significant. Difficult problems of the society have been solved using simple concepts of mechanical engineering, say for eg. use of lever principle to move heavy objects. In fact, mechanical engineering made a significant contribution to the first cycle of industrial revolution, i.e., industrial revolution 1.0 during the 18th century. James Watt is often called the 'Father of Mechanical Engineering', as his invention of steam engine led to significant developments during the industrial revolution and beyond. The earliest computers were mechanical devices with electronics.

Significant contributions have been made during the Vedic ages and the first ever mechanical device that was invented was wheel and potter. Surmyam Suiramiva identified metals like Fe, Cu, Ag, Au etc., during the Vedic times. People knew about materials and material processing during those times and identified terminologies for the same in Sanskrit and produced gold and silver coins.

Seers like Tritala, Jalayan, Karaa, Vayurathaa and Vidyutrathaa discovered about aerodynamics during Rig Veda period, much before Wright Brothers discovered about aero planes. Computational Fluid Dynamics (CFD) analysis, which we are talking about today for different analysis, was there in the Vimana Shastra slokas.

Mechanical and manufacturing technology of ancient India ensured processing of natural products and their transformation into goods of trade, commerce and export.

Many scientists have made significant contributions to this domain. Leonardo da Vinci (16th century) studied and designed many mechanical systems that were related to transportation and warfare. In 17th century, Isaac Newton contributed the Laws of Motion used in several applications. Rudolf Diesel (18th century) was a German inventor, who created the first successful diesel engine and today diesel engines play a very important role in the transport and power sector in the world. Carl Frederich Benz (18th century) was a German automotive engineer, who developed the first practical automobile.

Mechanical engineering has evolved over the years and today the advent of computer and IT tools has facilitated better mechanical engineering in terms of design, analysis, and manufacturing. A mechanical engineer needs to work in multiple domains and needs to possess multiple skills like design, redesign, analyze, test, manufacture etc. It has been one of the founding disciplines of engineering and has contributed and will keep contributing to the growth and developments in this physical world.

CIVIL ENGINEERING

Indian civilization was the oldest civilization in the world and has a strong tradition of science and technology. It was the land of sages, seers, scholars, and scientists. Hinduism is a knowledge-based civilization, the Vedic texts should not be ignored dismissed as mythologies or as the work of imagination or just containing some moral stories. The Veda means knowledge and they contain relevant knowledge otherwise these texts would not have survived the millennia years of the historic storm. Let us know some of the great work done in ancient times.

Ancient India not only practised scientific methods of design and construction but also documented them for future generations. Here are some tips given by ancient sages on selection of site and construction

(1) Vishwakarma Vastu Shastra- Vishwakarma explains the first point of construction in the ancient book Vastu Shastra – 'पूर्व भूमिं परिक्ष्येत पश्चात् वास्तु प्रकल्पयेत्', This means that before construction one should test the land. Vishwakarma further says that construction should not be done on the land which is very mountainous or on land with large cracks.

Vastu shastra literally "science of architecture" are texts on the traditional Indian system of architecture. These texts describe principles of design, layout, measurements, ground preparation, space arrangement, and spatial geometry. The designs aim to integrate architecture with nature, the relative functions of various parts of the structure, and ancient beliefs utilising geometric patterns (yantra), symmetry, and directional alignments.

(2) Kashyap Shilpa (Craft) – In this ancient book, Kashyap Rishi has said that the foundation should be dug until water is seen because this way you would ensure that you have reached the rock level and the foundation would be strong.

(3) Bhrigu Samhita – In this scripture saint Bhrigu says that before buying land, one should test it for form, colour, juice, smell and touch. Rishi Bhrigu also explains its methods in his book.

Ancient cities of India found on the basis of archaeological discoveries:

- Rama was the world's first king to build a bridge across the sea. But he did not do it on his own. He sought the help of a great engineer called Nala according to Valmiki Ramayana. Any wise man will seek local knowledge when he ventures into new places. Nala knew the shallow areas across the sea in and around Tamilnadu. American space agency NASA also confirmed that there was a bridge through the satellite pictures. Any wise engineer will use such naturally elevated areas instead of deep waters to build a bridge.
- Bageeratha changed the course of the mighty river Ganges. The vast forest areas of modern Bihar, Uttar Pradesh, and West Bengal were made into fertile lands by his marvelous engineering feat. In those days very few people lived in those jungles. Puranas say that Bageeratha did penance for several thousand years to do this that too 'standing in one foot'. This is a phrase Indians use very often. Even the great Tamil poet Tiruvalluvar uses the simile of Stork that stands in one foot to catch a fish. This is the hidden language to say that he tried for a very long time with focused attention.
- Vedic Saint Agasthya discovered the land route to South India via Vindhyas. The Puranas say that he "subdued the arrogance of the hills", this is hidden language. Till Agastya's this great discovery kings and travellers used only sea routes. Since they knew the secret of monsoon winds they can travel to West Bengal or Maharashtra from Sri Lanka in a few months' time.
- Uparichara Vasu, an ancient king made mountain passes for the benefit of land travellers. He was a Vasu king ruling over the Chedi kingdom. Mahabharata says that he kicked the Kolahal Mountain which was blocking the flow of the Shaktimati River. This is a hidden language to say that he diverted the river for irrigation by cutting the hills.
- In short Bageerathan, Agastya, and Uparichara Vasu are the earliest engineers who built dams across the rivers. But unlike modern engineers, they did not use cement or mortar but they used the hills themselves. To avoid the force they made checks and balances. They use a hidden language saying that Shiva bore the force when Ganga came down from heaven.
- Parasuraman retrieved a lot of lands and gave it to Indians. A Pandya king called Nilam Tharu Vil Nediyon built sea walls to prevent the sea from invading the land.

- Balraman always travelled with an axe to clear the forests and make them cultivable. He was a great agriculturist. When Krishna spent most of his time in politics, his brother Balarama did constructive work.
- The Mohanjodaro, created 3000 years ago, is considered as a wonderful piece of civil engineering. Found in archaeological excavations even the ruins prove that this town was well settled and its buildings and roads – all were made using symmetry and geometrical measurements. The roads found in this city were straight and were made from east to west and north to south and surprisingly they were at an angle of 90 degrees from each other. Buildings were also constructed in proportion. The intersection of the corners, the heights of the walls was equal. The city had public buildings, gardens, a restaurant, a large public bath as well as residential buildings. There was a provision for bathroom, living room etc in the residential buildings. The public buildings were 11.82m long, 7.01m wide and 2.44m high, and there were two streams of water. The building material and bricks of the walls were coated with a substance on which there was no effect of water. Archaeological research shows that people living here were well-versed in the construction techniques.
- Indus Valley Cities such as Harappa, Mohanjadaro, Lothal, Dholavira, Kalibangan need no new interpretations. The well-laid cities with uniform brick structures, Great Bath, most hygienic drainage systems, grain storage barns, and wells are all already well known to the world.
- Dwarka, also known as Lord Krishna's city, also narrates a similar story. Dr S R Rao discovered Dwarka in the archaeological excavation and found that the ancient city (Dwarka Nagar) was well built and settled. There was a wall around the city. The stones used for the construction of buildings did not erode despite the fact that the city was very close to the sea. Two-storey buildings, roads and water system are also found in the city. Copper, bronze and some alloys with zinc mixed up to 34 percent have also been found during the excavation. The size of columns, windows, etc reveals that they were designed with a complete mathematical precision.
- South Indian Tamil saint Appar always travelled with a pickaxe to clear the bushes from the temple towers. He simply followed Balarama. Great Chola king Karikalan built a dam across river Cauvery in Kal Anai. The Grand Anicut was an engineering wonder of ancient Tamils. It was built around the 1st century AD. Big temples of India, the number of which runs into thousands, stand as monumental proof for the engineering skills of Indians. Mamallapuram and other Pallavacave temples are well-known milestones in Indian architecture.
- The Group of Monuments at Hampi are also recognized as a UNESCO World Heritage Site. The Vittala temple—the stone chariot – is the most iconic symbol of Hampi. The Virupaksha Temple at Hampi was built in the seventh century by the Chalukya rulers.

Virupaksha and Vithala Temple in Hampi

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NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Established under Section 3 of UGC Act 1956 **Off-Campus Centre, Nitte - 574 110, Karnataka,India**

Accredited with 'A+' Grade by NAAC

Scheme & Syllabus for
B. Tech. in Electronics Engineering
(VLSI Design and Technology)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERIN

2023-27

NITTE (Deemed to be University) | NMAM INSTITUTE OF TECHNOLOGY

Established under Section 3 of UGC Act 1956 **Off-Campus Centre, Nitte - 574 110, Karnataka,India**

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B. Tech. in Electronics Engineering

(VLSI Design and Technology)

CREDIT DISTRIBUTION

No.	Course Category	Credit Range	Suggested Credits
1.	Basic Science Courses (BSC)	18-23	22
2.	Engineering Science Courses (ESC)	10-15	13
3.	Emerging Technology Courses (ETC)	03-05	03
4.	Programming Language Courses (PLC)	03-05	03
5.	Professional Core Courses (PCC)	52 - 58	55
6.	Professional Elective Courses (PEC)	12-18	15
7.	Open Elective Courses (OEC)	6	6
8.	Humanities, Social Sciences and Management courses (HSMC)	09-15	12
9.	Ability Enhancement Courses (AEC)	9	9
10.	Mandatory Non-credit Courses (MNC)	Non-Credit	0
11.	Holistic Education Courses (HEC)	2	1
12.	Vocational Education Courses (VEC)	1	1
13.	Project Work (PROJ) (UCC)	10-12	10
14.	Internship (INT) (UCC)	8-12	10
15.	Note: **Student can register between 16 to 28 credits per semester**		**160**
	Total minimum Credits to be earned: 160		

Course Numbering Scheme

Branch Code		**Course Level**	**Course Code**			**Separator**	**Version**
Letter	**Letter**	**Number**	**Number**	**Number**	**Number**	**-**	**Number**
Branch Code	**ME** is 2 Letter code for the Department of Mechanical Engineering						
Course Level	Course Level is a 1-digit number that can have a value between 1-6 and indicates the dependency of the course on other courses. Level-1 courses are basic courses with no Engineering Courses as pre-requisites Level-2 course(s) have Level-1 course(s) as prerequisites Level-3 course(s) have Level-2 course(s) as prerequisites Level-4 course(s) have Level-3 course(s) as prerequisites						
Course Code	Course Code is a 3 Digit number that can have a value between 001-999 and indicates the number assigned to a course based on the alphabetical order of Course Name, as per the following rules 001-199 is assigned to Professional Core Courses 001-099 for Integrated Professional Core Courses [4 Credit] 100-199 for Professional Core Theory Courses [3 Credit] 201-499 for Professional Elective Courses 201-299 Electives under Group I 301-399 Electives under Group II 401-499 for future use 501-550 for Open Elective Courses 551 – 599 for Vocational Education Courses 601-650 for Professional Core Lab Courses [1 Credit] 651-699 for Ability Enhancement Courses 701-799 for Courses offered to Honours Program						
Separator	"**-**" is used as a separator between the Course code and the version						
Version	Version is a 1-digit number that can have a value between 1-9 and indicates minor revisions of the same course.						

B.Tech. (VT) Scheme

B.Tech. (VT): Scheme of Teaching and Examinations 2023-27
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023 - 24)

2nd Year Scheme

III SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	BSC	MA2004-1	Vector Calculus & Transform Techniques	MAT	3	0	0	0	03	50	50	100	3
2.	IPCC	VT2002-1	Electronic Devices and Technology	VT	3	0	2	0	03	50	50	100	4
3.	IPCC	VT2003-1	Digital Logic Design with Verilog	VT	3	0	2	0	03	50	50	100	4
4.	PCC	EC2105-1	Network Theory and Control Systems	EC	3	0	0	0	03	50	50	100	3
5.	PCC	EC2106-1	Signals and Systems	EC	3	0	0	0	03	50	50	100	3
6.	PCC	EC2602-1	Python Programming Lab	EC	0	0	2	0	03	50	50	100	1
7.	HSMC	HU2001-1	Enhancing Self Competence	HU	2	0	0	0	03	50	50	100	2
8.	MNC	HU1003-1	Kannada (Balake / Samskrithika)	HU	1	0	0	0	-	50	-	50	0
9.	HEC	HU1005-1	Essence of Indian Culture	HU	1	0	0	0	-	50	-	50	0
TOTAL					**19**	**0**	**6**	**0**	**21**	**450**	**350**	**800**	**20**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs													
10	MNC	MA1011 – 1	Bridge course – Calculus & Laplace Transforms	MA	3	0	0	0	3	100	0	100	0

IV SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	BSC	MA2008-1	Probability Theory and Numerical Methods	MAT	3	0	0	0	03	50	50	100	3
2.	IPCC	VT2001-1	Analog Electronic Circuits	VT	3	0	2	0	03	50	50	100	4
3.	IPCC	EC2004-1	Microcontrollers	EC	3	0	2	0	03	50	50	100	4
4.	PCC	EC2102-1	Electromagnetic Wave Theory	EC	3	0	0	0	03	50	50	100	3
5.	PCC	VT2102-1	Microfabrication and MEMS	VT	3	0	0	0	03	50	50	100	3
6.	PCC (Lab)	EC2601-1	Linear IC Applications Lab	EC	0	0	2	0	03	50	50	100	1
7.	HSMC	HU1004-1	Universal Human Values	HU	1	0	0	0	01	50	50	100	1
8.	AEC	ME1654-1	Innovation and Design Thinking	ME	1	0	0	0	01	50	50	100	1
9.	VEC	ECx5xx-1	Department specific Vocational Education Course	EC	0	0	2	0	03	50	50	100	1
10.	UCC	UC1001-1	Internship – I (Activity based Internship)		Mandatory Intra Institutional Activity based Internship of 2 weeks duration (80 - 90 h) to be completed during the vacations of I & II Semesters. Lateral entry students have to complete the Internship - I during the vacation of III semester					100	-	100	2
TOTAL					**17**	**0**	**8**	**-**	**23**	**550**	**450**	**1000**	**23**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs													
11	MNC	MA1013-1	Bridge course - Probability & Differential Equations	MA	3	0	0	0	3	100	0	100	0

B.Tech. (VT): Scheme of Teaching and Examinations 2023-27

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023 - 24)

3rd Year Scheme

V SEMESTER													
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**				**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical/ Drawing**	**PBL**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**	**J**					
1.	IPCC	EC3003-1	Digital Signal Processing	EC	3	0	2	0	3	50	50	100	4
2.	IPCC	VT3002-1	Embedded Systems	VT	3	0	2	0	3	50	50	100	4
3.	PCC	EC3101-1	CMOS VLSI Design	EC	3	0	0	0	3	50	50	100	3
4.	PCC (Lab)	VT3601-1	VLSI Lab	VT	0	0	2	0	3	50	50	100	1
5.	PEC	VTXXXX-1	Professional Elective-I [Group-1]	VT	3	0	0	0	3	50	50	100	3
6.	HSMC	HU1006-1	Introduction to IPR	Any Dept	1	0	0	0	1	50	50	100	1
7.	AEC	ECx6xx-1	Program Specific Ability Enhancement Course	EC	1	0	2	0	3	50	50	100	2
		HU1010-1	Research Methodology	Any Dept	2	0	0	0					
8.	AEC	HU1007-1	Social Connect & Responsibility	Any Dept	1	0	0	0	1	50	50	100	1
9.	AEC	UM1003-1	Employability Skill Development	EC	1	0	0	0	-	50	-	50	1
			TOTAL		**16/ 17**	**0**	**8/6**	**-**	**20**	**450**	**400**	**850**	**20**

VI SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	IPCC	VT3003-1	Scripting Languages for VLSI	VT	3	0	2	0	3	50	50	100	4
2.	PCC	VT3102-1	Semiconductor Packaging and Testing	VT	3	0	0	0	3	50	50	100	3
3.	PCC (Lab)	EC3603-1	System Verilog Lab	EC	0	0	2	0	3	50	50	100	1
4.	PEC	VTXXXX-1	Professional Elective - II [Group-1]	VT	3	0	0	0	3	50	50	100	3
5.	PEC	VTXXXX-1	Professional Elective - III [Group-2]	VT	3	0	0	0	3	50	50	100	3
6.	OEC	XXX5XX-1	Open Elective –I	Any Dept	3	0	0	0	3	50	50	100	3
7.	HSMC	MG1004-1	Operations Research and Project Management	EC	3	0	0	0	3	50	50	100	3
8.	AEC	HU1008-1	Life Skills for Engineers	Any Dept	1	0	0	0	1	50	50	100	1
TOTAL					**19**	**0**	**4**	**-**	**22**	**400**	**400**	**800**	**21**

B.Tech. (VT): Scheme of Teaching and Examinations 2023-27

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023 - 24)

4th Year Scheme

VII SEMESTER

Sl. No.	Course and Course code		Course Title	Teaching Dept.	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hr	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1.	IPCC	VT3006-1	VLSI Testing and Verification	VT	3	0	2	0	3	50	50	100	4
2.	PCC (Lab)	VT3602-1	Semiconductor Memory Design Lab	VT	0	0	2	0	3	50	50	100	1
3.	PEC	VTXXXX-1	Professional Elective – IV [Group-1]	VT	3	0	0	0	3	50	50	100	3
4.	PEC	VTXXXX-1	Professional Elective – V [Group-2]	VT	3	0	0	0	3	50	50	100	3
5.	OEC	XXX5XX-1	Open Elective –II	Any Dept	3	0	0	0	3	50	50	100	3
6.	HSMC	MG1003-1	Management & Entrepreneurship	EC	3	0	0	0	3	50	50	100	3
7.	HEC	HU1009-1	Indian Knowledge Systems	Any Dept	1	0	0	0	-	50	-	50	1
8.	UCC	UC3001-1	Major Project Phase I	EC	-	-	4	-	-	100	-	100	2
TOTAL					**16**	**0**	**8**	**-**	**18**	**450**	**300**	**750**	**20**

VIII SEMESTER													
Sl. No.	**Course and Course code**		**Course Title**	**Teaching Dept.**	**Teaching Hours/Week**				**Examination**				**Credits**
					Theory Lecture	**Tutorial**	**Practical /Drawing**	**PBL**	**Duration in hr**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**	**J**					
1.	UCC	UC2001-1	Internship- II (Societal internship and Research/Industry Internship)	Any	Mandatory Societal internship for 2 weeks (80 – 90 h) and Research Internship / Industry Internship of 6 weeks (240 – 270 h) or Research Internship / Industry internship for a total of 8 weeks (320 – 360 h)to be completed in one/two stretches during the vacation periods between IV to VII semesters				3	50	50	100	8
2.	UCC	UC3002-1	Major Project	VT	Student should carry out project in research institute/industry/intra institute Canter of Excellences. Two contact hours /week for interaction between the project guide and students.				3	100	100	200	8
TOTAL					**-**	**-**	**-**	**-**	**6**	**150**	**150**	**300**	**16**

Department Specific Vocational Education Courses [VEC]	
Course Code	**Course Title**
VT2551-1	Data Analysis using Excel
EC3552-1	Introduction to PCB Design and Fabrication

Program Specific Ability Enhancement Courses [AEC]	
Course Code	**Course Title**
ME1659-1	Research Methodology
EC2651-1	Technical Content Writing
EC3651-1	Circuit Simulation using SPICE
EC3652-1	Problem Solving using MATLAB
EC3653-1	Problem Solving using SIMULINK

List of Professional Elective Courses [PEC]			
Microelectronics Circuits			
Group-1		**Group-2**	
VT4201-1	Analog CMOS Design	EC4332-1	Mixed Signal Design
VT4202-1	CMOS RF Circuits	VT4301-1	Communication Systems and Circuits
Microelectronic Systems			
Group-1		**Group-2**	
VT3202-1	Internet of Things and Applications	VT4302-1	Cyber Physical System Security
VT3206-1	System on Chip	EC4331-1	Low Power VLSI
Semiconductor Devices			
Group-1		**Group-2**	
VT3203-1	Semiconductor Devices Modelling and Simulation	**VT3303-1**	Semiconductor Materials Synthesis and Characterization
VT3201-1	Heterojunction Device Physics	VT3302-1	Nanoelectronics and Technology
VT3205-1	Semiconductor Optoelectronics		
Semiconductor Design Automation and IT			
Group-1		**Group-2**	
EC2272-1	Data Structures and Algorithms	VT3301-1	CAD for VLSI
EC2371	Object Oriented Programming in JAVA	VT4302-1	Machine Learning for VLSI
EC3272-1	Mobile Application Development	EC3261-1	Artificial Intelligence
Semiconductor Manufacturing			
Group-1		**Group-2**	
VT3204-1	Semiconductor Equipment Design and Technology	VT4303-1	Reliability Engineering (NPTEL/MOOC)
		VT4301-1	Lab/MOOC Virtual Lab
Embedded Systems			
Group-1		**Group-2**	
EC2221-1	Computer Operating Systems	EC3321-1	Embedded Linux
EC3211-1	DSP Processors and Architectures	EC2242-1	e-Vehicle Technology
EC3322-1	Real Time Operating Systems		

Basic Science Courses

VECTOR CALCULUS & TRANSFORM TECHNIQUES

Course Code:	**MA2004-1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**MA1001-2**		

Teaching Department: Mathematics

Course Objectives:

1.	Apply operators like gradient, divergence and curl to both scalar as well as vector functions.
2.	Evaluate surface and volume integrals in terms of line integrals using various integral theorems.
3.	Identify the functions in engineering problems as analytic function and their study as a function of a complex variables.
4.	Study Cauchy's theorem and formulae, and specify some difficult integration that appear in applications can be solved by complex integration.
5.	Perform Fourier analysis on non-sinusoidal periodic signals and apply Z-transform technique to solve difference equations.

UNIT-I

Vector Calculus — **15 Hours**

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

Vector integration: Line, surface & volume integrals. Green's, Gauss divergence & Stoke's theorems and applications.

UNIT-II

Theory of Complex Variables — **15 Hours**

Functions of complex variables, Cauchy Riemann equations, properties of analytic functions, conformal mapping, bilinear transformations.

Line integrals in complex plane, Cauchy's theorem, Cauchy's integral formula. Power series, Taylor's and Laurent's series. Residues, Cauchy's residue theorem. Evaluation of standard real integrals using contour integration.

UNIT-III

Fourier Series & Z-Transforms — **10 Hours**

Periodic functions, Euler's formulae, Trigonometric Fourier series.

Z transforms: Z-transforms of standard functions, Bilateral Z- Transform. ROC, linearity, Time shift, Convolution, Scaling & Differentiation in Z-Domain, Time reversal property, Initial and Final Value Theorems.

Inverse Z-transform: Partial Fraction Method, Power series/ division method, Contour integral Method.

Unilateral Z-Transform: Properties, Solution of difference equations.

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

1.	Solve the vector functions and their derivatives for engineering applications.
2.	Demonstrate the applications of Gauss divergence and Stoke's theorem.
3.	Solve Engineering problems using complex variable techniques.
4.	Illustrate the concept of complex variables and line integrals in complex plane.
5.	Apply the analytical technique to express periodic function as a Fourier sine and cosine Series and apply the concepts of Z- transforms to solve engineering problems.

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
MA2004-1.1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2004-1.2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2004-1.3	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2004-1.4	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2004-1.5	2	3	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. B. S. Grewal, "Higher Engineering Mathematics", 43rd edition.
2. Kreysizg, "Advanced Engineering Mathematics", John Wiley and Sons, 6th Edition.

REFERENCE BOOKS:

1. Wylie Ray, "Advanced Engineering Mathematics", 6th edition, McGraw Hill.Inc.
2. Murray R. Spiegal, "Vector Analysis", Schuam Publishing Co.

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

PROBABILITY THEORY AND NUMERICAL METHODS

Course Code:	**MA2008-1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisites	**MA1001-1**		

Teaching Department: Mathematics

Course Objectives:

1. Understand the concept of probabilistic models for situation involving chance effect.
2. Study different types of probability distributions.
3. Apply interpolation technique in real life problems
4. Apply numerical differentiation and integration methods, where the function is a
5. Complicated expression or given in terms of tabular values or not possible to evaluate

UNIT-I

Probability Theory **15 Hours**

Finite sample space, probability and conditional probability and independence, Bayes' theorem. One dimensional random variable: discrete and continuous random variable, probability functions, cumulative distribution function, expectation and variance. Two Distributions: Binomial, Poisson, Normal and exponential distributions

UNIT-II

Finite Differences and Interpolation **15 Hours**

Finite differences: forward, backward and central difference operators, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula, Lagrange's Inverse interpolation formula. Newton's divided difference interpolation formula.

Numerical Differentiation: Numerical differentiation using Newton's forward & backward formulae.

Numerical integration: General quadrature formula, Trapezoidal rule, Simpson's one third rule, Simpson's three eighth rule.

UNIT-III

Numerical Methods **10 Hours**

Solution of algebraic and transcendental equations: Regula falsi Method and Newton Raphson Method.

Numerical solution of ordinary differential equations: Taylor's series method, modified Euler's method and 4th order Runge –Kutta method, Predictor-Corrector methods

Numerical solution of partial differential equations: Solution of Laplace and Poisson equations by standard five point formulae, solution of heat and wave equations.

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

1. Demonstrate and appreciate probabilistic models for situations involving chance

	effect.
2.	Illustrate the applications different types of distributions for engineering problems.
3.	Using finite differences and interpolation technique in solving real life problems
4.	Understand the numerical differentiation and integration methods and be able to apply these methods to solve engineering problems
5.	Apply numerical methods to solve partial differential equations.

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
MA2008-1.1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2008-1.2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2008-1.3	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2008-1.4	2	3	-	-	-	-	-	-	-	-	-	-	-	-
MA2008-1.5	2	3	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. B. S. Grewal, “Higher Engineering Mathematics”, 43rd Edition, Khanna publishers, 2012.
2. P. L. Meyer, “Introduction of probability and Statistical applications”, Second Edition, American Publishing Co., 1975.

REFERENCE BOOKS:

1. Kreysizg, “Advanced Engineering Mathematics“, John Wiley and Sons, 6th Edition.
2. S. S. Sastry, “Introductory methods of Numerical Analysis“, 2nd Edition, Prentice Hall, 1990.
3. Wylie Ray, “Advanced Engineering Mathematics”, 6th Edition, McGraw Hill.Inc

ELECTRONIC DEVICES AND TECHNOLOGY

Course Code:	**VT2002-1**	**Course Type**	**IPCC**
Teaching Hours/Week (L: T: P: S)	**3:0:2:0**	**Credits**	**04**
Total Teaching Hours	**40+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1. Understand the fabrication process of semiconductor devices.
2. Understand the semiconductor device physics and their models.
3. Understand the working of optoelectronic devices and variations in the construction of semiconductor devices.

UNIT-I

Diode and Bipolar Junction Transistor — **15 Hours**

Integrated Professional Core Courses

Fabrication Processes: Thermal Oxidation, Diffusion, Rapid Thermal Processing, Ion implantation, chemical vapor deposition, photolithography, Etching, Metallization, Fabrication of diode. Intrinsic Semiconductors, Doped Semiconductors, Drift Current, Diffusion Current, Einstein relationship.

The PN-Junction: structure, depletion region, built-in voltage, width of the depletion region, pn Junction with forward bias, diode current, Reverse breakdown: Avalanche and Zener breakdown, depletion Capacitance, Diffusion Capacitance. Diode Characteristics, diode models, diode clippers and clampers.

Optoelectronic Devices: Photodiodes, Current and Voltage in an Illuminated Junction, Solar Cells, Photodetectors, Light Emitting Diode, Light Emitting material.

UNIT-II

Metal Oxide Semiconductor Field Effect Transistor — **15 Hours**

Fabrication of MOSFET, MOSFET operation, Current–Voltage Characteristics, Channel Length Modulation, Trans-conductance, Other 2nd order effects, PMOS transistor(Text 2)

MOS device Models: Large-Signal Model, Small-Signal Model, MOSFET internal capacitances and High frequency model, Transit Frequency.

Construction and working of GaAs MESFET, High Electron Mobility Transistor(HEMT), MISFET SOI MOSFET, FiNFET.

UNIT-III

Bipolar Junction Transistor — **10 Hours**

Fabrication of BJT, BJT working, current components, common emitter configuration, VI characteristics, operation in the active and saturation mode, BJT models: Large-Signal Model, Concept of Transconductance, Small-Signal Model, Early Effect, High-Frequency Model of Bipolar Transistor, Transit Frequency.
Other BJT models: Eber's-Moll Model, re-model and h-model for CE mode(qualitative)

Suggested List of Experiments

1. Half wane and Bridge rectifier with and without filter.
2. Zener voltage regulator
3. Design of Regulated power supply.
4. Diode Clippers and Clampers
5. Characteristics of optoelectronic devices: LDR, Photodiode, Solar cell.
6. Characteristics of Diode, BJT, MOSFET and find the model parameters.

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

1. Know the fabrication processes in semiconductor technology.
2. Understand the physics, characteristics and device models of diode and other types of diodes.
3. Know the fabrication of MOSFET, understand the physics and characteristics of MOSFET.
4. Understand the device models of MOSFET, to know the different types of FETs.
5. Know the fabrication of BJT, understand the physics, characteristics and device models of BJT.

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
VT2002-1.1	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2002-1.2	3	3	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2002-1.3	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2002-1.4	3	3	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2002-1.5	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Ben. G. Streetman, Sanjay Kumar Banergee, "Solid State Electronic Devices", 7th Edition, Pearson Education, 2016
2. Behzad Razavi, "Fundamentals of Microelectronics", PHI, 1999

REFERENCE BOOKS:

1. A.S. Sedra, K.C Smith, "Microelectronic circuits", Oxford University Press, 6th Edition 2004
2. Donald A Neamen, Dhrubes Biswas, "Semiconductor Physics and Devices", 4th Edition,MC Graw Hill Education, 2012, ISBN 978-0-07-107010-2
3. Kanaan Kano, "Semiconductor Devices", PHI, 2009
4. S.M.Sze, Kwok K. Ng, "Physics of Semiconductor Devices", 3rd Edition, Wiley, 2018

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/122106025/2
2.	https://nptel.ac.in/courses/117106091/
3.	https://www.mooc-list.com/tags/electronic-devices

ANALOG ELECTRONIC CIRCUITS

Course Code:	**VT3001-1**	**Course Type**	**IPCC**
Teaching Hours/Week (L: T: P: S)	**3:0:2:0**	**Credits**	**04**
Total Teaching Hours	**40+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1, VT2002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand the use of BJT in designing discrete voltage amplifiers.
2.	To understand the structure and operation of MOSFET.
3.	To know the design and operation of MOSFET amplifiers.
4.	To understand the working of Current Mirrors, Differential Amplifiers, and their use in construction of an Op-amp.

UNIT-I

BJT and MOS Amplifiers	**15Hours**

DC operating Point, CE Amplifier, Emitter-follower Configuration, small signal analysis of CE core, CE with degeneration.

MOS amplifier topologies, CS stage: CS core, current source load, triode load, CS stage with source degeneration, source follower, Cascode stage.

UNIT-II

Current Mirrors, Differential Amplifiers, Frequency response	**15 Hours**

MOS current mirror, active current mirrors. MOS differential pair, small signal analysis, cascode differential amplifier, common mode rejection, Differential pair with active loads,

Frequency Response: General considerations, relation between transfer function and frequency response, Bode’s rule, association of poles with nodes, Miller’s theorem, frequency response, input output impedance of CS stage and source follower.

UNIT-III

Feedback, Oscillators and Power Amplifiers	**09 Hours**

Feedback: General considerations, types and effects of feedback, Feedback topologies, practical amplifier circuits with feedback

Ring Oscillators,

Power amplifiers: Class A, Class B, efficiency, class AB, push-pull amplifiers, distortions in amplifiers.

Suggested List of Experiments

1	Design of BJT Bias circuits for the given operating point.
2	Design of CE amplifier for the given specification of gain and impedance [with & without bypass].
3	Design of Emitter follower for the impedance match.
4	Simulation of CS and CD Amplifiers.
5	Simulation of Current Mirrors, Differential Amplifier.
6	Simulation of Class A and Class B Output stage.

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

1.	Examine the given BJT amplifier circuit and compute the DC operating point, Voltage gain, Input and output impedances.
2.	Examine the given MOSFET amplifier circuit and compute the DC operating point, Voltage gain and input- output impedance

3.	Analyse differential amplifiers and current mirror
4.	Determine the transfer function of amplifier circuit.
5.	Identify type of feedback, topologies, explain class of amplifier operation, power amplifiers.

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
VT2001-1.1	3	3	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2001-1.2	3	3	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2001-1.3	3	3	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2001-1.4	3	3	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2001-1.5	3	3	-	-	3	-	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Behzad Razavi, “Fundamentals of Microelectronics”, 2nd Edition, Wiley, 2014.
2.	Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson 2011.

REFERENCE BOOKS:

1.	Adel S. Sedra and Kenneth C. Smith, “Microelectronic circuits”, 7th Edition, Oxford University Press, 2014.
2.	Donald A. Neaman, “Microelectronics: Circuit Analysis and Design”, 4th Edition, McGraw Hill, 2009.
3.	Thomas F. Schubert Jr. and Ernest M. Kim, "Fundamentals of Electronics: Book 1: Electronic Devices and Circuit Applications", Synthesis Lectures on Digital Circuits and Systems Series, Morgan & Claypool Publishers 2015.
4.	Thomas F. Schubert Jr. and Ernest M. Kim, "Fundamentals of Electronics: Book 2: Amplifiers: Analysis and Design", Synthesis Lectures on Digital Circuits and Systems Series, Morgan & Claypool Publishers 2015.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/108102112
2.	https://nptel.ac.in/courses/108105158
3.	https://nptel.ac.in/courses/108106084

DIGITAL LOGIC DESIGN USING VERILOG

Course Code:	**VT2001-1**	**Course Type**	**IPCC**
Teaching Hours/Week (L: T: P: S)	**3:0:2:0**	**Credits**	**04**
Total Teaching Hours	**40+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1002-2**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Know Verilog as HDL, its structure, data types and operators, logic synthesis and simulation.
2.	To introduce Gate level modeling, Dataflow level modeling, Behavioral modeling in Verilog and its application.
3.	To introduce HDL modeling of Digital system design and its application.
4.	Understand Testing, verification, basics of FPGA based design.

UNIT-I

Introduction to Verilog HDL **15 Hours**

Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis Tools, Verilog data types and operators, HDL Models: Data flow model, Gate level and Behavioral model, Verilog construct for initial, always, wait, case, IF, IF-then-Else, Loop, Task and Functions, files, directives, user defined primitives, Verilog modelling of basic digital Circuits.

UNIT-II

Modeling Combinational and Sequential Circuits **15 Hours**

Design of Combinational circuits: Design of combinational circuits: HDL modeling of combinational circuits, Datapath circuits: Adder, ALU, Comparator, Multipliers

Design of Sequential circuits: HDL modeling of Shift Registers, Counters: asynchronous Synchronous counters, basic RAM

UNIT-III

Fault Diagnosis and Finite State Machines **09 Hours**

Fault Diagnosis: Introduction, Fault-classes, Tests generation using Fault Table Method and Path-Sensitization Methods, Test bench for Combinational Circuits.

Finite State Machines: Moore and Mealy machines, Design and modeling of FSM using Verilog. Examples: Serial Adder, Sequence generators, sequence detectors.

Suggested List of Experiments

1	Introduction to Xilinx Software.
2	Circuit implementation using Verilog (Dataflow, Gate level and Behavioral).
3	Introduction to FPGA.
4	FPGA implementation of Combinational circuits.
5	FPGA implementation of Sequential circuits.
6	FPGA implementation of combinational and sequential circuits using Gate level style.
7	Verilog implementation of System Tasks and Functions, File-Based Tasks and Functions, Computer Directives.

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

1.	Describe Verilog hardware description language (HDL)
2.	Write Verilog code for digital circuits using dataflow, behavioral and structural models verify the functionality.
3.	Write Verilog code and test bench programs for datapath digital circuits and verify the

	functionality.
4.	Write Verilog code and test bench programs for sequential digital circuits and verify the functionality.
5.	Understand fault diagnosis, write Verilog code and test bench programs for finite state machines and verify the functionality.

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**
VT2001-1.1	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT2001-1.2	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT2001-1.3	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT2001-1.4	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT2001-1.5	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	T. R. Padmanabhan, B. Bala Tripura Sundari, “Design through Verilog HDL”, Wiley-IEEE Press, 2003.
2.	Zainalabedin Navabi, “Verilog Digital System Design”, McGraw-Hill, 2nd Edition,2005.
3.	Samir Palnitkar, “Verilog HDL”, 2nd Edition, Pearson Education, 2009.

REFERENCE BOOKS:

1.	Pong P. Chu, “FPGA Prototyping by Verilog examples”, Wiley
2.	Michael D. Ciletti, “Advanced Digital Design with Verilog HDL”, PHI, 2009.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/106105165

DIGITAL SIGNAL PROCESSING

Course Code:	**EC3003-1**	**Course Type**	**IPCC**
Teaching Hours/Week (L: T: P: S)	**3:0:2:0**	**Credits**	**04**
Total Teaching Hours	**40+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC2106-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Understand the concept of Frequency Domain Sampling, Computation of DFT and properties of DFT.
2.	Understand Linear Filtering methods using Overlap Add and Overlap Save Algorithms.
3.	Understand the Fast Fourier Transform using Radix 2 DITFFT and DIFFFT Algorithms.
4.	Design and Analyze the characteristics of Analog filters using Butterworth & Chebyshev approximation techniques.
5.	Design Digital Filters using Bilinear transformation Technique.
6.	Design Linear phase FIR filters using windowing and frequency sampling technique.
7.	Implement digital filters using various structures
8.	Understand architecture of DSP Processors and Filter Implementations using Fixed Point DSP processors.

UNIT-I

Discrete Fourier Transform, Fast Fourier Transform	**16 Hours**

Discrete Fourier Transform (DFT), DFT as a linear Transformation, Properties of DFT (derivation not included); Overlap-save and Overlap-add method; Decimation in Time FFT (DITFFT) algorithm and In-place computations, Decimation in Frequency FFT (DIFFFT) algorithm. Inverse Fast Fourier Transforms.

UNIT-II

Design of Infinite Impulse Response (IIR) Digital Filters, Design of Finite Impulse Response (FIR) Filters	**15 Hours**

IIR Butterworth and Chebyshev Filter Design by Impulse Invariance and Bilinear Transformation. IIR Filter structures (Direct Form I & Direct Form II). Design of FIR filters using windows, Design of FIR filters using Frequency Sampling method, FIR Filter Structures (Linear phase & Lattice structure).

UNIT-III

Digital Signal Processors	**09 Hours**

DSP Architecture, DSP Hardware Units, Fixed point format, Floating point Format, IEEE Floating point formats, Fixed point digital signal processors, Floating point processors, FIR and IIR filter implementations in Fixed point systems

Suggested List of Experiments

1	(i) Verification of Sampling theorem (ii) Finite and Infinite Response of an LTI System
2	Computation of N point DFT of a given sequence and to plot Magnitude and Phase Spectrum.
3	Linear & Circular Convolution of two given sequences.
4	Linear & Circular Convolution of two given sequences using DSP Kit
5	(i) Computation of N point DFT of a given sequence using DSP Kit. (ii) Impulse response of a given system of first and second order using DSP Kit.
6	Verification of DFT properties: i) Frequency shift ii) Time shift iii) Linearity iv) Auto Correlation & Cross Correlation

	v) Parseval's Theorem
7	Design and implementation of FIR filter to meet the given specifications using Rectangular /Bartlett /Hanning /Hamming/Blackman window for the following types of filters, i) LPF ii) HPF iii) BPF iv) BSF
8	Design and Implementation of Analog and Digital IIR filter to meet the given specifications for the following types of filters, i) LPF ii) HPF iii) BPF iv) BSF

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

1.	Develop representations for signal analysis and synthesis using DFT and its properties.
2.	Build and apply algorithms using Overlap Add Method and Overlap Save Method for sequences of length not more than 20 and faster algorithms Radix 2 DITFFT and Radix 2 DIFFFT to compute DFT.
3.	Make use of Butterworth & Chebyshev approximations to design and implement analog and digital IIR Filters.
4.	Design & implement FIR Filters using windowing and Frequency sampling approaches.
5.	Identify architectural features of Fixed point DSP processors and plan the implementation of Filters.

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**
EC3003-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
EC3003-1.2	3	-	-	-	-	1	-	-	-	-	-	-	3	-	-
EC3003-1.3	3	-	1	-	1	-	-	-	-	-	-	-	3	2	-
EC3003-1.4	3	-	1	-	1	-	-	-	-	-	-	-	3	2	-
EC3003-1.5	3	-	-	-	-	1	-	-	-	-	-	-	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Proakis, Manolakis, "Digital Signal Processing – Principles Algorithms & Applications", PHI, 4th Edition, New Delhi, 2007.
2.	Li Tan, "Digital Signal processing – Fundamentals and Applications", Academic Press, 2008.
3.	Avtar Singh and S Srinivasan, "Digital Signal Processing", Thomson Publishing, 2004.

REFERENCE BOOKS:

1.	Oppenheim and Schaffer, "Discrete Time Signal Processing", PHI, 2003.
2.	S. K. Mitra, "Digital Signal Processing", Tata McGraw Hill, 2nd Edition, 2004.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/117102060

MICROCONTROLLERS

Course Code:	**EC2004-1**	**Course Type**	**IPCC**
Teaching Hours/Week (L: T: P: S)	**3:0:2:0**	**Credits**	**04**
Total Teaching Hours	**40+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1, EC1002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

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

UNIT-I

Introduction to 8-bit Microcontroller — **16 Hours**

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

UNIT-II

Microcontroller Peripheral Modules — **15 Hours**

Programming 8051 I/O port, I/O interfacing examples using C programs (LED, Switch and Seven segment LED using multiplexing technique), 8051 Timers/Counters in Mode1 & Mode 2, Timer Programming examples using C, Serial Communication, Example C programs on serial communication and External Interrupts, timer interrupts and serial communication interrupts with example programs. I2C and SPI communication protocols

UNIT-III

Introduction to ARM processor — **09 Hours**

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

Suggested List of Experiments

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

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

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

4.	Describe the architecture of ARM processor and instruction formats.
5.	Analyze the working of instruction execution in ARM processor.

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**
EC2004-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
EC2004-1.2	3	1	-	-	3	-	-	-	-	-	-	-	3	3	1
EC2004-1.3	3	1	-	-	3	-	-	-	-	-	-	-	3	3	1
EC2004-1.4	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
EC2004-1.5	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay, "The 8051 Microcontroller and Embedded Systems – using assembly and C", PHI, 2006 / Pearson, 2006.

2. Steve Furber, "ARM System Architecture", Edison Wesley Longman 1996.

REFERENCE BOOKS:

1. Kenneth J. Ayala, "The 8051 Microcontroller", 3rd Edition, Thomson/Cengage Learning.

2. William Hohl, "ARM Assembly Language – Fundamentals and Techniques", CRC Press , 2009.

E Books / MOOCs/ NPTEL

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

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

EMBEDDED SYSTEMS

Course Code:	**VT3002-1**	**Course Type**	**IPCC**
Teaching Hours/Week (L: T: P: S)	**3:0:2:0**	**Credits**	**04**
Total Teaching Hours	**40+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC2004-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

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

UNIT-I

Introduction **16 Hours**

Introduction to embedded systems, Concept, Embedded System Design Issues.
RISC Principles, MIPS Architecture, SPARC Architecture, PowerPC Architecture, Itanium Architecture, ARM Architecture.

UNIT-II

ARM processor Fundamentals **15 Hours**

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

UNIT-III

Operating system for Embedded System **09 Hours**

ARM: Exception and Interrupt Handling, Assembly Language Programming and interfacing.
Introduction to Operating system for Embedded System.

Suggested List of Experiments

1	Writing embedded C program to interface I2C based temperature sensor with LPC176x ARM Processor.
2	Interfacing stepper motor using LPC176x ARM processor.
3	Interfacing analog sensors (pressure, light or strain) with LPC176x ARM processor and writing embedded C program for ADC.

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

1.	Apply the concept of embedded systems to understand and differentiate RISC/CISC, MIPS architecture.
2.	Apply the knowledge of ARM architecture and organization for modern ARM devices.
3.	Understand and apply the concept of Exception and interrupt Handling
4.	Describe the architecture of ARM processor and instruction formats.
5.	Use the concepts of Embedded operating System for designing OS based application.

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**
EC2004-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-

EC2004-1.2	3	1	-	-	3	-	-	-	-	-	-	-	3	3	1
EC2004-1.3	3	1	-	-	3	-	-	-	-	-	-	-	3	3	1
EC2004-1.4	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
EC2004-1.5	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Andrew N. Sloss, Dominic Symes, Chris Wright, “ARM System Developer's Guide Designing and Optimizing System Software", Morgan Kaufmann publications, 1st Edition, 2004.

2. Steve Furber, "ARM system on chip Architecture", Person Education Addison Wesley, 2nd Edition, 2000.

REFERENCE BOOKS:

1. Sivarama P. Dandamudi, "Guide to RISC Processors for Programmers and Engineers", Springer, 2005.

2. Steve Heath, Butterworth Helnemann, "Embedded System Design" , 2nd Edition, 2002.

3. Jean J. Labrosse, "Micro C/OS II The Real Time Kernel", CMP Books, 2nd Edition , 2002.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/106104128

VLSI TESTING AND VERIFICATION

Course Code:		**Course Type**	**IPCC**
Teaching Hours/Week (L: T: P: S)	**3:0:2:0**	**Credits**	**04**
Total Teaching Hours	**40+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1, EC1002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	The role of testing and verification in VLSI Development Process.
2.	An understanding on the functional and block level verification techniques in VLSI development process.
3.	To learn about Universal Verification Methodology Concepts to verify Design-Under Test (DUT)

UNIT-I

Introduction to Verification in VLSI Development process — **15 Hours**

Introduction: VLSI development process, role of testing and verification, verification methodology, Types of Design Verification - Functional Verification, Simulation Emulation Testing and verification: how to test chips? VLSI Technology Trends Affecting Testing.

Block-level Verification. Functional Verification through simulation. White box, black box and grey box testing. Verilog/VHDL test bench for functional verification

UNIT-II

Introduction to UVM — **15 Hours**

UVM Basics: The Structure of UVM testbenches and components, UVM Library Basics, the basic concepts and components that make up a standard reusable interface environment.

UVC development and Usage, The creation of simple testbenches, Various techniques for sequence and randomization control.

Advanced Concepts: A methodology and automation to enable productive and reusable register related verification logic. How to wrap device specific logic and reuse it in block, sub-system and system integration.

UNIT-III

SV/UVM Verification Practice Examples — **10 Hours**

Testbench Connection Examples, Messaging Example, Sequence Example, Analysis Example, Register Example, Functional Coverage Example, Testbench Build Example, Slave agent Example.

Suggested List of Experiments

1	Write Verilog/VHDL test bench for functional verification of a given Design-Under Test(DUT).
2	Write a code to demonstrate transaction methods.
3	Write a code to demonstrate stimulus generator class.
4	Write a code to build re-usable self checking scoreboards by using the in-built UVM comparator classes. constrained random stimulus, coverage, strings, queues and dynamic arrays.
5	Write code to verify Design-Under Test (DUT) using SV and UVM

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

1.	Understand the role of testing and verification, verification methodology, Types of Design Verification.

2.	Understand the Testing and Verification Methods.
3.	Understand the concept of UVM and verify DUT using SV and UVM
4.	Understand system Verilog and UVM
5.	Develop testbenches independently

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**
EC2004-1.1	3	-	-	-	3	-	-	-	-	-	-	-	3	3	-
EC2004-1.2	3	1	-	-	3	-	-	-	-	-	-	-	3	3	1
EC2004-1.3	3	1	-	-	3	-	-	-	-	-	-	-	3	3	1
EC2004-1.4	3	-	-	-	3	-	-	-	-	-	-	-	3	3	-
EC2004-1.5	3	-	-	-	3	-	-	-	-	-	-	-	3	3	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Chris Spear, "SystemVerilog for Verification: A Guide to Learning the Testbench Language Features", 2nd Edition, Springer, 2008
2.	Sharon Rosenberg, Kathleen Meade, “A practical guide to adopting Universal Verification Methodology”, Cadence Design Systems – USA.

REFERENCE BOOKS:

1.	UVM CookBook - by Siemens
2.	Mike Mintz, Robert Ekendahl, "Hardware Verification with System Verilog- An object-oriented framework", Springer, 2007.
3.	Janick Bergeron, “Writing Testbenches using System Verilog”, Springer, 2005.

E Books / MOOCs/ NPTEL

1.	https://www.doulos.com/knowhow/systemverilog/systemverilog-tutorials/
2.	https://www.youtube.com/SystemVerilog

SCRIPTING LANGUAGES FOR VLSI

Course Code:	**VT2003-1**	**Course Type**	**IPCC**
Teaching Hours/Week (L: T: P: S)	**3:0:2:0**	**Credits**	**04**
Total Teaching Hours	**40+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CS1002-1, CS1004-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand the concepts of scripting languages for developing web-based projects
2.	To Illustrates object-oriented concepts like TCL, PERL
3.	To understand security issues.
4.	To learn the concept of verification.

UNIT-I

Introduction to Scripting and PERL	**15 Hours**

Origin of Scripting, Scripting Today, Characteristics of Scripting Languages, Uses for Scripting Languages

PERL: Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, Basics I/O, regular expressions, Functions

UNIT-II

TCl ad TK	**15 Hours**

TCL Structure, syntax, Variables and Data in TCL, Control Flow, Procedures, strings, patterns.

Tk Fundamentals: Hello World In Tk, Naming Tk Widgets, Configuring Tk Widgets, About The Tk Man Pages, Summary Of The Tk Commands.

UNIT-III

Python	**10 Hours**

Introduction to Python language, python-syntax, statements, Files, Scripts, Python commands, Strings, Expressions, Built-in-functions, and Methods.

Suggested List of Experiments

1	Write a PERL script to print the message.
2	Write a PERL script to demonstrate control structures, array processing, functions.
3	Write a TCL script to demonstrate control flow, procedures, strings and patterns.
4	Write a Tk commands to name Tk Widgets, Configure Tk Widgets.
5	Write a python script to search the element in the list using Linear search & Binary search.

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

1.	Ability to understand the differences between scripting languages.
2.	Understand the general features of PERL scripting language;
3.	Explain syntax and variables in TCL.
4.	Identify the TK widgets and commands.
5.	Gain some fluency in programming using Python language.

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**

VT2003-1.1	3	1	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2003-1.2	3	1	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2003-1.3	3	1	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2003-1.4	3	1	-	-	3	-	-	-	-	-	-	-	3	-	-
VT2003-1.5	3	1	-	-	3	-	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Wall L. and Schwartz R, "Programming PERL", Sebastopol, O'Reilly Publications, 3rd Edition 2000.
2. Ousterhout J. and Jones K, "Tcl and the Tk toolkit", Upper Saddle River, NJ: Addison-Wesley, 2011.
3. Steve Holden and David Beazley, "Python Web Programming", New Riders Publications.

REFERENCE BOOKS:

1. David Barron, "The World of Scripting Languages", Wiley Publications.
2. B.B. Welch, K. Jones, J. Hobbs, "Practical programming in Tcl and Tk", Prentice Hall PTR, Upper Saddle River, N.J, 2014
3. Randal L, Schwartz Tom Phoenix, “Learning PERL”, Oreilly Publications, 3rd Edn., 2000.
4. Brent B. Welch and Ken Jones, “Practical Programming in Tcl and TK”, Pearson Education, 2003

VLSI TESTING AND VERIFICATION

Course Code:	**VT3003-1**	**Course Type**	**IPCC**
Teaching Hours/Week (L: T: P: S)	**3:0:2:0**	**Credits**	**04**
Total Teaching Hours	**40+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**VT2003-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	The role of testing and verification in VLSI Development Process.
2.	An understanding on the functional and block level verification techniques in VLSI development process.
3.	To learn about Universal Verification Methodology Concepts to verify Design-Under Test (DUT)

UNIT-I

Introduction to Verification in VLSI Development process **15 Hours**

Introduction: VLSI development process, role of testing and verification, verification methodology, Types of Design Verification - Functional Verification, Simulation Emulation Testing and verification: how to test chips? VLSI Technology Trends Affecting Testing.

Block-level Verification. Functional Verification through simulation. White box, black box and grey box testing. Verilog/VHDL test bench for functional verification

UNIT-II

Introduction to UVM **15 Hours**

UVM Basics: The Structure of UVM testbenches and components, UVM Library Basics, the basic concepts and components that make up a standard reusable interface environment.

UVC development and Usage, The creation of simple testbenches, Various techniques for sequence and randomization control.

Advanced Concepts: A methodology and automation to enable productive and reusable register related verification logic. How to wrap device specific logic and reuse it in block, sub-system and system integration.

UNIT-III

SV/UVM Verification Practice Examples **10 Hours**

Testbench Connection Examples, Messaging Example, Sequence Example, Analysis Example, Register Example, Functional Coverage Example, Testbench Build Example, Slave agent Example.

Suggested List of Experiments

1	Write Verilog/VHDL test bench for functional verification of a given Design-Under Test(DUT).
2	Write a code to demonstrate transaction methods.
3	Write a code to demonstrate stimulus generator class.
4	Write a code to build re-usable self checking scoreboards by using the in-built UVM comparator classes. constrained random stimulus, coverage, strings, queues and dynamic arrays.
5	Write code to verify Design-Under Test (DUT) using SV and UVM

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

1.	Understand the role of testing and verification, verification methodology, Types of Design Verification.
2.	Understand the Testing and Verification Methods.
3.	Understand the concept of UVM and verify DUT using SV and UVM
4.	Understand system Verilog and UVM
5.	Develop testbenches independently

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**
VT3003-1.1	3	1	-	-	3	-	-	-	-	-	-	-	3	-	-
VT3003-1.2	3	1	-	-	3	-	-	-	-	-	-	-	3	-	-
VT3003-1.3	3	1	-	-	3	-	-	-	-	-	-	-	3	-	-
VT3003-1.4	3	1	-	-	3	-	-	-	-	-	-	-	3	-	-
VT3003-1.5	3	1	-	-	3	-	-	-	-	-	-	-	3	-	-

TEXTBOOKS:

1.	Chris Spear, "SystemVerilog for Verification: A Guide to Learning the Testbench Language Features", 2nd Edition, Springer, 2008
2.	Sharon Rosenberg, Kathleen Meade, "A practical guide to adopting Universal Verification Methodology", Cadence Design Systems – USA.

REFERENCE BOOKS:

1.	UVM CookBook - by Siemens
2.	Mike Mintz, Robert Ekendahl, "Hardware Verification with System Verilog- An object-oriented framework", Springer, 2007.
3.	Janick Bergeron, "Writing Testbenches using System Verilog", Springer, 2005.

E Books / MOOCs/ NPTEL

1.	https://www.doulos.com/knowhow/systemverilog/systemverilog-tutorials/
2.	https://www.youtube.com/SystemVerilog

Professional Core Courses (Theory)

ELECTROMAGNETIC WAVE THEORY

Course Code:	**EC2102-1**	**Course Type**	**PCC**
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**
Prerequisite	**MA1001-1, MA1003-1, PH1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Understand the behaviour of static electric field and basic laws govern the Electrostatic and steady magnetic fields.
2.	Understand the behaviour and basic laws of Time Varying field and Learn Wave propagation in lossy and lossless medium.
3.	Understand characteristics and wave propagation on transmission lines and Learn Standing waves on Transmission line.
4.	Demonstrate Construction and Application of Smith Chart as impedance chart.

UNIT-I

Basic laws of Electromagnetics-I	**09 Hours**

Basics of Vector Algebra, Differential and Integral Vector calculus and coordinate Systems. Coulomb's law of Force and Electric field Intensity, Electric flux density, Gauss' law, Divergence Theorem, Potential & Potential gradient, Energy density in an electrostatic field, Conductors and dielectrics properties and boundary conditions.

Basic laws of Electromagnetics-II	**06 Hours**

Continuity of Current, Biot Savart's Law and applications, Ampere's Circuital Law, Stokes Theorem, Gauss Law, Magnetic flux and flux density, Boundary conditions at Media Interface.

UNIT-II

Time Varying fields	**05 Hours**

Faraday's Law of Electromagnetic Induction, Displacement current and current Density. Maxwell's Equations

Uniform Plane Wave	**08 Hours**

Plane Wave, Uniform plane wave, Derivation of Wave equations in terms of E and H, Propagation of wave, Wave polarization, Wave propagation in free space and conducting medium, Skin effect, Phase and Group velocity in free space propagating media, Power flow and Poynting vector.

UNIT-III

Transmission Lines	**08 Hours**

Equations of Voltage and Current on Transmission line, Propagation constant and characteristic impedance and reflection coefficient and VSWR, Standing waves on Loss less and Low loss Transmission line & Power calculation on Transmission line

Smith Chart	**04 Hours**

Construction and Application as impedance chart. Constant Resistance and Reactance circles. Applications and Properties of Smith Chart.

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

1.	Explain and derive basic laws of Electromagnetics pertaining to electrostatic fields.
2.	Explain and derive basic laws of Electromagnetics pertaining to steady magnetic fields
3.	Explain concept of time varying fields and derive basic laws pertaining to Time varying

	fields
4.	Explain Wave propagation in lossy and lossless Medium
5.	Demonstrate the Application of Smith Chart as an impedance chart.

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
EC2102-1.1	3	1	-	1	-	-	-	-	-	-	-	-	1	3	1
EC2102-1.2	3	1	-	1	-	-	-	-	-	-	-	-	1	3	1
EC2102-1.3	3	1	-	1	-	-	-	-	-	-	-	-	1	3	1
EC2102-1.4	3	1	-	1	-	-	-	-	-	-	-	-	1	3	1
EC2102-1.5	3	1	2	1	-	-	-	-	-	-	-	-	1	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	William H., Hayt Jr. and John A. Buck, "Engineering Electromagnetic", 7th Edition, Tata McGraw- Hill, 2006.
2.	John D Ryder, "Networks Lines & Fields", 2nd Edition, Pearson Education India, 2015

REFERENCE BOOKS:

1.	R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw- Hill, 2005.
2.	Narayana Rao, "Engineering Electromagnetics",3rd Edition, Prentice Hall, India, 1997.
3.	David K. Cheng, "Electromagnetics", Prentice-Hall

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/108106073/
2.	http://nptel.ac.in/courses/108104087/
3.	https://archive.nptel.ac.in/courses/108/106/108106157/
4.	https://nptel.ac.in/courses/108104130

NETWORK THEORY AND CONTROL SYSTEMS

Course Code:	**EC2105-1**	**Course Type**	**PCC**
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**
Prerequisite	**EE1001-1, EC1001-1, MA1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To Apply mesh and nodal techniques to solve electrical network.
2.	To Solve different problems related to Electrical circuits using Network Theorems
3.	To describe Two Port Networks
4.	To understand basics of control systems; to obtain transfer function for a given electrical system and to analyze time domain stability
5.	To analyze Frequency domain stability.

UNIT-I

Basic Concepts of Network Theory	**16 Hours**
Types of sources, Source transformations, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh.	
Network Theorems	
Superposition theorem, Thevenin’s theorem, Norton’s theorem, Maximum power transfer theorem	

UNIT-II

Two Port Network Parameters	**16 Hours**
Short- circuit Admittance parameters, Open- circuit Impedance parameters, Transmission parameters, Hybrid parameters	
Basic Concepts of Control Systems and Representation	
Types of control systems, effect of feedback systems, differential equation for electrical system, Introduction to block diagrams and Signal Flow Graphs	
Stability Analysis using Root Locus	
Concepts of stability, necessary condition for stability, Introduction to the root locus concepts, Construction of root loci	

UNIT-III

Stability Analysis using Bode Plot	**08 Hours**
Introduction, Bode plots for simple systems (systems with quadratic factors and transportation Lag excluded), Determination of Transfer function from Bode Plot	

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

1.	Analyze and solve Electric circuit by applying loop analysis and Nodal analysis
2.	Analyze and solve Electric circuit by applying network Theorems
3.	Evaluate two port parameters of a network
4.	Obtain transfer function for a given electrical system and to analyze time domain stability
5.	Analyze Frequency domain stability.

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
EC2105-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3	3
EC2105-1.2	3	-	-	-	-	-	-	-	-	-	-	-	1	1	1

EC2105-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	3	3
EC2105-1.4	3	-	-	-	-	-	-	-	-	-	-	-	3	3	3
EC2105-1.5	3	-	-	-	-	-	-	-	-	-	-	-	1	1	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. M E Van Valkenburg, "Network Analysis", 3rd Edition, PHI/ Pearson Education.
2. I J Nagrath, M. Gopal, "Control Systems Engineering", 5th Edition, New Age International Publishers.

REFERENCE BOOKS:

1. D Roy Choudhury, "Networks and Systems", 2nd Edition, New Age International publications, 2006 reprint.
2. H. Hayt, J.E. Kemmerly and S. M. Durbin, "Engineering Circuit Analysis", 6th Edition, Tata McGraw Hill, New Delhi, 2011
3. Benjamin C Kuo “Automatic Control System”, 8th Edition, John Wiley & Sons, 2007
4. K. Ogata, “Modern Control Engineering”, 5th Edition, Pearson, 2010

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/108102042
2. https://nptel.ac.in/courses/108105159
3. https://nptel.ac.in/courses/108106098
4. https://nptel.ac.in/courses/108102043
5. https://nptel.ac.in/courses/108102044
6. https://www.edx.org/course/dynamics-control-upvalenciax-dc201x-2

SIGNALS AND SYSTEMS

Course Code:	**EC2106-1**	**Course Type**	**PCC**
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**
Prerequisite	**MA1001-1, MA1003-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Understand different types of signals, systems, basic operations on signals.
2.	Study different representations for LTI systems
3.	Understand Fourier series representation for periodic signals.
4.	Study the Fourier transform representation for non-periodic signals and Understand the process of Sampling and its implications.
5.	Study Z transforms and its applications for discrete time signals.

UNIT-I

Introduction to Signals and Systems **16 Hours**

Signals: Continuous and Discrete time Signals, Periodic and Non periodic Signals, Energy and Power Signals, Representation of Basic Signals, Operations on Signals.

Systems: Linear Time Invariant Systems, Impulse Response and its properties, Step Response, Convolution, Difference Equations.

UNIT-II

Fourier Representation **15 Hours**

Fourier Series Representation: (CTFS & DTFS) and properties (derivation not included).

Fourier Transform: (CTFT & DTFT) and properties (derivation not included). Sampling Theorem and its implications: Spectra of sampled signals, Aliasing and its effects. Frequency response of LTI systems.

UNIT-III

Z-Transforms **09 Hours**

Z transform, properties of the region of convergence, properties of the Z-transform (derivation not included), Inverse Z-transform by partial fraction, Applications of Z transform.

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

1.	Apply the knowledge of classification of signals and perform Basic operations on Signals
2.	Solve an LTI system to determine the output.
3.	Determine Frequency domain representation of Periodic Signals
4.	Determine Frequency domain representation of non-periodic Signals. Make use of frequency domain representation in sampling process.
5.	Analyze Discrete time signals & Systems using Z transforms.

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
EC2106-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	1
EC2106-1.2	3	-	-	-	-	1	-	-	-	-	-	-	3	1	1
EC2106-1.3	3	-	-	-	-	1	-	-	-	-	-	-	3	1	1

EC2106-1.4	3	-	-	-	2	1	-	-	-	-	-	-	3	1	1
EC2106-1.5	3	-	-	-	2	1	-	-	-	-	-	-	3	1	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. A. V. Oppenheim, A. S. Willsky and I. T. Young, "Signals and Systems", Prentice Hall, 1983.
2. Simon Haykin and Barry Van Veen, “Signals and Systems”, John Wiley & Sons, 2001, Reprint 2002.

REFERENCE BOOKS:

1. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th Edition, Prentice Hall, 1998.
2. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition, 1999.
3. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley & Sons, 1995

E Books / MOOCs/ NPTEL

1. https://www.youtube.com/watch?v=7Z3LE5uM-6Y&list=PLbMVogVj5nJQQZbah2uRZIRZ_9kfoqZyx

MICROFABRICATION AND MEMS

Course Code:	**VT3102-1**	**Course Type**	**PCC**
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**
Prerequisite	**VT2002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To introduce MEMS and Microsystems
2.	To give an overview of Micro sensors, Actuators and Smart Materials
3.	To introduce CMOS compatible MEMS Fabrication Techniques
4.	To explain the electronic circuits for micro and smart systems
5.	To perform the case study of several MEMS Devices

UNIT-I

Micro Sensors, Actuators, Systems and Smart Materials: An Overview **16 Hours**

Introduction: Why Miniaturization, Microsystems Versus MEMS Why Microfabrication? Smart Materials, Structures and Systems, Integrated Microsystems- Micromechanical Structures, Microsensors , Microactuators

CMOS Compatible MEMS Fabrication- Silicon as a Material for Micromachining, Thin-film Deposition, Lithography, Doping the Silicon Wafer: Diffusion and Ion Implantation of Dopants, Etching, Silicon Micromachining, Specialized Materials for Microsystems, Advanced Microfabrication Processes.

UNIT-II

Microsystems and Signal Conditioning Circuits **15 Hours**

Micro Sensors, Actuators, Systems and Smart Materials: An Overview-Silicon Capacitive Accelerometer, Piezoresistive Pressure Sensor, Conductometric Gas Sensor, Fiber-Optic Sensors, Electrostatic Comb-Drive, Magnetic Microrelay, Microsystems at Radio Frequencies, Portable Blood Analyzer, Piezoelectric Inkjet Print Head, Micromirror Array for Video Projection, Micro-PCR Systems, Smart Materials and Systems.

Electronics Circuits for Micro and Smart Systems- Signal Conditioning Circuits, Practical Signal conditioning Circuits for Microsystem

UNIT-III

Case Study of MEMS Devices **09 Hours**

Pressure Sensors, Inertial Sensors, Piezoelectric Transducers, RF MEMS, Accelerometer with transducer.

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

1.	Explain the MEMS and microsystems
2.	Know the CMOS compatible MEMS Fabrication techniques.
3.	Explain microsensors, actuators, systems and smart materials.
4.	Understand different signal conditioning circuits for MEMS
5.	Perform the case study of several MEMS Devices

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
VT3102-1.1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1
VT3102-1.2	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1
VT3102-1.3	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1
VT3102-1.4	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1
VT3102-1.5	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre “Micro and Smart Systems Technology and Modeling”, John Wiley and Sons, 2009.

REFERENCE BOOKS:

1. Stephen D. Senturia, “Microsystem Design”, Kluar Publishers, 2001.

2. Nadim Maluf, “An Introduction to Microelectromechanical Systems Engineering”, Artech House, 2000.

E Books / MOOCs/ NPTEL

1. https://onlinecourses.nptel.ac.in/noc19_ee40

SEMICONDUCTOR PACKAGING AND TESTING

Course Code:	**VT3103-1**	**Course Type**	**PCC**
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**
Prerequisite	**VT2002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To introduce MEMS and Microsystems
2.	To give an overview of Micro sensors, Actuators and Smart Materials
3.	To introduce CMOS compatible MEMS Fabrication Techniques
4.	To explain the electronic circuits for micro and smart systems
5.	To perform the case study of several MEMS Devices

UNIT-I

Semiconductor Packaging: An Overview **15Hours**

Wafer packaging; Packaging evolution, Chip connection choices, Wire bonding, TAB and flipchip-1, TAB and flipchip-2, Need for packaging & Single chip packages or modules (SCM), Commonly used packages and advanced packages, Materials in packages, Thermal mismatch in packages, Current trends in packaging, Multichip modules (MCM)-type, System-in- package (SIP), Packaging roadmaps, Hybrid circuits.

UNIT-II

Printed Wiring Board Technologies **15 Hours**

Board-level packaging aspects, Review of CAD output files for PCB fabrication, Photo plotting, and mask generation, Process flow-chart; Vias; PWB substrates, Surface preparation, Photoresist and application methods, UV exposure and developing.

Printing technologies for PWBs, PWB etching, Resist stripping, Screen-printing technology, Through-hole manufacture process steps, Panel and pattern plating methods, Solder mask for PWBs, Multilayer PWBs; Introduction to microvias, Microvia technology, and Sequential build-up technology process flow for high-density interconnects, Conventional Vs HDI technologies; Flexible circuits.

UNIT-III

Surface Mount Technology **10 Hours**

SMD benefits; Design issues; Introduction to soldering, Reflow, and Wave Soldering methods to attach SMDs, Solders: Wetting of solders; Flux and its properties, Defects in wave soldering, Vapor phase soldering, BGA soldering, and desoldering/ Repair, SMT failures, SMT failure library, Tin Whiskers, Tin-lead, and lead-free solders; Phase diagrams, Thermal profiles for reflow soldering, Lead-free alloys, Lead-free solder considerations; Green electronics; RoHS compliance and e-waste recycling issues.

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

1.	Explain Wafer packaging; Packaging evolution, need for packaging.
2.	Explain packaging types used along with the associated thermal, speed, signal, and integrity power issues.
3.	Understand board-level packaging aspects.
4.	Explain various types of printing technologies for PWBs.
5.	Understand soldering methods in SMT, SMT failure analysis, RoHS compliance and e-waste

	recycling issues.

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
VT3103-1.1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1
VT3103-1.2	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1
VT3103-1.3	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1
VT3103-1.4	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1
VT3103-1.5	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw Hill, NY, 2001.
2.	Bosshart, Printed Circuit Boards Design and Technology, Tata McGraw Hill, 1988.

REFERENCE BOOKS:

1.	William D. Brown, Advanced Electronic Packaging, IEEE Press, 1999.
2.	Blackwell (Ed), The electronic packaging handbook, CRC Press, 2000

E Books / MOOCs/ NPTEL

1.	http:/nptel/courses/108108031

CMOS VLSI DESIGN

Course Code:	**VT3101-1**	**Course Type**	**PCC**
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**
Prerequisite	**VT2002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

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

UNIT-I

16 Hours

Introduction: Overview of VLSI design methodology, VLSI Design Flow, Design hierarchy, regularity, modularity, locality, VLSI design styles CMOS logic

Physical Design: CMOS Fabrication and layouts

MOSFET Scaling: Constant field scaling, constant voltage scaling

UNIT-II

15 Hours

Power dissipation in CMOS inverters.

DC and Transient Response: CMOS inverter DC characteristic, RC Delay Model, Transient response, Linear Delay Model, Logical Efforts of Paths.

Combinational Circuit Design: Pseudo-NMOS, CVSL.

Sequential Circuit Design: Latches and Flip-Flops.

UNIT-III

09 Hours

Dynamic Logic Circuits: Introduction, Dynamic CMOS Circuit Techniques: CMOS Transmission gate logic, dynamic CMOS logic, Domino CMOS logic, NORA CMOS logic.

Testing and Verification: Introduction to DFT, fault types and models, controllability, and observability, Adhoc testable design techniques, scan-based techniques, BIST techniques

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

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

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**

VT3101-1.1	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
VT3101-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
VT3101-1.3	3	1	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3101-1.4	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
VT3101-1.5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Neil H. E. Weste and David Money Harris, "CMOS VLSI Design- A Circuits and Systems Perspective", 4th Edition, Pearson Education India, 2011.
2. Sung-Mo Kang and Yosuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", 3rd Edition, Tata McGraw-Hill, 2003.

REFERENCE BOOKS:

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

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/108107129
2. https://nptel.ac.in/courses/117106091/

Professional Core Courses (Lab)

PYTHON PROGRAMMING LAB

Course Code:	**EC2602-1**	**Course Type**	**PCC Lab**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**0+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CS1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To write, test, and debug simple Python programs.
2.	Use functions for structuring Python programs.
3.	Represent compound data using Python lists, tuples, and dictionaries.
4.	Read and write data from/to files in Python.

List of Experiments

1	Create a list and perform the following methods 1) insert() 2) remove() 3) append() 4) len() 5) pop() 6) clear(). Create a dictionary and apply the following methods 1) Print the dictionary items 2) access items 3) use get() 4)change values 5) use len() Create a tuple and perform the following methods 1) Add items 2) len() 3) check for item in tuple 4) Access items
2	Write a python program to (a) add two numbers. (b) print if a number is positive/negative using if-else. (c) find largest number among three numbers. (d) read a number and display corresponding day using if_elif_else?
3	Write a Python program to use functions with arguments to (a) create a menu with the following options 1. ADDITION 2. SUBTRACTION 3. MULTIPLICATION 4. DIVISION, (b) accepts user inputs and perform the selected operation. Write a python program to check whether the given string is palindrome or not. Write a python program to find factorial of a given number using functions Write a Python function that takes two lists and returns True if they are equal otherwise false
4	Write a program to double a given number and add two numbers using lambda()? Write a program for filter() to filter only even numbers from a given list. Write a program for map() function to double all the items in the list? Write a program to find sum of the numbers for the elements of the list by using reduce()?
5	Demonstrate a python code to implement abnormal termination? Demonstrate a python code to print try, except and finally block statements Write a python program to open and write “hello world” into a file? Write a python program to write the content “hi python programming” for the existing file.
6	Write a python program to get python version. Write a python program to open a file and check what are the access permissions acquired by that file using os module? Write a python program to display a particular month of a year using calendar module. Write a python program to print all the months of given year.
7	Write a python program to print date, time for today and now. Write a python program to add some days to your present date and print the date added. Write a python program to print date, time using date and time functions

	Write a python program which accepts the radius of a circle from user and computes the area (use math module).
8	Write a python program to create a package (college), sub-package (alldept), modules (it,cse) and create admin and cabin function to module. Write a python program to create a package (Engg), sub-package (years), modules (sem) and create staff and student function to module.
9	Write a python Program to display welcome to MRCET by using classes and objects. Write a python Program to call data member and function using classes and objects Write a program to find sum of two numbers using class and methods Write a program to read 3 subject marks and display pass or failed using class and object.
10	Using a numpy module create an array and check the following: 1. Type of array 2. Axes of array 3. Shape of array 4. Type of elements in array Using a numpy module create array and check the following: 1. List with type float 2. 3*4 array with all zeros 3. From tuple 4. Random values Using a numpy module create array and check the following: 1. Reshape 3X4 array to 2X2X3 array 2. Sequence of integers from 0 to 30 with steps of 5 3. Flatten array 4. Constant value array of complex type
11	Write a python program to concatenate the dataframes with two different objects Write a python code to read a csv file using pandas module and print the first and last five lines of a file.
12	Write a python code to set background color and pic and draw a circle using turtle module Write a python code to set background color and pic and draw a square and fill the color using turtle module Write a python code to perform addition using functions with pdb module.

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

1.	Write, test, and debug simple Python programs. Implement Python programs with conditionals and loops.
2.	Develop Python programs step-wise by defining functions and calling them.
3.	Use Python lists, tuples, dictionaries for representing compound data. Read and write data from/to files in Python

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**
EC2602-1.1	3	2	1	-	3	-	-	-	-	-	-	-	1	3	1
EC2602-1.2	3	2	1	-	3	-	-	-	-	-	-	-	1	3	1
EC2602-1.3	3	2	1	-	3	-	-	-	-	-	-	-	1	3	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Kenneth A. Lambert, "The Fundamentals of Python: First Programs", 2012, Cengage Learning.
2.	Mark Lutz, "Learning Python", 5th Edition, O‟Reilly 2013.
3.	Paul Barry, "Head First Python", 2nd Edition, O‟Reilly 2016.
4.	Zed A. Shaw, "Learn Python the Hard Way", 3rd Edition, Addison Wesley 2013.

E Resources

1.	https://spoken-tutorial.org/tutorial-search/?search_foss=Python+3.4.3&search_language=English

VLSI LAB

Course Code:	**VT3602-1**	**Course Type**	**PCC Lab**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**0+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**VT2001-1, VT2002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand ASIC design flow from HDL to Layout.
2.	To understand ASIC design flow from schematic to Layout.
3.	To apply the concepts of delay and area minimization.
4.	To understand ASIC design flow of analog circuits.

List of Experiments

Write Verilog code for the following and Perform simulation for functional verification using test-bench. Observe the waveform. Synthesize the code using available technological library from RTL to GDS II for the given the constraints.

1	4-bit Parallel Adder
2	D Flip flop, T Flip flop, JK Flip flop
3	Shift register
4	Asynchronous and Synchronous counters

Design given logic gate and complex logic for the given specifications. Draw the schematic and perform simulation to do DC Analysis , Transient Analysis etc. Draw the Layout, perform DRC, LVS, perform layout synthesis and simulation with RC extraction.

5	CMOS Inverter, NAND and NOR gates
6	CMOS EXOR gate
7	CMOS Full Adder
8	Parallel Adder

Design the following circuits for the given specifications. Draw the schematic and perform simulation to do DC Analysis, Transient Analysis etc. Draw the Layout, perform DRC, LVS, perform layout synthesis and simulation.

9	Common source amplifier
10	Common Drain amplifier

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

1.	Demonstrate the ASIC design flow of digital logic from HDL and the schematic as per the specifications using EDA tool.
2.	Demonstrate the ASIC design flow of analog CMOS circuits as per the specifications using EDA tool.

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**
VT3602-1.1	3	-	-	-	2	-	-	-	1	2	-	-	3	3	1
VT3602-1.2	3	1	1	1	2	-	-	-	2	2	-	-	3	3	1

1: Low 2: Medium 3: High

LINEAR INTEGRATED CIRCUITS LAB

Course Code:	**VT2601-1**	**Course Type**	**PCC Lab**

Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**0+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To design circuits using OPAMP IC
2.	To design circuits using IC555 timer.
3.	To design DAC and ADC
4.	To study PLL IC, voltage regulator IC.

List of Experiments

1.	Inverting and Non inverting Amplifiers
2.	Summer, Difference Amplifier and Instrumentation Amplifier
3.	Waveform shaping circuits using opamp
4.	Comparator and Schmitt trigger
5.	Waveform Generation using Op-Amp (IC741).
6.	Astable multivibrator using Timer IC555
7.	Monostable multivibrator using Timer IC555
8.	Design of Active filters.
9.	Study and application of PLL IC’s
10.	Study of DAC and ADC
11.	Voltage Regulator- IC 723

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

1.	Design circuits using OPAMP.
2.	Design circuits using Timer, voltage regulator, PLL ICs.

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**
EC2601-1.1	3	-	-	-	2	-	-	-	1	2	-	-	3	3	1
EC2601-1.2	3	1	1	1	2	-	-	-	2	2	-	-	3	3	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	OP-AMP and Linear ICs Ramakant A.Gayakwad Prentice Hall / Pearson Education, 4th Edition, 2001
2.	Design with operational amplifiers and analog integrated circuits, 3rd Edition Sergio Franco Tata McGraw-Hill, 2007

SYSTEM VERILOG LAB

Course Code:	**EC3603-1**	**Course Type**	**PCC Lab**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**0+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC2003-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To Introduce System Verilog as a tool to test digital circuits

List of Experiments

1	Introduction to testing and verification tool
2	Verilog coding for Testing and verification
3	Verilog coding for Tasks, Functions and Computer Directives
4	Implementing Object-oriented programming concepts using Verilog
5	Experiments on Device Under Test

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

1.	Use relevant tools to perform testing and verification of the specified design.

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**
EC3603-1.1	3	2	1	-	3	-	-	-	-	-	-	-	1	3	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Chris Spear, "SystemVerilog for Verification: A Guide to Learning the Testbench Language Features", 2nd Edition, Springer, 2008.
2.	Mike Mintz, Robert Ekendahl, "Hardware Verification with System Verilog- An object-oriented framework", Springer, 2007.
3.	Janick Bergeron, "Writing Testbenches using System Verilog", Springer, 2005.

E Resources

1.	https://www.doulos.com/knowhow/systemverilog/systemverilog-tutorials/
2.	https://www.youtube.com/SystemVerilog

SEMICONDUCTOR MEMORY DESIGN LAB

Course Code:	**VT3601-1**	**Course Type**	**PCC Lab**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**0+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1002-2, VT2001-1**		

Teaching Department: To be offered by the industry

Course Objectives:

1.	To design basic memory cell
2.	To design memory

List of Experiments

1	Design of RAM cell
2	Design of DRAM cell
3	Design of flash memory
4	Design of M x N memory block
5	Study of memory architectures

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

1.	Use relevant EDA tools to design the semiconductor memory.
2.	Design and verify the memory block for the given specification.

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**
VT3601-1.1	3	2	1	-	3	-	-	-	-	-	-	-	1	3	1
VT3601-1.1	3	2	1	-	3	-	-	-	-	-	-	-	1	3	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	N. H. E. Weste and C. Harris, "Principles of CMOS VLSI Design: A System Perspective, 3rd Edition, Pearson Education 2007.
2.	Sung-Mo Kang and Yosuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", 3rd Edition, Tata McGraw-Hill, 2003.

E Resources

1.	
2.	

ANALOG CMOS DESIGN

Course Code:	**VT4201-1**	**Course Type**	**PEC**
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**
Prerequisite	**VT3001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand different types of MOS device models.
2.	To study and analyze single stage MOS amplifiers.
3.	To study and analyze MOS differential amplifiers and current mirrors.
4.	To construct an Op-amp using MOS circuits and know the different circuit topologies.

UNIT-I

MOS Device Models and Single Stage Amplifiers — **16 Hours**

Professional Elective Courses (Microelectronic Circuits)

MOS device models: MOS IV characteristics, threshold voltage, transconductance, channel length modulation, body effect, subthreshold conduction, large signal and small signal model, high frequency model, MOS SPICE models.

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

UNIT-II

Differential Amplifiers — **15 Hours**

Single-ended and differential operation, Basic differential pair, small signal analysis, half circuit concept, differential and common mode response, CMRR, Differential pair with MOS load.

Basic Current Mirror, Active current mirror, Transconductor Cell, CMRR.

UNIT-III

Operational Amplifiers — **09 Hours**

General considerations, telescopic opamp, folded cascode opamp, Two Stage OP-Amp, Gain boosting, Common Mode Feedback.

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

1.	Explain MOS device small signal models, high frequency model and interpret SPICE models.
2.	Identify single stage MOS amplifier topologies and do small signal analysis to compute ac

	parameters.
3.	Analyze differential amplifier with resistive and MOS loads and determine gain and CMRR.
4.	Explain different types of current mirrors and their applications.
5.	Explain operational amplifier realized using MOSFETs in different circuit topology.

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**
VT4201-1.1	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
VT4201-1.2	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
VT4201-1.3	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
VT4201-1.4	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
VT4201-1.5	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2002.
2. R. Jacaob Baker, Harry W Li, David E Boyce, "CMOS Circuit Design, Layout, Simulation", PHI Edn, 2005.

REFERENCE BOOKS:

1. Behzad Razavi, "Fundamentals of Microelectronics", 2nd Edition, Wiley, 2014.
2. P.E. Allen and D.R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2nd Edition, 2002.
3. Donald A. Neaman, "Microelectronics: Circuit Analysis and Design", 4th Edition, McGraw Hill, 2009.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/108102112
2. https://nptel.ac.in/courses/108105158
3. https://nptel.ac.in/courses/117101105

MIXED SIGNAL VLSI DESIGN

Course Code:	**EC4332-1**	**Course Type**	**PEC**
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**
Prerequisite	**VT3001-1, VT3101-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand the need for mixed signal design
2.	To know the performance parameters of Digital-to-Analog (DAC) and Analog-to-Digital (ADC).
3.	To analyse the operation of different architectures of DACs and ADCs.
4.	To understand the design of capacitors, resistors, MOSFET switch, delay and adder elements, to know the sub-micron CMOS technology and mixed signal layout issues.

UNIT-I

Digital-to-Analog Converter Fundamentals and Architectures **16 Hours**

Data Converter fundamentals: Analog versus Digital Discrete Time Signals, Sample & Hold Circuits, Digital-to-Analog Converter (DAC): Introduction, specifications: Resolution, Full scale voltage, Least Significant Bit (LSB), Most Significant Bit (MSB), percentage accuracy, Differential Non-Linearity (DNL), Integral Non-Linearity (INL), offset, gain error, Latency, Signal to Noise Ratio (SNR), Dynamic Range.

DAC Architectures: Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DAC, Cyclic DAC, Pipeline DAC.

UNIT-II

Analog-to-Digital Converter Fundamentals and Architectures **15 Hours**

Analog-to-Digital Converter (ADC): Introduction, Specifications: Quantization, Quantization error, Differential non-linearity, Missing codes, Integral Non-linearity, Offset and gain error, SNR, Aperture error,

ADC Architectures: Flash, 2-step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC.

UNIT-III

Sub-Micron CMOS Circuit Design **09 Hours**

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

Mixed Signal Layout Issues: Floor planning, power supply and grounding issues, fully differential design, guard rings, Shielding and interconnect considerations.

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

1.	Explain the sample mode and hold mode characteristics of Sample -and-Hold circuit.
2.	Compute the performance parameters for a given DAC, Select between Resistor String, R-2R, Current Steering, Charge Scaling, Cyclic, Pipeline DAC architectures for the given application & specification.
3.	Compute the performance parameters for a given ADC
4.	Select between Flash, 2- Step Flash, Pipeline, Dual Slope, Single Slope and SAR ADC for

	the given application & specification.
5.	Analyse the process flow for construction of transistors, Resistors and Capacitors in sub-micron technology, Describe the operation of CMOS Delay and Adder elements and mixed signal layout issues.

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
EC4332-1.1	2	3	1	1	1	-	-	1	2	3	-	-	3	2	-
EC4332-1.2	3	2	1	-	1	-	-	1	2	3	-	-	3	2	-
EC4332-1.3	3	1	1	-	-	-	-	1	2	3	-	1	3	2	-
EC4332-1.4	3	1	1	-	-	-	-	1	2	3	-	1	3	2	-
EC4332-1.5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	R. Jacaob Baker, Harry W Li, David E Boyce, "CMOS Circuit Design, Layout, Simulation", PHI Edn, 2005.
2.	R. Jacob Baker, "Mixed Signal Circuit Design (Vol II of CMOS: Circuit Design, Layout and Simulation)", CMOS –IEEE Press and Wiley Interscience, 2002.

REFERENCE BOOKS:

1.	P.E. Allen and D.R. Holberg, **"CMOS Analog Circuit Design"**, Oxford University Press, 2nd Edition, 2002.
2.	D. P. Kothari and J. S Dhillon, "Digital Circuits and Design", Pearson, 2016.
3.	Charles H Roth, "Fundamentals of Logic Design", Cengage Learning

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/117106034

CMOS RF CIRCUIT

Course Code:	**VT4202-1**	**Course Type**	**PEC**
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**
Prerequisite	**VT3001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To study the low noise amplifiers and mixers.
2.	To study VCO and PLLs.
3.	To design an RF/MW frequency converter, rectifiers, detectors, mixers etc.

UNIT-I

Low Noise Amplifiers and Mixers — **16 Hours**

Low Noise Amplifiers and Mixers: General considerations, Problem of input matching, LNA topologies:
common-source stage with inductive load, common-source stage with resistive feedback.
Mixers-General considerations, passive down conversion mixers, Various mixers- working and implementation.

UNIT-II

VCO and PLLs — **16 Hours**

VCO and PLLs- Oscillators- Basic topologies VCO and definition of phase noise, Noise power and trade off.
Resonator VCO designs, Quadrature and single sideband generators. Radio frequency Synthesizers-PLLS,
Various RF synthesizer architectures and frequency dividers, Power Amplifier design

UNIT-III

RF/MW Circuit design — **08 Hours**

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

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

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

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**

VT4202-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
VT4202-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
VT4202-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
VT4202-1.4	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
VT4202-1.5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. B. Razavi, “RF Microelectronics”, PHI, Second Edition.

REFERENCE BOOK:

1. Reinhold Ludwig and Pavel Bretchko, “RF Circuit Design Theory and Applications”, PE (Asia) Pvt. Ltd. 2004.
2. Thomas H. Lee, “Design of CMOS RF Integrated Circuits”, Cambridge University press, 1998

E Books / MOOCs/ NPTEL

1.

COMMUNICATION SYSTEMS AND CIRCUIT

Course Code:	**VT4301-1**	**Course Type**	**PEC**
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**
Prerequisite	**VT3001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To study the basic communication concepts.
2.	To study Transceiver Architectures.
3.	To study the radio frequency and medium wave concepts and the circuit representations of RF and MW networks.

UNIT-I

Communication Concepts — **16 Hours**

Communication Concepts: General concepts, analog modulation, digital modulation, spectral re-growth, coherent and non-coherent detection, Mobile RF communications, Multiple access techniques, Wireless standards, Appendix 1: Differential phase shift keying.

UNIT-II

Transceiver Architecture — **16 Hours**

Transceiver Architecture: General considerations, Receiver architecture, Transmitter architectures, Direct conversion and two-step transmitters, RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers

UNIT-III

Wave Propagation in Networks — **08 Hours**

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

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

1.	Explain analog modulation, digital modulation.
2.	Explain spectral re-growth, coherent and non-coherent detection, Mobile RF communications, Multiple access techniques, Wireless standards.
3.	Explain various receivers and transmitter topologies with their merits and drawbacks.
4.	Understand RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers
5.	Summarize the design procedures, performance and parameters of detector, mixer & control circuits that operate in RF band.

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**
VT4301-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
VT4301-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

VT4301-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
VT4301-4	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
VT4301-1.5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. B. Razavi, “RF Microelectronics”, PHI, Second Edition.

REFERENCE BOOK:

1. Reinhold Ludwig and Pavel Bretchko, “RF Circuit Design Theory and Applications”, PE (Asia) Pvt. Ltd. 2004.

2. Thomas H. Lee, “Design of CMOS RF Integrated Circuits”, Cambridge University press, 1998

R. Jacob Baker, H.W. Li, D.E. Boyce,” CMOS Circuit Design, layout and Simulation”, PHI 1998

E Books / MOOCs/ NPTEL

1.

Professional Elective Courses (Microelectronic Systems)

INTERNET OF THINGS AND APPLICATIONS

Course Code:	**VT3202-1**	**Course Type**	**PEC**
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**
Prerequisite	**EC1001-1, EC1002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Explain the definition and usage of the term "The Internet of Things" in different contexts.
2.	Understand the various concepts, terminologies, and architecture of IoT systems
3.	To introduce the concept of M2M (machine to machine) Communication.
4.	To Learn different protocols used for IoT design
5.	Understand various applications of IoT in different domains

UNIT-I

IoT Overview **16 Hours**

Introduction, Physical design of IoT, Logical design of IoT, IoT architectural view, Sources of IoT, M2M communication, Examples of IoT, Communication Technologies, IoT levels and deployment templates

UNIT-II

Design Principles for Web Connectivity **15 Hours**

Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, Web Connectivity for Connected Devices Network using Gateway, SOAP, REST, HTTP and Web Sockets

Internet Connectivity Principles

Internet Connectivity, Internet based Communication, IP addressing in IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet

UNIT-III

Domain specific IoTs **09 Hours**

Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry applications, Health and Lifestyle

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

1.	Explain IoT and describe the basic architecture of IoT.
2.	Explain M2M Communication and communication technologies for IoT
3.	Discuss communication Protocols and web Connectivity for connected devices.
4.	Describe the IP addressing and application layer protocols in IoT.
5.	Discuss the domain specific applications of IoT.

TEXTBOOKS:

1.	Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014
2.	Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

REFERENCE BOOKS:

1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
2.	Ovidiu Vermesan, Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems" River Publishers, 2013.
3.	Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Elsevier, 2016.
E Books / MOOCs/ NPTEL	
1.	https://nptel.ac.in/courses/106/105/106105166/
2.	https://nptel.ac.in/courses/108/108/108108098/

CYBER PHYSICAL SYSTEM SECURITY

Course Code:	**VT4302-1**	**Course Type**	**PCC**
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**
Prerequisite	**EC2103-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To learn the basics of security and various types of security issues.
2.	To study different cryptography techniques available and various security attacks.
3.	Explore network security and how they are implemented in real world.
4.	To get an insight of various issues of Web security and biometric authentication.

UNIT-I

Overview of Security — **16 Hours**

Overview of Security and Privacy in Information System. Applied Cryptography & Intrusion Detection, Architecture of Applied Cryptography, One Way Hash Function and Integrity, Encryption Algorithms and Confidentiality, Digital Signature and Authentication (DH, RSA, 2 class), Intrusion Detection and Information Theory.

UNIT-II

Security of IoT and SDN — **15 Hours**

Internet of Things Security, Security and Privacy for IoT Case Study: Smart Home, Smart Grid Network, Modern Vehicle, Wearable Computing & BYOD, Mobile HealthCare. Software-Defined Networks, Introduction of Software-Defined Networks, Security for Software-Defined Networks, Privacy Leakages for Software-Defined Networks, Case Studies: How to Attack Software-Defined Networks.

UNIT-III

Cyber Physical Systems — **09 Hours**

Cyber-Physical Systems (CPS), CPS - Platform components, CPS implementation issues, Intelligent CPS, Secure Deployment of CPS.

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

1.	To apply basics of security and issues related to it.
2.	To learn security issues in IoT
3.	To learn mechanism of Software defined networks and its security
4.	To learn mechanism of software defined network and its security
5.	To apply basics of cyber physical 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													1	2	3
VT4302-1.1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
VT4302-1.2	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
VT4302-1.3	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
VT4302-1.4	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
VT4302-1.5	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:	
1.	Cyber Security, Nina Godbole, John Wiley & Sons.
2.	Li Da Xu, Shancang Li, “Securing the Internet of Things”, Syngress.
REFERENCE BOOKS:	
1.	Alasdair Gilchrist, “IoT Security Issues”, De Gruyter
2.	Sean Smith, “The Internet of Risky Things”, Sean Smith, Shroff Publisher/O’Reilly Publisher
E Books / MOOCs/ NPTEL	
1.	https://youtu.be/0ebJuDaHTeo (search for cyber physical system)

SYSTEM ON CHIP

Course Code:	**VT3206-1**	**Course Type**	**PEC**
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**
Prerequisite	**VT2001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To develop knowledge on the various hardware devices employed in robotics
2.	To gain knowledge in Robot movement
3.	To understand the Robot operating system and Robot programming

UNIT-I

Motivation for SoC Design **15 Hours**

Review of Moore's law and CMOS scaling, benefits of system on chip integration in terms of cost, power, and performance. Comparison on System-on-Board, System on Chip, and System in Package. Typical goals in SoC design – cost reduction, power reduction, design effort reduction, performance maximization. Productivity gap issues and the ways to improve the gap – IP based design and design reuse.

UNIT-II

MPSoCs **15 Hours**

What are MPSoCs ,Why MPSoCs, Challenges, Design Methodologies, Hardware Architectures
Techniques for Designing Energy-Aware MPSoCs: Energy-Aware Processor Design, Reducing Active Energy, Reducing Standby Energy, Energy-Aware Memory System Design, Reducing Active Energy, Reducing Standby Energy, Influence of Cache Architecture on Energy, Reducing Snoop Energy, Energy-Aware On-Chip Communication System Design, Bus Encoding for Low Power, Low Swing Signaling, Energy Considerations in Advanced Interconnects.

UNIT-III

SoC Design Flow **10 Hours**

IP design, Set Top Box SOC, ASIC Design flow.
Verification: Types of design validation and verification. Formal verification, Assertion based verification
Design for integration: More on VoIP SoC, hardware-software co-design flow, hardware-software co-design at system level.

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

1.	Recall the fundamentals of VLSI and classify SoC, SoB and SiP.
2.	Understand the different IP based design to apply in SoCs.
3.	Explain the typical peripherals in a MP SoC and Hardware Accelerators in a MPSoC.
4.	Summarize the energy aware systems.
5.	Illustrate the design flow and packaging related problems in the field of SoC.

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
VT3603-1.1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
VT3603-1.2	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
VT3603-1.3	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-

VT3603-1.4	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
VT3603-1.5	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-

TEXTBOOKS:

1.	Sudeep Pasricha and Nikil Dutt, "On-Chip Communication Architectures: System on Chip Interconnect", Morgan Kaufmann Publishers © 2008.
2.	Henry Chang et al., "Surviving the SoC Revolution: A Guide to Platform-Based Design", Kluwer (Springer), 1999.

REFERENCE BOOKS:

1.	Rao R. Tummala, Madhavan Swaminathan, "Introduction to System-on-Package (SOP) Miniaturization of the Entire System" Copyright, 2008.
2.	Prakash Rashinkar, Peter Paterson and Leena Singh, "System on a Chip Verification Methodology and Techniques", Kulwer Publishers, 2001.
3.	Ahmed Amine Jerraya and Wayne Wolf, "Multiprocessor Systems-on-Chips", Morgan Kaufmann Publishers is an imprint of Elsevier, 2005.

E Books / MOOCs/ NPTEL

1.	System on Chip MOOC and Free Online Courses | MOOC List (mooc-list.com)

LOW POWER VLSI DESIGN

Course Code:	**EC4331-1**	**Course Type**	**PEC**
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**
Prerequisite	**EC3006-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

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

UNIT-I

Simulation Power Analysis	**16 Hours**

Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Basic Principles of Low Power Design.
Simulation Power analysis: SPICE circuit simulation, Gate Level Logic Simulation-Architecture Level Analysis, Data Correlation Analysis in DSP Systems, Monte Carlo simulation.

UNIT-II

Low Power Design	**15 Hours**

Probabilistic Power Analysis: Random Logic Signals, Probability and Frequency, Probabilistic Power Analysis Techniques, Signal Entropy.
Low Power Design at Circuit Level: Transistor and Gate Sizing- Sizing an Inverter chain, Transistor and Gate sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction. Network Restructuring and Reorganization
Low Power Design at Logic level: Gate reorganization, Signal Gating, Logic Encoding, State Machine Encoding, Pre-Computation Logic.

UNIT-III

Low power Clock Distribution and Low Power Design at Architecture and System Level	**09 Hours**

Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, Power reduction in clock networks.
Low Power Design at Architecture and System Level: Power and Performance Management, Switching Activity Reduction, Parallel Architecture with Voltage Reduction, Flow Graph Transformation.

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

1.	Explain the need for low power design in VLSI Chips, sources of power dissipation in CMOS circuits and analyse the basic and emerging low power design approaches
2.	Explain the simulation-based power analysis techniques to determine the power dissipation in VLSI circuits
3.	Determine the power dissipation in VLSI circuits using probabilistic power analysis

	techniques.
4.	Explain power reduction techniques at the circuit level and logic level for VLSI Circuits.
5.	Explain the approaches of low power design in clock distribution, architectural and system levels.

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
EC4331-1.1	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-
EC4331-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
EC4331-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
EC4331-1.4	3	-	-	-	2	-	-	-	-	-	-	-	3	2	-
EC4331-1.5	3	-	-	-	2	-	-	-	-	-	-	-	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

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

REFERENCE BOOKS:

1. Kaushik Roy, Sharat Prasad, “Low Power CMOS VLSI Circuit Design”, Wiley, 2000.

2. Rabaey, Pedram,“Low Power Design Methodologies”, Springer, 2009.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/106105034/

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

Professional Elective Courses (Semiconductor Devices)

SEMICONDUCTOR DEVICE MODELLING AND SIMULATION

Course Code:	**VT3203-1**	**Course Type**	**PEC**
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**
Prerequisite	**VT2002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To introduce semiconductor material physics
2.	To study physics of pn junction, BJT and MOS structures.
3.	To understand SPICE models of semiconductor devices.

UNIT-I

Semiconductor physics and pn junction — **15Hours**

Semiconductors in Equilibrium and Carrier Transport, Semiconductor Materials, Carrier Concentration, Carrier Drift, Carrier Diffusion, Generation and Recombination Process, Continuity Equation, Thermionic Emission, Tunnelling, Ballistic Transport, High Field Effects.

Physics of Junction Devices: Thermal Equilibrium Condition, Depletion region, Depletion, and Diffusion Capacitances, Current-Voltage characteristics, Charge Storage and Transient behavior, Junction Breakdown, Metal Semiconductor Contacts, forward and reverse-biased junctions, reversebias breakdown, transient, and ac conditions.

UNIT-II

Physics of Bipolar devices and MOS devices — **15 Hours**

Physics of Bipolar devices: Transistor action, Static Characteristics, minority carrier distribution and terminal currents, generalized biasing, secondary effects, Frequency Response and Switching, Semiconductor Heterojunctions.

Ideal MOS capacitor, Energy band diagram in equilibrium and under bias, Flat band voltage, Potential Balance and charge balance, Effect of gate body voltage on surface condition, Accumulation and depletion, Inversion, CV Characteristics, Frequency response, threshold voltages, output and transfer characteristics of MOSFET, short channel and Narrow width effects, MOSFET scaling.

UNIT-III

Optoelectronic devices and SPICE models for Semiconductor devices — **10 Hours**

Optoelectronics Devices: Light emitting diodes, Lasers, Photoconductors, Junction Photodiodes, Avalanche Photodiodes, Solar Cells.

SPICE Models for Semiconductor Devices: MOSFET Level 1, Level 2 and level 3 model, Model parameters; SPICE models of p-n diode and BJT

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

1.	Explain the equations, approximations of semiconductor materials and pn junction.
2.	Explain techniques available for deriving a model with specified properties, for pn junction device characteristic with known qualitative theory and simulate characteristics.
3.	Understand device physics of BJT and simulate characteristics.
4.	Understand physics of MOS structures and simulate characteristics.
5.	Understand physics of optoelectronic devices, SPICE model parameters of semiconductor devices, Simulate characteristics of a simple device using MATLAB, and SPICE 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	3
VT3203-1.1	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-
VT3203-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
VT3203-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
VT3203-1.4	3	-	-	-	2	-	-	-	-	-	-	-	3	2	-
VT3203-1.5	3	-	-	-	2	-	-	-	-	-	-	-	3	2	-

TEXTBOOKS:

1. B. G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th Edition, PHI Private Limited, 2011.

2. T. A. Fjeldly, T. Ytterdal, and M. Shur, “Introduction to Device Modelling and Circuit Simulation”, John Wiley, 1998.

3. Introduction to Semiconductor Materials and devices by M.S Tyagi, John Wiley & Sons, 5th Edition, 2005.

REFERENCE BOOKS:

1. G. Massobrio and P. Antognetti, Semiconductor Device Modelling with SPICE, 2nd Edition, TMH, 2010.

2. C. C. Hu, Modern Semiconductor Devices for Integrated Circuits, Pearson Education, 2010.

3. P. Bhattacharya, Semiconductor Optoelectronics Devices, 2nd Edition, PHI, 2009.

4. A.K. Maini, N. Maini, All-in-One Electronics Simplified, Khanna Book Publishing, New Delhi, 2021.

5. A.K. Maini, Analog Electronics, Khanna Book Publishing, New Delhi, 2022.

E Books / MOOCs/ NPTEL

1.

HETEROJUNCTION DEVICE PHYSICS

Course Code:	**VT3201-1**	**Course Type**	**PEC**
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**
Prerequisite	**VT2002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand structure, characteristics of heterojunction devices.
2.	To study 2D electron gas and Quantum wells in heterojunctions.
3.	To study Transport properties, Density of States in heterojunctions

UNIT-I

Semiconductor Heterojunctions — **15 Hours**

Semiconductor heterojunctions: Types of heterojunctions, energy band diagrams of heterostructures, current-voltage and, capacitance-voltage characteristics of anisotype heterojunctions, heterojunction bipolar transistors, electrical and optical characteristics of LEDs, laser gain semiconductor band system, high electron mobility transistor, hot electron heterojunction transistor.

UNIT-II

2D electron gas and Quantum wells: — **15 Hours**

2D electron gas in Si and GaAs MOS structures, effect of applied bias on energy bands of the MOS capacitors, bias dependence of capacitance, free charge carrier transfer.

Quantum wells: Triangular quantum wells (both finite and infinite), coupled quantum wells, and superlattices, double heterostructure lasers, single quantum well lasers, multiple quantum well lasers. Optical absorption due to electronic transitions in quantum wells

UNIT-III

Transport properties, Density of States — **10 Hours**

Transport properties of heterostructures and quantum devices: Effect of electric field parallel and perpendicular to the interfaces, effects of constant magnetic field, Landau levels, magneto conductivity in a 2D heterostructure. One-D and Zero-D quantum structures.

The density of states in 3D, 2D, 1D and 0D structures, 1D and 0D optical phenomena and optical devices, quantum confined stark effect, quantum well modulators, self-electro-optic effect devices, resonant tunneling devices, the coulomb blockade, single electron transistor

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

1.	Understand the band structure of heterojunction devices.
2.	Analyze the electrical behavior of 2D heterojunctions.
3.	Understand the density of states in different dimensional structures like 2D electron gas.
4.	Understand the Quantum wells.
5.	Understand the band structure of heterojunction devices and transport mechanisms.

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**
VT3201-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3201-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3201-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-

VT3201-1.4	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3201-1.5	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-

TEXTBOOKS:

1. Principles of Extractive Metallurgy, Terkel Rosenqvist, McGraw-Hill Book Company, 1973

2. Stoichiometry and Thermodynamics of Metallurgical Processes: Y K Rao, Cambridge University Press, 2009

3. Handbook of Extractive Metallurgy: Fathi Habashi; Wiley-VCH , 1997

4. Solar-Grade Silicon: Refining and Recycling: L Zhang et al, CRC Press, 2013

REFERENCE BOOKS:

1. Scheel and Capper: Crystal Growth Technology: From Fundamentals and Simulation to Large- scale Production, John Wiley & Sons, 2008

2. Nakajima and Usami: Crystal Growth of Si for Solar Cell, Springer, 2009

3. Essentials of Metallurgical Thermodynamics, R.H. Tupkary, Khanna Book Publishing, 2016.

E Books / MOOCs/ NPTEL

1.

SEMICONDUCTOR OPTOELECTRONICS

Course Code:	**VT3205-1**	**Course Type**	**PEC**
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**
Prerequisite	**VT2002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To study Semiconductor Device Physics.
2.	To study Semiconductor Photon Sources.
3.	To study Semiconductor Photodetectors.

UNIT-I

Semiconductor PN Junction Device and Semiconductor Laser Physics **15 Hours**

Review of Semiconductor Device Physics: Energy bands in solids, the E-k diagram, Density of states, Occupation probability, Fermi level, and quasi-Fermi levels, p-n junctions, Schottky junction, and Ohmic contacts.

Semiconductor optoelectronic materials, Bandgap modification, Heterostructures, and Quantum Wells. Interaction of photons with electrons and holes in a semiconductor: Rates of emission and absorption, Condition for amplification by stimulated emission, the laser amplifier.

UNIT-II

Semiconductor Photon Sources, Optical Amplifiers & Modulators **15 Hours**

Semiconductor Photon Sources: Electroluminescence. The LED: Device structure, materials and characteristics. The Semiconductor Laser: Basic structure, theory, and device characteristics, direct current modulation, Quantum-well lasers; DFB-, DBR- and vertical-cavity surface-emitting lasers (VCSEL), Laser diode arrays, Device packages, and handling.

Semiconductor Optical Amplifiers & Modulators: Semiconductor optical amplifiers (SOA), SOA, characteristics and some applications, Quantum-confined Stark Effect and Electro-Absorption Modulators.

UNIT-III

Semiconductor Photodetectors and OEICs **10 Hours**

Semiconductor Photodetectors: Types of photodetectors, Photoconductors, Single junction under illumination: photon and carrier-loss mechanisms, Noise in photodetection; Photodiodes, PIN diodes, and APDs: structure, materials, characteristics, and device performance. Photo-transistors, solar cells, and CCDs.

Optoelectronic integrated circuits - OEICs.

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

1.	Acquire a fundamental understanding of the basic physics behind pn junction device.
2.	Acquire a fundamental understanding of the basic physics behind Semiconductor laser.
3.	Develop a basic understanding of Semiconductor Photon Sources
4.	Acquire a depth understanding of optoelectronic modulation and switching devices,
5.	Acquire a depth understanding of photodetectors, detailed knowledge of develop a basic understanding of optoelectronic integrated circuits

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**
VT3205-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3205-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3205-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3205-1.4	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3205-1.5	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-

TEXTBOOKS:

1. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., 2nd Ed. (2007), Ch.16, 17, and 18.
2. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
3. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
4. G. Keiser, Optical Fiber Communications, McGraw-Hill Inc., 3rd Ed. (2000),Ch.4, 6.

REFERENCE BOOKS:

1. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007), 6th Ed. Ch.15-17.
2. J. M. Senior, Optical Fiber Communication: Principles and Practice, Prentice Hall of India, 2nd Ed. (1994)

E Books / MOOCs/ NPTEL

1.

SEMICONDUCTOR MATERIALS SYNTHESIS AND CHARACTERIZATION

Course Code:	**VT3303-1**	**Course Type**	**PEC**
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**
Prerequisite			

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand various synthesis processes and process kinetics.
2.	To understand Production of Metallurgical grade (MG) Si, Crystal Growth
3.	To understand Microscopy and Spectroscopy.

UNIT-I

Extraction and Process kinetics **15 Hours**

Principles of extraction, pyrometallurgical processes, material and heat balance of processes, thermodynamics of processes; introduction to laws, thermodynamic equilibrium, thermochemistry, Ellingham diagram. Process kinetics; introduction to chemical kinetics and rate processes, heterogeneous kinetics, kinetics of liquid-liquid reactions, concepts of reactor design. Structure & properties of molten liquids.

UNIT-II

Production of Metallurgical grade (MG) Si, Crystal Growth **15 Hours**

Production of metallurgical grade (MG) Si: Carbothermic reduction, principle, operation and practice of sub-merged arc furnace, energy and process calculation, refining & impurities control in molten MG Si.Production of electronic grade (EG) Si: Concept of fluidized bed reactor, Siemens Process. Crystal Growth: Crystal growth processes (Bridgman and its variants, Czochralski), heat and species transfer during non-steady and steady state plane-front growth, interface instability and effect of convection on interface stability

UNIT-III

Microscopy and Spectroscopy **10 Hours**

XRD (Bulk and thin film), Microscopy (Optical, SEM, TEM, SPM), UV-Visible spectroscopy, Photoluminescence, Raman spectroscopy

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

1.	Acquire a fundamental understanding of Extraction.
2.	Acquire a fundamental understanding of Process kinetics.
3.	Develop a basic understanding of Production of Metallurgical grade (MG) Si.
4.	Develop a basic understanding of Production of Crystal Growth.
5.	Acquire a depth understanding Microscopy and Spectroscopy.

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**
VT3303-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3303-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3303-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3303-1.4	3	3	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3303-1.5	3	3	-	-	-	-	-	-	-	-	-	-	3	1	-

TEXTBOOKS:

1.	Principles of Extractive Metallurgy, Terkel Rosenqvist, McGraw-Hill Book Company, 1973
2.	Stoichiometry and Thermodynamics of Metallurgical Processes: Y K Rao, Cambridge University Press, 2009
3.	Handbook of Extractive Metallurgy: Fathi Habashi; Wiley-VCH , 1997
4.	Solar-Grade Silicon: Refining and Recycling: L Zhang et al, CRC Press, 2013
REFERENCE BOOKS:	
1.	Scheel and Capper: Crystal Growth Technology: From Fundamentals and Simulation to Large- scale Production, John Wiley & Sons, 2008
2.	Nakajima and Usami: Crystal Growth of Si for Solar Cell, Springer, 2009
3.	Essentials of Metallurgical Thermodynamics, R.H. Tupkary, Khanna Book Publishing, 2016.
E Books / MOOCs/ NPTEL	
1.	

NANOELECTRONICS AND TECHNOLOGY

Course Code:	**VT3302-1**	**Course Type**	**PEC**
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**
Prerequisite			

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand basic CMOS Process flow and MOS scaling theory and requirements for Nonclassical MOS transistor
2.	To study the SOI MOSFETS, FinFETs and compound semiconductors.
3.	To study synthesis and characterisation of nanomaterials.

UNIT-I

Overview and requirements of Nanoelectronics device structures — **15 Hours**

Overview: Nanodevices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow, MOS Scaling theory, Issues in scaling MOS transistors: short channel effects, Description of a typical 65 nm CMOS technology.

Requirements for Nonclassical MOS transistor, MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics. Integration issues of high-k Interface states, bulk charge, band offset, stability, reliability – Qbd high field, possible candidates, CV and IV techniques.

UNIT-II

Metal gate transistor, Compound semiconductors — **15 Hours**

Metal gate transistor: Motivation, requirements, Integration Issues, Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot.

SOI - PDSOI and FDSOI, Ultrathin body SOI – double gate transistors, integration issues, Vertical transistors - FinFET and Surround gate FET, Metal source/drain junctions – Properties of Schottky junctions on Silicon, Germanium, and compound semiconductors-Work function pinning. Germanium Nano MOSFETs: strain, quantization, Advantages of Germanium over Silicon, PMOS versus NMOS.

Compound semiconductors – material properties, MESFETs Compound semiconductors MOSFETs in the context of channel quantization and strain, Heterostructure MOSFETs exploiting novel materials, strain, quantization

UNIT-III

Synthesis and Characterization techniques for nanomaterials — **10 Hours**

Synthesis of Nanomaterials: CVD, Nucleation and Growth, ALD, Epitaxy, MBE. Compound semiconductor hetero-structure growth and characterization: Quantum wells and Thickness measurement techniques: Contact - step height, Optical - reflectance and ellipsometry. AFM. Characterization techniques for nanomaterials: FTIR, XRD, AFM, SEM, TEM, EDAX etc. Applications and interpretation of results. Emerging nano materials: Nanotubes, nanorods and other nano structures, LB technique, soft lithography etc. Microwave-assisted synthesis, Self-assembly etc.

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

1.	Understand the fundamentals of classical CMOS technology.
2.	Understand the issues in scaling MOSFET in the sub-100nm regime.
3.	Analyze the non-classical transistors such as SOI MOSFETS, FinFETs
4.	Understand the compound semiconductor structures.
5.	Understand the synthesis and characterisation of nanomaterials.

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**
VT3302-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3302-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3302-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3302-1.4	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
VT3302-1.5	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-

TEXTBOOKS:

1. Fundamentals of Modern VLSI Devices, Y. Taur and T. Ning, Cambridge University Press.
2. Silicon VLSI Technology, Plummer, Deal, Griffin Pearson Education India.

REFERENCE BOOKS:

1. Encyclopedia of Materials Characterization, Edited by: Brundle, C.Richard; Evans, Charles A. Jr.;Wilson, Shaun ; Elsevier

E Books / MOOCs/ NPTEL

1.

Professional Elective Courses (Semiconductor Design Automation and IT)

DATA STRUCTURES AND ALGORITHMS

Course Code:	**EC2272-1**	**Course Type**	**PEC**
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**
Prerequisite	**CS1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Understanding of fundamental Data Structures including linked-lists, trees, binary search trees, AVL trees, stacks, queues, priority queues, and hash-tables and skip lists.
2.	Ability to program data structures and use them in implementations of abstract data types.
3.	Understanding of basic algorithmic complexity.

UNIT-I

Introduction to Stacks, queue, Linked list — **16 Hours**

Data structures: Definition, Types. Algorithm design, Complexity, Time-Space Tradeoffs. Use of pointers in data structures. Array Definition and Analysis, Representation of Linear Arrays in Memory, Traversing of Linear Arrays, Insertion And Deletion, Single Dimensional Arrays, Two Dimensional Arrays, Multidimensional Arrays, Function Associated with Arrays, Character String in C, Character String Operations, Arrays as parameters, Implementing One Dimensional Array, Sparse matrix.

Introduction to Stacks, queue, Linked list: Definition, Array representation of stacks, Operations Associated with Stacks- Push & Pop, Polish expressions, Conversion of infix to postfix, infix to prefix (and vice versa),Application of stacks recursion, polish expression and their compilation, conversion of infix expression to prefix and postfix expression. Queue: Definition, Representation of Queues, Operations of queues- QInsert, QDelete, Priority Queues, Circular Queue, Deque. Linked list: Introduction to Singly linked lists: Representation of linked lists in memory, Traversing, Searching, Insertion into, Deletion from linked list.

UNIT-II

Trees and Graphs Trees — **15 Hours**

Trees and Graphs Trees: Basic Terminology, Binary Trees and their representation, expression evaluation, Complete Binary trees, extended binary trees, Traversing binary trees, Searching, Insertion and Deletion in binary search trees, General trees, AVL trees, Threaded trees, B trees. Graphs: Terminology and Representations, Graphs & Multigraphs, Directed Graphs, Sequential representation of graphs, Adjacency matrices, Transversal Connected Component and Spanning trees.

Algorithm Design paradigms - motivation, concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Recurrences- substitution method, recursion tree method, master method.

UNIT-III

Divide and conquer and Dynamic Programming — **09 Hours**

Divide and conquer: Structure of divide-and-conquer algorithms: examples; Binary search, quick sort, Merge sort, Strassen Multiplication; Analysis of divide and conquer run time recurrence relations. Greedy Method Overview of the greedy paradigm examples of exact optimization solution (minimum cost spanning tree), Approximate solution (Knapsack problem), Single source shortest paths, traveling salesman.

Dynamic programming Overview, difference between dynamic programming and divide and conquer, Applications: Shortest path in graph, chain Matrix multiplication, Traveling salesman

Problem, longest Common sequence, knapsack problem.

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

1.	Learn the basic types for data structure, implementation and application.
2.	Apply the different linear data structures like stack, queue and Linked list to various computing problems.
3.	Implement different types of trees and Graphs and apply them to problem solutions.
4.	Analyze the various algorithms paradigms.
5.	Outline the concepts of Divide-And-Conquer technique algorithms and its 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**
EC2272-1.1	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2272-1.2	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2272-1.3	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2272-1.4	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2272-1.5	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Tannenbaum, “Data Structures”, PHI.
2.	E. Horowitz, S. Sahni, and S. Rajsekaran, “Fundamentals of Computer Algorithms” , Galgotia Publication.

REFERENCE BOOKS:

1.	Horowitz and Sahani, “Fundamentals of Data structures”, Galgotia publications.
2.	R.L. Kruse, B.P. Leary, C.L. Tondo, “Data structure and program design in C” , PHI.
3.	J.E Hopcroft, J.D Ullman, “Design and analysis of algorithms”.
4.	T. H. Cormen, Leiserson, Rivest and Stein, “Introduction of Computer algorithm”.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/106102064

OBJECT ORIENTED PROGRAMMING IN JAVA

Course Code:	**EC2371-1**	**Course Type**	**PEC**
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**
Prerequisite	**CS1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Introduce Java basics and Data Structures.
2.	Arm the students with the basic object-oriented programming concepts.
3.	Introduce different techniques like Inheritance, Multithreaded Programming and HTML.

UNIT-I

Java Basics and Java Object Oriented **16 Hours**

Java Basics: Concepts of OOP, Features of Java, How Java is different from C++, Environmental setup, Basic syntax, Objects and classes, Basic Data Types, Variable Types, Modifier Types, Basic operators, Loop Control, Decision Making, Strings and Arrays, Methods, I/O.

Java Object Oriented: Inheritance, Overriding, Polymorphism, Abstraction, Encapsulation, Interfaces, and Packages.

UNIT-II

Exception Handling, Threading **15 Hours**

Exception Handling, Threading: Exception Hierarchy, Exception Methods, Catching Exceptions, Multiple catch Clauses, Uncaught Exceptions Java's Built-in Exception. Creating, Implementing and Extending thread, thread priorities, synchronization suspending, resuming and stopping Threads, Multi-threading.

JDBC: Introduction, Drivers and architecture, Connections, statement, result set. Store, retrieve and transaction management.

UNIT-III

Java Servlets and Web development **09 Hours**

Basics and life cycle of Servlets. JSP, JSON

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

1.	Use the syntax and semantics of java programming language and basic concepts of OOP.
2.	Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages.
3.	Apply the concept of Exception handling, multithreaded programming to write a program using JAVA.
4.	Explain various principles of JDBC and its connectivity to access data from database.
5.	Develop web-based program using servlet and JSP.

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**
EC2371-1.1	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1

EC2371-1.2	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2371-1.3	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2371-1.4	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2371-1.5	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Patrick Naughton & Herbert Schild, "JAVA The Complete Reference", TMH.

2. Balaguruswamy, "Introduction to JAVA Programming a primer".

REFERENCE BOOKS:

1. Daniel/Young, “Introduction to JAVA Programming”, PHI.

2. Jeff Frentzen and Sobotka, “Java Script”, Tata McGraw Hill,1999.

E Books / MOOCs/ NPTEL

1. https://www.coursera.org/learn/object-oriented-java

2. https://spoken-tutorial.org/tutorial-search/?search_foss=Java&search_language=English

3. https://www.udacity.com/course/intro-to-java-programming–cs046

4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-092introductionto-programming-in-java-january-iap-2010/index.html

MOBILE APPLICATION DEVELOPMENT

Course Code:	**EC3272-1**	**Course Type**	**PEC**
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**
Prerequisite	**CS1001-1, EC2602-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1. To facilitate students to understand android SDK
2. To help students to gain a basic understanding of Android application development
3. To inculcate working knowledge of Android Studio development tool

UNIT-I

Android Application Design Essentials **16 Hours**

Introduction: Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

UNIT-II

Android User Interface Design Essentials **15 Hours**

Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.

Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

UNIT-III

Using Common Android APIs **09 Hours**

Using Common Android APIs: Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

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

1. Identify various concepts of mobile programming that make it unique from programming for other platforms
2. Critique mobile applications on their design pros and cons
3. Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
4. Program mobile applications for the Android operating system that use basic and advanced phone features
5. Deploy applications to the Android marketplace for distribution.

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**
EC3272-1.1	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC3272-1.2	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC3272-1.3	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC3272-1.4	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1

EC3272-1.5	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd edition, 2011.

REFERENCE BOOKS:

1.	Neal Goldstein, Tony Bove, "iPhone Application Development All-In-One For Dummies", John Wiley & Sons.
2.	Henry Lee, Eugene Chuvyrov, "Beginning Windows Phone App Development", Apress, 2012.
3.	Teach Yourself Android Application Development In 24 Hours, Edition: I, Publication: SAMS.
4.	Anubhav Pradhan, Anil V Deshpande, " Mobile Apps Development" Edition: I.
5.	Jeff McWherter, Scott Gowell "Professional Mobile Application Development", John Wiley & Sons, 2012.

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.nptel.ac.in/noc20_cs52/preview

CAD FOR VLSI

Course Code:	**VT3301-1**	**Course Type**	**PEC**
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**
Prerequisite	**EC1002-2, VT2001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Understand the concept of computational approach to Boolean algebra.
2.	To understand logic optimization algorithms.
3.	To understand layout optimization algorithms.

UNIT-I

Graph Theory and Boolean Algebra — **15 Hours**

Notation, undirected graphs, directed graphs, combinatorial optimization, Algorithms, tractable and intractable problems, algorithms for linear and integer programs, graph optimization problems and algorithms.

Boolean algebra: Introduction, Shannon's expansion theorem, Shannon's co-factor, Quantification Operators, Boolean Difference, consensus, smoothing, Binary Decision Diagram (BDD), Reduced ordered BDD, BDD sharing, BDD ordering, Satisfiability (SAT).

UNIT-II

Logic Optimization Algorithms — **15 Hours**

Two Level Logic optimization: Cover of a Boolean function, Tautology, containment, complementation algorithms.

Multiple Level Logic optimization: The Algebraic model, algebraic division, substitution, algebraic kernels and co-kernels, kernels set computation, extraction of single cube and multiple cube expressions, decomposition.

Basics, Implicit Don't Cares, Satisfiability Don't Cares, Controllability Don't Cares, Observability Don't Cares

UNIT-III

Layout Optimization Algorithms — **10 Hours**

ASIC Placement, Technology Mapping: Introduction, Wire length Estimation, Iterative Improvement Placement, Simulated Annealing Placement, Analytical Placement, Tree Mapping.

ASIC Routing, Timing Analysis: Basics, Detailed Routing, Global Routing, Maze Routing: 2-Point Multi-Point Nets, Logic-Level Timing: Basic Assumptions & Models, Elmore Delay Model

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

1.	Explain the computational approach to Boolean algebra.
2.	Design binary decision diagram and satisfiability logic for computational Boolean algebra.
3.	Understand two-level logic synthesis and optimization algorithms.
4.	Understand multi-level logic synthesis and optimization algorithms
5.	Explain the algorithms for placement and routing in physical design process and timing models of Boolean functions.

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**
VT3301-1.1	3	1	-	-	3	-	-	-	-	-	-	-	1	3	1

VT3301-1.2	3	1	-	-	3	-	-	-	-	-	-	-	1	3	1
VT3301-1.3	3	1	-	-	3	-	-	-	-	-	-	-	1	3	1
VT3301-1.4	3	1	-	-	3	-	-	-	-	-	-	-	1	3	1
VT3301-1.5	3	1	-	-	3	-	-	-	-	-	-	-	1	3	1

TEXTBOOKS:

1. De Micheli G., Synthesis and Optimization of Digital Circuits, McGraw Hill, (1994).
2. Sabih H. Gerez, “Algorithms for VLSI Design Automation”, Wiley Publication, 2011.
3. Pan, D.Z., VLSI Physical Design Automation, The University of Texas at Austin, (2015).
4. Nowick, S. M., Bhardwaj, K. Computer-Aided Design of Digital Systems, Columbia University, (2016).

REFERENCE BOOKS:

1. Niranjan N Chiplunkar, Manjunath Kotari, “VLSI CAD”, PHI Publisher, 2011.
2. Brunvand, E., Digital VLSI Chip Design with Cadence and Synopsys CAD Tools, Addison Wesley, (2010).
3. Gerez, S.H., Algorithms for VLSI Design Automation, Wiley, (1999).

E Books / MOOCs/ NPTEL

1.

MACHINE LEARNING FOR VLSI

Course Code:	**VT4302-1**	**Course Type**	**PEC**
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**
Prerequisite	**VT3101-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To study the fundamentals of Machine Learning in VLSI and algorithms for mask synthesis.
2.	To study the Machine Learning in Physical Verification, design and routing.
3.	To study the Machine Learning in mask synthesis and routing.

UNIT-I

Machine Learning in VLSI CAD **15 Hours**

A Preliminary Taxonomy for Machine Learning in VLSI CAD

Machine learning taxonomy, VLSI CAD Abstraction levels (Text Book:1 – 1.1, 1.2)

Machine Learning for Mask Synthesis

Introduction, Machine Learning guided OPC, MLP Construction, ML-EPC, EPC Algorithm (TextBook:1 – 3.1, 3.2, 3.2.2.2, 3.3.2, 3.3.2.4).

UNIT-II

Machine Learning in Physical Design **15 Hours**

Machine Learning in Physical Verification

Introduction, Machine Learning in Physical Verification – layout feature extraction & encoding, models for hotspot detection.

(Text.Book:1 – 4.1, 4.2)

Machine Learning in Physical Design:

Mask synthesis flow, Machine Learning for sub-resolution assist features, Machine Learning for optical proximity correction.

Machine Learning in Physical Design - for datapath placement, routability driven placement, clock optimization, lithography friendly routing (Text Book: 1 – 4.3, 4.4).

UNIT-III

Machine Learning for Manufacturing **10 Hours**

Gaussian Process-Based Wafer-Level Correlation Modeling and Its Applications

(Text Book: 1 – 5.1)

Machine Learning for Yield and Reliability:

High-volume manufacturing yield estimation – Histogram with random sampling, Histogram with GPST-PS, Kernel density estimation. (Text Book: 1 – 5.2.11).

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

1.	Understand the fundamentals of Machine Learning in VLSI
2.	Understand the Machine Learning algorithms for mask synthesis.
3.	Understand the Machine Learning in Physical Verification.
4.	Understand the Machine Learning in mask synthesis and routing.
5.	Understand the Machine Learning for Manufacturing.

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**
VT4302-1.1	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1

VT4302-1.2	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT4302-1.3	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT4302-1.4	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT4302-1.5	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1

TEXTBOOKS:

1. Ibrahim (Abe)M Elfadel, Duane SBoning, Xin Li, "Machine Learning in VLSI Computer Aided Design", Springer International Publishing, 2019

REFERENCE BOOKS:

1. Tom M Mitchell, "Machine Learning", McGraw-Hill 1997

2. Anuradha Srinivasaraghavan, Vincy Joseph, "Machine Learning", Wiley 2019

E Books / MOOCs/ NPTEL

1.

ARTIFICIAL INTELLIGENCE

Course Code:	**EC3261-1**	**Course Type**	**PEC**
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**
Prerequisite	**EC2602-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Introduce AI, propositional calculus, graph theory and Heuristic approach
2.	Arm the students with the basics of issues involved with knowledge presentation
3.	Learn the issues involved in knowledge presentation and algorithms of Al systems
4.	Understand the role of knowledge in language understanding
5.	Understand the image analysis with AI systems

UNIT-I

Introduction to Artificial Intelligence — **16 Hours**

Introduction to Artificial Intelligence (AI): The History of Artificial Intelligence and the State of the Art. Components of AI.

Problems, Problem Spaces, and Search: Defining the Problem as a State Space Search, Production Systems, Problem Characteristics, Production System Characteristics and Issues in Design of Search Problems.

Additional Problems:

Water Jug Problem, Missionaries and Carnivals Problem, 8-Puzzle Problem, Tower of Hanoi Problem, Cryptarithmetic Problem.

Heuristic Search Techniques: Hill Climbing, Best First Search-A* SEARCH, AO* Search, Problem Reduction and Constraint Satisfaction.

UNIT-II

Knowledge Based Systems and Natural Language Processing — **15 Hours**

Knowledge Based Systems (KBS): Type of Knowledge, Knowledge Acquisition, Knowledge Representation-Logic, Semantic Network, Frame, Conceptual Graphs Conceptual Dependency and Script.

Natural Language Processing (NLP): Applications of NLP, Examples of NLP Systems, Chomsky Hierarchy of Grammars, Transformational Grammar, Case Grammars (FILLMORE's) & Context Free Grammar (CFG).

Game Playing: MiniMax Search and Alpha- Beta (α-β) Pruning.

UNIT-III

Sensing The World — **09 Hours**

Vision, Image Transformation, Image Analysis, Pre-Processing, Finding Edges, Template Matching, Point Tracking, Threshold Variation, Segment Analysis, Forming Segments, Image Understanding, Optical Sensors, Telemarketing AI.

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

1.	An understanding of the concepts AI, basics of propositional calculus.
2.	An understanding of graph theory and Heuristic approach.
3.	An understanding of basics of issues involved with knowledge presentation.
4.	An understanding human language using NLP grammars and parsing techniques.
5.	Apply AI to template matching and Telemarketing.

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**
EC3261-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
EC3261-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
EC3261-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
EC3261-1.4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
EC3261-1.5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Elaine Rich, Kevin Knight, Shivashankar B. Nair "Artificial Intelligence", Tata McGraw Hills, 3rd Edition, 2009.
2. Charniak and Mc Dermott, "Introduction to Artificial Intelligence", Pearson Education, 1999.
3. Kevin Warwick, "Artificial Intelligence, the basics", Wearset Ltd.

REFERENCE BOOK:

1. George F Luger, "Artificial Intelligence", Pearson Education, 4th Edition, 2002

E Books / MOOCs/ NPTEL

1. nptel.ac.in/courses/106105077/
2. nptel.ac.in/courses/106106126/

Professional Elective Courses (Semiconductor Manufacturing)

SEMICONDUCTOR EQUIPMENT DESIGN AND TECHNOLOGY

Course Code:	**VT3204-1**	**Course Type**	**PEC**
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**
Prerequisite	**VT2002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To introduce nomenclature and definition and vacuum pumps, vacuum measurements
2.	To give an overview of Micro sensors, Actuators and Smart Materials
3.	To introduce CMOS compatible MEMS Fabrication Techniques

UNIT-I

Fundamentals of vacuum technology **15Hours**

Nomenclature and definition, pressure regions, gas properties and laws, molecular processes and kinetic theory, gas flow calculations, technology of vacuum pumps- throughput, pumping speed, forevacuum and high vacuum pumping, pump system design, diaphragm pumps, vacuum blowers, diffusion pumps, cryogenic pumps, turbomolecular pumps, pumps for ultra-high vacuum.

Vacuum measurements, types of gauges, mass analysis and spectrometry, mass flow control and measurement, vacuum valves, flanges and components, vacuum feedthroughs, vacuum seals, vacuum leak detectors, vacuum chambers and viewports, outgassing, vacuum applications such as sputtering, plasma etching, CVD, epitaxy, electron spectroscopies

UNIT-II

Plasma physics, Plasma Reactors **15 Hours**

Plasma physics- Motion of individual electrons and ions in electric and magnetic fields- Single, collisionless, particles in DC and AC electric fields, Particle orbits in magnetic fields, Space charge and collective effects, Debye shielding, Plasma oscillations and plasma frequency, Plasma shielding and plasma sheaths, Response to DC, RF and microwave fields, Plasma potential, Characteristic electron and ion transit times

Introduction to Plasma Reactors- Chamber pump systems, load locks, mass flow control, hazardouns gas handling, effluent control, Pressure gauges / control (Piranhi, thermocouple, ionization, baratron, convectron) Wafer chucks (Clamps/Electrostatic chucks)

UNIT-III

RF and microwave power sources and coupling **10 Hours**

Power sources, matching networks, feedthroughs and coupling

RF Capacitively and Inductively coupled plasmas- Spatial variations of plasma potential, electric field, charge density and energy, optical emission, Sheaths at powered, grounded and floating surfaces, parameters, models, matching networks, Ion bombardment - energy / time / frequency/ power dependencies

Applications in processes- etching, deposition, sputtering, ashing

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

1.	Understand Basics of Vacuum pumps
2.	Understand Basics of Vacuum measurement techniques.
3.	Understand Basics of Plasma Technology.
4.	Understand Basics of Plasma reactors.
5.	Ability to analyze vacuum and plasma based semiconductor equipment.

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
VT3204-1.1	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT3204-1.2	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT3204-1.3	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT3204-1.4	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1
VT3204-1.5	3	2	-	-	3	-	-	-	-	-	-	-	1	3	1

TEXTBOOKS:

1.	V.V. Rao, T.B. Ghosh, K.L. Chopra,, Vacuum Science and Technology, Allied Publishers Ltd., New Delhi 3. Handbook of Vacuum Technology: Karl Jousten, Wiley
2.	Handbook of Vacuum Science and Technology- Dorothy M. Hoffman, Bawa Singh, John H. Thomas, III, Academic Press
3.	Handbook of Vacuum Technology: Karl Jousten, Wiley

REFERENCE BOOKS:

1.	Plasma Etching: Fundamentals and Applications: 7 (Series on Semiconductor Science and Technology)- M. Sugawara, OUP Oxford
2.	Plasma Etching in Semiconductor Fabrication- Russ Morgan, Elsevier
3.	Fundamentals of Plasma Physics- J. A. Bittencourt, Springer India
4.	Plasma Physics and Engineering- Alexander Fridman, Lawrence Kennedy, CRC Press

E Books / MOOCs/ NPTEL

1.	

Professional Elective Courses (Embedded Systems)

COMPUTER OPERATING SYSTEMS

Course Code:	**EC2221-1**	**Course Type**	**PEC**
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**
Prerequisite	**EC1002-1, CS1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Define and Describe operating systems, Resource allocation, Operating System structure, Operating System operations and services
2.	Explain Process concept, Operations on processes, Inter process communication, Multi-Threaded Programming and Process management.
3.	Explain memory management concepts as applicable to kernel and programs in an Operating System.
4.	Define and Describe Virtual memory, Paging policies and Scheduling of processes in an Operating System.

UNIT-I

Introduction and Overview of Operating Systems **08 Hours**

Introduction to Operating system, Goals of an O.S, Operation of an O.S, Functions performed by an OS, Computational structures and OS responsibilities, O.S and the computer system, Efficiency and user convenience, Classes of operating systems, Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems, Distributed operating systems.

Structure of the Operating Systems **08 Hours**

Structure of an Operating system, Configuring and installing of the Kernel, Operating system with monolithic structure, Layered design, Virtual machine operating systems, Kernel based operating systems and Microkernel based operating systems.

UNIT-II

Process Management **08 Hours**

Concept of Processes and Programs, Programmer view of processes, OS view of processes, Interacting processes, Threads, Processes in UNIX, Threads in Solaris.

Memory Management **07 Hours**

Managing the memory hierarchy, Memory allocation preliminaries, Memory allocation to process, Reuse of memory, Contiguous and non-contiguous allocation to programs, Paging, Segmentation, Segmentation with paging, Kernel memory allocation.

UNIT-III

Virtual Memory and Scheduling **09 Hours**

Virtual memory basics, Demand paging, Address translation and page fault generation, Address translation in multi programming systems, Operation of a virtual memory handler, Page replacement policies, Shared pages, UNIX virtual memory.

Scheduling preliminaries, non-Pre-emptive scheduling algorithms FCFS, SRN, HRN, Pre-emptive scheduling algorithms- RR, LCN, STG, Scheduling in Practice Long-term scheduling, Medium and short term scheduling.

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

1.	Describe Computational structure, operations and services of Operating System.

2.	Explain fundamental classes and structures of Operating System
3.	Describe how processes and threads are used in operating system context.
4.	Illustrate how memory is managed in operating system and compare memory management techniques.
5.	Describe Virtual memory, paging policies, Scheduling of processes in an Operating System and apply the concepts of page replacement policies and scheduling to achieve effective resource utilization.

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**
EC2221-1.1	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2221-1.2	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2221-1.3	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2221-1.4	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
EC2221-1.5	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. D. M. Dhamdhare, "Operating Systems A Concept Based Approach" TMH, 2nd Ed, 2006.

REFERENCE BOOKS:

1. Silberschatz and Galvin, "Operating Systems Concepts", John Wiley, 5th Edition, 2001.

E Books / MOOCs/ NPTEL

1. https://www.digimat.in/nptel/courses/video/106105214/L01.html
2. https://nptel.ac.in/courses/106106144
3. https://onlinecourses.nptel.ac.in/noc20_cs04/preview
4. https://www.my-mooc.com/en/mooc/computer-hardware-and-operating-systems/
5. https://archive.nptel.ac.in/courses/106/102/106102132/

DSP PROCESSORS AND ARCHITECTURES

Course Code:	**EC3211-1**	**Course Type**	**PEC**
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**
Prerequisite	**EC2004-1, EC2106-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1. To understand the concepts of digital signal processor functional units.
2. To list various instructions of DSP processors.
3. To develop notations for fixed point numbers and interfacing peripherals.
4. To implement basic DSP algorithms.

UNIT-I

Basic Architectural Features — **15 Hours**

Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities Address Generation Unit, Programmability and Program Execution, Features for External Interfacing.

Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS32OC54xx., Memory Space of TMS32OC54xx Processors, Program Control.

UNIT-II

Instruction Set of TMS54xx Processors — **15 Hours**

Detail Study of TMS320C54X & 54xx Instructions and Programming, On-Chip peripherals, Interrupts of TMS32OC54XX Processors, Pipeline Operation of TMS32OC54xx Processor.

UNIT-III

Implementation of various DSP Algorithms Applications — **10 Hours**

Introduction, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit-Reversed Index Generation & Implementation on the TMS32OC54xx.

Introduction, Synchronous Serial Interface, A CODEC Interface Circuit. DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System.

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

1. Critically study the architectural units of a DSP processor.
2. Understand the architecture of TMS320C54xx processor.
3. Understand the instruction set of TMS320C54xx processor in detail.
4. Evaluate the performance of TMS320C54xx processor.
5. Implement various DSP algorithms using TMX320C54xx processors.

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**
EC3211-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-

EC3211-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
EC3211-1.3	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
EC3211-1.4	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
EC3211-1.5	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Avatar Singh and S. Srinivasan, “Digital Signal Processing”, Thomson Learning, 2004.

REFERENCE BOOKS:

1. Ifeachor E. C., Jervis B. W, “Digital Signal Processing: A practical approach”, Pearson-Education, PHI/ 2002.
2. B Venkataramani and M Bhaskar, “Digital Signal Processors” , TMH, 2nd, 2010.

REAL TIME OPERATING SYSTEMS

Course Code:	**EC3322-1**	**Course Type**	**PEC**
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**
Prerequisite	**EC2004-1, EC2221-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Understand the difference between a Real Time System and General computing system and calculate performability and program runtime in a Real Time System.
2.	Be familiar with various task scheduling methods and their intended usage.
3.	Learn various multiple access protocols used in Real Time Communication.
4.	Know the services offered issues involved in Real Time Operating Systems.
5.	Analyze and design the architecture of a Real Time Systems.

UNIT-I

Task Assignment & Scheduling — **16 Hours**

Introduction: Issues in Real Time Computing, Task classes. Characterizing Real Time Systems and Tasks: Performance measures for Real Time Systems, Estimating Program runtimes.

Task Assignment & Scheduling: Classical Uniprocessor scheduling algorithms: Rate Monotonic and Earliest Deadline First; Multiprocessor scheduling: Utilization-Balancing Algorithm, Next-Fit Algorithm, Bin-Packing Assignment.

UNIT-II

Real Time Communication and Real Time Operating Systems — **16 Hours**

Real Time Communication: Network topologies, Network architecture issues; Protocols: Contention-based protocol (VTCSMA only) and Token-based protocols: Timed Token Protocol.

Real Time Operating Systems (RTOS): OS Services, Real Time & Embedded System OS, RTOS Task scheduling models, OS security issues.

UNIT-III

RTOS Tools with case studies — **08 Hours**

RTOS Tools with case studies: Use of MUCOS/OS-II, Use of Vx Works, Case studies of Automatic Chocolate Vending machines, Coding for sending application layer byte streams on a TCP/IP network. (Excluding programming).

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

1.	Describe the structure, types and issues in the real time systems, illustrate the performability of a given real-time system and estimate source code run time.
2.	Illustrate RM and EDF uniprocessor scheduling algorithm and Utilization-Balancing, Next-Fit and Bin-Packing Assignment multiprocessor scheduling algorithms.
3.	Describe the network architectural issues and VT-CSMA, Timed token and Token ring real time protocols for real-time communication.
4.	Explain RTOS services, Kernel services, Scheduling algorithms and OS security issues.
5.	Describe the features of MUCOS and Vx-Works along with ACVM and Sending application layer bytes on a TCP/IP protocol.

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**
EC3322-1.1	-	1	-	-	-	2	-	-	-	-	-	-	-	-	1
EC3322-1.2	-	-	3	-	-	-	-	-	-	-	-	-	3	3	-
EC3322-1.3	3	-	2	-	-	-	-	-	-	-	-	-	-	2	-
EC3322-1.4	3	-	-	1	-	-	-	-	-	-	-	-	2	-	-
EC3322-1.5	-	1	-	-	-	1	-	-	-	-	-	-	3	2	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1. C M Krishna & Kang G Shin, “Real Time Systems”, MGH, 1997.
2. Raj Kamal, “Embedded System Architecture, Programming & Design”, TMH 2003.

REFERENCE BOOK:

1. Liu, “Real Time Systems”, Integre Technical Publishing Co. Inc., January 2000.

E Books / MOOCs/ NPTEL

1. http://nptel.ac.in/downloads/106105086/
2. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Embedded%20systems/Pdf/Lesson-28.pdf
3. http://nptel.ac.in/courses/108105063/pdf/L-37(SM)%20(IA&C)%20((EE)NPTEL).Pdf
4. https://www.coursera.org/lecture/real-time-systems/the-concepts-of-real-time-systems-tJncu
5. https://www.coursera.org/lecture/real-time-systems/the-concept-of-real-timetasks-j9CYf

EMBEDDED LINUX

Course Code:	**EC3321-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**2:2:0:0**	**Credits**	**03**
Total Teaching Hours	**27+26+0+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC2004-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

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

UNIT-I

Overview of Unix/Linux **11 Hours**

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

UNIT-II

Linux Kernel and Bootloaders **11 Hours**

Linux Kernel: Kernel Architecture and Functional Overview, Background, Kernel build system, Kernel configuration, Kernel initialization flow control, File System, System Calls.
Bootloaders: Role of a bootloader, Bootloader challenges, U-Boot, Lilo and GRUB.

UNIT-III

Introduction to Linux Device Drivers **05 Hours**

Device Drivers, Char Drivers, installing a device driver, loading device driver, Modules compilation.

Project based Lab:

Lab 1 to 4

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

Lab 5 to 11
Project work

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

1.	Understand the basic terminology of Linux operating system
2.	Use UNIX programming to code system call
3.	Identify and analyze the building blocks of Linux device drivers necessary for the hardware interface
4.	Use basic device drivers to work with hardware
5.	Prepare a design framework for the embedded system based on generic or Linux based system platform.

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**
EC3321-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
EC3321-1.2	3	-	-	-	1	-	-	-	-	-	-	-	3	3	-
EC3321-1.3	3	-	-	-	1	-	-	-	-	-	-	-	3	3	-
EC3321-1.4	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
EC3321-1.5	3	1	1	1	2	-	-	-	2	2	-	-	3	3	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. M. G. Venkateshmurthy “Introduction to Unix and Shell Programming” , Pearson Education, 2009.
2. K.V. K. K Prasad, “Embedded /Real-Time Systems: Concept, Design & Programming”, Dreamtech, 1st Edition, 2005.
3. Christopher Hallinan, Embedded Linux Primer: A Practical Real-World Approach (Pearson Open Source Software Development Series), Prentice Hall, 2nd edition, 2010.

REFERENCE BOOKS:

1. Yves Lepage, Paul Larrera “Unix Bible”, 2nd Ed, Wiley, 2000.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/117106113

E-VEHICLE TECHNOLOGY

Course Code:	**EC2242-1**	**Course Type**	**PEC**
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**
Prerequisite	**EE1001-1, EC1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To introduce Electric Vehicles, their types, and architectures.
2.	To understand the requirements and functioning of Battery Management Systems
3.	To understand the impact of EVs on Power grid

UNIT-I

Introduction to Electric and Hybrid Vehicles **15 Hours**

Electric Vehicles (EVs), Hybrid Electric Vehicles (HEVs), Electric and Hybrid Vehicle Components, Vehicle Mass and Performance, Electric Motor and Engine Ratings, Electric and Hybrid Vehicle History, EV/ICEV Comparison Vehicle Architectures and Design of EVs, HEVs, plug-in hybrid electric vehicle (PHEV).

UNIT-II

Batteries in Electric and Hybrid Vehicles **16 Hours**

Battery Cell Structure, Battery parameters, Basic Battery Model, Traction Batteries, Battery Management System, Soc Measurement, Cell Balancing, Battery Charging.

UNIT-III

Electric Vehicles and Power Grid **09 Hours**

Vehicle Grid Interface, G2V, V2G, V2H, H2V Frameworks, EV Charging, V2V And H2V Power Converter, EV Powertrain Converters.

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

1.	Understand the history and components of EV/HEV; Compare the ICEV with EV/HEV.
2.	Explain the various EV/HEV/PHEV architectures.
3.	Understand the various parameters of Battery; Explain different Battery chemistries used in EV/HEVs
4.	Understand the requirements and architecture of a BMS; Explain the need and basic approaches for Battery state/Health estimation and Cell balancing.
5.	Explain the effects of EVs on Power Grid and discuss the topologies of Power transfer.

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**
EC2242-1.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
EC2242-1.2	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
EC2242-1.3	3	1	-	-	1	-	-	-	-	-	-	-	3	3	-
EC2242-1.4	3	1	-	-	1	-	-	-	-	-	-	-	3	3	-
EC2242-1.5	3	1	-	-	-	-	-	-	-	-	-	-	3	3	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Iqbal Husain, “Electric and Hybrid Vehicles Design Fundamentals”, 3rd Edition, CRC Press, 2021.
2.	Gregory L. Plett, “Battery Management Systems - Volume II Equivalent-Circuit Methods”, Artech House, 2016.
REFERENCE BOOKS:	
1.	James Larminie and John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2012.
2.	Tom Denton, "Electric and Hybrid Vehicles", Routledge, 2016.
3.	Seth Leitman and Bob Brant, "Build Your Own Electric Vehicle", 2nd Edition, McGraw Hill, 2009.
4.	Rui Xiong, "Battery Management Algorithm for Electric Vehicles", Springer, 2020.
5.	San Ping Jiang, "Fundamentals and Application of Lithium-ion Battery Management in Electric Drive Vehicles", Wiley, 2015.
6.	Davide Andrea, "Battery management systems for large lithium battery packs", Artech House Publishers, 2010.
E Books / MOOCs/ NPTEL	
1.	https://archive.nptel.ac.in/courses/108/106/108106170/
2.	https://nptel.ac.in/courses/108102121
3.	https://nptel.ac.in/courses/108103009

Vocational Education Courses

DATA ANALYSIS USING EXCEL

Course Code	**VT2551-1**	**Course Type**	**VEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**0+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1, EE1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand the use and power of Microsoft Excel in data analysis and presentation

List of Experiments

1	Reading Data into Excel,
2	Basic Data Manipulation in Excel, Arithmetic Manipulation in Excel
3	Basic Functions in Excel, Functions Using Absolute and Relative References
4	IF, nested IF
5	VLOOKUP and HLOOKUP functions in Excel
6	Data Filtering in Excel
7	Constructing various Line, Bar and Pie charts.
8	Understanding and constructing Histograms and Scatterplots

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

1.	Demonstrate the use of excel to perform data analysis.
2.	Present the results by constructing charts or plots.

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
VT2551-1.1	3	1	-	-	2	-	-	-	1	2	-	-	3	3	1
VT3551-1.2	3	1	1	1	2	-	-	-	2	2	-	-	3	3	1

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Paul McFedries, Greg Harvey, "Excel All-IN-ONE for Dummies", John Wiley & Sons, 2022
2.	Paul McFedries, "Microsoft Excel 2019 Formulas and Functions" Microsoft Press, 2019
3.	Brian Moriarty, Bernd Held, Theodor Richardson, "Microsoft Excel Functions and Formulas: With Excel 2021 / Microsoft 365", Mercury Learning and Information, 2022

E Resources

1.	https://www.coursera.org/learn/excel-data-analysis/home/info
2.	https://www.coursera.org/learn/excel-basics-data-analysis-ibm?specialization=data-analysis-visualization-foundations
3.	https://www.youtube.com/watch?v=aJcfjdf3_Uw&list=PLEiEAq2VkUUKf8aLrspLg3zuyJ5S-5K5S

INTRODUCTION TO PCB DESIGN AND FABRICATION

Course Code	**EC3552-1**	**Course Type**	**VEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**0+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1, EC2001-1, EC2002-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To enable students to gain knowledge of Schematic Design techniques & PCB design techniques
2.	To expose students to complete PCB Design & manufacturing process

List of Experiments

1	Exploring the Kicad Schematic and layout tool
2	Developing a schematic circuit for microphone preamplifier
3	Designing a single side PCB layout for microphone preamplifier
4	Developing a schematic circuit for a microcontroller development board
5	Designing a double side PCB layout for a microcontroller development board
6	Choosing a new sensor/display module and building a schematic circuit for the user level application
7	Building a layout using single or double side PCB for the sensor/display module
8	Preparing the film for the bottom copper, solder mask and top silk (legend) to fabricate a single side PCB using chemical process
9	Preparing the film for the top copper, bottom copper, top solder mask, bottom solder mask and legend to fabricate double side PCB using chemical process
10	PCB routing, etching, cutting and drilling using CNC machine

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

1.	Draw schematic circuit and create PCB layout for single or multilayer PCB
2.	Fabricate single and double-layer PCB

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
EC3552-1.1	3	1	-	-	2	-	-	-	1	2	-	-	3	3	1
EC3552-1.2	3	1	1	1	2	-	-	-	2	2	-	-	3	3	1

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Peter Dalmaris, “Kicad Like a Pro”, Tech Exploration
2.	David L. Jones, “PCB Design Tutorials”, Alternate zone, 2004

E Resources

1.	www.alternatezone.com

Ability Enhancement Courses

INNOVATION AND DESIGN THINKING

Course Code	**ME1654-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**0:0:2:0**	**Credits**	**01**
Total Teaching Hours	**26**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	To explain the concept of design thinking for product and service development
2.	To explain the fundamental concept of innovation and design thinking
3.	To discuss the methods of implementing design thinking in the real world.

Note: Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course
outcomes.

1. Lecturer method (L) does not mean only the traditional lecture method, but a ifferent type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain concepts
3. Encourage collaborative (Group Learning) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. 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.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
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.	**PROCESS OF DESIGN** Understanding Design thinking Shared model in team-based design – Theory and practice in Design thinking – Explore the presentation Tools for Design Thinking Real-Time design interaction capture and analysis – Empathy for design Teaching-Learning Process Introduction about the design thinking: Chalk and Talk method Theory and practice through presentation Case studies on design thinking for real-time interaction and analysis
2.	**Design Thinking in IT** Design Thinking to Business Process modeling – Scenario-based Prototyping DT For strategic innovations Growth – Storytelling representation – Strategic Foresight - Change – Sense Making – Maintenance - Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design. Teaching-Learning Process Case studies on design thinking and business acceptance of the design

	Business model examples of successful designs
3.	Design thinking workshop Design Thinking Workshop Empathize, Design, Ideate, Prototype and Test Teaching-Learning Process Presentation by the students on the success of Live project on design thinking in a group of 4 students

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

1.	Appreciate various design process procedure
2.	Generate and develop design ideas through a different techniques
3.	Identify the significance of Design Thinking to Understand products

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
ME1654-1.1	2	-	2	-	-	-	-	-	-	-	-	-	1	-	-
ME1654-1.2	-	-	-	-	-	-	2	2	-	-	-	-	1	-	-
ME1654-1.3	-	-	-	-	-	-	-	-	-	3	3	-	-	1	-

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

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.	Jeanne Liedtka, Andrew King, Kevin Bennett, "Solving Problems with Design Thinking - Ten Stories of What Works", Columbia Business School Publishing, 2013.

E Resources

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 https://support.microsoft.com/en-us/kb/273814
7.	https://support.google.com/docs/answer/179740?hl=en
8.	https://www.youtube.com/watch?v=2mjSDIBaUlM thevirtualinstructor.com/foreshortening.html https://dschool.stanford.edu/.../designresources/.../ModeGuideBOOTCAMP2010L.pdf https://dschool.stanford.edu/use-our-methods/ 6. https://www.interactiondesign. org/literature/article/5-stages-in-the-design-thinking-process 7. http://www.creativityatwork.com/design-thinking-strategy-for-innovation/ 49 8. https://www.nngroup.com/articles/design-thinking/ 9. https://designthinkingforeducators.com/design-thinking/ 10. www.designthinkingformobility.org/wp-content/.../10/NapkinPitch_Worksheet.pdf

9.	Activity Based Learning (Suggested Activities in Class)/ Practical Based learning · http://dschool.stanford.edu/dgift/

RESEARCH METHODOLOGY

Course Code	**ME1659-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**2:0:0:0**	**Credits**	**02**
Total Teaching Hours	**25**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Explain the importance of research methodology, Explain the steps in defining the research problem.
2.	Explain methods of reviewing the literature and research design.
3.	Discuss the methods of designing sampling survey. Discuss methods of scaling and measuring of the data.
4.	Perform Hypothesis testing using the concept of mean and variance.
5.	Discuss interpretation and report writing techniques.

UNIT-I	**10 hours**

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Research Process

Defining the Research Problem: Research Problem, Selecting the Problem

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem

Research Design: Meaning of Research Design, Need for Research Design, Features of Good

UNIT-II	**10 hours**

Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors,

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

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses

UNIT-III	**5 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.

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

1.	Explain the importance of research methodology, Explain the steps in defining the research problem.
2.	Explain methods of reviewing the literature and research design.
3.	Discuss the methods of designing sampling survey.
4.	Perform Hypothesis testing using the concept of mean and variance
5.	Discuss interpretation and report writing techniques.

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
ME1659-1.1	3	2	-	-	-	-	-	-	-	3	-	-	-	-	1
ME1659-1.2	3	2	-	-	-	-	-	-	-	3	-	-	-	-	1
ME1659-1.3	3	2	-	-	-	-	-	-	-	3	-	-	-	-	1
ME1659-1.4	3	2	-	-	-	-	-	-	-	3	-	-	-	-	1
ME1659-1.5	3	2	-	-	-	-	-	-	-	3	-	-	-	-	1

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1. C. R. Kothari, Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International 4th Edition, 2018.

2. Ranjit Kumar, "Research Methodology a step-by step guide for beginners", SAGE Publications Ltd. 3rd Edition, 2011. (For the topic Reviewing the literature under Unit 2)

3. Trochim, "Research Methods: the concise knowledge base", Atomic Dog Publishing, 2005.

4. Fink A, "Conducting Research Literature Reviews: From the Internet to Paper", Sage Publications, 2009.

E Resources

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

CIRCUIT SIMULATION USING SPICE

Course Code	**EC3651-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**1:0:2:0**	**Credits**	**02**
Total Teaching Hours	**15+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC2001-1, EC2002-1, EC2105-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To understand the use and power of SPICE simulation tools in Circuit design and Analysis

List of Experiments

1	Transient analysis of RLC circuits
2	Current and Voltage waveform generation, Verification of Network Theorems
3	Frequency response of the given circuit
4	Transient response of a switching circuit
5	Calculation of Fourier Series Coefficients and usage of DOT commands
6	Simulation of Oscillator circuits
7	Simulation of circuits involving Diodes, Transistors, Op-Amps etc.

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

1.	Identify appropriate input source and relevant circuit elements, to draw a circuit schematic of a given design and analyze its operation by performing simulation.
2.	Report the simulation findings in a structured manner.

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
EC3651-1.1	1	2	-	3	3	-	-	-	2	-	-	-	3	3	-
EC3651-1.2	1	-	-	-	-	-	-	-	1	3	-	-	-	-	3

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Muhammad H. Rashid and Hasan M. Rashid, "SPICE for Power Electronics and Electric Power", 2nd Edition, CRC Press, 2006
2.	Das, Sandip; Thain, Walter; and Hill, Sheila, "Laboratory Manual for Engineering Electronics" (2019). Engineering Open Textbooks. 2. https://oer.galileo.usg.edu/engineering-textbooks/2

E Resources

1.	https://www.allaboutcircuits.com/technical-articles/basic-circuit-simulation-with-ltspice/
2.	https://learn.sparkfun.com/tutorials/getting-started-with-ltspice/all
3.	https://www.youtube.com/playlist?list=PL4vooS_8RnzE4EoE27QssuxsccFmspbRP
4.	LTspiceGettingStartedGuide.pdf

PROBLEM SOLVING USING MATLAB

Course Code	**EC3652-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**1:0:2:0**	**Credits**	**02**
Total Teaching Hours	**15+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC2105-1, EC2106-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To solve specified mathematical functions using MATLAB.

List of Experiments

1	Introduction to MATLAB and performing scalar mathematics and basic mathematical functions.
2	Performing trigonometry and complex numbers.
3	Generating vector arrays, matrix arrays and plots.
4	Generating and representing signals and plotting.
5	Solving polynomial equations, partial fraction expansion and functions of two variables.
6	Writing user-defined functions, plotting functions, integration and differentiation.
7	Determining maximum and minimum, sums and products.
8	Performing statistical analysis and random number generation
9	Generation and representation of Vectors, matrices and performing mathematical operations.
10	Solutions to systems of linear equations.
11	Applied problem solving and robot motion.
12	Determining minimum mean-square error, curve fitting and interpolation.

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

1.	Write MATLAB code and perform mathematical operations using MATLAB
2.	Document the errors and debug the same

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**
EC3654-1.1	3	3	-		2	-	-	-		-	-	-	2	2	-
EC3654-1.2	-	3	-	-	3	-	-	-	-	-	-	-	2	2	-

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Delores M Etter, "Engineering Problem Solving with MATLAB", 2nd Edition, Pearson, 1997.

E Resources

1.	https://www.academia.edu/5677952/Engineering_problem_solving_with_matlab

PROBLEM SOLVING USING SIMULINK

Course Code	**EC3653-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**1:0:2:0**	**Credits**	**02**
Total Teaching Hours	**15+0+26+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC2002-1, EC2105-1, EC2106-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Create a Simulink model, simulate it, and analyze the results
2.	Model and simulate basic programming constructs in Simulink
3.	Model and simulate continuous and discrete systems in Simulink

List of Experiments

1	Introduction to Simulink
2	Generation of standard test signals.
3	Designing of Differential equations
4	Implementation of Adder Circuits
5	Implementation of Operational Amplifier circuits and verifying their working
6	Verification of working of Rectifiers
7	Verification of Network Theorems
8	Mathematical modelling of Systems
9	Implementation of Pulse Code Modulation system
10	Implementation of Linear Filtering approach to filter a signal
11	Inspection of Sample and Frame Rates
12	Building of MiniProject

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

1.	Understand the basics of Simulink
2.	Able to simulate MATLAB Simulink examples
3.	Creating and modifying Simulink models and simulating system dynamics

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**
EC3655-1.1		-	2	-	2	-	-	-	-	-	-	-	-	-	-
EC3655-1.2		-	2	-	2	-	-	-	-	-	-	-	-	2	-
EC3655-1.3		-	3	-	2	-	-	-	-	-	-	-	-	-	2

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Agam Kumar Tyagi, “MATLAB and Simulink for Engineers”, OXFORD Higher Education.
2.	Shailendra Jain, “Modeling & Simulation using MATLAB – Simulink”, Wiley – India.
3.	Steven T. Karris, “Introduction to Simulink with Engineering Applications”, Orchard Publications.

E Resources

1.	https://onlinecourses.nptel.ac.in/noc19_ee45/preview
2.	https://nptel.ac.in/courses/108102044
3.	https://nptel.ac.in/courses/112107214
4.	https://in.mathworks.com/learn/training/simulink-fundamentals.html
5.	https://www.udemy.com/course/learn-matlab-and-simulink-programming/
6.	https://www.udemy.com/course/matlab4b/

TECHNICAL CONTENT WRITING

Course Code	**EC2651-1**	**Course Type**	**AEC**
Teaching Hours/Week (L: T: P: S)	**1:0:2:0**	**Credits**	**02**
Total Teaching Hours	**15+0+26+0**	**CIE + SEE Marks**	**50+50**

Prerequisite	**HU1001-1**

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1. Understand the importance of English in the fields of science and engineering.

2. Understand common problems associated with using technical vocabulary in specialist fields.

3. Use effective strategies to learn technical vocabulary in specialist fields.

4. Use text analysis tools to identify differences in the audience, purpose, structure, style, and presentation of technical texts in different fields.

5. Identify the structure of technical research papers in specialist fields.

6. Understand research journal Call for Papers and Instructions for Authors.

List of Activities

1 Introduction to Technical Writing Review of Technical Writing 1: What is research/How do you structure a research paper

2 Introduction to Literature Review

3 Introduction to text analysis tools: analyzing research paper biographies

4 First steps in text analysis: creating vocabulary lists, searching for words, phrases, and grammar patterns. Building a corpus of research papers.

5 Writing a research paper proposal: brainstorming topics, narrowing the scope, finalizing the decision.

6 Writing a research paper title: keywords, noun phrases, and prepositions

7 Writing a research paper introduction (1): characteristic features and structure of introductions

8 Writing a research paper introduction (2): explaining the situation, describing problems/limitations, describing the response

9 Writing a research paper methods section: explaining methods and processes

10 Writing a research paper results section: deciding the type of visual aid, explaining figures and tables.

11 Writing a research paper discussion/conclusion section: summarizing results, adjusting the strength of interpretations using hedging with chapters

12 Writing a thesis using research chapters

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

1. Understand to write Literature review

2. Understand to write Technical Abstract

3. Understand to write Science and Technology Research Paper

4. Understand to write Science and Technology Thesis

5. Understand to write Science and Technology Presentations

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**
EC2651-1.1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-
EC2651-1.2	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-
EC2651-1.3	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-
EC2651-1.4	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-

EC2651-1.5	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

E Resources

1.	https://www.prismnet.com/~hcexres/textbook/acctoc.html

SOCIAL CONNECT AND RESPONSIBILITY

Course Code:	**HU1007-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P: S):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	Understand Rural Society
2.	Acquire the knowledge about Rural Economy
3.	Know the working of rural administration
4.	Familiarize the different rural schemes of Governance

UNIT-I

Appreciation of Rural Society — **3 Hours**

Rural Society, Caste and Gender relations, Rural values, Nature and Resources, Rural infrastructure.

Understanding Rural Economy & Livelihood — **3 Hours**

Agriculture, Farming, Landownership, Water Management, Animal Husbandry, Non-Farm Livelihoods And Artisans, Rural Entrepreneurs.

UNIT-II

Rural Institutions — **3 Hours**

Traditional Rural Organizations, Self-help Groups, Panchayat Raj Institutions - Gram Sabha, Gram Panchayat, Standing Committees

Rural Development Programmes — **3 Hours**

History of Rural Development in India, Current National Programmes - Sarva Shiksha Abhiyaan, Beti Bachao – Beti Padhao, Ayushmaan Bharath, Swachh Bharath, PM Awaas Yojana, Skill India, Decentralised Planning, NRLM, MNREGA

UNIT-III

Corporate Social Responsibility (CSR) — **3 Hours**

Global Guidelines on CSR, Growing Importance of CSR, CSR in India

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

1.	Comprehend Rural Society and its Economy
2.	Identify the working of Rural Administration and different rural schemes
3.	Grasp the working of Corporate Social Responsibility

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
HU1007-1.1	-	-	-	-	-	-	-	-	-	-	2	3	-	-
HU1007-1.2	-	-	-	-	-	-	-	-	-	-	2	3	-	-
HU1007-1.3	-	-	-	-	-	-	-	-	-	-	2	3	-	-

1: Low 2: Medium 3: High

REFERENCES:	
1.	UGC., “Unnat Bharat Abhiyan”, 2020
2.	Agarwal, S.K., “Corporate Social Responsibility in India”, SAGE Publication, 2008.
3.	Unnat Bharat Abhiyan. (n.d.). Unnat Bharat Abhiyan Brochure. Retrieved from https://unnatbharatabhiyan.gov.in/app/webroot/files/brochure.pdf

LIFE SKILLS AND PERSONALITY DEVELOPMENT

Course Code:	**HU1008-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P: S):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	Understand Time Management, Managing Information Overload, Coping with Peer pressure and Stress Management
2.	Familiarize the Science behind Personal Health Management and Addictions
3.	Appreciate the importance of cultivating good hobbies, need for forming good habits and discarding bad habits and holding difficult conversations during crises
4.	Comprehend the importance of Creative Thinking, Continuous and Lifelong Learning, Collaboration and Team Work
5.	Equip them to excel in real work environment proactively

UNIT-I

Introduction to Life Skills — **3 Hours**

Meaning and Importance of Life Skills, Competitive Job market, Fast paced changes in Technology, Proliferation of Electronic Gadgets and harmful online content.

Time Management

Introduction to Time Management, Impulsive Behaviour vis-a-vis goal Directive Behaviour, Time log, Information Overload and coping with Information & Communication Technology (ICT) Revolution; Proliferation of Electronic Media; Exponential growth in online content; Impact of Information Overload on human brain

Science behind Personal Health Management — **3 Hours**

Ignorance in Society on health issues, World Health Organization (WHO) - Definition of Health, Human Evolution, Importance of physical work for human body & mind, Dangers of sedentary lifestyle, Germ diseases versus Lifestyle diseases, Integrating physical exercise into daily life

Science behind Addictions

Addiction - Meaning, Neurology and Hormonal basics of Addictive Behaviour, How addictions are formed; Harmful effects of addictions on Physical and Mental Health, Recognizing addictions in oneself, Coming out of addictions

UNIT-II

Need for cultivating good hobbies — **3 Hours**

Need for Hobbies in maintaining Work-Life Balance; how hobbies help in maintaining good physical and mental health, Various Hobbies

Habits

Difference between hobbies & habits, Cultivating good habits & discarding bad habits: Role of habits for a successful life, How habits form; Analyzing one's own habits; Recognizing useless & harmful habits, Cultivating & Sustaining useful habits

Peer pressure and How to cope with it — **3 Hours**

Human being as a Social Animal, Physical Pain & Social Pain; Awareness of Harmful Social

Pressure, Role of Prefrontal Cortex in Judgement and Decision Making, why teenagers are vulnerable to peer pressure, strategies to overcome harmful peer pressure

Stress Management

Stress, Types of Stress, Fight & Flight Response of Humans; Harmful effects of chronic stress; Symptoms of Poor Coping Skills of Stress, Stress & Psychiatric problems, Easy coping strategies for stress

UNIT-III

Continuous & Lifelong Learning **3 Hours**

Accelerated change in Technology Landscape, Shorter Life Cycles of Technologies, Need for Continuous Learning of other skills

Team Working Skills & Collaboration

Team Work – Meaning, Skills and Relevance, Importance of Collaboration to succeed in one's own career, How to be a good team member

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

1. Apply the concept of Time Management, cope with Information Overload and withstand harmful peer pressure
2. Comprehend the need to stay away from addictions by realizing the biological basis behind these concepts
3. Develop good hobbies to maintain ideal work-life balance
4. Develop the aptitude for finding creative solutions to problems and realize the importance of continuous and lifelong learning
5. Demonstrate positive and progressive abilities

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
HU1008-1.1	-	-	-	-	-	-	-	-	-	2	1	3	-	-
HU1008-1.2	-	-	-	-	-	-	-	-	-	3	2	3	-	-
HU1008-1.3	-	-	-	-	-	-	-	-	-	3	1	3	-	-
HU1008-1.4	-	-	-	-	-	-	-	-	2	2	1	2	-	-
HU1008-1.5	-	-	-	-	-	-	-	-	1	2	1	2	-	-

1: Low 2: Medium 3: High

REFERENCES:

1. Lieberman, D.E., "The Story of the Human Body", Pantheon Books, 2013.
2. Ratey, J.J., "Spark. Little Brown Spark", 2013.
3. De Bono, E., "Creative Thinking", Penguin UK, 2016.
4. Pachter, B., "The Power of Positive Confrontation", Da Capo Lifelong Books, 1999.
5. Duhigg, C., "The Power of Habit", Random House Trade Paperbacks, 2012.
6. Sharma, S., & Mishra, B., "Communication Skills for Engineers and Scientists", PHI Learning, 2009.
7. Tracy, B., "Time Management", AMACOM, 2014.

EMPLOYABILITY SKILL DEVELOPMENT

Course Code:	**UM1003-1**	**Course Type**	**AEC**

Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**1**
Total Teaching Hours	**15+0+0+0**	**CIE + SEE Marks**	**50+00**

Teaching Department: Electronics & Communication Engineering

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.	Answer the quantitative multiple-choice questions.
2.	Analyse the analytical and logical questions.
3.	Improve the professional language grammar, vocabulary and communication skills.
4.	Clear the aptitude tests of any employer or higher educational institution.
5.	Advance in the chosen field of interest by appending aptitude skills with the technical 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	1	-			
UM1003-1.3	3	3	2	-	-	-	-	-	2	2	1	-			
UM1003-1.4	3	3	2	-	-	-	-	-	2	2	1	-			
UM1003-1.5	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

Humanities, Social Sciences & Management Courses

ENHANCING SELF-COMPETENCE

Course Code:	**HU2001-1**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T: P: S)	**2:0:0:0**	**Credits**	**02**
Total Teaching Hours	**26+0+0+0**	**CIE + SEE Marks**	**50+50**
Prerequisite			

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 — **09 Hours**

Types & Kinds of personality, Ways to Identify Self (SWOT Analysis, Johari Window), Concepts of Self-Management and Self-Motivation

Effective Communication Skills

One-way and Two-way Communication, Interpersonal & Social Skills

UNIT-II

Social Behaviour and Cultural Etiquette — **09 Hours**

Time Management, Personal Grooming, Making Small Talk, Customs & Manners

Professional Presentation Techniques

Formal Presentation, Sensitivity towards multi-cultural workspaces

UNIT-III

Job-Related Communication — **08 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.
2.	Demonstrate knowledge of theory and competence in office communication.
3.	Develop and assess various types of communication.
4.	Be Familiar with the current practices of social behaviour.
5.	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	3
HU2001-1.1	-	1	-	-	-	2	2	-	3	-	-	-			
HU2001-1.2	-	-	-	-	-	-	-	3	2	1	-	1			
HU2001-1.3	-	-	2	-	-	2	2	2	-	-	-	2			
HU2001-1.4	-	3	-	-	-	-	-	-	2	3	2	-			
HU2001-1.5	2	2	-	1	-	-	-	-	2	-	-	-			

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1. R R Gaur, R Sangal, G P Bagaria, “Human Values and Professional Ethics”, Excel Books, New Delhi, 2010.

2. Ronald B Adler and Jeanne Marquardt Elmhorst, "Communicating at Work – Principles and Practices for Business and the Professions", 6th Edition, McGraw Hill College.

3. Stephen R. Covey, "The 7 Habits of Highly Effective People", Simon & Schuster, 1994.

4. Sarvesh Gulati, "Corporate grooming and Etiquette", Rupa Publications India Pvt. Ltd., 2010.

5. Fred. Luthans, "Organizational Behaviour", McGraw Hill International.

6. Tom Rath, “Strengths Finder 2.0", Gallup Press, 2007.

7. M Ashraf Rizvi, "Effective Technical Communication", Tata McGraw- Hill, 2005.

8. Stephen P. Robbins, "Organizational Behaviour", Prentice Hall.

9. Dale Carnegie, "How to Win Friends and Influence People", Gallery Books, 2016.

UNIVERSAL HUMAN VALUES

Course Code:	**HU1004-1**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T: P: S)	**1:0:0:0**	**Credits**	**01**
Total Teaching Hours	**15+0+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Humanities

Course Objectives:

1.	Enable students appreciate values, skills and behaviour with an appropriate understanding of 'Self' to attain sustained happiness and prosperity with right aspirations of life.
2.	Develop a holistic perspective among the students towards physical needs and prosperity of life.
3.	Develop a holistic approach and understand the importance of co-existence and living in harmony ensuring mutually fulfilling interaction with the society and nature.
4.	Strengthening of self-reflection.
5.	Development of commitment and courage to act.

UNIT-I

Need, Basic Guidelines, Content and Process for Value Education	**06 Hours**

Self-Exploration; 'Natural Acceptance' and Experiential Validation; Continuous Happiness and Prosperity; Right understanding, Relationship and Physical Facility; Understanding Happiness and Prosperity - living in harmony at various levels**.**

UNIT-II

Understanding Harmony in the Human Being, Family and Society	**06 Hours**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body; the needs of Self ('I') and 'Body'; the Body as an instrument; Holistic perspective of Physical needs and Prosperity; Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

UNIT-III

Whole existence as Coexistence: Implications of the above Holistic Understanding of Harmony and Professional Ethics	**03 Hours**

Understanding the harmony in the Nature and Existence; Existence as Co-existence, Holistic perception of harmony at all levels of existence; Natural acceptance of human values, Professional Ethics

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

1.	Have a better self-exploration and understanding with a capacity to identify the priorities of life.
2.	Generate Sustainable solution to problems with focus on human values and value-based living.
3.	Have an understanding of the Holistic perspective of Physical needs
4.	Understand and practice living in harmony, co-existence and natural acceptance
5.	Exhibit Professional Ethics in 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	3
HU1004-1.1	-	-	-	-	-	-	-	3	-	-	2	2			

HU1004-1.2	-	-	-	-	-	-	-	2	-	-	2	2			
HU1004-1.3	-	-	2	-	-	-	1	2	-	-	2	2			
HU1004-1.4	-	-	-	-	-	-	-	1	-	-	-	-			
HU1004-1.5	-	-	1	-	-	-	-	3	-	-	2	2			

1: Low 2: Medium 3: High

TEXTBOOKS:

1. R R Gaur, R Sangal, G P Bagaria, "Human Values and Professional Ethics", Excel Books, New Delhi, 2010

REFERENCE BOOKS:

1. A Nagaraj, "Jeevan Vidya: Ek Parichaya", Jeevan Vidya Prakashan, Amarkantak, 1999
2. A.N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth"
5. E. F Schumacher, "Small is Beautiful"
6. Cecile Andrews, "Slow is Beautiful"
7. J C Kumarappa, "Economy of Permanence"
8. Pandit Sunderlal, "Bharat Mein Angreji Raj"
9. Dharampal, "Rediscovering India"
10. Mohandas Karamchand Gandhi, "Indian Home Rule"
11. Maulana Abdul Kalam Azad, "India Wins Freedom"
12. Romain Rolland, "Vivekananda"
13. Romain Rolland, "Gandhi"

INTRODUCTION TO IPR

Course Code:	**HU1006-1**	**Course Type:**	**HSMC**
Teaching Hours/Week (L: T: P: S):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	Enhancing the learning system through innovation and creative thinking skills for effective business process.
2.	Acquaint with special challenges of starting new ventures.
3.	Facilitate Entrepreneurial skills in recognizing opportunities for competitive advantages.
4.	Provide insights of financial aspects in planning and executing a business plan.
5.	Ascertain the role of IPR to protect innovations and intangible assets.

UNIT-I

Intellectual Property Rights (IPR) — **6 Hours**

Introduction to IPR: Business Perspective, IPR in India – Genesis and Development, International Context, Concept of IP Management, Uses in marketing

UNIT-II

Types of Intellectual Property — **6 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-III

Basic Tenets of Information Technology Act, 2000 — **3 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.	Comprehend Innovation, its process and sources.
2.	Apply the process of building an innovative organization.
3.	Recognize the characteristics of different types of Entrepreneurships
4.	Formulate a business plan based on a business idea in Technology.
5.	Interpret basic tenets of Information Technology 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
HU1006-1.1	-	-	-	-	-	-	-	-	-	2	-	3	-	-
HU1006-1.2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
HU1006-1.3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
HU1006-1.4	-	-	-	-	-	-	-	-	2	2	-	2	-	-

HU1006-1.5	-	-	-	-	-	-	-	-	1	2	-	2	-	-

1: Low 2: Medium 3: High

REFERENCES:

1. Tidd, J., & Bessant, J., “Managing Innovation: Integrating Technological, Market and Organizational Change”, Wiley, 2021.
2. Case Study Materials: To be distributed for Class Discussion
3. Reddy, G. B., “Intellectual Property Rights and the Law”, Gogia Law Agency, 2012.
4. Wadehra, B. L., “Law relating to Intellectual Property”, Universal Law Publishing Co., 2011.
5. Narayanan, P., “IPR”, Eastern Law House Private Ltd, 2017.

MANAGEMENT & ENTREPRENEURSHIP

Course Code:	**MG1003-1**	**Course Type**	**HSMC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**39**	**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 discuss the importance of Small Scale Industries and methods for generating new business ideas and business opportunities
5.	To introduce the concepts of financial concepts in enterprises.

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:	**03 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	**04 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.	

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	
UNIT-II	
Social Responsibilities of Business:	**03 Hours**
Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics, and Corporate Governance.	
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).	
Institutional Support for Business Enterprises	**02 Hours**
Introduction, Policies & Schemes of Central–Level Institutions, State-Level Institutions	
UNIT-III	
Finance Management in enterprises	**10 Hours**
Introduction, functions, Accounting and Bookkeeping, Financial Statements, Working Capital Management, Break even Analysis, Financial ratio Analysis.	
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.	Develop an understanding of the role of SSI's in the development of country and state/central level institutions/agencies supporting business enterprises.
5.	Apply the concepts of financial management for effective use in enterprises

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
MG1003-1.1	3	-	-	-	-	-	-	2	2	-	3	-	-	1
MG1003-1.2	3	-	-	-	-	-	-	2	2	-	3	-	-	2
MG1003-1.3	3	-	-	-	-	-	-	2	2	-	3	-	-	2
MG1003-1.4	3	-	-	-	-	-	-	2	2	-	3	-	-	2
MG1003-1.5	3	-	-	-	-	-	-	2	2	-	3	-	-	2

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.

OPERATIONS RESEARCH AND MANAGEMENT

Course Code:	**MG1004-1**	**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

Mandatory Non-credit Courses

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/

ಆಡಳಿತ ಕನ್ನಡ (Kannada for Administration)

Course Code	**HU1003-1**	**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+0**

Teaching Department: Any Department

Course Objectives:

1.	ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು, ಕನ್ನಡ ಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2.	ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು ಮತ್ತು ಕನ್ನಡ ಭಾಷಾ ರಚನೆಯಲ್ಲಿನ ನಿಯಮಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
3.	ಕನ್ನಡ ಭಾಷಾ ಬರೆಹದಲ್ಲಿ ಕಂಡುಬರುವ ದೋಷಗಳು ಹಾಗು ಅವುಗಳನಿವಾರಣೆ.
4.	ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
5.	ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿ ಕೊಡುವುಧು.

UNIT - I

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

06 Hours

UNIT – II

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

ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ

1. ಡಾ. ಸ ಏಂ ವಿಶ್ವೇಶ್ವರಯ್ಯ - ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ: ಎ ಎನ್ಮೂರ್ತಿ ರಾವ್

06 Hours

2. ಯುಗಾದಿ: ವಸುಧೇಂದ್ರ 3. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ: ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ	

UNIT – III

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	**03 Hours**

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

1.	ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು, ಕನ್ನಡಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡುನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2.	ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕನ್ನಡಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು ಮತ್ತು ಕನ್ನಡ ಭಾಷಾ ರಚನೆಯಲ್ಲಿನ ನಿಯಮಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
3.	ಕನ್ನಡ ಭಾಷಾ ಬರೆಹದಲ್ಲಿ ಕಂಡುಬರುವ ದೋಷಗಳು ಹಾಗು ಅವುಗಳ ನಿವಾರಣೆ.
4.	ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆ ಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
5.	ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುಧು.

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
HU1003-1.1	-	-	-	-	-	-	-	3	-	-	1	1			
HU1003-1.2	-	-	-	-	-	-	-	2	-	-	1	1			
HU1003-1.3	-	-	2	-	-	-	1	2	-	-	1	1			
HU1003-1.4	-	-	-	-	-	-	-	1	-	-	-	-			
HU1003-1.5	-	-	1	-	-	-	-	3	-	-	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, ೨೦೦೯, 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	**HU1003-1**	**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+0**

Teaching Department: Any Department

Course Objectives:

1.	The course will enable the students to cognize Kannada and communicate in basic Kannada language.

UNIT - I

Basic Kannada Grammar Personal Pronouns, Possessive Forms, Interrogative words Possessive forms of nouns, Dubitive question and Relative nouns Qualitative, Quantitative and Colour Adjectives, Numerals Predictive Forms, Locative Case Dative Cases, and Numerals Ordinal numerals and Plural markers Defective / Negative Verbs and Colour Adjectives Permission, Commands, encouraging and Urging words (Imperative words and sentences) Accusative Cases and Potential Forms used in General Communication Helping Verbs “iru and iralla”, Corresponding Future and Negation Verbs Comparative, Relationship, Identification and Negation Words Different types of forms of Tense, Time and Verbs Formation of Past, Future and Present Tense Sentences with Verb Forms Karnataka State and General Information about the State Kannada Language and Literature Do's and Don'ts in Learning a Language	**06 Hours**

UNIT – II

Kannada Language Script Part – 1	**06 Hours**

UNIT – III

Kannada Vocabulary List & Kannada Words in Conversation	**03 Hours**

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

1.	Understand the parts of speech of Kannada
2.	Know the script in Kannada
3.	Able to Converse daily usages in Kannada
4.	Enrich Basic Kannada Vocabulary
5.	Have 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
HU1003-1.1	-	-	-	-	-	-	-	3	-	-	1	1		
HU1003-1.2	-	-	-	-	-	-	-	2	-	-	1	1		
HU1003-1.3	-	-	2	-	-	-	1	2	-	-	1	1		
HU1003-1.4	-	-	-	-	-	-	-	1	-	-	-	-		
HU1003-1.5	-	-	1	-	-	-	-	3	-	-	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, ಸಂಗಮೇಶ್ಸವ 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.

BRIDGE COURSE - CALCULUS & LAPLACE TRANSFORMS
(COMMON TO CV\EC\EE\ME)

Course Code:	**MA1011-1**	**Course Type:**	**MNC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**0**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**100+00**

Teaching Department: Mathematics

Mandatory Non – credit course (MNC):

This course is prescribed to the lateral entry Diploma holders admitted to III semester of BE/B.Tech., programs, they shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE.

MNC Courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree

Course Objectives:

This course will enable the students to master the basic tools of differential calculus, partial differentiation, Laplace Transforms and Integration and become skilled for solving problems in science and engineering.

UNIT-I

DIFFERENTIAL CALCULUS	**07 Hours**
Limit, continuity, differentiation rules-product rule, quotient rule and chain rule. Taylor's series, Maclaurin's series of simple functions in single variable.	
PARTIAL DIFFERENTIATION	**08 Hours**
Definition, simple problems to find partial differentials, total differentiation, differentiation of composite functions, illustrative examples and problems. Taylor's and Maclaurin's series for a function of 2 variables.	

UNIT-II

LAPLACE TRANSFORMS	**07 Hours**
Definitions, transforms of elementary functions, transforms of derivatives and integrals-properties.	
INVERSE LAPLACE TRANSFORM	**08 Hours**
Inverse Laplace transforms and properties. Solutions of ordinary differential equations. Applications to engineering problems.	

UNIT-III

INTEGRAL CALCULUS-I	**5 Hours**
Introduction, rules of integration, solution of integrals using the methods-substitution and partial fraction, integrals of standard functions, definite integral, simple problems.	
INTEGRAL CALCULUS-II	**5 Hours**

Double integrals, change of order of integration, change in to polar coordinates. Triple integrals, simple Problems and applications.

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

1.	Learn the concept of limit, continuity, differentiability and Taylor's theorem.
2.	Learn the concept of partial differentiation of a function with two or more independent variables.
3.	Apply the concept of Laplace transform in engineering applications.
4.	Find the inverse Laplace transform and hence to solve differential equations
5.	Apply the notion of multiple integrals to find areas and volumes.

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
MA1011-1.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1011-1.2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1011-1.3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
MA1011-1.4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1011-1.5	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.

REFERENCE BOOKS:

1. G. B. Thomas and R. L. Finney, "Calculus and Analytic Geometry", Pearson, 2002.
2. T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
3. B. V. Ramana, "Higher Engineering Mathematics", Tata Mc Graw –Hill, New Delhi, 2010.

BRIDGE COURSE - PROBABILITY & DIFFERENTIAL EQUATIONS (COMMON TO CV\EC\EE\ME)

Course Code:	**MA1013-1**	**Course Type:**	**MNC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**0**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**100+00**

Teaching Department: Mathematics

Mandatory Non – credit course (MNC):

This course is prescribed to the lateral entry Diploma holders admitted to III semester of BE/B.Tech., programs, they shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE.

Course Objectives:

This course will enable the students to master the basic tools of matrix theory, probability, differential equations, partial differential equations and become skilled for solving problems in science and engineering.

UNIT-I

MATRICES — **08 Hours**

Elementary operations of a matrix, echelon form of a matrix, Rank of a matrix (both definitions). Consistency and solution of system of linear equations - Gauss elimination method. Eigen values and eigen vectors of matrices.

PROBABILITTY — **07 Hours**

Finite sample space, event, mutually exclusive event, equally likely event, probability, addition theorem, conditional probability and independence conditions, multiplication theorem. Bayes' theorem.

UNIT-II

DIFFERENTIAL EQUATIONS — **08 Hours**

Introduction, order and degree of differential equations, examples. Solution of first order and first-degree differential equations–variable separable method, Linear, Bernoulli’s and exact differential equations (without I. F).

SECOND AND HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS — **07 Hours**

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

UNIT-III

FIRST AND HIGHER ORDER PARTIAL DIFFERENTIAL EQUATIONS — **10 Hours**

First and higher order partial differential equations. Formation of partial differential equations by elimination of arbitrary constants/ arbitrary functions. Solution of PDE's by direct integration method.

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

1.	Reduce the matrix to echelon form and find its rank
2.	Understand the concept of probability and apply Bayes theorem to real life problems
3.	Solve the differential equations
4.	Solve higher order linear differential equations
5.	Form partial differential equations by eliminating the arbitrary constants and functions

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
MA1013-1.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1013-1.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1013-1.3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1013-1.4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1013-1.5	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.	P. L. Meyer, “Introduction of Probability and Statistical Applications”, 2nd Edition, American Publishing, 1975.

REFERENCE BOOKS:

1.	T. Veerarajan, “Engineering Mathematics”, McGraw-Hill, New Delhi, 2008.
2.	B. V. Ramana, “Higher Engineering Mathematics”, Tata Mc Graw –Hill, New Delhi,2010.
3.	N.P. Bali and M. Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, 2010.

Holistic Education Courses

ESSENCE OF INDIAN CULTURE

Course Code:	**HU1005-1**	**Course Type:**	**HEC**
Teaching Hours/Week (L: T: P: S):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	To facilitate students with the concepts of Indian Culture and to make them understand the roots of knowledge system.
2.	To acquaint students with Indian Culture and inculcate an ability to analyze it.
3.	To apply various approaches for the enhancement of living ideals based on Indian traditional knowledge.

UNIT-I

Introduction to Traditional Knowledge **6 Hours**

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge and its characteristics, Traditional Knowledge vis-a-vis Indigenous Knowledge, Traditional Knowledge vis-a-vis Western Knowledge

UNIT-II

Significance of Traditional Knowledge **6 Hours**

Value of Traditional Knowledge in global economy, Role of Government in harnessing Traditional Knowledge, Traditional medicine system, Traditional Knowledge in agriculture. food and healthcare.

UNIT-III

Holistic Healthcare for Human Well-being **3 Hours**

Definition of Ayurveda, Ayurveda for Life, Health and Well-being, Introduction to principles of Ayurvedic healing and Astanga Ayurveda.

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

1.	Identify the concept of Traditional Knowledge and its importance.
2.	Explain the need for and importance of protecting Traditional Knowledge.
3.	Illustrate the various enactments related to Traditional Knowledge.
4.	Familiarize the importance of Holistic Healthcare.

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
HU1005-1.1	-	-	-	-	-	-	-	-	-	2	2	3	-	-
HU1005-1.2	-	-	-	-	-	-	-	-	-	3	2	3	-	-
HU1005-1.3	-	-	-	-	-	-	-	-	-	3	2	3	-	-
HU1005-1.4	-	-	-	-	-	-	-	-	2	2	2	2	-	-
HU1005-1.5	-	-	-	-	-	-	-	-	1	2	2	2	-	-

	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

INDIAN KNOWLEDGE SYSTEMS

Course Code:	**HU1009-1**	**Course Type:**	**HEC**
Teaching Hours/Week (L: T: P: S):	**1:0:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	Enhance knowledge about the History of Ancient India and Rich Culture of the country
2.	Gain an introduction to ancient Indian Engineering Technology and Architecture
3.	Familiarize Indian indigenous wisdom in Modern scientific paradigm
4.	Understanding the Scientific Value of the Traditional Knowledge of our country
5.	Comprehend and compare the Ancient and Current Knowledge Systems

UNIT-I

Indian History — **6 Hours**

History - Land, Environment, and people in Ancient India; Ancient Education System, Takṣaśilā and Nālandā University, Hunting to Agriculture; Introduction to Vedas and Upanishads; Great Indian Epics; Indian Festivals

UNIT-II

Engineering, Technology, and Architecture — **6 Hours**

Pre-Harappan and Sindhu Valley Civilization, Laboratory and Apparatus, Juices, Dyes, Paints and Cements, Glass and Pottery, Metallurgy, Engineering Science and Technology in the Vedic Age and Post-Vedic Records, Iron Pillar of Delhi, Rakhigarhi, Mehrgarh, Sindhu Valley Civilization, Marine Technology

UNIT-III

Science, Astronomy, and Mathematics — **3 Hours**

Concept of Matter, Life and Universe, Gravity, Sage Agastya's Model of Battery, Velocity of Light, Vimāna: Aeronautics, Vedic Cosmology and Modern Concepts, History and Culture of Astronomy, Sun, Earth, Moon, Eclipses, Rotation of Earth, Concepts of Zero and Pi, Number System, Pythagoras Theorem and Vedic Mathematics.

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

1.	Understand the relevance of studying history
2.	Comprehend the origin of Vedas and epics
3.	Realize the scientific value of the Traditional Knowledge of India
4.	Converting the Bhāratīya wisdom into the applied aspect of the modern scientific paradigm
5.	Preserve and disseminate Indian Knowledge Systems in Research and Societal applications

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
HU1009-1.1	-	-	-	-	-	-	-	-	-	-	2	3	-	-
HU1009-1.2	-	-	-	-	-	-	-	-	-	-	3	3	-	-
HU1009-1.3	-	-	-	-	-	-	-	-	-	-	2	3	-	-
HU1009-1.4	-	-	-	-	-	-	-	-	-	-	2	2	-	-
HU1009-1.5	-	-	-	-	-	-	-	-	-	-	2	2	-	-

1: Low 2: Medium 3: High

REFERENCES:

1.	Tripati, R.S., “History of Ancient India”, Motilal Banarsidass, 1942.
2.	Mahajan, V.D.. “Ancient India”, S. Chand and Company, 1985.
3.	Ramasubramanian, K., & Srinivas, M.D., “Development of Calculus in India”, 2010.
4.	Ramasubramanian, K., Srinivas, M.D., & Sriram, M.S., “The Traditional Indian Planetary Model and its Revision by Nilakantha Somayaji”, 2011.
5.	Srinivas, M.D., “Proofs in Indian Mathematics”, Hindustan Book Agency, 2005.
6.	Srinivas, M.D., “The Algorithmic Approach of Indian Mathematics”, 2015.
7.	Srinivas, M.D. “Indian Tradition of Science: An Introductory Overview”, 2016.
8.	Rahika, M., & Balasubramanian, A.V., “Ayurvedic Principles of Food and Nutrition”, Part 1. Lok Swasthya Parampara Samvardhan Samithi, 1990.

University Core Courses

INTERNSHIP-I

Course Code	**UC1001-2**	**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

2. This course is meant to provide students an opportunity to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the institution; contribution at incubation/ innovation /entrepreneurship cell of the institution; participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research projects within the institution and Participation in all the activities of Institute’s Innovation Council.

Activities: Refer Appendix B - 3.4 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
UC2001-1.1	3	1	-	-	1	-	-	-	2	3	1	-	-	-	-
UC2001-1.2	3	1	-	-	1	-	-	-	2	3	1	-	-	-	-
UC2001-1.3	3	1	-	-	1	-	-	-	2	3	1	-	-	-	-

1: Low 2: Medium 3: High

INTERNSHIP - II

Course Code:	**UC2001-1**	**Course Type**	**UCC**
Teaching Hours/Week (L: T: P: S)	**-**	**Credits**	**08**
Total Teaching Hours	**-**	**CIE + SEE Marks**	**50+50**
Prerequisite			

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→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO↓**		
↓ Course Outcomes													**1**	**2**	**3**
UC2001-1.1	3	2	-	-	1	1	-	-	2	3	1	-	1	1	1
UC2001-1.2	3	2	-	-	1	1	-	-	2	3	1	-	1	1	1
UC2001-1.3	3	2	-	-	1	1	-	-	2	3	1	-	1	1	1

1: Low 2: Medium 3: High

MAJOR PROJECT

Course Code:	**UC3001-1 & UC3002-1**	**Course Type:**	**UCC**
Teaching Hours/Week (L: T: P: S):	**24**	**Credits:**	**2+8**
Total Teaching Hours:	**-**	**CIE + SEE Marks:**	**(100+0) + 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**
UC2002-1/UC3001-1.1	-	1	-	-	2	2	3	1		-	-	-	1	1	2	2
UC2002-1/UC3001-1.2	-	1	2	1	1	-	1	2		1	-	1	1	1	2	2
UC2002-1/UC3001-1.3	-	1	2	2	1	-	1	1		1	1	1	1	1	2	2
UC2002-1/UC3001-1.4	1	3	2	2	1	2	2	3		3	3	3	2	1	2	2
UC2002-1/UC3001-1.5	-	1	1	-	1	2	2	3		3	3	3	1	1	2	2

1: Low 2: Medium 3: High

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Open Elective Courses

LIST OF OPEN ELECTIVE COURSES

Sl No.	Department	Course Codes	Open Elective Courses
1	BT	BT1501-1	Bio Fuel Engineering
2	BT	BT1502-1	Solid Waste Management
3	CS	CS2501-1	Fundamentals of AI and ML
4	CS	CS2502-1	Introduction to Data Structures
5	CV	CV2501-1	Disaster Management
6	CV	CV2502-1	Environmental Hygiene, Sanitation and Waste Management
7	CV	CV2503-1	Environmental Impact Assessment
8	CV	CV2504-1	Introduction to Geoinformatics
9	CY	CY2501-1	Corrosion Science (Only for CV and ME)
10	CY	CY2502-1	Natural Products Chemistry (Only For BT)
11	EC	EC1501-1	Artificial Neural Network Systems
12	EC	EC1502-1	Introduction to MATLAB Programming: A Hands-on Approach (only for CV and BT)
13	EC	EC1503-1	Robotics
14	EC	EC2501-1	Consumer Electronics
15	EC	EC2502-1	PCB Design and Fabrication
16	EC	EC2503-1	Space Technology and Applications
17	EE	EE2501-1	Battery Management System
18	EE	EE2502-1	Biomedical Instrumentation
19	EE	EE2503-1	Electric Vehicle Technology
20	EE	EE2504-1	Fundamentals of PLC and its applications
21	EE	EE2505-1	Motors and Motor Control Circuits
22	EE	EE2506-1	Non-Conventional Energy sources
23	HU	HU1501-1	Elements of Yoga
24	HU	HU1502-1	Intellectual Property Rights
25	HU	HU1503-1	Introduction to German Language
26	HU	HU1504-1	Introduction to Japanese Language
27	HU	HU1505-1	National Cadet Corps: Organization, Functions & Capabilities
28	HU	HU1506-1	Overview of Indian Culture
29	HU	HU1507-1	Philosophy
30	HU	HU1508-1	Principles of Physical Education
31	HU	HU1509-1	Indian Culture – Dance *
32	HU	HU1510-1	Indian Culture – Music *
33	HU	HU1511-1	Engineering Ethics *
34	HU	HU1512-1	Art of Communication and Interpersonal Skills*
35	HU	HU2501-1	Common sense and Critical Thinking
36	HU	HU2502-1	Linguistics & Language Technology

37	IS	IS2501-1	Introduction to Cyber Security (except EC, EE, AM, AD, CC, CS, IS)
38	IS	IS2502-1	Python Application Programming
39	IS	IS2503-1	Software Engineering Practices
40	IS	IS2504-1	Web technologies
41	MA	MA1501-1	Graph Theory (for BT, CV, EC, EE, ME and RI)
42	MA	MA1502-1	Number Theory
43	MA	MA3501-1	Linear Algebra (for BT, CV, EE, ME and RI)
44	ME	ME1501-1	Automotive Engineering
45	ME	ME1502-1	Industrial Pollution Control
46	ME	ME1503-1	Sustainable Development Goals
47	ME	ME1504-1	Technology Innovation
48	MG	MG1501-1	Human Resource Management
49	MG	MG1502-1	Management Accounting and Control Systems
50	MG	MG1503-1	Operations and Quality Management
51	MG	MG1504-1	Organizational Behaviour
52	MG	MG1505-1	Taxation for Engineers
53	MG	MG1506-1	Working Capital Management
54	PH	PH2501-1	Nanotechnology
55	PH	PH2502-1	Optoelectronic Devices (EC, EE, CSE, ISE, AM and CC branches)
56	RI	RI2501-1	Autonomous Mobile Robots
57	RI	RI2502-1	Medical Robotics (for all except AI)
58	RI	RI2503-1	PLC Control of Hydraulic and Pneumatic Circuits (for all except AI)

*** For students admitted under Twinning Program**

BIOFUEL ENGINEERING

Course Code:	**BT1501-1**	**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: Biotechnology

Course Objectives:

1.	To learn the fundamental concepts of biofuels, types of biofuels, their production technologies.
2.	To learn the concepts of feedstock utilization and energy conversion technologies.

UNIT-I

Liquid Biofuels **15 Hours**

Description and classification of Biofuels; Primary biomass: Plant Materials-Woody biomass, Lignocellulosic and agroindustrial by-products, starchy and sugary crops. Secondary biomass: Waste residues and co-products- wood residues, animal waste, municipal solid waste. Biomass production for fuel – algal cultures, yeasts (Lipid and carbohydrate).

Production of biodiesel: Sources of Oils – edible and non-edible; Esterification and Transesterification. Free fatty acids; saponification; Single step and two step biodiesel production. Catalysts for biodiesel production – homogeneous (alkali/acidic) and heterogeneous; Lipase mediated process. General procedure of biodiesel production and purification Quality Control Aspects: GC analysis of biodiesel, fuel property measurements, ASTM (D-6751) and Indian standards (IS15607). Algal Biodiesel production.

Production of Bioethanol: Bioethanol production using Sugar; Starch and Lignocellulosic feedstocks; Pretreatment of lignocellulosic feed stock

UNIT-II

Biohydrogen and Microbial Fuel Cells **15 Hours**

Enzymes involved in H_2 Production; Photobiological H_2 Production: Biophotolysis and Photo fermentation; H_2 Production by Fermentation: Biochemical Pathway, Batch Fermentation, Factors affecting H_2 production, Carbon sources, Detection and Quantification of H_2. Reactors for biohydrogen production.

Microbial Fuel cells: Biochemical Basis; Fuel Cell Design: Anode & Cathode Compartment, Microbial Cultures, Redox Mediators, Exchange Membrane, Power Density; MFC Performance Methods: Substrate & Biomass Measurements, Basic Power Calculations, MFC Performance: Power Density, Single vs Two-Chamber Designs, Wastewater Treatment Effectiveness; Advances in MFC.

UNIT-III

Recovery of Biological Conversion Products **10 Hours**

Bio gasification of municipal solid waste: Anaerobic processing; Types of digesters, Biogas plant in India.

Thermochemical processing: Planning an incineration facility, Incineration technologies: Mass burning system; Refuse derived fuel (RDF) system; modular incineration; Fluidized bed incineration; energy recovery; Fuel production through biomass incineration, Pyrolysis and gasification, hydrothermal processing.

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

1.	Mark the significance of biofuels and raw materials and Identify suitable feedstock for production of biofuels.
2.	Illustrate the production of liquid biofuels from various feed stocks.
3.	Demonstrate production of biohydrogen using microbial sources.
4.	Extend the concepts of microbial fuel cells towards development of specific application.
5.	Understand and apply the concepts of biochemical processing to harvest energy from waste products/streams.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
BT1501-1.1	-	2	-	-	-	-	-	-	1	-	-	-
BT1501-1.2	-	2	-	-	-	-	-	-	1	-	-	-
BT1501-1.3	-	2	-	-	-	-	-	-	1	-	-	-
BT1501-1.4	-	2	-	-	-	-	-	-	1	-	-	-
BT1501-1.5	-	2	-	-	-	-	-	-	1	-	-	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Drapcho, C. M., Nhuan, N. P.and Walker, T.H. ,"Biofuels Engineering Process Technology", Mc Graw Hill Publishers, New York, 2008.
2.	Jonathan R.M, Biofuels, "Methods and Protocols (Methods in Molecular Biology Series)", Humana Press, New York, 2009.
3.	Olsson L. (Ed.), "Biofuels (Advances in Biochemical Engineering/Biotechnology Series", Springer-Verlag Publishers, Berlin, 2007.
4.	Glazer, A. and Nikaido, H., "Microbial Biotechnology – Fundamentals of Applied Microbiology", 2 Ed., Cambridge University Press, 2007.
5.	Godfrey Boyle (Ed). "Renewable Energy- Power for sustainable future", 3rd Ed. Oxford. 2012.
6.	Ramachandran, T. V., "Management of municipal solid waste", Environmental Engineering Series. Teri Press, 2016.

SOLID WASTE MANAGEMENT

Course Code:	**BT1502-1**	**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: 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 and its Segregation & Transportation	**15 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. Concept of waste reduction, recycling and reuse.

Waste collection and segregation: Solid waste generation, Onsite handling and segregation of wastes at source, Collection and storage of municipal solid wastes, Equipment used and manpower required in collection, Collection systems and routes.

Transportation: Transfer stations: types, location, maintenance, Methods and means of transportation.

UNIT-II

Processing Techniques, Recovery of Resources and Waste Disposal	**15 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, Drying and dewatering of wastes.

Recovery of Resources: Heat recovery in incineration process, energy recovery and conversion of products from biological processes.

Dumping of solid wastes, Landfills – Types, site selection, preliminary design, operation, case study, Advantages and disadvantages of landfills, Leachate and landfill gases: Collection and treatment, Landfill disposal for hazardous wastes, biomedical waste.

UNIT-III

Solid Waste Management Rules and Planning Issues	**10 Hours**

Legislative trends and impacts: Major legislations, Government agencies. Municipal Solid Waste Management Act (1999), Hazardous Wastes (Handling and Management) Rules, Biomedical Waste (Handling and Management) Rule (1998), e-Waste (Management and Handling) Rule 2011.

Planning and developing a site for solid waste management, Site Remediation: Assessment and Inspection, Remedial techniques, 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

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
BT1502-1.1	1	-	-	-	-	-	-	-	1	-	-	-
BT1502-1.2	1	1	-	-	-	1	1	-	1	-	-	-
BT1502-1.3	-	2	-	-	-	-	-	-	1	-	-	-
BT1502-1.4	-	2	-	-	-	1	1	-	1	-	-	-
BT1502-1.5	1	-	-	-	-	-	-	-	1	-	-	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Tchobanaglous, G., Theisen, H. and Vigil, S. A. "Integrated Solid Waste Management", McGraw – Hill. 1993.
2.	Tchobanoglous, G., Thiesen, H., Ellasen, "Solid Waste Engineering Principles and Management", McGraw – Hill, 1997.
3.	Landrefh, R. E. and Sundaresan, B. B. "Solid Waste Management in Developing Countries", Indian National Scientific Documentation Centre. New Delhi, 2000.

FUNDAMENTALS OF AI AND ML

Course Code:	**CS2501-1**	**Course Type:**	**OEC**
Teaching Hours/Week (L: T: P: S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50**
Prerequisite	**CS1002-1**		

Teaching Department: Computer Science & Engineering

Course Objectives:

1.	Analyze the most fundamental knowledge to the students so that they can understand what the AI is.
2.	Gain a historical perspective of AI and its foundations
3.	Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4.	Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool.
5.	Explore the current scope, potential, limitations, and implications of intelligent systems.

UNIT-I

Introduction **15 Hours**

What is AI? Foundation of AI, Early History of AI, The Middle Ages and Dark Ages of AI, Renaissance, Future of AI.

Intelligence of AI

AI An Impossible Task, Animal Intelligence, Brain Size And Performance, Sensing And Movement, Subjective Intelligence, Iq Tests. Comparative Intelligence,

Chapter No 1: Introduction and Intelligence (Page No 11-37)

UNIT-II

Classical Artificial Intelligence **15 Hours**

Introduction, Expert Systems, Conflict Resolution, Multiple Rules, Forward Chaining, Backward Chaining, Problems With Expert Systems, Fuzzy Logic, Fuzzification, Fuzzy Rules, Defuzzification, Fuzzy Expert System, Problem Solving. Chapter No 2: Classical AI (Page No 38-45)

UNIT-III

Foundations of Machine Learning **10 Hours**

What is machine learning? Applications of Machine learning, Understand Data, Types of machine learning: Supervised, Unsupervised, Reinforcement Learning, Theory of learning: feasibility of learning, error and noise, training versus testing, theory of generalization, bias and variance, learning curve,.

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

1.	Explain the fundamental understanding of the history of artificial intelligence (AI) and its foundation
2.	Interpret the basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
3.	Describe the awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models

4.	Identify and explain the proficiency developing applications in an 'AI language', expert system shell, or data mining tool.
5.	Explain the fundamental concept and importance of machine learning.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
CS2501-1.1	3	3	-	-	-	-	-	-	-	-	-	-
CS2501-1.2	3	3	-	-	-	-	-	-	-	-	-	-
CS2501-1.3	3	3	-	-	-	-	-	-	-	-	-	-
CS2501-1.4	3	3	2	-	-	-	-	-	-	-	-	-
CS2501-1.5	3	3	2	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Kevin Warwick, "Artificial Intelligence the basics", Typeset in Bembo by Wearset Ltd, Boldon, Tyne and Wear, Library of Congress Cataloging in Publication Data Warwick, K. ISBN: 978-0-415-56482-3 (hbk).

REFERENCE BOOKS:

1.	Stuart Russel and Peter Norvig, "Artificial Intelligence A Modern Approach", Pearson 3rd Edition , 2016.
2.	Dan W Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson, 1st edition 2015.
3.	Elaine Rich, "Artificial Intelligence", Mc Graw Hill 3rd Edition, 2017.

E Books / MOOCs/ NPTEL

1.	Practical Artificial Intelligence Programming With Java, Third Edition ,Mark Watson
2.	Artificial Intelligence -http://www.nptelvideos.in/2012/11/artificial-intelligence.html
3.	http://nptel.ac.in/courses/106105077/
4.	https://www.udemy.com/artificial-intelligence
5.	https://www.edx.org/course/artificial-intelligence-ai-columbiax-csmm-101x-4

INTRODUCTION TO DATA STRUCTURES

Course Code:	**CS2502-1**	**Course Type:**	**OEC**
Teaching Hours/Week (L:T:P:S):	**3:0:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50**
Prerequisite	**CS1001-1**		

Teaching Department: Computer Science & Engineering

Course Objectives:

1.	Outline the concepts of data structures, types, operations, structures, pointers
2.	Implement linear data structures stacks, queues and usage of stacks in various applications.
3.	Implement the operations of singly linked lists
4.	Identify and differentiate different types of binary trees and binary search trees data structures
5.	Illustrate and classify threaded binary trees.

UNIT-I

Introduction **15 Hours**

Data Structure, Classification (Primitive and non-primitive), data structure operations, Arrays, Pointers and structures, Dynamic Memory Allocation Functions,

Linear Data Structures – Stacks

Introduction and Definition, Representation of stack: Array and structure representation of stacks, Operations on stacks,

Applications of Stack

Conversion of Expressions, Evaluation of expressions, Recursion: Implementation, Simulating Recursion, examples on Recursion.

UNIT-II

Linear Data Structures – Queues **15 Hours**

Introduction and Definition Representation of Queue: Array and Structure, representation of Queue, Various queue structures: ordinary queue, circular Queue

Linear Data Structures - Linked Lists

Definition and concepts singly linked List: Representation of link list in memory, Operations on singly Linked List, Circular Linked List, Doubly Linked List: Representation and Operations, Circular doubly Link list: Representation and Operations.

UNIT-III

Nonlinear Data Structures- Tree Data Structures **10 Hours**

Basic Terminologies, Binary Trees: Properties, Representation of Binary Tree: Linear representation, Linked representation, Operations on Binary Tree: Insertion, traversals. Introduction to Binary Search Tree

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

1.	Acquire the fundamental knowledge of various types of data structures and pointers.
2.	Apply the fundamental programming knowledge of data structures to design stack and

	use them for solving problems.
3.	Apply the fundamental programming knowledge of data structures to design queues and use them for solving problems.
4.	Design various functions for implementation of linked list.
5.	Implement and apply the concept of binary trees and binary search tree data structure.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CS2502-1.1	-	-	-	-	-	-	-	-	-	-	-	-
CS2502-1.2	3	1	2	-	-	-	-	1	-	-	-	1
CS2502-1.3	3	2	2	-	-	-	-	1	-	-	-	1
CS2502-1.4	3	2	-	-	-	-	-	1	-	-	-	1
CS2502-1.5	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Aaron M. Tenenbaum, Yedidyah Langsam& Moshe J. Augenstein, "Data Structures using C", Pearson Education/PHI, 2009.
2.	Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd edition, Universities Press, 2014.

REFERENCE BOOKS:

1.	Seymour Lipschutz, "Data Structures, Schaum's Outlines", Revised 1st edition, McGraw Hill, 2014.

E Books / MOOCs/ NPTEL

1.	Data Structures Using C, ISRD Group, Tata McGraw Hill, 2006.
2.	Data Structures Using C, Reema Thareja, 2nd edition, Oxford University Press, 2014
3.	Introduction to Data Structures by edx , URL: https://www.edx.org/course/
4.	Data structures by Berkley, URL: https://people.eecs.berkeley
5.	Advance Data Structures by MIT OCW , URL: https://www.mooclab.club/
6.	Data Structure by Harvard Extension School, URL: http://www.extension.harvard.

DISASTER MANAGEMENT

Course Code:	**CV2501-1**	**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**
Prerequisite	**CV1002-1**		

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	**04 Hours**
Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.	
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-II

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.	
Disaster Management in India	**06 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-III

Applications of Science and Technology for Disaster Management	**06 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

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CV2501-1.1	-	-	-	-	-	3	2	-	-	-	1	2
CV2501-1.2	-	-	-	-	-	3	2	-	-	-	1	2
CV2501-1.3	-	-	-	-	-	3	2	-	-	-	1	2
CV2501-1.4	-	-	-	-	-	3	2	-	-	-	1	2
CV2501-1.5	-	-	-	-	-	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 HYGIENE, SANITATION AND WASTE MANAGEMENT

Course Code:	**CV2502-1**	**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**
Prerequisite	**CV1002-1**		

Teaching Department: Civil Engineering

Course Objectives:

1.	Creation of awareness among student's health issues and Swachh Bharath mission and the consequent responsibilities.
2.	To understand the culture cleanliness, engineering applications in creation of ODF (Open defecation free) concept, Importance of legal & cultural issues related to Environmental Hygiene.
3.	To know the importance of sanitation, gender sensitive sanitation issues & use of engineering technology in construction of toilets.
4.	To know the importance of waste management system, wastewater audit and waste water treatment process.
5.	To study the role of student in Swachh Bharata Abhiyan, solid and waste water treatment process.

UNIT-I

Prospective: Environmental Hygiene (EH), Sanitation, Solid Waste and Wastewater **06 Hours**

Introduction- Swachh Bharath Mission (SBM)-Mission Objectives-Duration- Components Environmental Hygiene-Benefits-Sanitation-Waste Management. Work opportunities in Environmental Hygiene, Sanitation and Waste Management. Participatory Learning for Environmental Hygiene, Sanitation and Waste Management.

Sociology of environmental hygiene management, solid waste and waste water and impacts **08 Hours**

Open Defecation-Habits & attitude towards waste-Goals of SBA. Community Consciousness and Engagement on Sanitation Aspects, Roles & Responsibilities, Job Charts, Frequency, Schedules and Timelines in Swachhata Management, Culture of Cleanliness (Swachh Bharat Abhiyan), Behaviour Change Communication, Role of Habits and Attitudes in Environmental Hygiene Management, Waste and Wastewater Disposal; Change Management.

UNIT-II

Infrastructure for Sanitation **08 Hours**

Containment-Preparation of toilets –Toilet Types Evaluation of Construction and Maintenance of Community, Public, Institutional and Individual Sanitation Infrastructure Toilets-Proportion and Number of toilets, Gender Sensitive Sanitation Facilities, Ramps for Differently Abled, Types – Indian and Western. Faecal Sludge treatment - Single / Twin pit, Eco San, Septic Tank and Formal Sewerage.

Solid Waste Management **08 Hours**

Swachh Survekshan- Solid Waste management- Steps- Waste Audit-Classification Methods of Solid Waste Disposal and Management-Composting-Different types of composting- Waste Minimization-Waste Management.

UNIT-III

Waste & Wastewater Audit	**06 Hours**

Waste Audit -Environmental Impact Assessment, Waste Characterization, Quantity Determination, Primary Collection Methods, Secondary Transportation.

Wastewater Audit-Water Budget, Types of Wastewater, Survey of Distribution Network and Feasibility of Various Wastewater Treatment Methods.

Swachh Bharath Mission and Inclusivity	**04 Hours**

Swacch Bharath Mission in rural & Urban Context-Gender Issues in sanitation. Role of women in Sanitation.

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

1.	Creation of awareness among student's health issues and Swachh Bharath mission and the consequent responsibilities.
2.	To understand the culture cleanliness, engineering applications in creation of ODF (Open defecation free) concept, Importance of legal & cultural issues related to Environmental Hygiene.
3.	To know the importance of sanitation, gender sensitive sanitation issues & use of engineering technology in construction of toilets.
4.	To know the importance of waste management system, wastewater audit and waste water treatment process.
5.	To study the role of student in Swachh Bharata Abhiyan, solid and waste water treatment process.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CV2502-1.1	1	1	-	-	-	2	3	2	-	-	-	-
CV2502-1.2	1	1	-	-	-	2	3	2	-	-	-	-
CV2502-1.3	1	1	-	-	-	2	3	2	-	-	-	-
CV2502-1.4	1	1	-	-	-	2	3	2	-	3	-	-
CV2502-1.5	1	1	-	3	-	2	3	2	-	-	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Joanne E. Drinan and Frank Spellman, "Water and Wastewater Treatment: A Guide for the Non-engineering Professional".
2.	M. S. Bhatt and Asheref Illiyan, "Solid Waste Management: An Indian Perspective".
3.	Jagbir Singh, "Solid Waste Management: Present and Future Challenges".
4.	M. S. Bhatt, "Solid Waste Management: An Indian Perspective".
5.	T. V. Ramachandra, "Management of Municipal Solid Waste".
6.	Syed R. Qasim, "Wastewater Treatment Plants: Planning, Design and Operation".

REFERENCE BOOKS:

1.	Swachhbharatmission.gov.in/
2.	https://www.india.gov.in//swachh-bharat-mission-gramin-portal
3.	https://www.swachhsurvekshan2018.org/
4.	https://zerowasteeurope,eu/

5.	www.zerowasteindia.in/
E Books / MOOCs/ NPTEL	
1.	http://www.un.org/waterforlifedecade/pdf/award_south_africa_eng_for_web.pdf
2.	http://www.sulabhinternational.org
3.	http://swachhbharatmission.gov.in/sbmcms/writereaddata/images/pdf/Guidelines/Complete-set-guidelines.pdf

ENVIRONMENTAL IMPACT ASSESSMENT

Course Code:	**CV2503-1**	**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**
Prerequisite	**CV1002-1**		

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 **16 Hours**

Concepts of EIA, EIA methodologies (Adhoc, Network Analysis, Checklists, Map overlays, Matrix method), Screening and scoping, Rapid EIA and Comprehensive EIA, General Framework for Environmental Impact Assessment, EIA Specialized areas like environmental health impact assessment, Environmental risk analysis.

UNIT-II

14 Hours

Baseline data study, Prediction, and assessment of impacts on physical, biological, and socio-economic environment, Legislative and environmental clearance procedures in India, Public participation, Resettlement, and rehabilitation.

UNIT-III

10 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

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

↓ **Course Outcomes**												
CV2503-1.1	1	1	-	-	-	2	3	2	-	-	-	-
CV2503-1.2	1	1	-	-	-	2	3	2	-	-	-	-
CV2503-1.3	1	1	-	-	-	2	3	2	-	-	-	-
CV2503-1.4	1	1	-	-	-	2	3	2	-	3	-	-
CV2503-1.5	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

INTRODUCTION TO GEOINFORMATICS

Course Code:	**CV2504-1**	**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**
Prerequisite	**CV1001-1, CV1002-1**		

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.

UNIT-I

16 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
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-II

15 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.

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-III

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

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CV2504-1.1	2	2	-	-	-	2	-	-	-	-	-	-
CV2504-1.2	2	2	-	-	-	2	1	-	-	-	-	-
CV2504-1.3	2	2	-	-	-	2	1	-	-	-	-	-
CV2504-1.4	2	2	-	-	-	2	1	-	-	-	-	-
CV2504-1.5	2	2	-	-	-	2	1	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Anji Reddy, M, "Text Book of Remote Sensing and Geographical Information Systems", Fourth Edition, BS Publication, Hyderabad, 2012.
2.	Bhatta, Basudeva, "Remote Sensing and GIS", 2nd edition, Oxford University Press, N. Delhi, 2011.
3.	Lillesand, T.M., Kiefer, R.W and Chipman, J. W., "Remote sensing and Image Interpretations", 7th edition, John Wiley and sons, New Delhi, 2015.

REFERENCE BOOKS:

1.	Anji Reddy, M. and Hari Shankar, Y., "Digital Image Processing", BS Pub., Hyd, 2006.
2.	Bernhardsen, Tor, "Geographic Information Systems", 3rd Ed., Wiley India, Delhi, 2002.
3.	Canada Centre for Remote Sensing, Fundamentals of Remote sensing-Tutorial, 2011.
4.	Chang, Kang-tsung, "Introduction to Geographic Information Systems", 4th Ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
5.	Korte, George B., "The GIS Book", Onword Press, Thomson Learning Inc., USA, 2001.
6.	Kumar, S., "Basics of Remote sensing and GIS", Laxmi Publications (P) Ltd., Delhi, 2008.
7.	Longler, Paul A., Goodchild, Michael F., Maguire, David J., Rhind. David W., "Geographic Information Systems and Science", John Wiley & Sons Ltd., ESRI Press, 2004.
8.	Sabins, F. L., "Remote Sensing: Principles and Interpretation" 3rd edn. WH Freeman and Company, New York, 1997.

E Books / MOOCs/ NPTEL

1.	https://www.youtube.com/user/edusat2004
2.	https://eclass.iirs.gov.in/login

CORROSION SCIENCE

Course Code:	**CY2501-1**	**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**
Prerequisite	**CY1001-1**		

Teaching Department: Chemistry

Course Objectives:

1.	To provide fundamental understanding aspects of electrochemistry and material science related to corrosion. To understand the types of corrosion attacking on the metal and its preventions.
2.	To impart knowledge on corrosion science and its applications to the engineering materials.
3.	To identify practice for the prevention and remediation of the corrosion. To provide methodologies for measuring the corrosion performance of materials.

UNIT-I

Fundamentals of Corrosion	**09 Hours**
Definition, cost of corrosion, Corrosion Damage and consequences, Classification of corrosion, Electrochemical Aspects of corrosion, Electrochemical reactions, Different Environmental aspects, polarization and passivity, Corrosion Rate Expression, Determination. Standard electrode potential, EMF and Galvanic series, Potential-pH (Roubaix Diagram).	
Forms of Corrosion	**08 Hours**
Galvanic corrosion, Crevices corrosion, Filiform corrosion, Pitting corrosion, Uniform corrosion and Atmospheric corrosion, Inter granular corrosion, Selective leaching, Erosion corrosion, Cavitation damage, Stress corrosion , Impingement attack, Inlet tube corrosion, Corrosion fatigue, Hydrogen blistering, Hydrogen embrittlement.	

UNIT-II

Corrosion at Elevated Temperature	**08 Hours**
High temperature materials, Metal oxides, Pilling bed worth rule, oxide defect structure, Hot corrosion, Corrosion of mineral acids-corrosion of steel, stainless steel, Cu and Al.	
Corrosion Testing	**07 Hours**
Weight loss method, Tafel extrapolation test, linear polarization test and AC impedance method.	

UNIT-III

Corrosion Prevention Methods	**08 Hours**
Materials Selections, 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 student will be able to

1.	Explain the fundamentals of difference in electrode potential across an interface in particular a metal/ electrolyte and the relationship between rates of electrochemical reactions and the potential drop across interfaces.
2.	Analyze the causes and mechanisms of various types of corrosion including uniform, galvanic, crevice, pitting, inter granular and various modes of environmentally cracking.

	Acquire knowledge of influence of a materials composition, the effect of an electrolytes composition on the corrosion of metals and microstructure on its corrosion performance.
3.	Identify the materials that will exhibit adequate corrosion resistance in a particular environment and remedial action that will reduce corrosion to a acceptable level. Explain the concepts of different measuring techniques of corrosion.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CY2501-1.1	3	3	3	-	-	1	1	-	-	-	-	-
CY2501-1.2	3	3	3	-	-	1	1	-	-	-	-	-
CY2501-1.3	3	3	3	-	-	1	1	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Mars G Fontana, "Corrosion Engineering", 3rd Edition, Tata Mcgraw-Hill Edition.

REFERENCE BOOKS:

1	Chamberlian and K. Trethway, "Corrosion", Longman scientific and technical, John Wiley and Sons.

NATURAL PRODUCTS CHEMISTRY

Course Code:	**CY2502-1**	**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**
Prerequisite	**CY1001-1**		

Teaching Department: Chemistry

Course Objectives:

1.	Identify the structure of terpenoids and their biosynthesis. Elucidate the structure of β-carotene, haemoglobin and chlorophyll.
2.	Understand the chemistry underlying steroids and sex hormones. Get introduced to the different types of prostaglandins as well as theory and chemistry behind natural dyes.
3.	Gain knowledge on general methods of structural determination of some of the important alkaloids.

UNIT-I

Terpenoids & Carotenoids — **08 Hours**

Introduction and classification, isoprene rules, general methods of determination of structure of terpenoids. Structure elucidation of the following terpenoids-geraniol, α-pinine, camphene and farnesol. Biosynthesis of terpenoids.

Introduction and classification of carotenes. Structural elucidation of β-carotene.

Porphyrins — **07 Hours**

Introduction to porphyrins, structure and degradation products of haemoglobin and chlorophyll.

UNIT-II

Steroids — **08 Hours**

Introduction, Dile's hydrogenation. Chemistry of cholesterol, Blanc's rule, Barbier-Wielman degradation, Oppenuer oxidation. Constitution of bile acids.

Sex hormones: Chemistry of oestrone, progesterone, androsterone and testosterone.

Prostaglandins & Natural Dyes — **08 Hours**

Introduction, nomenclature, classification, and biological role of prostagladins. Structure elucidation of PGE_1, Biosynthesis of PGE_2 and $PGF_{2\alpha}$.

Introduction, Witt's theory of colour, methods of dyeing, chemical constitution of alizarin.

UNIT-III

Alkaloids — **09 Hours**

Definition, Classification and isolation of alkaloids. General methods of structural determination of alkaloids. Detailed study of structure elucidation of the following alkaloids- papaverine, cinchonine and nicotine.

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

1	Elucidate the structure of terpenoids like geraniol, a-pinine, camphene and farnesol. Explain the structural chemistry of carotenoids and porphyrins.
2	State the basic reactions governing steroids and sex hormones. Explain the biological role and structure of prostaglandins and state the methods employed for dyeing.
3	Apply the general methods of structural determination to elucidate the structure of alkaloids like papaverine, cinchonine and nicotine.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
CY2502-1.1	3	3	-	-	-	1	1	-	-	-	-	-
CY2502-1.2	3	3	-	-	-	1	1	-	-	-	-	-
CY2502-1.3	3	3	-	-	-	1	1	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	**21.** Agarwal, "Organic Chemistry of Natural Products", Vol.-I & Vol.-II, O.P. Goel Publishing House, 2014.

REFERENCE BOOKS:

1.	K. Nakanishi, T. Goso, S. Ito, S. Natori and S. Nozoe, "Natural Products Chemistry", Vol. I & II, Academic Press, Ny, 1974.
2.	Gurudeep R. Chatwal, "Organic Chemistry of Natural Products", Vol. I & II, Himalaya Publishing House, 2013.
3.	G.A. Swal, "An Introduction to Alkaloids", Backwell Scientific Publications, 1967.
4.	Hand book of naturally occurring Compounds, Vol. II, terpenes, T.K. Davon, A.I. Scott, Academic Press, Ny, 1974.

ARTIFICIAL NEURAL NETWORK SYSTEMS

Course Code:	**EC1501-1**	**Course Type**	**OEC**
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.	To learn basic building blocks of ANNs and its terminology
2.	To understand the working of McCulloch-Pitts Neuron and different types of learning rules
3.	To understand decision regions, discriminant functions and training concept
4.	To understand the working of perceptron as classifier
5.	To understand the mathematics behind different types of single layer feedback networks

UNIT-I

Introduction to Artificial Neural networks **16 Hours**

Introduction, Basic building blocks: network architecture, setting the weights, activation functions, ANN terminologies: weights, activation functions, bias, threshold, McCulloch-Pitts Neuron Model, Learning Rules

UNIT-II

Single Layer Perceptron Classifiers **15 Hours**

Classification Model, Features, and Decision Regions, Discriminant Functions, Linear Machine and Minimum Distance Classification, Nonparametric Training Concept, Training and Classification Using the Discrete Perceptron: Algorithm and Example, Single-Layer Continuous Perceptron Networks for Linearly Separable Classifications, Multicategory Single-Layer Perceptron Networks

UNIT-III

Single-Layer Feedback Networks **09 Hours**

Basic Concepts of Dynamical Systems, Mathematical Foundations of Discrete-Time Hopfield Networks, Mathematical Foundations of Gradient-Type Hopfield Networks. Transient Response of Continuous-Time Networks, Relaxation Modeling in Single-Layer Feedback Networks

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

1.	Describe the building blocks of artificial neural and terminologies
2.	Describe the working of neural network and learning rules
3.	Describe training of Single layer perceptron and classification using it.
4.	Explain use of Single layer perceptron for linearly separable and multicategory problems
5.	Explain the mathematics behind different single-layer feedback networks

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
EC1501-1.1	3	-	-	-	-	-	-	-	-	-	-	-
EC1501-1.2	3	-	-	-	-	-	-	-	-	-	-	-

EC1501-1.3	3	-	-	-	-	-	-	-	-	-	-	-
EC1501-1.4	3	-	-	-	-	-	-	-	-	-	-	-
EC1501-1.5	3	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw-Hill Education, 2006
2.	Jacek M. Zurada "Introduction to Artificial Neural Systems", 1st Edition, St. Paul West Publishers-USA, 1992.
3.	Michael A Neilsen, "Neural Networks and Deep Learning", Determination Press, 2015

INTRODUCTION TO MATLAB PROGRAMMING: A HANDS-ON APPROACH

Course Code:	**EC1502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**2:0:2:0**	**Credits**	**03**
Total Teaching Hours	**27+0+26+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Electronics & Communication Engineering
Offered to Civil & BT

Course Objectives:

1.	To demonstrate basic understanding of MATLAB programming
2.	To use and write functions
3.	To use MATLAB programming for image processing

Unit-I	**27 Hours**

Introduction to MATLAB: Starting MATLAB and familiarization with its user interface, syntax and semantics, ways in which MATLAB provides help, create plots in MATLAB.

Matrices and Operators: defining matrices, manipulation of matrices, extract parts of them and combine them to form new matrices, use of operators to add, subtract, multiply, and divide matrices, and we will learn that there are several different types of multiplication and division.

Functions: creating reusable functions, how the environment inside a function is separated from the outside via a well-defined interface through which it communicates with that outside world, define a function to allow input to it when it initiates its execution.

Programmer's Toolbox: polymorphism and how MATLAB exploits it to change a function's behavior on the basis of the number and type of its inputs, random number generator, how to get input from the keyboard, how to print to the Command Window, and how to plot graphs in a Figure window, how to find programming errors with the help of the debugger, how to print to the Command Window, and how to plot graphs in a Figure window, how to find programming errors with the help of the debugger.

Selection Statement and Loops: how to use the if-statement, how to use relational operators and logical operators, how to write polymorphic functions and how to make functions resistant to error, the for-loop and the while-loop, how the break-statement works, nested loops, logical indexing and implicit loops.

Data Types: character arrays and how the characters in them are encoded as numbers, string and datetime datatype, how to produce heterogeneous collections of data via structs and cells.

File Input/Output: reading and writing files, how to create, read from, and write into MAT-files, Excel files, text files, and binary files, how to navigate among folders with MATLAB commands.

Image Processing using MATLAB: pre-processing – conversion of color image to gray scale image, decomposition of color images to single color component image, histogram of image, thresholding

List of Experiments

22. 1	Starting MATLAB and familiarization with its user interface, syntax and semantics, ways in which MATLAB provides help, create plots in MATLAB.
23. 2	Defining matrices, manipulation of matrices, extract parts of them and combine them to form new matrices, use of operators to add, subtract, multiply, and divide matrices, and we will learn that there are several different types of multiplication and division.
24. 3	creating reusable functions, how the environment inside a function is separated from the outside via a well-defined interface through which it

	communicates with that outside world, define a function to allow input to it when it initiates its execution.
25. 4	Polymorphism and how MATLAB exploits it to change a function's behavior on the basis of the number and type of its inputs, random number generator, how to get input from the keyboard, how to print to the Command Window
26. 5	How to plot graphs in a Figure window, how to find programming errors with the help of the debugger, how to print to the Command Window, and how to plot graphs in a Figure window, how to find programming errors with the help of the debugger.
27. 6	How to use the if-statement, how to use relational operators and logical operators, how to write polymorphic functions and how to make functions resistant to error.
28. 7	The for-loop and the while-loop, how the break-statement works, nested loops, logical indexing and implicit loops.
29. 8	Character arrays and how the characters in them are encoded as numbers, string and datetime datatype, how to produce heterogeneous collections of data via structs and cells.
30. 9	Reading and writing files, how to create, read from, and write into MAT-files, Excel files, text files, and binary files, how to navigate among folders with MATLAB commands.
31. 10	Reading an image, saving, basic manipulation of images, arithmetic operations
32. 11	Pre-processing – conversion of color image to gray scale image, decomposition of color images to single color component image.
33. 12	Histogram processing.
34. 13	Thresholding operation.

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

1.	Use matrices and operators in MATLAB programming
2.	Use and write functions; use MATLAB toolbox
3.	Use toolbox and selection statement in MATLAB programming
4.	Write MATLAB programs using loops and summarize data types
5.	Summarize file input/output methods using MATLAB commands and apply pre-processing and thresholding operations on images

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
EC1502-1.1	1	-	-	-	3	-	-	-	-	-	-	-
EC1502-1.2	1	-	-	-	3	-	-	-	-	-	-	-
EC1502-1.3	1	-	-	-	3	-	-	-	-	-	-	-
EC1502-1.4	1	-	-	-	3	-	-	-	-	-	-	-
EC1502-1.5	1	-	-	-	3	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Stormy Attaway, “Matlab: A Practical Introduction to Programming and Problem Solving”, Second Edition, Butterworth-Heinemann, 2011

2.	Fitzpatrick and Ledeczi, “Computer Programming with MATLAB”, eBook, 2013
3.	Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins, Digital Image Processing using MATLAB, first edition, Dorling Kindersley Pvt Ltd, 2006.
REFERENCE BOOKS:	
1.	Duane C. Hanselman, Bruce L. Littlefield, “Mastering MATLAB” , first edition, Pearson, 2011
E Books / MOOCs/ NPTEL	
1.	https://nptel.ac.in/courses/103/106/103106118/
2.	https://www.coursera.org/learn/matlab

ROBOTICS

Course Code:	**EC1503-1**	**Course Type**	**OEC**
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. Understand Anatomy of a robot.
2. Analyse the robot motion using translation and rotational matrix.
3. Discuss Robot trajectory planning and robot control.
4. Categorise the various sensors used in robotics
5. Understand the robot programming.

UNIT-I

Introduction **16 Hours**

Definition, anatomy of robot, classification configurations, robot links and joints, robot specifications, resolution accuracy and repeatability, simple numerical problems, robot drive systems, hydraulic, pneumatic and electric drive systems, wrist and its motions, end effectors, types of end effectors, mechanical & Non-mechanical grippers, methods of constraining parts in grippers.

Motion analysis

Direct kinematics and inverse kinematics, 3D homogeneous transformations, rotation, translation and displacement matrix, composite rotation matrix, rotation matrix about an arbitrary axis.

UNIT-II

Control and trajectory planning **15 Hours**

Trajectory planning, definition, steps in trajectory planning, joint space techniques, use of a p-degree polynomial as interpolation function, cubic polynomial trajectories, linear function with parabolic blends, joint space verses, simple numerical problems on joint space trajectory planning.

Sensors

Classification, Types- Contact & Non-Contact sensors.

Machine Vision

Machine vision, functions of machine vision system, sensing and digitizing, imaging devices, analog to digital signal conversion, quantization and encoding, simple numerical problems, image storage, image processing and analysis, image data reduction, segmentation, feature extraction, object recognition, robotic machine vision applications, inspection, identification, visual surveying and navigation.

UNIT-III

Programming **09 Hours**

Introduction to robot programming, robot cell layout, work cell control and interlocks, manual programming, lead through and walkthrough programming, off-line programming, robot programming languages, examples

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

1. Explain the working principle, various performance parameters of robots and identify the types of robots employed in industry.
2. Discuss the concept of direct and inverse kinematics. Determine the position and orientation of End-Effector subjected to transformations. Demonstrate the applications of

	Denavit-Hartenberg (DH) method for different robot configurations.
3.	Determine the technique of trajectory planning, control schemes for robot joints and understand the types of the sensors used in robotics.
4.	Apply engineering knowledge in robot visual surveying and navigation.
5.	Analyze and formulate different types of robot cell layouts and use modern tools to write robot programs for different tasks.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EC1503-1.1	3	2	2	1	-	-	-	-	-	-	-	1
EC1503-1.2	3	3	2	2	-	-	-	-	3	3	-	1
EC1503-1.3	3	2	2	2	-	-	-	-	3	3	-	1
EC1503-1.4	3	2	2	1	-	-	-	-	-	-	-	1
EC1503-1.5	3	3	3	2	2	-	-	-	-	-	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	R. K. Mittal and I. J. Nagrath, “Robotics and Control”, Tata-McGraw-Hill Publications, 2007.
2.	Mikell P. Groover, Mitchel Weiss, Roger N. Nagel and Nicholas G. Odrey, “Industrial Robotics”, McGraw-Hill Publications, International Edition, 2008

REFERENCE BOOKS:

1.	Fu K. S., Gonzelez R. C., Lee C. S. G., "Robotics: Control, Sensing, Vision, Intelligence," , McGraw Hill Book Co., International edition, 2008.
2.	Yorem Koren, "Robotics for Engineers", McGraw-Hill Publication, International edition, 1987.
3.	Craig, J. J., "Introduction to Robotics: Mechanics and Control", 3rd Edition, Pearson PrenticeHall Publications, 2005.
4.	Schilling R. J., "Fundamentals of Robotics, Analysis and Control", Prentice-Hall Publications, Eastern Economy edition, 2007.
5.	AppuKuttan K. K., "Robotics", I.K. International Publications, First Edition, 2007.
6.	James G. Keramas, "Robot Technology Fundamentals", Cengage Learning, 1999.
7.	Richard K. Barnhart, Stephen B. Hottman, Douglas M. Marshall, Eric Shappee, "Introduction to Unmanned Aircraft Systems", CRC Press, 2012.
8.	Ghosh, "Control in Robotics and Automation", Allied Publishers.
9.	Deb, "Robotics Technology", Wiley India.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/112105249

CONSUMER ELECTRONICS

Course Code:	**EC2501-1**	**Course Type**	**OEC**
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**
Prerequisite	**EC1001-1**		

Teaching Department: Electronics & 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 & Vision **15 Hours**

Sound: Definition and properties of sound, Transducers: Micro Phone – characteristics and types, and Loud Speakers – characteristics and types, Enclosures and baffles, mono-stereo, audio amplifiers-characteristics, Synthesizers.

Vision: Displays-LED, LCD, PLASMA, Camera: basic principle, CCTV Camera.

UNIT-II

Recording, Playback, Communication & Broadcasting Systems **15 Hours**

Recording and Playback: Audio recording methods-magnetic recording, optical recording, digital recording, erasing methods, optical discs- recording and playback, Film projector, Theatre Sound, HiFi system.

Communications And Broadcasting: 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-III

Other Electronic Systems **10 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

1.	Recall basics of sound and transducers.
2.	Understand the working principles of display units and CCTV camera.
3.	Explain basic working of Recording, storage devices
4.	Explain basics of communication and broadcasting
5.	Recall basic working of commonly used electronic gadgets

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EC2501-1.1	1	-	-	-	-	1	-	-	-	-	2	2
EC2501-1.2	1	-	-	-	-	1	-	-	-	-	2	2

EC2501-1.3	1	-	-	-	-	1	-	-	-	-	2	2
EC2501-1.4	1	-	-	-	-	1	-	-	-	-	2	2
EC2501-1.5	1	-	-	-	-	1	-	-	-	-	2	2

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Anand, “Consumer Electronics”, Khanna publications, 2011.

2. Bali S. P., “Consumer Electronics”, Pearson Education, 2005.

REFERENCE BOOK:

1. Gulati R. R. "Modern Television Engineering", Wiley Eastern.

PCB DESIGN AND FABRICATION

Course Code	**EC2502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**1:0:4:0**	**Credits**	**03**
Total Teaching Hours	**15+0+52+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EC1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	To enable students to gain knowledge of Schematic Design techniques & PCB design techniques
2.	To expose students to complete PCB Design & manufacturing process

Unit-I

Circuit Schematic	**05 Hours**

Introduction to Kicad schematic design tool, features, node connections, labeling, creating new component.

Unit-II

PCB Layout:	**05 Hours**

Introduction to Kicad layout editor, features, layer selections, manual and auto routing in Kicad, verification of footprint, creating footprint for a given component.

Unit-III

PCB Fabrication	**05 Hours**

Generating and verifying the PCB Gerber file, preparing artwork for a single side PCB fabrication, preparing PCB artwork for double side PCB, Etching process, tin plating, legend printing, green masking and through hole plating

List of Experiments

35.1	Exploring the Kicad Schematic and layout tool
36.2	Developing a schematic circuit for microphone preamplifier
37.3	Designing a single side PCB layout for microphone preamplifier
38.4	Developing a schematic circuit for a microcontroller development board
39.5	Designing a double side PCB layout for a microcontroller development board
40.6	Choosing a new sensor/display module and building a schematic circuit for the user level application
41.7	Building a layout using single or double side PCB for the sensor/display module
42.8	Preparing the film for the bottom copper, solder mask and top silk (legend) to fabricate a single side PCB using chemical process
43.9	Preparing the film for the top copper, bottom copper, top solder mask, bottom solder mask and legend to fabricate double side PCB using chemical process
44.10	PCB routing, etching, cutting and drilling using CNC machine

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

1.	Draw schematic circuit and create PCB layout for single or multilayer PCB
2.	Fabricate single and double-layer PCB

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EC2502-1.1	3	-	-	-	-	-	-	-	-	-	-	-
EC2502-1.2	3	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Peter Dalmaris, “Kicad Like a Pro”, Tech Exploration.

REFERENCE BOOKS:

1.	Peter Dalmaris, “Kicad Like a Pro”, Tech Exploration.
2.	David L. Jones, “PCB Design Tutorials”, Alternate zone, 2004.

E Books / MOOCs/ NPTEL

1.	www.alternatezone.com

SPACE TECHNOLOGY AND APPLICATIONS

Course Code:	**EC2503-1**	**Course Type**	**OEC**
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**
Prerequisite	**EC1001-1**		

Teaching Department: Electronics & Communication Engineering

Course Objectives:

1.	Understand the general laws governing satellite orbits and its parameters.
2.	Discuss effect of space environment on satellite signal propagation.
3.	Illustrate various segments employed in satellite and ground station.
4.	Calculate the uplink / downlink subsystem characteristics.
5.	know the effects on the EM waves in propagation through space.
6.	Explain the satellite launch in the space and their applications in remote sensing.
7.	Discuss the different communication systems used for satellite access.
8.	Summarise Advanced space systems for mobile communication, VSAT, GPS.

UNIT-I

Satellite Technology — **15 Hours**

Satellite communications: Introduction, Kepler's laws, definitions, orbital element, apogee and perigee heights, orbit perturbations, inclined orbits.

Space environment: Earth's Atmosphere, Ionosphere and Meteorological effects on space systems, propagation of signal, Transmission losses in space environment.

Satellite Technology: Space segment, Ground segment, Quality and Reliability, Satellite Communication systems.

UNIT-II

Space Applications — **15 Hours**

Launch Vehicles: Working, stages, Fuel, payload protection, Navigation, guidance and control, Reliability, launching into outer space and launch bases. Types of launch vehicles.

Space Applications: Digital DBS TV, DBS-TV System Design, Master Control Station and Uplink Antennas. Introduction, Radio and Satellite Navigation,

Remote Sensing: Introduction to Remote Sensing, Concepts and Applications of satellite Remote sensing.

UNIT-III

Advanced Space Systems — **10 Hours**

Satellite Access: 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).

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

1.	Discuss the fundamental principles of Satellite communication systems.
2.	Understand the Propagation impairments of satellite link.
3.	Explain various segments employed in satellite and ground station.
4.	Discuss the satellite launch mechanism and roll of those satellite in remote sensing.
5.	Understand the different communication systems used for satellite access and list the

	recent satellites that have been launched for mobile communication, GPS.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EC2503-1.1	3	2	2	-	1	-	-	-	-	-	-	-
EC2503-1.2	-	3	-	-	2	1	-	-	-	-	-	-
EC2503-1.3	3	-	-	1	-	1	1	-	-	-	-	-
EC2503-1.4	-	-	-	-	-	1	3	-	-	-	-	-
EC2503-1.5	-	-	-	-	-	3	3	2	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Dennis Roddy, “Satellite Communications”, McGraw Hill ,1996.
2.	Timothy Pratt, “Satellite Communications”, Wiley India Ltd , 2006.
3.	K Ramamurthy, “Rocket Propulsion”, McMillan Publishers India Ltd, 2010.

REFERENCE BOOKS:

1.	George Joseph, “Fundamentals of Remote Sensing”, Universities press, India 2003.
2.	B C Pande, “Remote sensing and Applications”, VIVA Books pvt ltd, 2009.
3.	Meynart Roland, “Sensors systems and next generation satellites”, SPIE Publication.
4.	Thyagarajan , “Space Environment”, ISRO Hand Book Publication.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/101106046

BATTERY MANAGEMENT SYSTEM

Course Code:	**EE2501-1**	**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**
Prerequisite	**EE1001-1**		

Teaching Department: Electrical & Electronics Engineering

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

UNIT-I

Battery System	**08 Hours**

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

BMS Options	**07 Hours**

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-II

BMS Functions	**07 Hours**

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

Custom BMS Design	**08 Hours**

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-III

Deploying a BMS	**10 Hours**

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

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EE2501-1.1	1	3	-	-	-	-	-	-	-	-	-	-
EE2501-1.2	1	3	-	-	-	-	-	-	-	-	-	-
EE2501-1.3	1	2	3	-	-	-	-	-	-	-	-	-
EE2501-1.4	1	2	2	3	-	-	-	-	-	-	-	-
EE2501-1.5	1	3	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Davide Andrea, "Battery Management Systems for Large Lithium-Ion Battery Packs", ARTECH HOUSE 2010.

REFERENCE BOOKS:

1	Rui Xiong, "Battery Management Algorithm for Electric Vehicles", Springer 2019.
2	Nicolae Tudoroiu, "Battery Management Systems of Electric and Hybrid Electric Vehicles", MDPI 2021

BIOMEDICAL INSTRUMENTATION

Course Code:	**EE2502-1**	**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**
Prerequisite	**EC1001-1**		

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	The course is designed to give the basic concepts of Instrumentation involved in medical field and human physiology.
2.	To introduce an fundamental of transducers as applicable to physiology
3.	To explore the human body parameter measurements setups
4.	To make the students understand the basic concepts of forensic techniques.
5.	To give basic ideas about Electrophysiological measurements, medical imaging

UNIT-I

Physiology and transducers	**08 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 sensors.

Electro – Physiological measurements	**09 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-II

Non-electrical parameter measurements	**08 Hours**

Measurement of blood pressure, Cardiac output, Heart rate, Heart sound Pulmonary function measurements, spirometer, Photo Plethysmography, Body Plethysmography, Blood Gas analyzers : pH of blood, measurement of blood pCO2, pO2, finger-tip oximeter, ESR, GSR measurements

Medical Imaging	**07 Hours**

Radiographic and fluoroscopic techniques, X rays, Computer tomography, Mammography, MRI, fMRI, Ultrasonography, Endoscopy, Thermography, Different types of biotelemetry systems and patient monitoring

UNIT-III

Assisting and therapeutic equipments:	**08 Hours**

Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart Lung machine, Audio meters, Dialyzers, Lithotripsy

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

1	Understand the physiology of biomedical system
2	Measure biomedical and physiological information
3	Discuss the application of Electronics in diagnostics and therapeutic area.
4	Analyze the images and do a prediction using image processing.
5	Understand the different equipment's used for various measurements of physiology

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EE2502-1.1	3	3	-	2	1	1	-	-	-	-	-	-
EE2502-1.2	2	2	2	2	-	-	-	-	-	-	-	-
EE2502-1.3	3	2	2	1	2	1	-	-	-	-	-	-
EE2502-1.4	2	3	-	-	1	-	-	-	-	-	1	-
EE2502-1.5	3	3	-	-	2	-	-	-	-	-	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, "Bio-Medical Instrumentation and Measurements", II edition, Pearson Education, 2002.
2.	R. S. Khandpur, "Handbook of Bio-Medical instrumentation", Tata McGraw Hill Publishing CoLtd., 2003.
3.	J. Webster, "Medical Instrumentation", John Wiley & Sons, 1995.
4.	L. A. Geddes and L. E. Baker, "Principles of Applied Bio-Medical Instrumentation", John Wiley & Sons, 1975.
5.	David. Cooney and Michel Deckker, "Bio- Medical Engineering Principles", INC.

REFERENCE BOOKS:

1	David Cooney, "Bio-Medical Engineering Principles", 2015, 1st Edition, Marcel Deckker Pub Co., New York.

ELECTRIC VEHICLE TECHNOLOGY

Course Code:	**EE2503-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EE1001-1**		

Teaching Department: Electrical & Electronics Engineering

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

UNIT-I

Vehicle Mechanics	**07 Hours**

Roadway Fundamentals, Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power, Force-Velocity Characteristics, Maximum Gradability, Velocity and Acceleration, Constant FTR, Level Road, Velocity Profile, Distance Traversed, Tractive Power, Energy Required, Nonconstant FTR, General Acceleration, Propulsion System Design..

Electric and Hybrid Electric Vehicles	**07 Hours**

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-II

Energy storage for EV and HEV	**08 Hours**

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.

Electric Propulsion	**08 Hours**

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-III

Design of Electric and Hybrid Electric Vehicles	**10 Hours**

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

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EE2503-1.1	2	3	-	-	-	-	-	-	-	-	-	-
EE2503-1.2	1	2	3	-	-	-	-	-	-	-	-	-
EE2503-1.3	1	2	3	-	-	-	-	-	-	-	-	-
EE2503-1.4	1	2	3	-	-	-	-	-	-	-	-	-
EE2503-1.5	1	2	2	-	-	-	-	-	-	-	3	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1	Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003.
2	M. Ehsani, Y. Gao, S.Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2005.

REFERENCE BOOKS:

1	Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013.
2	C.C. Chan and K.T. Chau, "Electric Vehicle Technology", OXFORD University, 2001
3	Chris Mi, M. Abul Masrur, David Wenzhong Gao, "Hybrid Electric Vehicles Principles And Applications with Practical Perspectives", 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:	**EE2504-1**	**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**
Prerequisite	**EC1001-1**		

Teaching Department: Electrical & Electronics Engineering

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

UNIT-I

Programmable Logic Controllers	**02 Hours**
Introduction, Parts of a PLC, Principles of Operation, PLC Size and Application.	
PLC Hardware Components	**05Hours**
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).	
Basic Programming Language	**05Hours**
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	**03Hours**
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-II

Programming Timers	**02 Hours**
Introduction, Necessity of Energy Storage and Methods of Energy Storage (Classification and brief description using block diagram representation)	
Programming Counters	**04 Hours**
Counter Instructions, Up-Counter, Down-Counter, Cascading Counters, Incremental Encoder-Counter Applications, Combining Counter and Timer Functions.	

Program Control Instructions	**05 Hours**
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	**02 Hours**
Data Manipulation, Data Transfer Operations, Data Compare Instructions, Data Manipulation Programs, Numerical Data I/O Interfaces, Closed-Loop Control.	
Math Instructions	**02 Hours**
Math Instructions, Addition Instruction, Subtraction Instruction, Multiplication Instruction, Division Instruction, Other Word-Level Math Instructions, File Arithmetic Operations	
UNIT-III	
Sequencer and Shift Register Instructions	**05 Hours**
Mechanical Sequencers, Sequencer Instructions, Sequencer Programs, Bit Shift Registers, Word Shift Operations.	
Process Control, Network Systems, and SCADA	**05 Hours**
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

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EE2504-1.1	3	-	-	-	-	-	-	-	-	-	-	-
EE2504-1.2	1	3	-	-	-	-	-	-	-	-	-	-
EE2504-1.3	1	2	3	-	-	-	-	-	-	-	-	-
EE2504-1.4	1	2	3	-	-	-	-	-	-	-	-	-
EE2504-1.5	1	2	3	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Frank Petruzella, "Programming Logic Controllers", Fifth Edition.
2.	W Bolton, "Programmable Logic controllers", 6th edition, Elsevier- newness, 2015.

REFERENCE BOOKS:	
1.	John W Webb, Ronald A Reis, "Programmable logic controllers - principles and applications", 5th edition, 2nd impression, Pearson education, 2009
2.	L. A Bryan, E. A Bryan, "Programmable Controller Theory and Implementations", 2nd edition, 2003
3.	S. P. Sukhumi, J. K. Nayak, “Solar Energy: Principles Collection and Storage”, 3rd edition, McGraw-Hill Education (India) , 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:	**EE2505-1**	**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**
Prerequisite	**EE1001-1**		

Teaching Department: Electrical & Electronics Engineering

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

UNIT-I

AC Motor Designs	**08 Hours**
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.	
AC Motor Control:	**07 Hours**
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-II

DC Motors	**07 Hours**
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	
DC Motor Control and Stepper Motors	**08 Hours**
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-III

Sensors	**10 Hours**
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.	Understand 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.	Understand the basic principles of DC motor controls which includes starters, contactors, and control relays
5.	Set up sensors in order to give feedback to a control circuit

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
EE2505-1.1	3	-	-	-	-	-	-	-	-	-	-	-
EE2505-1.2	2	3	3	-	-	2	-	-	-	-	-	-
EE2505-1.3	3	-	-	-	-	-	-	-	-	-	-	-
EE2505-1.4	2	3	3	-	-	2	-	-	-	-	-	-
EE2505-1.5	2	3	3	-	-	2	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	S. K. Bhattacharya Birjindersingh, "Control of electrical machines", New Age International.
2.	Gary J. Rockis & Glen A. Mazura, "Electrical Motor Controls", 5th Edition, ISBN number is 9780826912268

REFERENCE BOOKS:

1.	Stephen L. Herman, "Industrial Motor Control", 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:	**EE2506-1**	**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**
Prerequisite	**EE1001-1**		

Teaching Department: Electrical & Electronics Engineering

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

UNIT-I

Energy Sources — **03 Hours**

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 — **05 Hours**

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

Solar Thermal Systems — **04 Hours**

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 — **04 Hours**

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-II

Energy Storage — **04 Hours**

Introduction, Necessity of Energy Storage and Methods of Energy Storage (Classification and brief description using block diagram representation)

Wind Energy — **04 Hours**

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.

Biomass Energy — **06 Hours**

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-III

Energy From Ocean — **05 Hours**

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 — **05 Hours**

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

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
EE2506-1.1	2	3	-	-	-	1	2	1	-	-	-	-
EE2506-1.2	2	3	-	-	-	1	2	1	-	-	-	-
EE2506-1.3	2	3	-	-	-	1	2	1	-	-	-	-
EE2506-1.4	2	3	-	-	-	1	2	1	-	-	-	-

EE2506-1.5	2	3	-	-	-	1	2	1	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Rai G. D., "Non-Conventional Sources of Energy", 4th Edition, Khanna Publishers, New Delhi, 2007.

REFERENCE BOOKS:

1.	Mukherjee D. and Chakrabarti, S., "Fundamentals of Renewable Energy Systems", New Age International Publishers, 2005.
2.	Khan, B. H., "Non-Conventional Energy Resources", TMH, New Delhi, 2006.
3.	S. P. Sukhumi, J. K. Nayak "Solar Energy: Principles Collection and Storage", 3rd edition, McGraw-Hill Education (India) , 2009.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/108108078

ELEMENTS OF YOGA

Course Code:	**HU1501-1**	**Course Type**	**OEC**
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: Mechanical Engineering

Course Objectives:

1. To give a brief history of the development of Yoga
2. Identify names of different classical texts on Yoga
3. To illustrate how Yoga is important for healthy living
4. To explain the Asanas and other Yogic practices
5. To explain, how Yoga practices can be applied for overall improvement

UNIT-I

Yoga — **09 Hours**

Meaning and initiation, definitions and basis of yoga, History and development, Astanga yoga, Streams of yoga. Yogic practices for healthy living.

General guidelines for Yoga practices for the beginners: Asanas, Pranayama.

Classification of Yoga and Yogic texts — **07 Hours**

Yogasutra of Patanjali, Hatha yogic practices- Asanas, Pranayama, Dharana, Mudras and bandhas.

UNIT-II

Yoga and Health — **06 Hours**

Concept of health and Diseases-Yogic concept of body – pancakosa viveka, Concept of disease according to Yoga Vasistha.

04 Hours

Yogic concept of healthy living- rules & regulations, yogic diet, ahara, vihara. Yogic concept of holistic health.

Applied Yoga for elementary education — **04 Hours**

Personality development- physical level, mental level, emotional level. Specific guidelines and Yoga practices for - Concentration development, Memory development

UNIT-III

Yoga and physical development — **05 Hours**

Mind-body, Meditation, Yogasanas and their types. Different Yoga practices and Benefits.

05 Hours

Specific guidelines and Yoga practices for **–** Flexibility, Stamina, Endurance (Surya Namaskara)

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

1. Understand a brief history of the development of Yoga
2. Know important practices and principles of Yoga
3. Explain how Yoga is important for healthy living
4. Practice meditation to improvement of concentration etc.
5. Have knowledge about specific guidelines of yoga practices

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU1501-1.1	-	-	-	-	-	1	-	-	1	-	-	1
HU1501-1.2	-	-	-	-	-	1	-	-	1	-	-	3
HU1501-1.3	-	-	-	-	-	2	-	-	1	-	-	3
HU1501-1.4	-	-	-	-	-	3	-	-	2	-	-	3
HU1501-1.5	-	-	-	-	-	2	-	-	2	-	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	B. K. S. Iyengar, “Light on Yoga: The Classic Guide to Yoga by the World’s Foremost Authority”, Thorsons publisher 2016.
2.	Makarand Madhukar Gore, “Anatomy and Physiology of Yogic Practices: Understanding of the Yogic Concepts and Physiological Mechanism of the Yogic Practices”, Motilal Banarsidass Publishers; 6 edition (2016).
3.	Swami Satyananda Saraswati, “Asana, Pranayama, Mudra and Bandha: 1”, Yoga Publications Trust.

REFERENCE BOOKS:

1.	Ann Swanson, "Science of Yoga: Understand the Anatomy and Physiology to Perfect Your Practice".
2.	Dianne Bondy, "Yoga for Everyone : 50 Poses For Every Type of Body".

E Books / MOOCs/ NPTEL

1.	https://onlinecourses.swayam2.ac.in/aic19_ed29/preview
2.	https://youtu.be/FMf3bPS5wDs

INTELLECTUAL PROPERTY RIGHTS

Course Code	**HU1502-1**	**Course Type**	**OEC**
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: Humanities

Course Objectives:

1.	Understand the creativity component in intellectual property, different types of legal protection of intellectual properties and other basic concepts of Intellectual property.
2.	Analyze different types of protection for inventions, different types of agreements and treaties for Intellectual properties with an ability to examine patent types, specifications and patent search and database for 'prior art'.
3.	Understand the basic procedure of drafting claims, apply for patents, other legal forms of intellectual property rights and also to examine the protocol involved in protection of inventions like patents.

UNIT - I

Introduction to Intellectual Property **08 Hours**

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.

Agreements and Treaties **08 Hours**

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 - II

Basics of Patents and Concept of Prior Art **08 Hours**

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.)

Patent filing procedures **08 Hours**

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 - III

Case Studies **08 Hours**

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.	Have awareness of different forms of intellectual property rights, national and international IPR related legislations.
3.	Have a general understanding about the provisions, privileges and limitations of intellectual property right holders with an understanding of the legal aspects (civil or criminal) of the use of intellectual property rights.
4.	Acquire Knowledge of National and International Trade Agreements and Agencies functioning in relation to intellectual property rights
5.	Be aware and have a general understanding of patenting procedures and licensing.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU1502-1.1	-	3	3	2	-	3	-	-	2	2	-	3
HU1502-1.2	2	2	3	-	-	3	-	3	1	1	2	2
HU1502-1.3	2	-	-	2	-	3	-	-	2	2	2	3
HU1502-1.4	-	-	1	1	-	3	-	-	1	2	-	3
HU1502-1.5	3	2	1	-	-	3	-	-	3	1	-	2

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	BAREACT, "Indian Patent Act 1970 Acts & Rules", Universal Law Publishing Co. Pvt. Ltd., 2007.
2.	Kankanala C., "Genetic Patent Law & Strategy", 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007.
3.	Subbaram N.R., "Handbook of Indian Patent Law and Practice", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
4.	Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1794.
5.	Intellectual Property Today: Volume 8, No. 5, May 2001.
6.	M B Rao, "WTO and International Trade", 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.	Rachna Singh Puri and Arvind Vishwanathan, “Practical Approach to Intellectual Property Rights”; 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 GERMAN LANGUAGE

Course Code	**HU1503-1**	**Course Type**	**OEC**
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: Mechanical

Course Objectives:

1.	Distinguish - definite and indefinite articles, declension of singular and plural nouns by adding certain endings to them to differentiate between subjects, objects and indirect objects and construct sentences of simple day to day usage.
2.	Differentiate between nomnative and akkusative cases with transitive and intransitive verbs, and negation with Kein/e/er
3.	Differentiate use of dative object besides the subject for some specific verbs and Apply the grammar principles of use of personal pronoun as a substitute for noun as per the case, number and gender of the noun.
4.	Differentiate preposition forms when used exclusively in akkusative or Dative forms or on combination of the two cases
5.	Differentiate conjugation of verbs in present, present-perfect and past participle tenses, separable and inseparable verbs, application of conjugation of modal verbs and position of modal verb in a sentence.

UNIT - I

15 Hours

Introduction: Mein Name ist (saying who you are, greeting people and saying goodbye, asking people where they come from and where they live. Language point: I and you), Lesen der politischen Karte der Welt, Nationalitaeten und Spachen, Die Uhrzeit (The time) telling time and talking about daily routine, Tage der Woche, die Monate, die vier Jahreszeiten, die Jahre
Mir geht es gut: Asking people how they are, saying how you are, saying which cities and counries people come from, Language points: verb endings),
Wie schreibt man das (how do you write that?) Counting from 1-100 and above, alphabet, spelling our names and words, talking about us and them. Language points: Yes-no questions

Artikel (Articles): As in English, there are definite (der/die/das) and indefinite (ein/eine) articles:
the · der/die/das; a/an · ein/eine
Die vier Fälle (The four cases): Nominativ, Akkusativ, Dativ, Genitiv(Not in level A-1)
Deklination des bestimmten Artikels der/die/das
Deklination des unbestimmten Artikels ein/eine
(Deklination/Declension: the variation of the form of a noun, pronoun, or adjective, by which its grammatical case, number, and gender are identified)
Deklination von Substantiven (Declension of nouns) (Singular and Plural)
(German nouns are declined by attaching certain endings to them, according to case, number and gender. This helps to differentiate between subjects, objects and indirect objects).

Nominativ und Akkusativ(nominative and accusative cases)
The verb determines the case of the noun. Some verbs only go with the nominative, others only with the accusative (or the dative). Thus, German verbs are either transitive or intransitive.

(Nominative and accusative cases) Intransitive Verben (intransitive verbs) Transitive Verben (transitive verbs)

Negation „kein/e/er “(negation with „kein/e/er “)
(Singular und Plural)
The negation of the indefinite article (ein/eine/ein) is kein/keine/kein. For this, you just have to put a „k“ at the beginning of the declined form of ein/eine/ein.
Peter sieht ein Haus. · Negation · Peter sieht kein Haus.
(Peter sees a house. · negation · Peter does not see a house.)

(With examples, writing and hearing exercises, and German to English Glossary as applicable)

UNIT - II

14 Hours

Dativ (the dative)
(You are already familiar with verbs which require a direct accusative object in addition to the subject, which is in the nominative case. But there also some verbs which require a dative object besides the subject. To identify the dative object you ask “(To) whom?”)

Der Plural (the plural)
There are many different forms of the plural in the German language. Principally, the gender and the ending of the noun determine the plural form. Then, you either attach a plural ending to the noun, change a vowel, or keep the noun as it is in the singular.

Das Personalpronomen (the personal pronoun)
The personal pronoun is a substitute for a noun. Its forms are determined by the case, number and gender of the noun which is to be replaced.

Die Formen des Personalpronomen im Nominativ
(The nominative forms of the personal pronoun):

Präpositionen (prepositions)
German prepositions are followed by an object, either in the accusative or the dative case.Some prepositions always take an accusative object, others always a dative object. But thereare also prepositions which can be followed by both. In this case, the question “Where(to)?” (· accusative) or “Where?” (· dative) determines the case of the object.

Präpositionen mit Akkusativ und Dativ
(Prepositions with accusative and dative)
1.Präpositionen mit Akkusativ (prepositions with accusative)
2.Präpositionen mit Dativ (prepositions with dative)
3.Präpositionen mit Akkusativ oder Dativ (prepositions with accusative or dative)

(With examples, writing and hearing exercises, and German to English Glossary as applicable)

UNIT - III

11 Hours

Konjugation von Verben im Präsens
(Conjugation of verbs in present tense)

Verbs are conjugated by attaching certain endings, depending on the person and number ofthe subject.

Trennbare und untrennbare Verben
(separable and inseparable verbs)
Verbs with prefixes are dinstinguished between separable and inseparable verbs.
The prefix of an inseparable verb must never be separated from the stem. Here the stress is on the stem: be-kommen. The prefix of a separable verb gets separated from the stem when the verb is conjugated. In the infinitive, the stress is on the prefix: an-kommen
1.Trennbare Verben (separable verbs)
2.Untrennbare Verben (inseparable verbs)

Konjugation von Verben im Perfekt
(Conjugation of verbs in present perfect)
The present perfect (Perfekt) describes something which happened in the past and isespecially used in spoken German. It is formed with the present tense form of „haben" or
„sein" and the past participle of the main verb.
1. Die Bildung des Partizips
(the formation of the past participle)
2. Die Bildung des Perfekts mit „haben" und „sein"
(the formation of the present perfect with „haben" and „sein")

Modalverben (modal verbs)
A modal verb is rarely used as a main verb; instead, it usually modifies the main verb. Whilethe main verb remains in the infinitive, the modal verb is conjugated.
In German, there are 7 modal verbs:
können (can/be able), dürfen (may/be allowed), wollen (want),
müssen (must/have to), sollen (shall), mögen (to like), möchten (wish/would like)

1. Konjugation der Modalverben
(Conjugation of the modal verbs)
2. Stellung des Modalverbs im Satz
(Position of the modal verb within a sentence)

(With examples, writing and hearing exercises, and German to English Glossary as applicable)

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

1.	Distinguish - definite and indefinite articles, declension of singular and plural nouns by adding certain endings to them to differentiate between subjects, objects and indirect objects and construct sentences of simple day to day usage.
2.	Differentiate between nomnative and akkusative cases with transitive and intransitive verbs, and negation with Kein/e/er
3.	Differentiate use of dative object besides the subject for some specific verbs and Apply the grammar principles of use of personal pronoun as a substitute for noun as per the case, number and gender of the noun.
4.	Differentiate preposition forms when used exclusively in akkusative or Dative forms or on combination of the two cases
5.	Differentiate conjugation of verbs in present, present-perfect and past participle tenses, separable and inseparable verbs, application of conjugation of modal verbs and position of modal verb in a sentence.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU1503-1.1	-	-	-	-	-	3	-	-	2	1	-	1
HU1503-1.2	-	-	-	-	-	3	-	-	2	1	-	1
HU1503-1.3	-	-	-	-	-	3	-	-	2	1	-	1
HU1503-1.4	-	-	-	-	-	3	-	-	2	1	-	1
HU1503-1.5	-	-	-	-	-	3	-	-	2	1	-	1

1: Low 2: Medium 3: High

TEXT BOOKS:

1. Ulrich Haessermann, Georg Dietrich, Christianne C. Guenther, Diethelm Kaminski, Ulrike Woods and Hugo Zenker, Sprachkurs Deutsch Neusaffung 1, Unterrichtswerk fuer Erwachsene, Verlag Moritz Diesterweg, Universitaetsdruckerei H. Stuertz AG Wuerzburg, 1989.
2. Paul Coggle and Heiner Schenke, Teach Yourself German (a complete course in understanding, speaking and writing), Teach Yourself Books, Hodden & Stoughton Educational, UK, 2001
3. Langenscheidt German In 30 Days: Book + Cd Paperback, www.amazon.in, – 1 September 2011

REFERENCE MATERIALS:

1. Deutsche Sprachlehre für Ausländer.
2. Themen Aktuell (Text and workbook).
3. Deutsch als Fremdsprache 1A.
4. Tangram Aktuell 1A/1B (Text and workbook).
5. Wherever required the Videos/Audios are also played in the class room sessions

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_hs30/preview
   NPTEL-Swayam, German-I by Prof. Milind Brahme | IIT Madras
2. https://www.traingerman.com/en/
   powered by Sprachinstitut TREFFPUNKT Online

INTRODUCTION TO JAPANESE LANGUAGE

Course Code	**HU1504-1**	**Course Type**	**OEC**
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:

Course Objectives:

1.	Have basic spoken communication skills
2.	Write Simple Sentences
3.	Listen and comprehend basic Japanese spoken Japanese
4.	Read and understand basic Japanese characters including Kanji

UNIT - I

(Lessons 1-6) **15 Hours**

Grammar – Introduction, Alphabets, Accents, Noun, Pronoun, Present Tense, Past tense
Vocabulary – Numbers, Days, week days, months, Seasons, Nature, Dialogs and Video Clips

UNIT - II

(Lessons 7-13) **14 Hours**

Communication skills – Time, Addective, Seasons, Conversation, Q&A, Hobby, 5-W/1-H, Entering School/Company, Body Parts, Colours, Features etc**.**

UNIT - III

(Lessons 14-20) **11 Hours**

Japanese Counting System, Birth/Death, Dialogs (Going to Party, Restaurant), My day, Success/Failure, Kanji Characters, and sentence making, Video Clips

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→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
HU1504-1.1	-	-	-	-	-	3	-	-	2	1	-	1
HU1504-1.2	-	-	-	-	-	3	-	-	2	1	-	1
HU1504-1.3	-	-	-	-	-	3	-	-	2	1	-	1
HU1504-1.4	-	-	-	-	-	3	-	-	2	1	-	1
HU1504-1.5	-	-	-	-	-	3	-	-	2	1	-	1

1: Low 2: Medium 3: High

NATIONAL CADET CORPS: ORGANIZATION, FUNCTIONS AND

CAPABILITIES

Course Code	**HU1505-1**	**Course Type**	**OEC**
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: Chemistry

Course Objectives:

1.	To create evolved youth, who will be equipped to contribute in the development of the nation.
2.	To train students so as to achieve their physical and mental endurance. To acquire body language of smart soldier and to inculcate the sense of authority by commanding the troop under him/her.
3.	To inculcate spirit of adventure, undertake adventure activities, to hone leadership qualities and risk-taking abilities.
4.	To understand and develop life skills, soft skills and to improve emotional quotient of the student.
5.	To impart basic military training, to develop awareness about the defense forces and expose learners to military ethos / values

UNIT - I

NCC: Aims, Objectives and Organization	**07 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.

Personality Development	**07 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 - II

Naval Communication and Seamanship	**08 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.

Disaster management and environmental awareness	**08 Hours**

Disaster Management- Organization, Types of Disasters, Essential Services, Assistance, Civil Defence organization. Adventure Activities.

Dos and Don’ts, Fire services and Firefighting, Environmental Awareness and Conservation.

UNIT - III

Naval Orientation	**10 Hours**

Naval Orientation- Armed Forces and Navy Capsule, EEZ Maritime Security & ICG. Border & Coastal Areas: Security setup and Boarder/Coastal management in the area. Naval

Orientation: Modes of Entry- IN, ICG, Merchant Navy.
Border and Coastal areas: Security Challenges & role of cadets in Border management

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

1.	Display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion.
2.	Demonstrate the sense of discipline, improve bearing, smartness, turnout and develop the quality of immediate and implicit obedience of orders, with good reflexes.
3.	Acquaint, expose & provide knowledge about Army/Navy/ Air force and acquire information about expanse of Armed Forces, service subjects and important battles.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO ↓**	
↓ Course Outcomes													1	2
HU1505-1.1	-	-	-	-	-	3	3	1	-	-	-	-	-	-
HU1505-1.2	-	-	-	-	-	3	3	-	-	-	-	-	-	-
HU1505-1.3	-	-	-	-	-	-	-	-	1	-	-	-	-	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	R.K. Guptha, "Cadets Handbook", Ramesh Publishing House, New Delhi.

OVERVIEW OF INDIAN CULTURE

Course Code	**HU1506-1**	**Course Type**	**OEC**
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: Humanities

Course Objectives:

1.	To understand the relevance of Culture in Human Life, dynamism of Indian Culture and Arts through ages.
2.	To understand the local culture and its vibrancies.
3.	To develop awareness about Indian Society, Culture and Arts under Western rule.
4.	To comprehend different dimension and aspects of the Indian culture and arts.
5.	To appreciate cultural performances in India.

UNIT - I

Knowing Culture	**08 Hours**
What is Culture, Different aspects of Culture, Cultural expression, Importance of Culture	
Influence of Culture	**07 Hours**
Relationship of Culture with: Language, Religion and History, Gender	

UNIT - II

Media and Culture	**07 Hours**
Role of News Papers, Indian Cinema, Music, Advertisements	
Languages, Literature and Culture	**07 Hours**
Role of Sanskrit, Vedas, Upanishads, Ramayana and Mahabharata, Puranas, other Sanskrit Literature, Buddhist and Jain Literature, Dravidian Languages and Literature, North Indian Languages and Literature, Subaltern Literature	

UNIT - III

Arts and Culture	**07 Hours**
Indian Theatre and Performing Arts, Ritual performances, and Tuluva cultural and ritual performances.	
(Self-study Component) **Contribution of Indian History to Culture**	**04 Hours**

Ancient India – Persian and Macedonian invasions and its impact on Indian Culture, Development of Culture and Arts during the Mauryan Empire (Ashoka), the Guptas, the South Indian Dynasties – the Cholas, Nalanda as a Centre of Learning.

Medieval India – Life of People under Delhi Sultanate, Rise of Islam and Sufism, Political Scene of India, Bhakti Movement, Folk Arts, Rise of Modern Indian Languages.

Modern India – British Ruling and its impact on Indian Culture, Social and Religious Reforms, Indian National Movement and Achievement of Independence.

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

1.	Examine how the culture has a very important role in human life and growth of human civilization and have a general awareness on historical perspective of growth of Indian Culture and Arts.
2.	Appreciate their own local culture from an academic perspective.
3.	Know about the impact of Western Rule in India and Indian Struggle for Freedom and also

	its impact on Indian Culture and Arts and able to appreciate and the role of language in connecting people, growth of culture and arts beyond the barriers of religion and ages.
4.	Take interest in learning these forms of arts, and also appreciate and preserve them for the future generations feeling proud of Indian Culture, Arts and Architecture.
5.	Appreciate art performances in India which will enable them to get exposed to an artistic sphere, which eventually help them to be creative and imaginative.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
HU1506-1.1	-	1	-	-	-	3	-	3	3	1	-	3
HU1506-1.2	-	-	-	2	-	3	-	2	3	3	-	3
HU1506-1.3	-	-	-	-	-	3	-	1	-	-	-	1
HU1506-1.4	-	-	-	-	-	3	-	2	1	2	-	3
HU1506-1.5	-	-	-	-	-	3	-	3	3	3	-	2

1: Low 2: Medium 3: High

PHILOSOPHY

Course Code	**HU1507-1**	**Course Type**	**OEC**
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: Visiting

Course Objectives:

1.	To provide a new understanding based on which one can move to overcome the current problems, both at the individual level as well as at the societal level.
2.	To introduce an orientation course for humanities courses in general and for philosophy courses in particular.
3.	To relate philosophy to literature, culture, society and lived experience.
4.	To train students in already available philosophical systems.
5.	To bridge the gap between theory and practice.

UNIT - I

Knowledge (Vidya) and Ignorance (Avidya) — **14 Hours**

Upanishads
Six systems orthodox and Heterodox schools of Indian philosophy
Greek philosophy

Origin of the universe

NasidiyaSukta: “Who really knows?”
Brhadaranyaka Upanishad; Chandogya Upanishad: Non-Self, real and unreal
Taithriya Upanishad: SikshaValli
Plato’s Symposium: Lack as the source if desire and knowledge.
Socratic method of knowledge as discovery
Language: word as root of knowledge (Bhartrahari’s Vakyapadiyam)
Fourteen Knowledge basis as a source of Vidya: Four Vedas, six auxiliary sciences (vedangas); Purana, Nyaya, Mimamsa and Dharma Sastras.

UNIT - II

Knowledge as Power — **16 Hours**

Francis Bacon. Knowledge as both power and self- realization in Bhagavad Gita.

Knowledge as Oppression

M. Foucault. Discrimination between Ram and Satyam in Indian Philosophy.

Knowledge as Invention

Modern definition of creativity; scientific activity in the claim that science invents new things at least through technology.

UNIT - III

10 Hours

Knowledge about the self, transcendental self; knowledge about society, polity and nature
Knowledge about moral an ethics codes.

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

1.	To provide a new understanding based on which one can move to overcome the current problems, both at the individual level as well as at the societal level.
2.	To introduce an orientation course for humanities courses in general and for philosophy courses in particular.
3.	To relate philosophy to literature, culture, society and lived experience.
4.	To train students in already available philosophical systems.
5.	To bridge the gap between theory and practice.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
HU1507-1.1	-	-	-	-	-	3	-	-	2	1	-	1
HU1507-1.2	-	-	-	-	-	3	-	-	2	1	-	1
HU1507-1.3	-	-	-	-	-	3	-	-	2	1	-	1
HU1507-1.4	-	-	-	-	-	3	-	-	2	1	-	1
HU1507-1.5	-	-	-	-	-	3	-	-	2	1	-	1

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1. Copleston, Frederick, "History of Philosophy", Vol. 1. Great Britain: Continuum.

2. Hiriyanna, M. , "Outlines of Indian Philosophy", Motilal Banarsidass Publishers; Fifth Reprint edition, 2009.

3. Sathaye, Avinash, "Translation of Nasadiya Sukta".

4. Raju, P. T. "Structural Depths of Indian Thought", Albany: State University of New York Press.

5. Plato, Symposium, Hamilton Press

PRINCIPLES OF PHYSICAL EDUCATION

Course Code	**HU1508-1**	**Course Type**	**OEC**
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: 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

15 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
International Olympic Committee (IOC), Indian Olympic Association (IOA)
Sports awards - Eligibility, Objectives & Criteria
Yoga - Meaning and Importance
World Health organization (WHO)

UNIT - II

14 Hours

Concept of Health - Meaning of Health, Health Definition, Factors Affecting Health, Qualities of Healthy Person. Health Hazards of College Students, Physical Fitness and Exercises.
Food and Nutrition - Food & Nutrition Defined, Nutrients and their Functions - i) Proteins ii) Carbohydrates iii) Fats iv) Vitamins
Balanced Diet & Malnutrition
Health Education - Meaning of Health Education, Health Education Defined, Scope of Health Education, Importance of Health Education.
Posture - Concept of Posture, Correct Postures, Common Postural Defects
First Aid - First Aid Defined, Need and importance of First Aid, The Requisites of First Aid, Scope of First Aid, Qualities of a First Aider, Fundamental Principles to be followed and the Duties to be performed by the First Aider, First Aid in Different Cases.
Physical Education - Concept of Physical Education, Physical Education Defined, Importance of Physical Education, Scope of Physical Education, Aims and Objectives of Physical Education.
Teaching Aid in Physical Education
Competition - Introduction, Types of competition, Knock out, League or Round Robin Tournament.

UNIT - III

11 Hours

Training in Sports – Meaning, Principles, Warming Up & Limbering Down
Importance of Anatomy and Physiology in Physical Education, Oxygen Debt and Second wind

Leadership and Supervision – Leadership, Qualities of a good leader in Physical Education, Types of Leadership in Physical Education - 1. Teacher Leadership 2. Student Leadership.
Measurement & specification of various playing fields – Cricket, Volley Ball, Basket Ball, Badminton, Ball Badminton, Foot Ball, Hand Ball & their basic playing skills.

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→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
HU1508-1.1	-	-	-	-	-	3	-	-	2	1	-	1
HU1508-1.2	-	-	-	-	-	3	-	-	2	1	-	1
HU1508-1.3	-	-	-	-	-	3	-	-	2	1	-	1
HU1508-1.4	-	-	-	-	-	3	-	-	2	1	-	1
HU1508-1.5	-	-	-	-	-	3	-	-	2	1	-	1

1: Low 2: Medium 3: High

COMMON SENSE AND CRITICAL THINKING

Course Code	**HU2501-1**	**Course Type**	**OEC**
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**
Pre-requisite	**HU1001-1 (Technical 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 behavior
4.	Exhibit better comprehension of the social implications of human body
5.	Understand the importance of reading and writing skills

UNIT - I

Common sense and Emotional Intelligence	**15 Hours**
Common sense, Commonsensical Consensus, Critical thinking, Unsettling commonsensical Consensus, Role of language in Common sense and Critical Thinking;Nature & Functions of Emotional Intelligence, Emotions, Intelligence and Creativity, Growth of Emotional Intelligence	
Etiquettes & Workplace	
Etiquette, Workplace Etiquettes, Workplace Readiness Skills, Significance of Cross-Cultural Understanding; Cultural Sensitivity, Impact of social media in Workplace	

UNIT - II

Social Networking Sites and its Impacts	**15 Hours**
Emergence of social media, Impact on Gender and Self Representation, Regulatory and Liberatory aspects of social media, Offline Norms & Online Behaviour	
Gender and Body	
Gender & Sex, Genderization, Homogeneity and Heterosexuality, Gender Expressions, Gender Schooling, Representations of Body, Objectification, Gender Perspectives of Body, Different Ways of Seeing the Body, Discipline & Coercion, ISA & RSA	

UNIT - III

Writing	**10 Hours**
Types of Writing, Note Taking Methods, Plagiarism	
Reading	
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 behavior
4.	Exhibit better comprehension of the social implications of human body
5.	Understand the importance of reading and writing skills

Course Outcomes Mapping with Program Outcomes

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

HU2501-1.1	-	3	-	-	-	-	-	-	3	3	-	3
HU2501-1.2	-	2	-	-	-	-	-	3	2	3	-	2
HU2501-1.3	-	3	-	-	-	-	-	-	2	2	-	3
HU2501-1.4	-	3	-	-	-	-	-	-	2	2	-	3
HU2501-1.5	-	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 & LANGUAGE TECHNOLOGY

Course Code	**HU2502-1**	**Course Type**	**OEC**
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**
Pre-requisite	**HU1001-1 (Technical 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 — **08 Hours**

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).

Phonology and Morphology — **08 Hours**

Perspectives in Linguistics, Phonemes, Allophones, Phonemic Analysis, Morphology and Morphemes, Word building process, Morphological Analysis.

UNIT - II

Syntax — **16 Hours**

Constituent structure (Simple Sentence, Noun Phrase, Verb Phrase, Prepositional Phrase, Adjective Phrase, Adverb Phrase, Structure Rules), Tree Diagrams, Case

UNIT - III

Sociolinguistics & Psycholinguistics, Artificial Intelligence — **08 Hours**

Notion of Language Variety, Languages in Contact, Language and Mind, Error Analysis.

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

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
HU2502-1.1	-	1	-	-	1	1	-	-	1	-	-	2
HU2502-1.2	-	-	2	-	-	-	-	-	2	2	-	-
HU2502-1.3	2	3	-	3	-	-	-	-	3	2	-	-
HU2502-1.4	-	-	-	-	2	-	-	-	1	2	-	-
HU2502-1.5	-	2	-	-	-	2	1	-	-	-	-	1

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	Akmaijan, A, R. A. Dimers and R. M. Harnish. "Linguistics: An Introduction to Language and Communication". London: MIT Press, 1979.
2.	Chomsky, Noam. "Language in Mind". New York: Harcourt Brace Jovanovich, 1968.
3.	Fabb, Nigel. "Sentence Structure". London: Routledge, 1994.
4.	Hockett, C. "A Course in Modern Linguistics". New York: Macmillan, 1955.
5.	O'Grady, W., O. M. Dobrovolsky and M. Aronoff. "Contemporary Linguistics: An Introduction". New York: St. Martin's Press, 1991.
6.	Pride, J. B. and J. Holmes. "Sociolinguistics". Harmondsworth: Penguin, 1972.
7.	Richards, J. C. "Error Analysis: Perspectives in Second Language Acquisition". London: Longman, 1974.
8.	Salkie, R. "The Chomsky Update: Linguistics and Politics". London: Unwin Hyman Ltd., 1990.
9.	Sinclair, J. M. C. H. and R. M. Coulthard. "Towards an Analysis of Discourse". Oxford: OUP, 1975.
10.	Thomas, Linda. "Beginning Syntax". Oxford: Blackwell, 1993.
11.	Verma, S. K. and N. Krishnaswamy. "Modern Linguistics: An Introduction". New Delhi: OUP, 1989.
12.	Wekker, Herman and Liliane Haegeman. "A Modern Course in English Syntax". Kent: Croom Helm, 1985.

INTRODUCTION TO CYBER SECURITY

Course Code:	**IS2501-1**	**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**
Prerequisite	**IS1651-1**		

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 — **15 Hours**

Concepts of Cyber Security, Formal Methods of Security Validation, CIA framework-Confidentiality, Integrity and Authenticity, Threat modelling, Domains of cyber security, Security attacks, Security services, Security Mechanisms, Fundamental security design principles, Types of Cyber Threat.

UNIT-II

Tools and methods used in Cybercrime — **14 Hours**

Introduction, Proxy Servers and Anonymizers, Intruders and Hackers, Insider threats, Cybercrimes. 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, Introduction to Phishing, Identity Theft (ID Theft).

UNIT-III

Understanding Computer Forensics — **11 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

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
IS2501-1.1	2	-	-	-	-	1	-	3	-	-	-	-
IS2501-1.2	-	3	-	1	-	2	-	-	2	-	-	-
IS2501-1.3	-	3	2	-	-	-	-	-	-	-	-	-
IS2501-1.4	2	-	-	-	-	2	-	-	-	-	-	-
IS2501-1.5	-	-	-	-	-	-	-	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.
3.	Santosh B. J., K. V. S. S. S. S. Sairam, Shubham Kumar, Chandu Jagan Sekhar M, "Information and Cyber Security", Scientific International Publishing House, ISBN-978-93-5625-694-1.

PYTHON APPLICATION PROGRAMMING

Course Code:	**IS2502-1**	**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**
Prerequisite	**CS1002-1**		

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

UNIT-I

Functions, Classes and OOP — **15 Hours**

Functions: Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions

Classes and OOP: Classes, objects, attributes and methods; defining classes; design with classes, data modelling; persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block

UNIT-II

Lists, Tuples, and Dictionaries — **14 Hours**

Lists, tuples, and dictionaries: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing, and replacing values; traversing dictionaries.

File Handling: Reading From Text Files, Writing to Text Files, Working with Excel Sheets ,CSV, PDF, Word,

UNIT-III

Essential Python Libraries — **11 Hours**

Working with SciPy, Numpy, Matplotlib, Pandas.

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

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
IS2502-1.1	2	-	-	-	2	-	-	-	-	-	-	3
IS2502-1.2	2	-	-	-	2	-	-	-	-	-	-	3
IS2502-1.3	2	-	-	-	2	-	-	-	-	-	1	3
IS2502-1.4	-	-	-	-	-	-	-	-	-	-	-	-
IS2502-1.5	-	-	-	-	-	-	-	-	-	-	-	-

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:	**IS2503-1**	**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**
Prerequisite	**CS1002-1**		

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	**15 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

Requirements Engineering

Functional and non-functional requirements, Requirements engineering processes, Requirements Elicitation and Analysis, Requirements specification, Software requirements document, Requirements validation & management.

UNIT-II

System Models	**15 Hours**

Context models, Interaction models, Structural models, Behavioral models.

T Architectural Design

Architectural design decisions. Architectural Views and patterns, Application architectures.

Design and implementation

Object oriented Design using UML.

Agile Software Development

Agile methods, Plan-driven and agile development, Extreme Programming, Agile project management.

UNIT-III

Project Management	**10 Hours**

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 products

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
IS2503-1.1	-	3	1	-	-	-	-	2	-	-	-	-
IS2503-1.2	1	3	1	-	-	-	-	-	-	-	-	-
IS2503-1.3	1	1	3	-	-	-	-	-	-	-	-	-
IS2503-1.4	1	3	2	-	-	-	-	-	-	-	-	-
IS2503-1.5	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:	**IS2504-1**	**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**
Prerequisite	**CS1002-1**		

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 **15 Hours**

HTML tags and simple HTML forms, web site structure, HTML table, Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colours and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

UNIT-II

Client side Scripting **15 Hours**

Introduction to JavaScript: JavaScript language – declaring variables, scope of variables functions, event handlers (on click, on submit etc.), Document Object Model, Form validations. Introduction to PHP: Declaring variables, data types, arrays, strings, operations, expressions, control structures, functions, Reading data from web form controls like Text Boxes, radio buttons, lists etc.,

UNIT-III

PHP Databases **10 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

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
IS2504-1.1	1	2	-	2	-	-	-	-	-	-	-	1
IS2504-1.2	1	-	-	2	-	-	-	-	-	-	-	1
IS2504-1.3	1	2	-	2	3	-	-	-	-	-	-	1
IS2504-1.4	1	2	-	2	3	-	-	-	-	-	-	1
IS2504-1.5	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

Course Code:	**MA1501-1**	**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: Mathematics

Course Objectives:

1.	Explain subgraphs, bipartite graphs, isomorphic graphs etc. Apply the concept of trees and its properties
2.	Distinguish between Hamilton and Eulerian graph. Distinguish between planar and nonplanar graphs and apply their properties to solve problems.
3.	Represent a graph in terms of adjacency matrix, incidence matrix etc. and vice-versa.
4.	Find the shortest path between two vertices in a graph. Find minimal spanning tree.

UNIT-I

Introduction to graphs	**15 Hours**
Graphs and Graph Models, digraphs, Konigsberg bridge problem. Special Types of Graphs: Subgraphs-spanning and induced subgraphs, complete graph, Bipartite Graphs. Isomorphism of graphs. Complement of a graph and its properties. Connectivity-point and line connectivity. Trees and its properties. Euler and Hamilton graphs and their applications.	

UNIT-II

Planar graphs	**09 Hours**
Euler's polyhedron formula, outer planar graphs, applications	
Colorability	**07 Hours**
Chromatic number, five color theorem, chromatic polynomial, Applications of graph coloring.	
Matrix representation of graphs	
Adjacency matrix, incidence matrix, circuit matrix, cut set matrix, Path matrix.	

UNIT-III

Network Flows	**04 Hours**
Max -flow and Min-cut Theorem(statement), problems.	
Shortest paths in weighted graphs	
Dijkstra's algorithm to find shortest paths.	
Spanning trees	**05 Hours**
Algorithms to find a spanning tree, minimal spanning tree-Kruskal's & Prim's algorithm.	

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

1.	Distinguish between bipartite and complete bipartite graphs, identify whether two graphs are isomorphic, find subgraphs of a graph etc.
2.	Distinguish between Eulerian and Hamiltonian graphs.
3.	Identify whether a graph is planar and to find the chromatic polynomial of a graph.
4.	Representing graphs interms of Matrices.
5.	Apply algorithmic methods to find the shortest path between two given vertices. Use a suitable algorithm to find a minimal spanning tree.

Course Outcomes Mapping with Program Outcomes

Program	1	2	3	4	5	6	7	8	9	10	11	12

Outcomes→ **↓ Course Outcomes**												
MA1501-1.1	3	3	-	-	-	-	-	-	-	-	-	-
MA1501-1.2	2	1	-	-	-	-	-	-	-	-	-	-
MA1501-1.3	2	3	-	-	-	-	-	-	-	-	-	-
MA1501-1.4	3	2	-	-	-	-	-	-	-	-	-	-
MA1501-1.5	3	2	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	F. Harary, "Graph theory", Narosa Publishing House, 1988.
2.	Narsing Deo, "Graph Theory with applications to Engg. and Comp. Sciences", PHI,1974.
3.	Kenneth H. Rosen, "Discrete Mathematics and its applications", Tata McGraw Hill, V Edition-2003.

REFERENCE BOOKS:

1.	D. B. West, "Introduction to Graph Theory", PHI,2001.
2.	Chartrand and Zhang, "First Course in Graph Theory", 2012

E Books / MOOCs/ NPTEL

1.	http://diestel-graph-theory.com.
2.	https://nptel.ac.in/courses/111106102

NUMBER THEORY

Course Code:	**MA1502-1**	**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: 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 and the theory of congruences — **15 Hours**

Division algorithm, Euclid's algorithm for the greatest common divisor. Linear Diophantine equations. Prime numbers, fundamental theorem of arithmetic. Basic properties of congruences, Linear congruences and Chinese reminder theorem.

UNIT-II

07 Hours

Fermat’s theorem, Wilson’s theorem, Euler’s Phi function, Euler’s theorem.

Primitive roots and Quadratic congruences — **08 Hours**

Order of an integer modulo n, primitive roots for primes, Euler’s criterion, Legendre symbol and its properties.

UNIT-III

Cryptography — **10 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

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

Outcomes												
MA1502-1.1	2	3	-	-	-	-	-	-	-	-	-	-
MA1502-1.2	2	3	-	-	-	-	-	-	-	-	-	-
MA1502-1.3	2	3	-	-	-	-	-	-	-	-	-	-
MA1502-1.4	2	3	-	-	-	-	-	-	-	-	-	-
MA1502-1.5	2	3	-	-	-	-	-	-	-	-	-	-

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. William J. LeVeque, "Fundamentals of Number Theory".

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

LINEAR ALGEBRA

Course Code:	**MA3501-1**	**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**
Prerequisite	**MA1001-1 and MA2009-1**		

Teaching Department: Mathematics

Course Objectives:

1.	Understand the concepts of vectors, bases.
2.	Determine the kernel, range, rank, and nullity of a linear transformation and apply them suitably in their field of study.
3.	Find the canonical forms and appraise its importance in various fields.
4.	Make use of Gram-Schmidt process to produce an orthonormal basis.
5.	Learn the concepts of singular value decomposition and PCA.

UNIT-I

Vector spaces	**08 Hours**
Vector spaces, subspaces, bases and dimensions, coordinate vecotrs, null spaces and column spaces of the matrices.	
Linear Transformations	**07 Hours**
Linear transformations, rank-nullity theorem, algebra of linear transformations, change of basis, linear operators, linear functionals, transpose of a linear transformation.	

UNIT-II

Canonical Forms	**08 Hours**
Review of characteristic values, similarity of matrices, Cayley Hamilton theorem, annihilating polynomials, invariant subspaces, Jordan and rational canonical forms.	
Inner Product Spaces	**07 Hours**
Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization, Least-squares problems.	

UNIT-III

Symmetric Matrices and Quadratic Forms	**10 Hours**
Diagonalization, quadratic forms, constrained optimization, singular value decomposition and principal component analysis. Applications to linear recurrence relations.	

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

1.	Interpret vectors in two and three-dimensional spaces both algebraically and geometrically.
2.	Analyze the concept of a linear transformation as a mapping from one vector space to another and be able to calculate its matrix representation with respect to standard and nonstandard bases.
3.	Understand the concepts of Jordan and rational canonical forms.
4.	Make use of Gram-Schmidt process to produce an orthonormal basis and also able to use least square approximation method to obtain the solution of ill conditioned system.
5.	Apply techniques of constrained optimization singular value decomposition and PCA for problems arising in various engineering fields.

Course Outcomes Mapping with Program Outcomes

	Program	1	2	3	4	5	6	7	8	9	10	11	12	

Outcomes→ **↓ Course Outcomes**												
MA3501-1.1	3	2	-	-	-	-	-	-	-	-	-	-
MA3501-1.2	2	2	-	-	-	-	-	-	-	-	-	-
MA3501-1.3	3	1	-	-	-	-	-	-	-	-	-	-
MA3501-1.4	3	2	-	-	-	-	-	-	-	-	-	-
MA3501-1.5	3	2	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Kenneth Hoffman and Ray Kunze, "Linear Algebra," 2nd edition, Pearson Education (Asia) Pte. Ltd, 2004.

2. David C. Lay, "Linear Algebra and its Applications",3rd edition, Pearson Education (Asia) Pte. Ltd, 2005.

REFERENCE BOOKS:

1. M. Artin, "Algebra", Prentice Hall of India, 2004.

2. Gilbert Strang, "Linear Algebra and its Applications", 4th edition, Thomson Learning Asia, 2003.

3. Bernard Kolman and David R. Hill, "Introductory Linear Algebra with Applications", Pearson Education (Asia) Pte.Ltd, 7th edition ,2003.

4. Sheldon Axler, "Linear Algebra Done Right", Springer International Publication, Third Edition, 2015.

AUTOMOTIVE ENGINEERING

Course Code:	**ME1501-1**	**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: 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

Engine Components and Cooling & Lubrication Systems **08 Hours**

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, crankshaft/flywheel position sensor, accelerator pedal sensors, engine coolant water temperature sensor.

Fuel Supply Systems for SI and CI Engines **08 Hours**

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, Fuel gauge sensor, Throttle position sensor, Mass air flow sensors.

Ignition Systems : Battery Ignition systems, magneto Ignition system, Transistor assisted contacts. Electronic Ignition, Automatic Ignition advance systems, Lighting systems, Rain/Light sensors, starting device (Bendix drive)

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-II

Power Trains **07 Hours**

Clutches - Single plate, multiplate and centrifugal clutches. Gear box: Necessity for gear ratios in transmission, Constant mesh gear box, Synchromesh gear box, principle of automatic transmission, Vehicle Speed Sensors, calculation of gear ratios, Types of transmission systems. No numerical.

Drive to Wheels **08 Hours**

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-III

Brakes	**09 Hours**

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

1.	Describe and demonstrate the layout of an automobile and components of an automobile engine. Explain cooling and lubrication systems.
2.	Explain and demonstrate the fuel supply and Ignition systems for SI and CI engines.
3.	Describe and demonstrate the transmission system
4.	Explain and demonstrate the components of drive to wheel and suspension system, calculate the parameters of steering geometry.
5.	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

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
ME1501-1.1	3	1	-	-	-	1	-	-	3	1	-	1
ME1501-1.2	3	1	-	-	-	1	-	-	3	1	-	1
ME1501-1.3	3	1	1	-	-	1	-	-	3	1	-	1
ME1501-1.4	2	3	1	-	-	1	-	-	3	1	-	1
ME1501-1.5	3	1	1	-	-	1	1	1	3	1	-	1

1: Low 2: 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

INDUSTRIAL POLLUTION CONTROL

Course Code:	**ME1502-1**	**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: 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

Introduction to Pollution	**08 Hours**

Man and the environment, types of pollution and its consequences, Changing environmental management concept, sustainable industrial growth, carbon audit, Ill effects of various pollutants, permissible concentration levels & AQI.

Meteorology	**08 Hours**

Meteorology, Wind rose, Lapse rate, plume dispersion studies & Numerical problems.

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-II

Separation techniques	**08 Hours**

Different types of Particulates, Need for Separation techniques, Sources of Particulates Matter Fly Ash Electrostatic precipitator (Problems) Theory of settling processes (Design Problems), Bag House fabric filter Cyclone separator Spray Tower Scrubbers & Venturi Scrubber

Smoke and gaseous pollutants:	**08 Hours**

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-III

	08 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

1.	Identify the various types of pollutants and distinguish between them with regards to Particulate matters and AQI.
2.	Outline the instruments for Meteorological measurements, distinguish types of plume dispersions and its effect; analyze the concentration of various gaseous pollutants from T-Z diagrams
3.	Explain the Particulates and fly ash separation techniques, compare and Interpret their efficiency
4.	Illustrate Formation, measurement and control techniques for Smoke and gaseous pollutants
5.	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

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
ME1502-1.1	1	-	-	1	-	3	3	2	1	2	-	3
ME1502-1.2	1	2	1	1	3	2	3	1	1	1	-	2
ME1502-1.3	1	2	2	1	1	2	3	1	1	1	-	1
ME1502-1.4	1	1	1	1	1	2	3	1	1	1	-	2
ME1502-1.5	1	-	-	1	-	2	3	1	1	1	-	3

1: Low 2: 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

SUSTAINABLE DEVELOPMENT GOALS

Course Code:	**ME1503-1**	**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: Mechanical Engineering

Course Objectives:

1.	To provide the knowledge, skills, attitudes and values necessary to address sustainable development challenges
2.	Address the global challenges including poverty, inequality, climate change, environmental degradation, peace and justice.
3.	To learn more and take action.
4.	Addresses critical global challenges put forth by UN.
5.	Analyze how sustainable development can be achieved in practice.

UNIT-I

08 Hours

The origin, development and idea of the SDGs History and origins of the Sustainable Development Goals. What are the SDGs? What are their aims, methodology and perspectives? How are they related to the Millennium Development Goals?

SDGs and Society **08 Hours**

Ensuring resilience and primary needs in society In-depth discussion and analysis of goals related to poverty, hunger, health & well-being and education

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-II

SDGs and Society **14 Hours**

Strengthening Institutions for Sustainability In-depth discussion and analysis of goals related to gender equality, affordable and clean energy, sustainable cities & communities, and peace, justice & strong institutions

SDGs and the Economy: Shaping a Sustainable Economy In-depth discussion and analysis of goals related to work & economic growth, industry, innovation & infrastructure, inequalities, responsible production & consumption

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-III

SDGs and the Biosphere **10 Hours**

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.

Pedagogy: Chalk and talk method, Power Point Presentation

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

1.	Summarize the UN‟s Sustainable Development Goals and how their aims, methodology and perspectives.

2.	Analyze the major issues affecting sustainable development and how sustainable development can be achieved in practice.
3.	Identify and apply methods for assessing the achievement/possibilities of sustainable development in Nitte gram panchayath.
4.	Evaluate the implications of overuse of resources, population growth and economic growth. sustainability & Explore the challenges the society faces in making transition to renewable resource use.
5.	Create skills that will enable students to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
ME1503-1.1	1	2	1	1	1	3	3	1	1	1	-	2
ME1503-1.2	2	2	1	1	1	3	3	2	1	1	-	1
ME1503-1.3	3	2	2	1	1	3	3	2	3	1	-	1
ME1503-1.4	3	2	3	1	1	3	3	2	1	1	-	1
ME1503-1.5	1	2	2	1	1	3	3	2	2	2	-	1

1: Low 2: 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 / Working Paper 08-18, 2008.

REFERENCE BOOKS:

1.	Elliott, Jennifer, "An introduction to sustainable development", Routledge, 2012.

E Books / MOOCs/ NPTEL

1.	https://www.un.org/sustainabledevelopment/poverty/

TECHNOLOGICAL INNOVATION

Course Code:	**ME1504-1**	**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: Mechanical Engineering

Course Objectives:

1. Understand basics of operations management and Quality.
2. Define the concept of technological innovation.
3. Discuss Innovation management and the difference between Invention and Innovation.
4. Appreciate the importance of Innovation as a management process and Innovation management techniques.
5. Discuss the Innovation system, Understand the importance of Technology management and Transfer and basics of Technological Forecasting.

UNIT-I

Production and Operations Management and Introduction to Quality Concepts — **04 Hours**

Production and Operations Management: Introduction - Functions within business organizations - the operation management function - Classification of production systems.
Introduction to Quality Concepts: The Meaning of Quality and Quality Improvement - Key dimensions of Quality - Concept of cost of quality - Customers' perception of quality.

Introduction to Technological Innovation — **09 Hours**

Basic Concepts and Definitions: Technology - Technology Management – Invention – Creativity – Innovation - The Concept of Technological Innovation - Innovation Posture, Propensity and Performance - Innovation Measurement - Key factors linking creativity and innovation – Classifications of Innovations – Innovation Process.

Startup Idea Pitching — **03 Hours**

UNIT-II

Introduction to Innovation Management and Innovation & Competitiveness — **07 Hours**

Introduction to Innovation Management: Innovation Management Through Management of Knowledge and Education – Types of Learning - Difference Between Innovation and Invention - Types and Characteristics of Innovation.
Innovation and Competitiveness: Case Study – Barriers for Innovation and Competitiveness

Innovation as a Management Process — **08 Hours**

Activities to enhance companies' capacity for innovation – Management of Technological Innovation: Corporate Perspective, National Perspective, Theoretical Perspective and Individual Perspective - Challenges in Technological Innovation Management - Case Study in Technological Innovation Management - Innovation Management Techniques (IMTs).

UNIT-III

Innovation Systems and Technology Management & Transfer — **04 Hours**

Innovation Systems: The Concept of Innovation Systems - Innovation Systems: Sectoral, Regional, National.
Technology Management and Transfer: Technology Transfer - Impacts of MNCs in technology transfer

Introduction to Technological Forecasting — **05 Hours**

Introduction - Applications & Limitations of Technological Forecasting – Technology Forecasting Techniques – Exploratory Forecasting – Normative Forecasting – Delphi Technique – Problems of Technological Forecasting

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

1. Define operations management and quality.
2. Describe technological innovation and its key features for business.
3. Discuss innovation management and the difference between invention and innovation.
4. Explain innovation as a management process, its management and perspectives. Understand Innovation management techniques.
5. Explain innovation systems, technology management transfer and basics of technological forecasting.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
ME1504-1.1	3	2	-	-	-	1	1	-	1	-	-	1
ME1504-1.2	3	2	-	-	-	1	1	-	1	-	-	1
ME1504-1.3	2	2	-	-	-	1	1	-	1	-	-	1
ME1504-1.4	2	2	-	-	-	1	1	-	1	-	-	1
ME1504-1.5	3	2	-	-	-	1	1	-	1	-	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Carayannis, Elias G., Samara, Elpida T., Bakouros, Yannis L., "Innovation and Entrepreneurship Theory, Policy and Practice", Springer, 2015.

REFERENCE BOOKS:

1. Dick Whittington, "Digital Innovation and Entrepreneurship", Cambridge University Press, 2018.

E Books / MOOCs/ NPTEL

1. https://krishi.icar.gov.in/jspui/bitstream/123456789/46063/1/21_Technological%20forecasting.pdf dtd 12/06/2022
2. http://www.oipec.eu/wp-content/uploads/2017/07/Introduction-to-Technology-Forecasting.pdf dtd 12/06/2022

HUMAN RESOURCE MANAGEMENT

Course Code:	**MG1501-1**	**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: Mechanical Engineering

Course Objectives:

1. To develop a meaningful understanding of HRM theory, functions and practices.
2. To understand concepts and skills recruitment.
3. To understand the concepts of training and development.
4. To deal with employees' grievances, safety and health types of organizations.
5. To understand the concepts of e-HRM.

UNIT-I

Human Resource Management & HRP	**08 Hours**

Introduction, meaning, nature, scope of HRM. Major functions of HRM, Personnel Management vs Human Resource Management, job design, job evaluation, job analysis, job specification, job enlargement, job enrichment. Role of HR Manager.HR Planning. Process HRP.

Recruitment **08 Hours**

Definition, Sources and Methods of Recruitment Selection: Definition and Process of Selection. Cost benefit analysis of selection.

Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation. Performance Appraisal methods.

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-II

Training and development **07 Hours**

Training v/s development, stages in training, Training Methods, Executive Development, Methods and Development of Management Development, Career and Succession Planning.

Compensation **08 Hours**

Employee remuneration, rewards, Wage and Salary Administration, Bonus, fringe benefits. Internal Mobility, External Mobility, Trade union Act (Amendment) 2001.

Employee Grievances: Employee Grievance procedure. Discipline procedure

Collective bargaining; Characteristics, Necessity, Forms Safety & Health; Industrial accidents, Safety Quality circle; Meaning, Structure

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT-III

IHRM and e-HRM **09 Hours**

Managing IHRM. e-HR Activities, Global recruitment, selection, expatriates. Industrial conflict – Causes, Types, Prevention and Settlement.

Aspects of e-HRM,e-Job design & Analysis, Ethical issues in employment

Pedagogy: Chalk and talk method, Power Point Presentation

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

1. Describe the basic concepts of HRM & HRP.
2. Elucidate the HRM functions of recruitment, selections, and appraisal.
3. Apply the training, development and compensation methods in HRD.
4. Identify the employee grievances to spell out the remedial measures.
5. Infer the concepts of e-HRM and I-HRM.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
MG1501-1-1.1	3	-	-	-	-	1	-	-	1	1	-	1
MG1501-1-1.2	3	-	-	-	-	1	-	-	1	1	-	1
MG1501-1-1.3	3	-	-	-	-	1	-	-	1	1	-	1
MG1501-1-1.4	3	-	-	-	-	1	-	-	1	1	-	1
MG1501-1-1.5	3	-	-	-	-	1	-	-	1	1	-	1

1: Low 2: Medium 3: High	
TEXTBOOKS:	
1.	P Courseba Rao, "Essentials of Human Resource Management & Industrial Relations", Third Revised Edition.
REFERENCE BOOKS:	
1.	John M. Ivancevich, "Human Resource Management", 10/e, McGraw Hill.
2.	Flippo, "Human Resource Management".
E Books / MOOCs/ NPTEL	
1.	http://edx.nimt.ac.in/courses/course-v1:nimtX+PGDM1212+2017_H1/about

MANAGEMENT ACCOUNTING AND CONTROL SYSTEM

Course Code:	**MG1502-1**	**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: 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	**07 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.

Marginal Costing	**08 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 II

Standard Costing and Budgetary Control	**07 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)

Budgetary Control	**08 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 III

Fund Flow and Cash Flow Statement	**05 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
MG1502-1-1.1	3	-	-	-	-	1	-	-	1	1	-	1
MG1502-1-1.2	3	-	-	-	-	1	-	-	1	1	-	1
MG1502-1-1.3	3	-	-	-	-	1	-	-	1	1	-	1
MG1502-1-1.4	3	-	-	-	-	1	-	-	1	1	-	1
MG1502-1-1.5	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:	**MG1503-1**	**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: Management

Course Objectives:

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.

45.

46.

UNIT-I

Production and Operations Management	**06 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	**11 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, c_p – process capability index, c_{pk}, p_p – process performance index, summary of process measures. Numerical problems. Concept of Six sigma.

Pedagogy: Chalk and talk method, Power Point Presentation

UNIT II

Quality Concepts and Reliability	**06 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.

Operations Management activities	**12 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.

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.

UNIT III

Replacement Theory	**05 Hours**

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
MG1503-1-1.1	2	1	-	-	-	-	-	-	-	-	2	-
MG1503-1-1.2	2	2	-	-	-	-	-	-	-	-	2	-
MG1503-1-1.3	1	1	-	-	-	-	-	-	-	-	2	-
MG1503-1-1.4	3	2	-	-	-	-	-	-	-	-	3	-
MG1503-1-1.5	1	1	-	-	-	-	-	-	-	-	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Joseph G Monks, "Production / Operations Management", McGraw Hill Books
2.	William J Stevenson, "Production and Operations Management", Tata McGraw Hill, 8th Edition.
3.	RC Gupta, "Statistical Quality Control", Khanna Publishers, New Delhi, 2005.
4.	N.D. Vohra, "Quantitative Techniques in Management", Tata McGraw Hill, 2015

REFERENCE BOOKS:

1.	E.L. Grant and R.S. Leavenworth, **"Statistical Quality Control",** 7th edition, McGraw- Hill publisher, 2004.
2.	Prem Kumar Gupta, D S. Hira, "Operations Research", S Chand Publications, New Delhi, 2nd edition 2008, Prentice Hall.
3.	W S Messina**, "Statistical Quality Control for Manufacturing Managers",** Wiley & Sons, Inc. New York, 1987
4.	Montgomery, Douglas, "**Statistical Quality Control",** 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ.
5.	Jerry Banks, "**Principles of Quality Control",** Wiley & Sons, Inc. New York.

ORGANIZATIONAL BEHAVIOUR

Course Code:	**MG1504-1**	**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: Management

Course Objectives:

1.	Describe the Nature and Characteristics, Determinants and Approaches of Organizational Behaviour. Describe the concepts of Perception, Attitudes and values and their implications.
2.	Describe the concepts of learning and motivation along with their managerial implications.
3.	Describe the concepts of Leadership along with their managerial implications.
4.	Discuss the concepts of group dynamics and conflict management along with their implications.
5.	Discuss the concepts of Organization culture and change and conflict management along with their implications.

47.

UNIT-I

15 Hours

Introduction: Conceptual Foundation of Organisational Behaviour; Nature and Characteristics; Determinants; Contributing Disciplines; Challenges and Opportunities for Organisational Behaviour, Models and Approaches of Organizational Behaviour, OB and Emotional Intelligence.

Perception, Attitude, and Values: Nature, Process, Importance, Factors Influencing Perception; Attribution Theory of Perception; Issues Involved in Perception: Selective Perception, Halo Effect, Contrast Effect, Projection, Stereotyping; Concept of Pygmalion Effect; an overview of Emotions and feelings, Values, Beliefs and Attitudes with Managerial Implications.

Learning: Concept; Theories of Learning: Conditioning, Social Learning, Managerial Implication of Learning Theories. Reinforcement.

Motivation: Concept, Major Theories and Process of Motivation: Maslow's Need-Hierarchy Theory; Herzberg's Motivation-Hygiene Theory; McGregor's Theory X and Theory Y; Goal- Setting Theory; ERG Theory; Vroom's Expectancy Theory; Equity Theory; Managerial implications of Various Theories.

Pedagogy: Chalk and talk method, Power Point Presentation, Case studies

UNIT II

15 Hours

Leadership: Concept and Functions; Style and Theories of Leadership: Traits, Behavioural and Situational/ Contingency Groups of Theories; Inspirational approaches to Leadership; Charismatic Leadership, Transformational Leadership, and Transactional Leadership, Contemporary Leadership Roles; Challenges to the Leadership Construct; Substitutes and Neutralizers to Leadership.

Group Behaviour: Groups: Concept and Classification; Stages of Group Development; Group Structure; Roles and Norms; Premise and Issues; Group Decision-Making: Group vs Individual; Groupthink and Groups Shift; Group Decision Making Techniques and Process.

Conflict Management: Concept; Causes; Types; Stages; Effects; Management of Conflicts.

Pedagogy: Chalk and talk method, Power Point Presentation, Case studies

UNIT III

10 Hours

Organizational Culture: Concept; Dominant Culture; Strong vs Weak Cultures ; Creating and

Sustaining Culture; Employees Learning of The Culture; Creating a Customer-Responsive Culture.
Organizational Changes: Concept and Forces for Change; Managing Planned Changes; Resistance to Change; Approaches to Manage Organizational Change; Organizational Development; Culture-Boundedness of Managing the Change.
Pedagogy: Chalk and talk method, Power Point Presentation, Case studies

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

1.	Describe the Nature and Characteristics, Determinants and Approaches of Organizational Behaviour. Describe the concepts of Perception, Attitudes and values and their implications.
2.	Describe the concepts of learning and motivation along with their managerial implications.
3.	Describe the concepts of Leadership along with their managerial implications.
4.	Discuss the concepts of group dynamics and conflict management along with their implications.
5.	Discuss the concepts of Organization culture and change and conflict management along with their implications.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
MG1504-1-1.1	2	-	-	-	-	-	-	-	3	1	-	-
MG1504-1-1.2	2	-	-	-	-	-	-	-	3	1	-	-
MG1504-1-1.3	1	-	-	-	-	-	-	-	3	1	-	-
MG1504-1-1.4	3	-	-	-	-	-	-	-	3	1	-	-
MG1504-1-1.5	1	-	-	-	-	-	-	-	-	1	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Robbins, SP Stephen P, Timothy Judge and Nehasika Vohra, "Organisational Behaviour", 12th or 16th edition, Pearson Education, 2011.
2.	Fred Luthans, "Organisational Behaviour", 11th edition, Mc Graw Hill, 2009.
48.	

REFERENCE BOOKS:

1.	W. Newstrom, John, "Organisational Behaviour", 10th edition, Tata Mc Graw –Hill 2009.
2.	Paul Heresy, Kenneth H. Blanchard, and Dewey E. Johnson, "Management of Organisational Behaviour", Leading Human Resources, 2008.
3.	Dr S S Khanka, "Organisational Behaviour", S. Chand & Co, New Delhi, 2008.
4.	Sanghi Seema, "Organisational Behaviour", Pearson, 2011.

TAXATION FOR ENGINEERS

Course Code:	**MG1505-1**	**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: Management

Course Objectives:

1.	To make students understand the overview of Income Tax Law in India.
2.	To make students understand the basic concepts of income tax such as residential status, tax incidence.
3.	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.
4.	To help students understand the determination of tax liability Individual assessees.
5.	To make students understand the deductions u/s 80.

49.

UNIT-I

Basic concepts and Explanation under various Heads of Income **15 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)

Explanation under various Heads of Income: Income from Salary (theory, basic and full-fledged problems on allowances, perquisites and retirement benefits)

UNIT II

Income under the head Profit and gains of Business or Professions and Income under Capital Gain **15 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)

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 III

Income from House Property and Other Sources **10 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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
MG1505-1-1.1	2	-	-	-	-	1	-	-	1	-	2	1
MG1505-1-1.2	2	-	-	-	-	1	-	-	1	-	2	1
MG1505-1-1.3	3	-	-	-	-	1	-	-	1	-	2	1
MG1505-1-1.4	3	-	-	-	-	1	-	-	1	-	2	1
MG1505-1-1.5	3	-	-	-	-	1	-	-	1	-	2	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Vinod Singhania, "Students Guide to Income Tax", Taxman Publications.
2.	Mehrotra & Goyal, "Direct Tax", Sahitya Bhavan.
3.	Lal & Vashisht, "Direct Tax", Pearson Ed. 28E.
4.	V S Datey, "Indirect Taxes", Taxman Publications.
5.	Vinod Singhania, "Direct Taxes", Taxman Publications.
6.	T N Manoharan, "Students Guide to Income Tax", Snow White.
7.	Kul Bushan, "How to deal with VAT", Pearson Education/PHI, 1/e.
8.	Mahesh Chandra & Shukla , "Income Tax Law & Practice", Pragathi Publications.
9.	Dr.Pillai, "VAT", Jaico Publications.

WORKING CAPITAL MANAGEMENT

Course Code:	**MG1506-1**	**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**

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:

1.	Discuss the importance of working capital management.
2.	Evaluate working capital requirement.
3.	Assess the challenges faced in managing working capital in domestic and international operations.
4.	Plan for financing working capital requirement.

50.

UNIT-I

Working Capital Decisions, Working Capital Management and Sources of Working Capital **15 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.
Sources of Working Capital: Financing of long term working capital & short term working capital. Factoring - Meaning mechanism, Functions, types, merits & demerits.

UNIT II

Liquidity Management and Receivable Management **15 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)

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 III

Inventory Management **10 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
MG1506-1-1.1	2	-	-	-	-	1	-	-	-	1	2	1
MG1506-1-1.2	2	-	-	-	-	1	-	-	-	1	2	1
MG1506-1-1.3	2	-	-	-	-	1	-	-	-	1	2	1
MG1506-1-1.4	2	-	-	-	-	1	-	-	-	1	2	1
MG1506-1-1.5	2	-	-	-	-	1	-	-	-	1	2	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Sekhar Satya G.V., "Working Capital Management", 1/e; New Delhi: Wiley, 2014.
2.	Bhalla V. K., "Working Capital Management", 1/e; New Delhi: S. Chand Publishing, 2014.
3.	Sagner James S., "Working Capital Management, Applications and Cases", 1/e, New Delhi: Wiley, 2015.

NANOTECHNOLOGY

Course Code:	**PH2501 -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**
Prerequisite	**PH1001 -1**		

Teaching Department: PHYSICS

Course Objectives:

1.	To understand the basic scientific concepts of nanoscience, properties of nano materials, synthesis and fabrication of nano materials.
2.	To understand the various characterization techniques of nano materials.
3.	Study of carbon nano technology and its characterizations.
4.	To understand the applications of nano technology in various science, engineering and technology fields.

UNIT-I

Properties of Materials **07 Hours**

Introduction: History of nano science, definition of nano meter, nanomaterials, nano technology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes, Band structure.

Properties Of Materials: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

Synthesis and Fabrication **08 Hours**

Synthesis of bulk polycrystalline samples, growth of single crystals, Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top Down Approach – Ball milling, micro fabrication, lithography, Requirements for realizing semiconductor nano structure, growth techniques for nano structures.

UNIT-II

Characterization Techniques **15 Hours**

X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy (TEM), scanning probe microscopy (SEM), atomic force microscopy (AFM), piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, UV-VIS-IR Spectrophotometers, Magnetic and electrical measurements and Infrared/ Raman, EPR and NMR

UNIT-III

Carbon Nano Technology **05 Hours**

Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano crystalling diamond films, grapheme, and applications of carbon nano tubes.

Applications of Nano Technology **05 Hours**

Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin films, applications of quantum dots.

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

1.	Ability to choose the appropriate nano material to meet the requirement of a particular

	application.
2.	Identify the essential concepts used in nanotechnology.
3.	Identify the materials, properties, synthesis and fabrication of nanomaterials.
4.	Understand the various characterization techniques of nano materials.
5.	Applications of nanomaterials in various fields

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
PH2501-1.1	3	3	-	-	-	-	-	-	-	-	-	-
PH2501-1.2	3	3	-	-	-	-	-	-	-	-	-	-
PH2501-1.3	3	3	-	-	-	-	-	-	-	-	-	-
PH2501-1.4	3	3	-	-	-	-	-	-	-	-	-	-
PH2501-1.5	3	3	-	-	-	-	-	-	-	-	-	-

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.

E Books / MOOCs/ NPTEL

1.	https://youtu.be/ebO38bbq0_4
2.	https://youtu.be/0MzIh7wkgMs

OPTOELECTRONIC DEVICES

Course Code:	**PH2502-1**	**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**
Prerequisite	**PH1001 -1**		

Teaching Department: PHYSICS

Course Objectives:

1.	To understand the basic principles of construction, working and applications of various optoelectronic devices.
2.	Study of sources of radiation like lasers and LED, their specific properties and hence their use for applications.
3.	Study of radiation detectors like semiconductor detector, diode as detector and photo multiplier.
4.	Understanding the fabrication and applications of optical fibers, optical modulators and waveguides for optical communication

UNIT-I

Optical processes in Semiconductor, Display devices & Optical fibers — **15 Hours**

Elements of optical phenomena in Semiconductors- fundamentals of Fermi-Dirac distribution, band structure, direct and indirect band gap semiconductors, generation-recombination mechanisms, absorption and emission processes.

Display devices- cathode ray tube, liquid crystal display, charge coupled devices, plasma display.

Optical fibers- types of fibers, modes of propagation, attenuation and losses, optical fiber communication system, advantages.

UNIT-II

Optical Sources and Detectors — **15 Hours**

Lasers- basic principles, optical resonator-types, modes and quality factor, practical lasers- Nd-YAG, CO2, Excimer laser, Semiconductor laser- basic structure, laser action, heterojunction laser, quantum well laser, applications.

Light emitting diode- electroluminescence in p-n junction, LED characteristics, efficiency and responsivity, Heterojunction LED, Surface-Emitting LED and Edge emitting LED.

Photo detectors- photo conductor detector, junction photo diode, p-i-n photo diode, avalanche photo diode. Photo multiplier tube.

UNIT-III

Integrated Optics and Modulators — **10 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. Waveguides- device structure, waveguide devices – waveguide lenses, light bending devices, optical power dividers, directional couplers, waveguide polarizer, wavelength multiplexers and demultiplexers. Waveguide coupling. Optoelectronic integrated circuit

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

1.	Ability to choose the appropriate device to meet the requirement of a particular application.

2.	Making modifications to device structures by understanding the factors affecting their performance.
3.	Attempting better efficiency and utility through an understanding of the principles of performance.
4.	Use the technical knowledge acquired to troubleshoot and rectify devices and circuits.
5.	Explore the possibility of designing devices with better characteristics.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
PH2502-1.1	3	3	-	-	-	-	-	-	-	-	-	-
PH2502-1.2	3	3	-	-	-	-	-	-	-	-	-	-
PH2502-1.3	3	3	-	-	-	-	-	-	-	-	-	-
PH2502-1.4	3	3	-	-	-	-	-	-	-	-	-	-
PH2502-1.5	3	3	-	-	-	-	-	-	-	-	-	-

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 Opto Electronic Devices", Prentice Hall of India Pvt., Ltd., New Delhi, 2006.

REFERENCE BOOKS:

1.	J.Wilson and J.Haukes, "Opto electronics- an introduction", Prentice Hall of India, New Delhi.
2.	Jasprit Singh, '"Opto electronics- an introduction to Materials and Devices", McGraw Hill international ed., 1998.
3.	A.Ghatak and Thyagarajan, "Introduction to opto electronics", New Age International Publication.

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/115102026/

AUTONOMOUS MOBILE ROBOTS

Course Code:	**RI2501-1**	**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**
Prerequisite	**EC 1001-1, ME 1003-1**		

Teaching Department: Robotics and Artificial Intelligence

Course Objectives:

1.	Explain different types of locomotion in mobile robots to obtain a required task.
2.	Understand the different types of kinematics and dynamics involved in a mobile robot.
3.	Study the different types of sensors used in an autonomous mobile robot.
4.	Understand the different types of algorithms to identify the position of the mobile robot.
5.	Understand the various algorithms for planning and navigation of the mobile robot.

UNIT-I

Robot locomotion	**07 Hours**

Types of locomotion, hopping robots, legged robots, wheeled robots, stability, maneuverability, and controllability.

Mobile robot kinematics and dynamics	**09 Hours**

Forward and inverse kinematics, holonomic and nonholonomic constraints, kinematic models of simple car and legged robots, dynamics simulation of mobile robots.

UNIT-II

Perception	**07 Hours**

Proprioceptive/Exteroceptive and passive/active sensors, performance measures of sensors, sensors for mobile robots like global positioning system (GPS), Doppler effect-based sensors, vision-based sensors, uncertainty in sensing, filtering.

Localization	**07 Hours**

Odometric position estimation, belief representation, probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, and positioning beacon systems.

UNIT-III

Introduction to planning and navigation	**10 Hours**

Path planning algorithms based on A-star, Dijkstra, Voronoi diagrams, probabilistic roadmaps (PRM), rapidly exploring random trees (RRT), Markov Decision Processes (MDP), stochastic dynamic programming (SDP).

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

1.	Explain different types of locomotion in mobile robots to obtain a required task.
2.	Identify the different types of kinematics and dynamics involved in a mobile robot.
3.	Apply the different types of sensors used in an autonomous mobile robot.
4.	Apply the different types of algorithms to identify the position of the mobile robot.
5.	Apply the various algorithms for planning and navigation of the mobile robot to reach the destination.

Course Outcomes Mapping with Program Outcomes

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

Outcomes												
RI2501-1.1	3	3	3	3	2	1	-	-	-	-	-	3
RI2501-1.2	3	3	3	3	2	1	-	-	-	-	-	3
RI2501-1.3	3	3	3	3	2	1	-	-	-	-	-	3
RI2501-1.4	3	3	3	3	2	1	-	-	-	-	-	3
RI2501-1.5	3	3	3	3	2	1	-	-	-	-	-	3

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

MEDICAL ROBOTICS

(For All except AI)

Course Code:	**RI2502-1**	**Course Type**	**PEC**
Teaching Hours/Week (L: T: P: S)	**3:0:0:0**	**Credits**	**03**
Total Teaching Hours	**40**	**CIE + SEE Marks**	**50+50**
Prerequisite	**PH 1001-1, IS 1001-1, CY 1001-1**		

Teaching Department: Robotics and Artificial Intelligence

Course Objectives:

1.	Understand the types of medical robots used in the field of healthcare.
2.	Explain the various localization and tracking sensors
3.	Understand the applications of surgical robots with the help of few case studies
4.	Understand Rehabilitation of limbs and brain machine interface with the help of few case studies
5.	Understand the design methodology of medical robots.

UNIT-I

Introduction **07 Hours**

Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics - State of art of robotics in the field of healthcare. Localization And Tracking

Position sensors requirements **09 Hours**

Tracking - Mechanical linkages - Optical - Sound-based - Electromagnetic -Impedance-based - In-bore MRI tracking - Video matching - Fiber optic tracking

UNIT-II

Control Modes Radiosurgery **07 Hours**

Orthopedic Surgery - Urologic Surgery and Robotic Imaging - Cardiac Surgery – Neurosurgery – case studies.

Rehabilitation **07 Hours**

Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles – case studies.

UNIT-III

Design of Medical Robots **10 Hours**

Characterization of gestures to the design of robots- Design methodologies- Technological choices - Security

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

1.	Describe the types of medical robots and the concepts of navigation and motion replication.
2.	Describe about the sensors used for localization and tracking
3.	Explain the applications of surgical robots
4.	Explain the concepts in Rehabilitation of limbs and brain machine interface
5.	Classify the types of assistive robots and analyze the design characteristics, methodology and technological choices for medical robots.

Course Outcomes Mapping with Program Outcomes

Program	1	2	3	4	5	6	7	8	9	10	11	12

Outcomes→ **↓ Course Outcomes**												
RI2502-1.1	3	-	1	-	-	-	-	-	-	-	-	1
RI2502-1.2	3	-	1	-	-	-	-	-	-	-	-	1
RI2502-1.3	3	-	1	-	-	-	-	-	-	-	-	1
RI2502-1.4	3	-	1	-	-	-	-	-	-	-	-	1
RI2502-1.5	3	-	3	-	-	-	-	-	-	-	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "Robot Modeling and Control", Wiley Publishers, 2006.
2. Paula Gomes, "Medical robotics- Minimally, Invasive surgery", Woodhead, 2012.
3. Achim Schweikard, Floris Ernst, "Medical Robotics", Springer, 2015.

REFERENCE BOOKS:

1. Jocelyne Troccaz, "Medical Robotics", Wiley-ISTE, 2012.
2. Vanja Bonzovic, "Medical Robotics", I-tech Education publishing Austria, 2008.
3. Daniel Faust, "Medical Robotics", Rosen Publishers, 2016.
4. Jocelyne Troccaz, "Medical Robotics", Wiley, 2013.

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

(For All except AI)

Course Code:	**RI2503-1**	**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**
Prerequisite	**EE 1001-1, EC 1001-1**		

Teaching Department: Robotics and Artificial Intelligence

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 — **06 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.

Control Components — **04 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-II

Pneumatic system components — **07 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

Fluidics & Pneumatic circuit design — **08 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-III

Fluid power circuits — **10 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

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
RI2503-1.1	3	2	3	2	3	-	-	-	-	-	-	3
RI2503-1.2	3	2	3	2	3	-	-	-	-	-	-	3
RI2503-1.3	3	2	3	2	3	-	-	-	-	-	-	3
RI2503-1.4	3	2	3	2	3	-	-	-	-	-	-	3
RI2503-1.5	3	2	3	2	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