Regulations and Curriculum for

Bachelor of Technology (B.Tech.) in Artificial Intelligence and Data Science

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 interdisciplinary 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.
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	14ENGR01D2
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 Artificial Intelligence and Data Science Engineering and approved by the Academic Council.
Effective from	09-03-2024
Approvals	• Approved in the 54th Academic Council meeting of NITTE (Deemed to be University), held on 24.06.2023 and vide Notification of Ref: N(DU)/REG/AC-NMAMIT/2022-23/1264 dated 18.07.2023. • 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/2023-24/925 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 to 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 benefit 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.

Sl. No	Academic Level	Entry Level Qualifications	Qualifications at Exit	NCrF Level
1	1st yr. of UG Degree	A candidate completing 10+2 years with Diploma of Vocation or passed 12th std. or equivalent vocational training with NCrF level 4	**UG Certificate***	4.5
2	2nd yr. of UG Degree	A candidate with Diploma in appropriate branch of Engineering/ UG Certificate/ Equivalent Vocational or Technical Program NCrF level 4.5	**UG Diploma (Engg.)***	5.0
3	3rd yr. of UG Degree	A candidate with 10+3+1/12+2/ UG Diploma (Engg.) in appropriate domain with NCrF level 5	**B. Sc (Engg.)***	5.5
4	Final yr. of UG Degree	A candidate with 3 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 credits through internship/training/specialized courses before the award of qualification 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 Engineering	(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 Engineering	(AM)
xii)	Computer and Communication Engineering	(CC)
xiii)	Robotics and Artificial Intelligence Engineering	(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.

a. Each course will be identified by a unique Course Code of seven alpha-numerals (two alphabets followed by 5 digits). The alphabet reflects 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

a. 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).

b. 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.

c. 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 to fulfill 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		

a. 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 t h e program duration, giving flexibility to a student to plan their career.

8.4 Program structure and suggested Course offerings

I/II SEMESTER (AI&DS, AI&ML, CC, CS, IS, RI)													
Sl 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	MA1002 – 1	Calculus and Differential Equations	MAT	3	0	0	3	50	50	100		3
2	BSC	PH1004-1	Quantum Computing and Modern Physics	PHY	3	0	2	3	50	50	100		4
3	ESC	CS1005-1	Introduction to Python Programming	CS	2	0	2	3	50	50	100		3
4	ESC	EC1001-1	Basic Electronics	EC	3	0	0	3	50	50	100		3
5	ETC	IS1101-1	Fundamentals of Cyber Security	CS	3	0	0	3	50	50	100		3
6	AEC	CS1651-1	IT Skills	CS	1	0	2	3	50	50	100		2
7	MNC	CV1002-1	Environmental Studies	CV	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

I/II SEMESTER (AI&DS, AI&ML, CC, CS, IS, RI)													
Sl 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	MA1007– 1	Discrete Mathematics and Transform Techniques	MAT	4	0	0	3	50	50	100		4
2	BSC	CY1003-1	Materials Chemistry for Computer Systems	CHE	3	0	2	3	50	50	100		4
3	ESC	EC1002-1	Applied Digital Logic Design	EC	2	0	2	3	50	50	100		3
4	PLC	CS1004-1	Introduction to C Programming	CS	2	0	2	3	50	50	100		3
5	ESC	EE1001-2	Basic Electrical Engineering	EE	2	0	2	3	50	50	100		3
6	HSMC	HU1001-1	Technical English	HU	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	ESC	ME1004-1	Engineering Visualization	ME	0	0	2	-	50	-	50		1
9	MNC	HU1002-1	Constitution of India	HU	1	0	0	-	50	-	50		0
TOTAL					**16**	**0**	**12**	**19**	**450**	**350**	**800**		**21**

Mandatory Internship-I*								
10	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 Department**	**Teaching Hours /Week**				**Examination**				**Credits**
					Lecture	**Tutorial**	**Practical/**	**PBL**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total**	
					L	**T**	**P**	**J**					
1	BSC	MA2001-1	Statistics & Probability Theory	MA	3	0	0	0	3	50	50	100	3
2	IPCC	CS2001-1	Data Structures	AD	3	0	2	0	3	50	50	100	4
3	IPCC	CS2002-1	Object Oriented Programming	AD	3	0	2	0	3	50	50	100	4
4	PCC	AD1101-1	Computer Organization	AD	3	0	0	0	3	50	50	100	3
5	PCC	AD1102-1	Fundamentals of Data Science	AD	3	0	0	0	3	50	50	100	3
6	PCC	AD2601-1	Practicing Data Science with MS Excel and Python	AD	0	0	2	0	3	50	50	100	1
7	AEC	ME1654-1	Innovations and Design Thinking	Any Dept.	1	0	0	0	1	50	50	100	1
8	HSMC	HU1004-1	Universal Human Values	Any Dept.	1	0	0	0	1	50	50	100	1
9	MNC	HU1003-1	Kannada (Balake / Samskrithika)	Any Dept.	1	0	0	0	-	50	-	50	0
Total					**18**	**0**	**6**	**0**	**20**	**450**	**400**	**850**	**20**
Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs													
10	MNC	MA1012 -1	Bridge Course – Calculus & Differential Equations	MA	3	0	0	0	3	100	0	100	0

IV SEMESTER														
Sl No.	**Course and Course code**		**Course Title**	**Teaching Department**	**Teaching Hours /Week**				**Examination**				**Credits**
					Lecture	**Tutorial**	**Practical/ Drawing**	**PBL**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total**	
					L	**T**	**P**	**J**					
1	BSC	MA2006-1	Linear Algebra, Statistical Analysis & Computing	MA	3	0	0	0	3	50	50	100	3
2	IPCC	CS3004-1	Design and Analysis of Algorithms	AD	3	0	2	0	3	50	50	100	4
3	IPCC	AD2001-1	Fundamentals of Machine Learning	AD	3	0	2	0	3	50	50	100	4
4	PCC	AD1103-1	Software Engineering	AD	3	0	0	0	3	50	50	100	3
5	PCC	CS2102-1	Database Management Systems	AD	3	0	0	√	3	50	50	100	3
6	PCC	AD1602-1	Data Handling and Visualization with R	AD	0	0	2	0	3	50	50	100	1
7	HSMC	HU2001-1	Enhancing Self Competence	HU	2	0	0	0	3	50	50	100	2
8	HEC	HU1005-1	Essence of Indian Culture	Any Dept.	1	0	0	0	-	50	-	50	0
9	VEC	AD2551-1	Building Responsive and Accessible Web Interfaces	AD	0	0	2	0	3	50	50	100	1
10	UCC	UC1001-1	Internship – I (Activity-based Internship)	Mandatory Intra Institutional Internship of 2 weeks duration (80 - 90 Hours) 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					**18**	**0**	**8**	√	**24**	**550**	**400**	**950**	**23**
Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs													
11	MNC	MA1014-1	Bridge Course – Discrete Mathematics & Numerical Methods	MA	3	0	0	0	3	100	0	100	0

V SEMESTER														
Sl No.	**Course and Course code**		**Course Title**	**Teaching Department**	**Teaching Hours /Week**				**Examination**					**Credits**
					Lecture	**Tutorial**	**Practical/ Drawing**	**PBL**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total**		
					L	**T**	**P**	**J**						
1	IPCC	AD1002-1	Cloud Computing	AD	3	0	2	0	3	50	50	100		4
2	IPCC	AD2003-1	Principles of Artificial Intelligence	AD	3	0	2	0	3	50	50	100		4
3	PCC	AD2104-1	Operating System	AD	3	0	0	0	3	50	50	100		3
4	PCC	AD3603-1	Database Management Systems Lab	AD	0	0	2	0	3	50	50	100		1
5	PEC	AD2XXX-1	Professional Elective-I	AD	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	AD2651-1	C++ and Unix Programming	AD	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	AD	1	0	0	0	1	50	50	100		1
9	AEC	UM1003-1	Employability Skill development	AD	1	0	0	0	-	50	-	50		1
Total					**16/17**	**0**	**8/6**	**0**	**20**	**450**	**400**	**850**		**20**

VI SEMESTER														
Sl No.	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week				Examination					Credits
					Lecture L	Tutorial T	Practical/ Drawing P	PBL J	Duration in hours	CIE Marks	SEE Marks	Total		
1	IPCC	AD1004-1	Computer Networks	AD	3	0	2	0	3	50	50	100		4
2	PCC	AD2105-1	Bigdata Analytics	AD	3	0	0	0	3	50	50	100		3
3	PCC	AD2604-1	Full stack development	AD	0	0	2	0	3	50	50	100		1
4	PEC	AD2XXX-1	Professional Elective - II	AD	3	0	0	0	3	50	50	100		3
5	PEC	AD2XXX-1	Professional Elective -III	AD	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	MG1003-1	Management & Entrepreneurship	Any Dept.	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**	**0**	**22**	**400**	**400**	**800**		**21**

VII SEMESTER

Sl No.	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hours	CIE Marks	SEE Marks	Total	
					L	T	P	J					
1	IPCC	AD2005-1	Data Privacy and Internet Security	AD	3	0	2	0	3	50	50	100	4
2	PCC	AD2605-1	Practice of a Modern Tool for Data Science	AD	0	0	2	0	3	50	50	100	1
3	PEC	AD2XXX-1	Professional Elective – IV	AD	3	0	0	0	3	50	50	100	3
4	PEC	AD2XXX-1	Professional Elective – V	AD	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	MG1002-1	Financial Management	Any Dept.	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	AD	-	-	4	-	-	100	-	100	2
Total					**16**	**0**	**8**	**0**	**18**	**450**	**300**	**750**	**20**

VIII SEMESTER													
Sl No.	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Lecture L	Tutorial T	Practical/ Drawing P	PBL J	Duration in hours	CIE Marks	SEE Marks	Total	
1	UCC	UC2001-1	Internship – II (Societal internship and Research/Industry Internship)	AD	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- II/ Research Project/ Industry project	AD	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					**0**	**0**	**0**	**0**	**6**	**150**	**150**	**300**	**16**

8.5 Eligibility for submission of Project Work Report

a. 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.**

b. 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.

c. Project viva-voce examination shall be conducted individually.

8.6 ELECTIVES

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

b. 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).

c. 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.

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

b. **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.

c. **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.

d. **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.

e. 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.

f. 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.

a. Absolute Grading – Letter Grade and its range

The grade point scale for absolute grading

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

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

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

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

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

11.8 Earning of Credits

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

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

b. **Grade "I"**: To a student having attendance ≥85% and CIE ≥70%, in a course, but remained absent from SEE for valid & convincing reasons acceptable to the College, like:
   i. Illness or accident, which disabled him/her from attending SEE.
   ii. A calamity in the family at the time of SEE required the student to be away from the College.
   iii. However, the committee chaired by the Principal is authorized to relax the requirement of CIE ≥ 70% if the student is hospitalized or advised long-term rest after discharge from the hospital by the Doctor.
   iv. Students who remain absent for Semester End Examinations due to valid reasons and those who are absent due to health reasons are required to submit the necessary documents along with their request to the Controller of Examinations to write Makeup Examinations within 2 working days of that examination for which he or she is absent, failing which they will not be given permission.

c. **Grade "W":** To a student having satisfactory attendance at classes, but withdrawing from that course before the prescribed date in a semester under Faculty Advice

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

11.9 Summer / Fast Track semester

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

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

c. The course/s for which the student does not possess satisfactory attendance and CIE score shall be marked as 'N' on the Grade sheet. Such students are not permitted to SEE for the Courses marked as 'N' on the Grade sheet. The students have to re-register only for course/s marked as 'N' in the summer/ subsequent semester whenever that course is offered and obtain the required CIE and attendance. Subsequently, they are eligible to appear for SEE in such course/s.

d. Courses with Transitional Grades viz "W", "I", and "X" are also eligible to register in the summer semester in case they wish to improve their score in CIE.

e. All courses may not be offered in the summer semester. It is the discretion of the University to offer the courses based on the availability of resources. The Institutes shall notify timetable for the summer semester well in advance.

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

g. A student is permitted to register for a maximum of 16 credits in the Summer / fast track semester.
h. A student has to choose those courses which are offered by the Institution in a given summer Semester.
i. In the summer semester, each course needs to be offered for the required number of lectures/ tutorial/ laboratory hours as prescribed in the syllabus.

11.10 Grade Card

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

11.11 Re-evaluation and paper seeing.

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

11.12 The Make-Up Examination

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

a) All the "I" and "X" grades awarded to the students would be converted to appropriate letter grades after the make-up examinations. Any outstanding "I" and "X" grades after the last scheduled make-up examinations shall be automatically converted to "F" grades.
b) All the "W" grades awarded to the students would be eligible for conversion to the appropriate letter grades only after the concerned students re-register for these courses in a main/ Summer semester and fulfill the passing standards for their CIE and (CIE+SEE).

11.13 Rules for grace marks

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

12. EVALUATION OF PERFORMANCE

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

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

CGPA is computed as follows:

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

13. COMMUNICATION OF GRADES

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

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

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

14.2 However, at the beginning of an Academic year, 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 course(s), 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):

a. 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.**

b. 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.

c. 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.

a. A candidate who fails/remains absent (after submitting exam application) in the main examination and passes one or more subjects/courses or all subjects/courses in the 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

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

b. Candidates with W, N, I, X & F grades and who passes the courses in the subsequent/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 Artificial Intelligence and Data Science 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><th>Rubrics per experiment</th><th>Marks Distribution</th><th>Remarks</th><th>Rubrics</th><th>Marks distribution</th><th>Remarks</th></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 grade)	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 certificate issued from	Institute Faculty (mentor)
		Good	60 to 79		
		Satisfactory	40 to 59		
		Unsatisfactory and fail	< 39		
2	Working for consultancy/ Research project.	Excellent	80 to 100		
		Good	60 to 79		
		Satisfactory	40 to 59		

		Unsatisfactory and fail	< 39	the relevant authorized Authority	together with External Expert, if any.
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>
<tr><th colspan="5">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)</th></tr>
<tr><th>Sub Activity Head</th><th>Performance/ Appraisal</th><th>Assessment Rubrics</th><th>Proposed Document as Evidence</th><th>Evaluated by</th></tr>
<tr><td rowspan="4">(1) Development of new product/ Business Plan/ registration of start-up/societal internship</td><td>Excellent</td><td>80 to 100</td><td rowspan="8">(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.</td><td rowspan="8">(i)Institute Faculty (mentor) together with External Expert if any.</td></tr>
<tr><td>Good</td><td>60 to 79</td></tr>
<tr><td>Satisfactory</td><td>40 to 59</td></tr>
<tr><td>Unsatisfactory and fail</td><td>< 39</td></tr>
<tr><td rowspan="4">(2) Internship with Industry/ Govt. / NGO/ PSU/ Any Micro/ Small/Medium Enterprise.</td><td>Excellent</td><td>80 to 100</td></tr>
<tr><td>Good</td><td>60 to 79</td></tr>
<tr><td>Satisfactory</td><td>40 to 59</td></tr>
<tr><td>Unsatisfactory and fail</td><td>< 39</td></tr>
<tr><td colspan="5">Note:
(i) The total CIE marks shall be the sum of marks allotted to successfully completed activities by the student.</td></tr>
</table>

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 steppingstone 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 concepts	10
		The clarity in answering the questions related to the project	05
		The understanding ability of the questions asked	05
		The confidence in answering the questions asked.	05
		Total Marks	**100**

NITTE (Deemed to be University)
Established under Section 3 of UGC Act 1956
Accredited with 'A+' Grade by NAAC

NMAM INSTITUTE OF TECHNOLOGY
Off-Campus Centre, Nitte - 574 110, Karnataka, India

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. (Artificial Intelligence and Data Science)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
2023-24

B. Tech. in Artificial Intelligence and Data Science

Vision:

To achieve excellence in engineering education by creating a dynamic learning environment, fostering collaboration and interdisciplinary research in Artificial Intelligence and Data science, while empowering our graduates to become leaders in the global AI landscape.

Mission:

- Creating an ecosystem of academic excellence by incorporating the best possible teaching-learning methodology, collaborative research and the usage of modern IT infrastructure and tools.
- Grooming professionals with high ethical values and inculcate the ability to solve real-life problems that involves data analytics.
- Contribute towards the innovation of computing, AI system and Data Science to raise satisfaction level of all stakeholders.
- To prepare professionals for employment in industry, research, higher education, community partnerships, and entrepreneurship to benefit the society.

Program Educational Objectives (PEOs):

Program educational objectives are the broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

1. To have a successful professional career with capabilities to build innovative solutions by applying the knowledge of Data Science and using technology as a tool to solve real-world problems.
2. To develop an ethical attitude and shall exhibit effective skills in communication, management, teamwork, and leadership to lead and work as a team in a professional environment.
3. To develop engineering, problem-solving, and critical thinking skills to create social, economical and sustainable impact and develop an ability to adapt themselves to the dynamically changing technologies for catering to the organizational needs.

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):

1. Apply the principles of artificial intelligence and data science to develop the systems that require data analysis, inference, perception, knowledge representation, and learning.
2. Obtain the competencies to excel in Employment, Higher studies and Research in Artificial Intelligence and Data Science while upholding ethical values.
3. Demonstrate proficient professional abilities for seamless collaboration within diverse and interdisciplinary teams, embracing a growth-oriented mindset.

B. Tech. in Artificial Intelligence and Data Science

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

<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 Artificial Intelligence and Data Science 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)

I/II SEMESTER (AI&DS, AI&ML, CC, CS, IS, RI)													
Sl 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	MA1002 – 1	Calculus and Differential Equations	MAT	3	0	0	3	50	50	100		3
2	BSC	PH1004-1	Quantum Computing and Modern Physics	PHY	3	0	2	3	50	50	100		4
3	ESC	CS1005-1	Introduction to Python Programming	CS	2	0	2	3	50	50	100		3
4	ESC	EC1001-1	Basic Electronics	EC	3	0	0	3	50	50	100		3
5	ETC	CS1101-1	Fundamentals of Cyber Security	CS	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	MNC	CV1002-1	Environmental Studies	CV	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**

I/II SEMESTER (AI&DS, AI&ML, CC, CS, IS, RI)

Sl 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	MA1007– 1	Discrete Mathematics and Transform Techniques	MAT	4	0	0	3	50	50	100	4
2	BSC	CY1003-1	Materials Chemistry for Computer Systems	CHE	3	0	2	3	50	50	100	4
3	ESC	EC1002-1	Applied Digital Logic Design	EC	2	0	2	3	50	50	100	3
4	PLC	CS1004-1	Introduction to C Programming	CS	2	0	2	3	50	50	100	3
5	ESC	EE1001-2	Basic Electrical Engineering	EE	2	0	2	3	50	50	100	3
6	HSMC	HU1001-1	Technical English	HU	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	ESC	ME1004-1	Engineering Visualization	ME	0	0	2	-	50	-	50	1
9	MNC	HU1002-1	Constitution of India	HU	1	0	0	-	50	-	50	0
TOTAL					**16**	**0**	**12**	**19**	**450**	**350**	**800**	**21**
Mandatory Internship-I*												
10	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

CALCULUS AND DIFFERENTIAL EQUATIONS

Course Code:	**MA1002-1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P):	**3:0:0**	**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 differential calculus, partial differentiation, vector differentiation, differential equations, multiple integrals and become skilled for solving problems in science and engineering.

UNIT-I

Differential Calculus — **7 Hours**

Polar curves, angle between the radius vector and the tangent, angle of intersection of two curves, derivatives of arcs and radius of curvature-cartesian, parametric and polar forms. Rolle's theorem (without proof), mean value theorems and applications to simple problems, Taylor's theorem for functions of single variable.

Partial Differentiation — **8 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).

UNIT-II

Vector Differential Calculus — **7 Hours**

Vector algebra(review), scalar and vector valued functions, gradient, directional derivative and hessian of multi-variable function, Divergence, and curl of a vector valued function. Solenoidal and irrotational vectors.

Ordinary and Partial Differential Equations — **8 Hours**

Ordinary differential equations(review), linear and nonlinear differential equations. Second and higher order linear differential equations with constant coefficients.

Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions. Classification of second order PDES. Solution of P.D.E by the method of separation of variables.

UNIT-III

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.

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

1. Apply the concept of radius of curvature and mean value theorems.
2. 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.
3. Solve the vector functions and their derivatives for engineering applications.
4. Apply the concepts of ordinary and partial differential equations in engineering problems.
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	3
MA1002-1.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

MA1002-1.2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1002-1.3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1002-1.4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1002-1.5	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.
3. Murray R. Spiegel, Seymour Lipschutz, Dennis Spellman, "Vector Analysis", Schuam's outlines series, 2nd edition, 2009.

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.
5. W.E. Boyce and R.C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.
6. E.A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
7. G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.
8. Shanthi Narayan, "Differential Calculus, 6th edition, Shyam Lal Charitable Trust, Delhi.

E Books / Moocs/ NPTEL

1. http://nptel.ac.in/courses/111106100/
2. https://nptel.ac.in/courses/122101003
3. http://nptel.ac.in/courses/111106100/

QUANTUM COMPUTING AND MODERN PHYSICS

Course Code:	**PH1004 -1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L:T:P):	**3:0:2**	**Credits:**	**04**
Total Teaching Hours:	**40+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Physics

Course Objectives:

1.	To study the principles of quantum mechanics and its application in quantum computing
2.	To study the concepts of semiconductors and semiconductor devices
3.	To study the properties of superconductors and their applications
4.	To understand the principle, working and applications of lasers.
5.	To understand the principle, working and applications of optical fibers.

UNIT-I

Quantum Computing — **15 Hours**

Fundamentals of Quantum Mechanics:
Introduction to Quantum mechanics. Fundamental postulates of QM: Representation of states, dynamical variables - Adjoint of an operator. Eigen value problem - degeneracy. Eigenvalues and Eigenfunctions. Completeness and normalization of eigen functions. Closure. Physical interpretation of Eigen values, Eigen functions and expansion coefficients

Matrix formulation of quantum mechanics.
Matrix formalism of quantum mechanics: Linear vector spaces - orthogonality and linear independence, bases and dimensions, completeness, Hilbert's spaces. Hermitian operators. Bra and Ket notations for vectors. Representation theory, Schwartz inequality.

Dirac representation and matrix operations:
Matrix representation of 0 and 1 States, Identity Operator I, Applying I to$|0\rangle$and $|1\rangle$ states, Pauli Matrices and its operations on $|0\rangle$and $|1\rangle$states, Explanation of i) Conjugate of a matrix and ii) Transpose of a matrix. Unitary matrix U, Examples: Row and Column Matrices and their multiplication (Inner Product), Probability, and Quantum Superposition, normalization rule. Orthogonality, Orthonormality. Numerical Problems

Principles of Quantum Information & Quantum Computing:
Introduction to Quantum Computing, Moore's law & its end, Differences between Classical & Quantum computing. Concept of qubit and its properties. Representation of qubit by Bloch sphere. Single and Two qubits. Extension to N qubits.

Quantum Gates: Single Qubit Gates: Quantum Not Gate, Pauli – X, Y and Z Gates, Hadamard Gate, Phase Gate (or S Gate), T Gate

UNIT-II

Electrical Properties of Materials: Semiconductors — **11 Hours**

Semiconductors: Band structure - classification of solids. Semiconductors - intrinsic and extrinsic semiconductors, carrier generation. Direct and indirect band gap semiconductors. Fermi - Dirac Statistics, Fermi factor, Fermi energy level in intrinsic and extrinsic semiconductors and effect of temperature on Fermi level, intrinsic effect - maximum device temperature. Conductivity of intrinsic and extrinsic semiconductors - derivation. Effect of temperature on conductivity of intrinsic and extrinsic semiconductor. Hall effect - derivation of Hall coefficient, carrier concentration and mobility. Applications of Hall effect. Numerical examples.

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

Electrical Properties of Materials: Superconductors — **4 Hours**

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

UNIT-III

Photonics: Lasers	**05 Hours**
Introduction to lasers, Characteristics of LASER, Interaction of radiation with matter, Einstein's coefficients, Requisites of a Laser System. Conditions for Laser action. Principle, Construction and Working of Nd:YAG laser and Semiconductor laser. Application of Lasers in Bar code scanner and Laser Printer. Numerical Problems.	
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 and Mention of Expression for Attenuation coefficient, Attenuation Spectrum of an Optical Fiber- 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

1.	Energy gap of a semiconductor by four-probe technique.
2.	Hall effect
3.	I-V characteristics of Zener diode
4.	Dielectric constant by charging and discharging of a capacitor.
5.	Solar cell characteristics.
6.	Semiconductor laser - Determination of wavelength by diffraction.
7.	Determination of acceptance angle and numerical aperture of the given Optical Fiber.
8.	Photo electric effect – Determination of the work function of the material of the emitter of a photocell.
9.	Photo-Diode characteristics
10.	LED characteristics and determination of Planck's Constant using LEDs.

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

1.	**Describe** the fundamental principles of the Quantum Mechanics and quantum computing
2.	**Summarize** the properties of semiconductors and the working principles of semiconductor devices.
3.	**Summarize** the essential properties of superconductors and its applications.
4.	**Describe** the principles of LASERS and their relevant applications.
5.	**Describe** the principles of Optical fibers and their relevant 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
PH1004-1.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1004-1.2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1004-1.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1004-1.4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PH1004-1.5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Parag K Lala, "Quantum Computing – A Beginner's Introduction", Indian Edition, McGraw Hill, Reprint 2020.
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.	Michael A. Nielsen & Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge Universities Press, 2010 Edition.
2.	Vishal Sahani, "Quantum Computing", McGraw Hill Education, 2007 Edition.
3.	Maria Luisa Dalla Chiara, Roberto Giuntini, Roberto Leporini, Giuseppe Sergioli, "Quantum Computation and Logic: How Quantum Computers Have Inspired Logical Investigations", Trendsin Logic, Volume 48, Springer.
4.	Gupta and Kumar, "Solid State Physics", K. Nath & Co., Meerut.
5.	A. J. Dekker, "Electrical Engineering Materials", Prentice Hall India Pub., New Delhi, Reprint 2011.
6.	S. O. Pillai, "Solid State Physics", New Age International Private Limited, 8th Edition, 2018.
7.	M. Ali. Omar, "Elements of Solid State Physics: Principles and Applications", Pearson Publishers.
8.	Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill Education Private Limited, Special Indian Edition, 2009.
9.	Kenneth Krane, "Modern Physics", Wiley International, 3rd Edition, 2012.
10.	Michael Tinkham, "Introduction to Superconductivity", II Edition, McGraw Hill, INC
E Books / MOOCs/ NPTEL/ Web links	
1.	LASER: https://www.youtube.com/watch?v=WgzynezPiyc
2.	Superconductivity : https://www.youtube.com/watch?v=MT5Xl5ppn48
3.	Optical Fiber : https://www.youtube.com/watch?v=N_kA8EpCUQo
4.	Quantum Mechanics : https://www.youtube.com/watch?v=p7bzE1E5PMY&t=136s
5.	Quantum Computing : https://www.youtube.com/watch?v=jHoEjvuPoB8
6.	Quantum Computing :https://www.youtube.com/watch?v=ZuvCUU2jD30
7.	Physics of Animation : https://www.youtube.com/watch?v=kj1kaA_8Fu4
8.	Statistical Physics Simulation : https://phet.colorado.edu/sims/html/plinko-probability/latest/plinkoprobability_en.html
9.	NPTEL Supercoductivity:https://archive.nptel.ac.in/courses/115/103/115103108/
10.	NPTEL Quantum Computing : https://archive.nptel.ac.in/courses/115/101/115101092
11.	Virtual LAB :https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham
12.	Virtual LAB : https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning	
1.	http://nptel.ac.in
2.	https://swayam.gov.in
3.	https://virtuallabs.merlot.org/vl_physics.html
4.	https://phet.colorado.edu
5.	https://www.myphysicslab.com

INTRODUCTION TO PYTHON PROGRAMMING

Course Code:	**CS1005-1**	**Course Type:**	**PLC**
Teaching Hours/Week (L: T: P: S):	**2:0:2**	**Credits:**	**03**
Total Teaching Hours:	**25**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Computer Science & Engineering

Course Objectives:

1.	Construct python programs using data types and looping.
2.	Make use of python operators for manipulating lists, dictionaries and files.
3.	Design function-based Python programs.
4.	Design list, tuple related programs in Python.
5.	Write string handling programs in python.

UNIT-I

Introduction	**10 Hours**

Introduction to Computer generations and types, CPU, Primary Memory, Secondary Memory, Ports and Connections.
Problem solving, Program Development steps, Introduction to Algorithms and Flowcharts.
Introduction to python, basic syntax, interactive shell, editing, saving, and running a script.
The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages; Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit evaluation

UNIT-II

Data structure and function	**10 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.
FUNCTIONS: Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Recursive functions, Lambda functions.
Introduction to Object oriented concepts – Class, object and member function

UNIT-III

Strings and text files	**06 Hours**

STRING MANIPULATIONS: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa, Binary, octal, hexadecimal numbers
Manipulating files and directories, text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated).

Suggested List of Experiments

1.	Experiments related to basic operation, data types and variables.
2.	Experiments related to operations of Lists, tuples and dictionaries.

3.	Experiments on writing functions and parameter passing.
4.	Experiments related to working with strings.
5.	Experiments related to file handling.

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

1.	Experiment with the basics of python programming like data types and looping
2.	Experiment string manipulation operators in programming
3.	Apply the Python operators for manipulating lists, dictionaries and files
4.	Design functions in python for modular programming
5.	Perform operations on string

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
CS1005-1.1	1	2	1	2	-	-	2	-	-	-	-	2	-	1	1
CS1005-1.2	-	2	-	-	-	1	-	-	-	-	-	1	-	2	-
CS1005-1.3	1	-	-	-	-	-	-	-	-	-	-	1	-	-	1
CS1005-1.4	-	1	-	2	-	1	-	-	-	-	-	1	-	-	-
CS1005-1.5	-	-	1	3	-	-	2	-	-	-	1	2	-	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Kenneth A. Lambert, “The Fundamentals of Python: First Programs”, Cengage Learning, 2011.
2.	Magnus Lie Hetland, “Beginning Python from Novice to Professional”, Second Edition, Apress, 2009.
3.	Mark Summerfield, “Programming in Python 3 - A Complete Introduction to the Python Language”, Second Edition, Addison-Wesley, 2009.
4.	Y. Daniel Liang, “Introduction to Programming Using Python”, Pearson, 2013.

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

FUNDAMENTALS OF CYBER SECURITY

Course Code:	**IS1101-1**	**Course Type:**	**ETC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**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→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													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:

Thomas J. Mowbray, "Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions", John Wiley & Sons, Inc, ISBN: 978 -1-118 -84965 -1, 2014.

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.

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.

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:**	**MNC**
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

DISCRETE MATHEMATICS AND TRANSFORM TECHNIQUES

Course Code:	**MA1007 - 1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P):	**4:0:0**	**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 set theory and relations, propositional and predicative logics, numerical methods, Fourier series and transforms and become skilled for solving problems in science and engineering.

UNIT-I

Logics	**8 Hours**

Propositional logic, logical operations, Rules of inference, Predicates calculus. Methods of Proof: Direct, Indirect and Proof by Contradiction and Contrapositive. Proofs by Mathematical Induction (both weak and strong inductions).

UNIT-II

Set Theory And Graph Theory	**11 Hours**

Relations- Relations and Digraphs, Properties of Relations, Equivalence Relations, Transitive Closure and Warshall’s Algorithm.
Functions- permutations functions, functions for computer science.
Graphs: Basic terminologies, simple graphs, complete graphs, bipartite graphs. Adjacency matrices, incidence matrices and graph isomorphism. Connectivity- vertex and edge connectivity. Euler and Hamiltonian graphs and their applications. Planar graphs, graph coloring and their applications.

UNIT-III

Numerical Methods	**11 Hours**

Roots of algebraic and transcendental equations- Newton Raphson method, Regula Falsi method.
Numerical solution of ordinary differential equations- Taylor’s series method, Modified Euler’s method and Runge –Kutta method of fourth order.

Numerical solution of partial differential equations-classification of partial differential equations, examples, solution of Laplace and Poisson equations by standard five point formulae, solution of heat and wave equations.

UNIT-IV

Fourier Series and Fourier Transform	**10 Hours**

Periodic functions, Euler's formulae, Fourier series of odd and even functions, functions with arbitrary period, half range series. Fourier transform, inverse Fourier transform, convolution theorem, Fourier sine and cosine transforms. Discrete Fourier transform(DFT) and Fast Fourier transform (FFT)- applications.

UNIT-V

Z-Transforms	**10 Hours**

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.	Establish by deduction the validity of an argument using inference rules.
2.	Represent a relation in terms of matrix and digraph, apply permutation functions for encoding and decoding simple text massages. Identify suitable data structure for representing a graph, apply the concept of connectivity in real life problems.
3.	Apply numerical methods to find solutions of algebraic equations and ordinary differential equations and partial differential equations.
4.	Apply the analytical technique to express periodic function as a Fourier sine and cosine series and apply the concepts of Fourier- transforms to solve engineering problems.
5.	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	3
MA1007 - 1.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1007 - 1.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1007 - 1.3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1007 - 1.4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1007 - 1.5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Kenneth H. Rosen, "Discrete Mathematics and its applications",Tata McGraw Hill, V Edition, 2003.
2.	B.S. Grewal, J. S. Grewal, "Numerical Methods in Engineering and Science", Khanna Publishers, 6th edition, 2002.
3.	Martin Vetterli, Jelena Kovacevic and Vivek Goyal, "Foundations of Signal Processing", Cambridge University Press, 2014.

REFERENCE BOOKS:

1.	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition

	(Reprint), 2016.
2.	Bernard Kolman, Robert C. Busby, Sharon Ross, “Discrete Mathematical Structures” III edition, PHI 2001.
3.	Ralph P. Grimaldi, “Discrete and Combinatorial Mathematics”, Pearson Education, Asia, IV Edition-2002.
4.	J. P. Tremblay, R. Manohar, “Discrete Mathematical Structures with applications to computer Science”, Tata McGraw Hill-1987.
5.	S. S. Sastry, “Introductory methods of Numerical Analysis”, Prentice Hall, 2nd edn.1990.
6.	M. K. Jain, S.R.K. Iyengar and R.K. Jain “Numerical methods for Scientific and Engineering computations”, Wiley Eastern, edn.1985.
E Books / MOOCs/ NPTEL	
1.	http://www.nptelvideos.in/2012/11/discrete-mathematical-structures.html
2.	http://cglab.ca/~discmath/notes.html
3.	http://ocw.mit.edu/courses/mathematics/ (online course material)

MATERIALS CHEMISTRY FOR COMPUTER SYSTEMS

Course Code:	**CY1003-1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T:P):	**3:0:2**	**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	
Electrode & Energy Systems	8 Hours
Electrode System: Introduction to galvanic cell. Reference electrode - Introduction, calomel electrode – construction, working and applications. Concentration cell –Definition, construction, working, and numerical problems. Ion selective electrode–definition, construction, and advantages of glass electrode, determination of pH using glass electrode. Energy Systems: Introduction to batteries, construction, working and applications of Lithium ion, and Sodium ion batteries. Fuel cells, Construction, working and applications of methanol-oxygen fuel cell.	
Polymers & Analytical Techniques	07 Hours
Polymers: Introduction, Molecular weight –Number average, weight average and numerical problems. Preparation, properties, and commercial applications of carbon fibre. Conducting polymers– synthesis and conducting mechanism of polyaniline and commercial applications. 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-II	
Sensors and PCB	07 Hours
Sensors: Introduction, working, principle and applications of Conductometric sensors, Electrochemical sensors, Thermometric sensors (Flame photometry) and Optical sensors(colorimetry). Sensors for the measurement of dissolved oxygen (DO). Electrochemical sensors for pharmaceuticals. Electrochemical gas sensors for SOx and NOx. Disposable sensors in the detection of biomolecules and pesticides. Printed Circuit Boards: Electroless plating – Introduction, Electroless plating of copper in the manufacture of double-sided PCB and its applications.	
Memory Devices and Display Systems	08 Hours
Memory Devices: Introduction, Basic concepts of electronic memory, History of organic/polymer electronic memory devices, Classification of electronic memory device, types of organic memory devices (organic molecules, polymeric materials, organic-inorganic hybrid materials). Display Systems: Photoactive and electroactive materials, Nanomaterials and organic materials used in optoelectronic devices. Liquid crystals (LC's)- Introduction, types, properties and applications in Liquid Crystal Displays (LCD's)- Electro-optic effect, Properties, and application of Organic Light Emitting Diodes (OLED's) and Quantum Light Emitting Diodes (QLED's), Light emitting electrochemical cells.	
UNIT-III	
E-Waste Management & Green Fuels	10 Hours
E-Waste: Introduction, sources of e-waste, Composition, Characteristics, and Need of e-waste management. Toxic materials used in manufacturing electronic and electrical products, health hazards due to exposure to e-waste. Recycling and Recovery: Different approaches of recycling (separation, thermal treatments, hydrometallurgical extraction, pyrometallurgical methods, direct recycling). Extraction of gold from E-waste. Role of stake holders in environmental management of e-waste (producers, consumers, recyclers, and statutory bodies). Green Fuels: Introduction, construction and working of solar photovoltaic cell, advantages, and disadvantages. Generation of energy (green hydrogen) by electrolysis of water and its advantages.	

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
CY1003-1.1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1003-1.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1003-1.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1003-1.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CY1003-1.5	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

APPLIED DIGITAL LOGIC DESIGN

Course Code:	**EC1002-1**	**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→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	PSO↓		
↓ Course Outcomes													1	2	3
EC1002-1.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EC1002-1.2	3	1	1	-	3	-	-	-	3	1	-	-	-	-	-
EC1002-1.3	3	2	1	-	3	-	-	-	3	1	-	-	-	-	-
EC1002-1.4	3	-	-	-	3	-	-	-	3	1	-	-	-	-	-
EC1002-1.5	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

INTRODUCTION TO C PROGRAMMING

Course Code:	**CS1004-1**	**Course Type:**	**PLC**
Teaching Hours/Week (L: T: P):	**2:0:2**	**Credits:**	**03**
Total Teaching Hours:	**25+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 and Structures
5.	Demonstrate the usage of Pointers, and File handling that are essential for understanding the concepts with simple examples.

UNIT-I

Introduction To C Programming Language	**10 Hours**
Basic C 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	**05 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

6.	Write a C program to find the roots of a quadratic equation $ax^2+bx+c=0$

7.	Write a C program to find the sum of all the digits and occurrence of a digit in the number.
8.	Write a C program to find the GCD and LCM of given two numbers using Euclid's method.
9.	Write a C program to print the prime numbers in a given range.
10.	Write a C program to find if a given string is a palindrome or not using string manipulation functions.
11.	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.]
12.	Write a C program to read N integers into an array A and find the sum of elements using pointers.
13.	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.

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

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

BASIC ELECTRICAL ENGINEERING

Course Code:	**EE1001-2**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P):	**2:0:2**	**Credits:**	**03**
Total Teaching Hours:	**40+0+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

IT SKILLS			
Course Code:	**CS1651-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P):	**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*BiologyforEngineers*,PHIlearningPrintBookISBN:9789391818142eBook 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.andSimmons,C.A.*Introductorybiomechanics*-Fromcellstoorganisms.Cambridge University Press,2012

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.

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.

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	**MA1002-1**		

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

Suggested 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	Differentiation of composite and implicit functions.
4	Taylor's/ Maclaurin's series expansion of a function of single variable.
5	Computation of partial derivatives and Jacobians
6	Evaluation of double/triple integrals with constant/variable limits.
7	Computation of angle between (a) radius vector and tangent (b) two curves

8	Computation of radius of curvature
9	Computation and visualization of (a) gradient of a scalar function (b) divergence and curl of a vector function
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

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
MA1006-1-1.1	3	2		-	-	-	-	-	-	-	-	-	-	-	-
MA1006-1-1.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MA1006-1-1.3	3	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 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

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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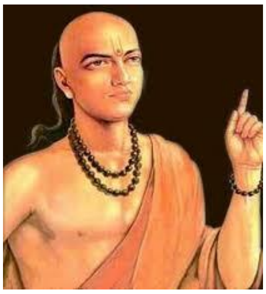
HOLISTIC COMPONENTS

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.

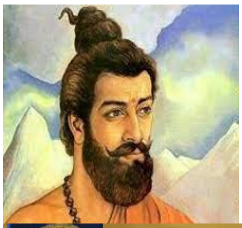
"If you wish to make an apple pie from scratch, you must first invent the universe."So said astronomer Carl Sagan in an episode of his landmark television series, Cosmos. Embedded in Sagan's memorable quip is a certain holistic understanding of the universe — a notion that the existence of any one thing 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.

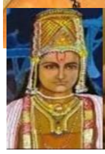
CHEMISTRY

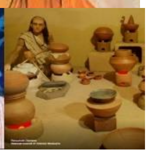
ANCIENT SEERS OF INDIA – CHEMISTRY

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.

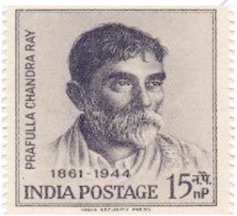


It is said that **Maharshi Kanada** was the first to propound that the *Parmanu* (atom) was an indestructible particle of matter and that Universe is made up of *Kana*. When matter is divided and sudivided, we reach a stage beyond which no division is possible, the undivisible element of matter is *Parmanu*. 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 $\mathbf{ax^2 + bx + c = 0, a \neq 0}$ 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 $\mathbf{10^{53}}$** (10 to the power 53) with specific names. The largest used number today is **Tera $\mathbf{10^{12}}$**.

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 ञ(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 (16^{th} century) studied and designed many mechanical systems that were related to transportation and warfare. In 17^{th} century, Isaac Newton contributed the Laws of Motion used in several applications. Rudolf Diesel (18^{th} 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 (18^{th} 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

Scheme & Syllabus for
B. Tech. (Artificial Intelligence and Data Science)

HIGHER SEMESTER COURSES

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
2023-24

B.Tech. (AD): 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 Department	Teaching Hours /Week				Examination				Credits
					Lecture L	Tutorial T	Practical/ P	PBL J	Duration in hours	CIE Marks	SEE Marks	Total	
1	BSC	MA2001-1	Statistics & Probability Theory	MA	3	0	0	0	3	50	50	100	3
2	IPCC	CS2001-1	Data Structures	AD	3	0	2	0	3	50	50	100	4
3	IPCC	CS2002-1	Object Oriented Programming	AD	3	0	2	0	3	50	50	100	4
4	PCC	AD1101-1	Computer Organization	AD	3	0	0	0	3	50	50	100	3
5	PCC	AD1102-1	Fundamentals of Data Science	AD	3	0	0	0	3	50	50	100	3
6	PCC	AD2601-1	Practicing Data Science with MS Excel and Python	AD	0	0	2	0	3	50	50	100	1
7	AEC	ME1654-1	Innovations and Design Thinking	Any Dept.	1	0	0	0	1	50	50	100	1
8	HSMC	HU1004-1	Universal Human Values	Any Dept.	1	0	0	0	1	50	50	100	1
9	MNC	HU1003-1	Kannada (Balake / Samskrithika)	Any Dept.	1	0	0	0	-	50	-	50	0
Total					**18**	**0**	**6**	**0**	**20**	**450**	**400**	**850**	**20**
Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs													
10	MNC	MA1012 -1	Bridge Course – Calculus & Differential Equations	MA	3	0	0	0	3	100	0	100	0

B.Tech. (AD): Scheme of Teaching and Examinations 2023-27
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2nd Year Scheme

IV SEMESTER

Sl No.	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week				Examination					Credits
					Lecture L	Tutorial T	Practical/ Drawing P	PBL J	Duration in hours	CIE Marks	SEE Marks	Total		
1	BSC	MA2006-1	Linear Algebra, Statistical Analysis & Computing	MA	3	0	0	0	3	50	50	100		3
2	IPCC	CS3004-1	Design and Analysis of Algorithms	AD	3	0	2	0	3	50	50	100		4
3	IPCC	AD2001-1	Fundamentals of Machine Learning	AD	3	0	2	0	3	50	50	100		4
4	PCC	AD1103-1	Software Engineering	AD	3	0	0	0	3	50	50	100		3
5	PCC	CS2102-1	Database Management Systems	AD	3	0	0	√	3	50	50	100		3
6	PCC	AD1602-1	Data Handling and Visualization with R	AD	0	0	2	0	3	50	50	100		1
7	HSMC	HU2001-1	Enhancing Self Competence	HU	2	0	0	0	3	50	50	100		2
8	HEC	HU1005-1	Essence of Indian Culture	Any Dept.	1	0	0	0	-	50	-	50		0
9	VEC	AD2551-1	Building Responsive and Accessible Web Interfaces	AD	0	0	2	0	3	50	50	100		1
10	UCC	UC1001-1	Internship – I (Activity-based Internship)	Mandatory Intra Institutional Internship of 2 weeks duration (80 - 90 Hours) 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		**18**	**0**	**8**	**√**	**24**	**550**	**400**	**950**		**23**
Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs														
11	MNC	MA1014-1	Bridge Course – Discrete Mathematics & Numerical Methods	MA	3	0	0	0	3	100	0	100		0

B.Tech. (AD): 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 Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hours	CIE Marks	SEE Marks	Total	
					L	T	P	J					
1	IPCC	AD1002-1	Cloud Computing	AD	3	0	2	0	3	50	50	100	4
2	IPCC	AD2003-1	Principles of Artificial Intelligence	AD	3	0	2	0	3	50	50	100	4
3	PCC	AD2104-1	Operating System	AD	3	0	0	0	3	50	50	100	3
4	PCC	AD3603-1	Database Management Systems Lab	AD	0	0	2	0	3	50	50	100	1
5	PEC	AD2XXX-1	Professional Elective-I	AD	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	AD2651-1	C++ and Unix Programming	AD	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	AD	1	0	0	0	1	50	50	100	1
9	AEC	UM1003-1	Employability Skill development	AD	1	0	0	0	-	50	-	50	1
Total					**16/17**	**0**	**8/6**	**0**	**20**	**450**	**400**	**850**	**20**

VI SEMESTER

Sl. No	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	PBL	Duration in hours	CIE Marks	SEE Marks	Total	
					L	T	P	J					
1	IPCC	AD1004-1	Computer Networks	AD	3	0	2	0	3	50	50	100	4
2	PCC	AD2105-1	Bigdata Analytics	AD	3	0	0	0	3	50	50	100	3
3	PCC	AD2604-1	Full stack development	AD	0	0	2	0	3	50	50	100	1
4	PEC	AD2XXX-1	Professional Elective - II	AD	3	0	0	0	3	50	50	100	3
5	PEC	AD2XXX-1	Professional Elective -III	AD	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	MG1003-1	Management & Entrepreneurship	Any Dept.	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**	**0**	**22**	**400**	**400**	**800**	**21**

B.Tech. (AD): 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 Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week: Lecture (L)	Tutorial (T)	Practical/ Drawing (P)	PBL (J)	Examination: Duration in hours	CIE Marks	SEE Marks	Total	Credits
1	IPCC	AD2005-1	Data Privacy and Internet Security	AD	3	0	2	0	3	50	50	100	4
2	PCC	AD2605-1	Practice of a Modern Tool for Data Science	AD	0	0	2	0	3	50	50	100	1
3	PEC	AD2XXX-1	Professional Elective – IV	AD	3	0	0	0	3	50	50	100	3
4	PEC	AD2XXX-1	Professional Elective – V	AD	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	MG1002-1	Financial Management	Any Dept.	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	UC2002-1	Major Project Phase I	AD	-	-	4	-	-	100	-	100	2
			Total		**16**	**0**	**8**	**0**	**18**	**450**	**300**	**750**	**20**

VIII SEMESTER

Sl. No	Course Type	Course Code	Course Title	Teaching Department	Teaching Hours /Week: Lecture (L)	Tutorial (T)	Practical/ Drawing (P)	PBL (J)	Examination: Duration in hours	CIE Marks	SEE Marks	Total	Credits
1	UCC	UC2001-1	Internship – II (Societal internship and Research/Industry Internship)	AD	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	UC3001-1	Major Project- II /Research Project/ Industry project	AD	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		**0**	**0**	**0**	**0**	**6**	**150**	**150**	**300**	**16**

List of Professional Elective Courses [PEC]			
Group-1		**Group-2**	
Code	**Elective Course Title**	**Code**	**Elective Course Title**
AD1201-1	Image and Video analytics	AD1301-1	Augmented and Virtual Reality
AD1202-1	Knowledge Engineering	AD1302-1	Multimedia Data Compression and Storage
AD1203-1	Recommender Systems	AD1303-1	Operations Research
AD2201-1	Business Analytics	AD1304-1	SAS Programming

AD2202-1	Business Intelligence	AD2301-1	Advanced Java Programming
AD2203-1	Cognitive Science	AD2302-1	Mobile App Development
AD2204-1	Data Wrangling	AD2303-1	Cryptocurrency and Blockchain Technologies
AD2205-1	High-Dimensional Data Analysis	AD2304-1	Cyber Security
AD2206-1	Natural Language Processing	AD2305-1	Ethics and AI
AD2207-1	Neural Networks and Deep Learning	AD2306-1	Intelligent Database System
AD2208-1	Social Web analytics	AD2307-1	Internet of Things
AD2209-1	Soft Computing	AD2308-1	Object Oriented Modeling Design
AD2210-1	Statistical Inference for Data Science	AD2309-1	Robotic Process Automation
AD2211-1	Stream Processing	AD2310-1	Software Testing and Automation
AD2212-1	Text and Speech Analysis	AD2311-1	Storage Technologies
AD2213-1	Time Series Analysis	AD2312-1	Supply Chain Management
		AD2313-1	UI and UX Design

Courses from Basic Science

STATISTICS & PROBABILITY THEORY

Course Code:	**MA2001-1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**MA1002-1**		

Teaching Department: Mathematics

Course Objectives:

1.	Understand the basic principles of probability, Bayes theorem, understand the definitions of discrete, continuous, and joint random variables, compute the mean, variance, and covariance of random variables.
2.	Define the binomial, uniform, Poisson, exponential and normal random variables use these principles in problem solving situations.
3.	Understand the concepts of statistical population and sample, variables and attributes. Learn about moments and their use in studying various characteristics of data and various distributions.

UNIT-I

PROBABILITY THEORY — **16 Hours**

Finite sample space, probability, conditional probability and independence, Bayes' theorem. One dimensional random variable: discrete and continuous random variable, probability functions, cumulative distribution function, expectation, and variance.
Two-dimensional random variable: joint pdf, marginal pdf's, covariance
Distributions: Binomial, Poisson, Uniform, Normal and exponential distributions. Moment generating function- properties and simple problems.

UNIT-II

SAMPLING DISTRIBUTION AND ESTIMATION — **14 Hours**

Random Sample, Sample mean, sample variance, sampling distribution of mean, Central limit theorem, sampling distributions of proportions and sums. Student's t-distribution, Chi-square distribution. Sample distribution of variance.
Estimation: Point estimation, interval estimation, confidence intervals for means and variance.

CURVE FITTING AND REGRESSION

Least square principle, fitting of straight lines, polynomials, and exponential curves. Correlation, Rank correlation, Coefficient of correlation, Linear regression.

UNIT-III

STOCHASTIC PROCESS — **10 Hours**

Stochastic processes, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, transition probabilities, Birth-death process, Queuing theory – M/M/1 Model, simple problems.

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

1.	Apply the concepts of probability, including discrete and continuous random variables, probability distributions, conditioning, independence, expectations, and variances.
2.	Define and explain the different statistical distributions (e.g., Normal, Binomial, Poisson) and the areas of their application.
3.	Explain the concept of correlation and the difference between positive and negative correlation. Compute the correlation coefficient, r, Explain and apply the least square errors method numerically and algebraically to find the curve of best fit.

4.	Able to apply the central limit theorem to sampling distribution. Translate real-world problems into probability models.
5.	Identify and apply the most appropriate stochastic process technique for a given applied problem. Calculate probabilities of absorption and expected hitting times for discrete time Markov chains with absorbing states.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	**PSO↓**		
↓ Course Outcomes													1	2	3
MA2001-1.1	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-
MA2001-1.2	2	2	-	-	-	-	-	-	-	-	-	-	3	2	-
MA2001-1.3	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
MA2001-1.4	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-
MA2001-1.5	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Paul L Meyer, "Introductory Probability and Statistical Applications", Addison-Wesley Publishing Company, 2nd Edition (Reprint), 1970.
2.	Hogg and Craig, "Introduction to mathematical Statistics", Pearson Education, New Delhi, 6th Edition.

REFERENCE BOOKS:

1.	Schaum Outlines, "Probability and Statistics", Mc Graw Hill, 3rd edition, 2010.
2.	T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
3.	B. V. Ramana, "Higher Engineering Mathematics", Tata Mc Graw –Hill, New Delhi,2010.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/110107114
2.	https://nptel.ac.in/courses/111105090
3.	https://nptel.ac.in/courses/111102098

LINEAR ALGEBRA, STATISTICAL ANALYSIS & COMPUTING

Course Code:	**MA2006-1**	**Course Type:**	**BSC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisites	**MA1002-1, MA1004-1, MA2001-1**		

Teaching Department: Mathematics

Course Objectives:

1.	Learn to apply elementary row operations to solve linear systems of equations and find the eigenvalues and eigenvectors of a matrix.
2.	Find the eigenvalues and eigenvectors of a square matrix using the characteristic polynomial and will know how to diagonalize a matrix, when this is possible.
3.	To understand the testing hypothesis of large and small samples.
4.	To Analyse multivariate distributions and test for multiple correlation coefficients.

UNIT-I

15 Hours

Linear Algebra: 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.

Trace, relation between trace and Eigen values of a matrix, Eigen values and Eigen vectors of symmetric matrices, Rayleigh's power method to find the largest eigen values and eigen vectors of square matrices. Diagonalization.

UNIT-II

15 Hours

Tests of Hypothesis, Sampling and Design of Experiments: Confidence interval-large and small samples. Tests of significance-large and small sample, Z-test, t-test, F-test and chi-square tests. Sampling- random sampling. Experimental designs, Analysis of variance- one way and two-way classifications. Resampling Techniques and Bootstapping. Introduction to contemporary statistical packages.

UNIT-III

10 Hours

Multivariate Analysis: Multivariate distributions: multivariate normal distribution and its properties, distributions of linear and quadratic forms, tests for partial and multiple correlation coefficients and regression coefficients and their associated confidence regions. Data analytic illustrations.

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

1.	Solve the system of linear equations for exact or approximate solutions.
2.	Compute and use eigenvectors and eigenvalues and perform diagonalization of matrices
3.	Choose a suitable hypothesis testing procedure and evaluate the outcomes.
4.	Obtain simple statistical experiments, collect data and perform statistical analysis of variance.
5.	Analyse multivariate distributions and test for multiple correlation coefficients

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
MA2006-1.1	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
MA2006-1.2	2	3	-	-	-	-	-	-	-	-	-	-	3	2	-

MA2006-1.3	2	3	-	-	-	-	-	-	-	-	-	-	3	2	-
MA2006-1.4	2	3	-	-	-	-	-	-	-	-	-	-	3	2	-
MA2006-1.5	2	3	-	-	-	-	-	-	-	-	-	-	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Kenneth Hoffman And Ray Kunze, “Linear Algebra”, Prentice-Hall, 2nd Edition, 1971.
2.	Hogg and Craig, “Introduction to mathematical Statistics”, Pearson Education, New Delhi, 6th Edition.
3.	T. W. Anderson, “An Introduction to Multivariate Statistical Analysis”.

REFERENCE BOOKS:

1.	Schaum Outlines, “Probability and Statistics”, Mc Graw Hill, 3rd Edition, 2010.
2.	S. Ross, “Introduction to Probability Models”.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/111101115
2.	https://nptel.ac.in/courses/111104073
3.	https://nptel.ac.in/courses/111104024

Bridge Courses for Lateral Entry Students

CALCULUS & DIFFERENTIAL EQUATIONS
(COMMON TO AM\CC\CS\IS\DS\RI)

Course Code:	**MA1012-1**	**Course Type:**	**MNC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**00**
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, Vector differentiation and Integration and become skilled for solving problems in science and engineering.

UNIT-I

DIFFERENTIAL CALCULUS	**07 Hours**

Polar curves, angle between the radius vector and the tangent, angle of intersection of two curves, derivatives of arcs and radius of curvature -cartesian, parametric and polar forms (No Derivation). Taylor’s theorem for functions of single variable. Mean value theorems.

PARTIAL DIFFERENTIATION	**08 Hours**

Partial derivatives of simple functions, Total differentiation - differentiation of composite and implicit functions. Taylor’s theorem for functions of two variables, maxima and minima for functions of two variables.

UNIT-II

VECTOR DIFFERENTIAL CALCULUS	**07 Hours**

Vector algebra(review), scalar and vector valued functions, gradient, directional derivative and hessian of multivariable function, Divergence and curl of a vector valued function.

ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS	**08 Hours**

Ordinary differential equations(review), linear and nonlinear differential equations. Second and higher order linear differential equations with constant coefficients.
Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions. Solution of P.D.E by the method of separation of variables.

UNIT-III

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.

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

1.	Apply the concept of radius of curvature and mean value theorems.
2.	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.
3.	Solve the vector functions and their derivatives for engineering applications.

4.	Apply the concepts of ordinary and partial differential equations in engineering problems.
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
MA1012-1.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1012-1.2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1012-1.3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
MA1012-1.4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1012-1.5	3	2	-	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43^{rd} Edition, 2015.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10^{th} Edition (Reprint), 2016.
3.	Murray R. Spiegal, "Vector Analysis", Schuam Publishing Co.

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 - DISCRETE MATHEMATICS & NUMERICAL METHODS (COMMON TO AM\CC\CS\IS\DS\RI)

Course Code:	**MA1014-1**	**Course Type:**	**MNC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**00**
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 set theory and relations, propositional and predicative logics, numerical methods, Fourier series and transforms and become skilled for solving problems in science and engineering.

UNIT-I

Set Theory and Logic	**07 Hours**

Sets- operations on sets, product sets and partitions (review)
Relations- representation of relations as matrices and digraphs, equivalence relations.
Functions- permutations functions, functions for computer science.
Fundamentals of logic-
Propositional logic, logical operations(review), rules of inference Predicates calculus.

Graph Theory	**08 Hours**

Graphs: Basic terminologies, some special simple graphs, bipartite graphs, adjacency matrices, incidence matrices, graph isomorphism, connectivity- vertex and edge connectivity, Euler and Hamiltonian graphs and their applications, planar graphs, graph coloring and their applications.

UNIT-II

Numerical Methods	**15 Hours**

Roots of algebraic and transcendental equations- Newton Raphson method, Regula Falsi method.
Numerical solution of ordinary differential equations- Taylor's series method, Modified Euler's method and Runge –Kutta method of fourth order.
Numerical solution of partial differential equations- Classification of partial differential equations, examples, solution of Laplace and Poisson equations by standard five-point formulae, solution of heat and wave equations by explicit method.

UNIT-III

Fourier Series and Transforms	**10 Hours**

Periodic functions, Euler's formulae, Fourier series of odd and even functions, functions with arbitrary period, half range series. Fourier transform, inverse Fourier transform, Convolution theorem, Fourier sine and cosine transforms.

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

1.	Represent a relation in terms of matrix and digraph, apply permutation functions for encoding and decoding simple text messages and establish by deduction the validity of an argument

	using inference rules. Identify suitable data structure for representing a graph, apply the concept of connectivity in real life problems
2.	Identify suitable data structure for representing a graph, apply the concept of connectivity in real life problems.
3.	Apply numerical methods to find solutions of algebraic equations and ordinary differential equations.
4.	Apply numerical methods to solve partial differential equations
5.	Apply the analytical technique to express periodic function as a Fourier sine and cosine series and apply the concepts of Fourier- 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
MA1014-1.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1014-1.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1014-1.3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1014-1.4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA1014-1.5	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. T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.

2. B. V. Ramana, "Higher Engineering Mathematics", Tata Mc Graw –Hill, New Delhi,2010.

Integrated Professional Core Courses

DATA STRUCTURES

Course Code:	**CS2001-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P):	**3:0:2**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**CS1001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Outline the concepts of data structure, it's operations, Memory allocation functions and design the programs using arrays and structures, pointers, pointer to structure.
2.	Implement linear data structure stack and usage of stacks in various applications.
3.	Implement linear data structure Ordinary Queue, Circular Queue, and priority queues.
4.	Implement the operations of singly linked lists and circular linked lists, doubly linked list and circular doubly lists.
5.	Identify and differentiate different types of binary trees and binary search trees data structures and implement them and illustrate threaded binary trees, expression trees, graph representation and techniques of hashing.

UNIT-I

15 Hours

Introduction: Data Structure Definition, Classification (Primitive and non-primitive), data structure operations, Pointers, and Dynamic Memory Allocation functions with programming examples
Arrays and Structures: Arrays in C, dynamically allocated arrays, Structures and Union, Array of Structures and Pointer to Structure, Programming Example.
Linear Data Structures-Stack: Introduction and Definition, Representation of stack: Array and structure representation of stacks, Primitive operations on stacks
Applications of Stack: Conversion of Expressions
Algorithms and C programs with tracing Examples: For evaluating postfix expression, infix to postfix conversion.
Recursion: Definition, Implementation, Examples on Recursion with tracing: Factorial function, Fibonacci sequence and Tower of Hanoi

UNIT-II

15 Hours

Linear Data Structures-Queue: Introduction and Definition, Representation of Queue: Array and Structure representation of Queue, Other queue structures: circular queue, priority queue.
Linear Data Structures-Linked List: Singly Linked List and chains, representing chain in C using dynamic variables, Inserting and deleting nodes, other list Operations on singly Linked List, Linked Stack and Queues, Header Nodes, Representation of Linked list using arrays.
Circular Linked List, Doubly Linked List and Circular doubly Link list: Representation and Operations.

UNIT-III

10 Hours

Tree data structures:
Introduction- Tree definition, Terminology, Binary Trees- Definition, Types, Properties, Representation of Binary Tree: Array representation, Linked representation, Binary Tree traversals- Preorder, Inorder and postorder. Threaded binary Trees: Definition, types, Data structure and memory representation of threaded tree, Binary Search Tree: Definition, Construction- Searching, Insertion operations, deletion process, Traversal examples.

Expression Tree- Constructing expression tree for a given expression, traversals, Evaluation of expression, programming examples.
Nonlinear Data structures: Graphs- Representation of graphs: Definition, types and terminology, Matrix representation, Adjacency list chain and sequential representation.
Hashing: Hash Table organizations, Hashing Functions, Overflow handling.

Suggested List of Experiments

1.	Programs on arrays and structures using Pointers
2.	Stack and Ordinary Queue implementation using array and structure.
3.	Application of stack data structure- • Evaluation of post fix and Tower of Hanoi problem using recursion. • Conversion infix to postfix
4.	Circular and priority queues.
5.	Operation on Singly Linked list implementation using dynamic variables.
6.	Dynamic implementation of stack and Queue data structure.
7.	Circular linked list
8.	Doubly linked list implementation.
9.	Binary Search Tree Construction and Tree traversal operations.
10.	Hashing- Searching and collision handling

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

1.	Acquire the fundamental knowledge of various types of data structures, dynamic memory allocation and design the programs using arrays, structures, and pointers
2.	Apply the fundamental knowledge of data structures to design stack and use them for solving problems.
3.	Apply the fundamental knowledge of data structures to design queues and use them for solving problems.
4.	Design and develop singly linked lists, circular linked lists, and doubly linked list.
5.	Acquire the knowledge of trees and employ binary trees and binary search tree data structure, advanced trees, representation of graphs and hashing 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**
CS2001-1.1	3	1	3	-	-	-	-	-	-	-	-	1	3	2	-
CS2001-1.2	3	1	3	-	-	-	-	-	-	-	-	1	3	2	-
CS2001-1.3	3	1	3	-	-	-	-	-	-	-	-	1	3	2	-
CS2001-1.4	3	1	3	-	-	-	-	-	-	-	-	1	3	2	-
CS2001-1.5	3	1	3	-	-	-	-	-	-	-	-	1	3	2	-

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.

OBJECT ORIENTED PROGRAMMING

Course Code:	**CS2002-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P):	**3:0:2**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**CS1001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Learn fundamental features of object-oriented language and JAVA programming constructs.
2.	Develop and run simple Java programs using OOPS concepts of java.
3.	Create multi-threaded programs and event driven Graphical User Interface (GUI) programming using swing package.

UNIT-I

15 Hours

Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, this keyword, Method overloading, using objects as parameters, Argument passing, returning objects, Access control, static, final, Using command line arguments, variable length arguments.

Inheritance: Inheritance Basics, using super, creates a Multilevel Hierarchy, when constructors are called? Method Overriding, using abstract classes, Using final with Inheritance.

Packages and Interfaces: Packages, Access protection, Importing Packages, Interfaces.

Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, multiple catch Clauses, Nested try statements, throw, and throws, finally.

UNIT-II

15 Hours

Multithreaded Programming: The Java Thread Model, The Main Thread, creating a Thread, Creating Multiple Threads, Using is Alive () and join (), Thread Priorities.

File Handling: Serial Access Files, File Methods.

Event Handling: Two Event Handling Mechanisms, the Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Event Model.

Generics: What are Generics? A Simple Generics Example, A Generic class with two type parameters, the general form of a generic class, Creating a Generic method, Generic Interfaces.

UNIT-III

10 Hours

Collections framework: Collection Interfaces – List, Set, Queue. Collection classes – ArrayList, LinkedList, HashSet, LinkedHashSet, TreeSet, PriorityQueue, Stack, Arrays.

Swings: The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Event Handling, Jlabel and ImageIcon; JTextField; The Swing Buttons; JTabbedPane; JScrollPane; JList; JComboBox; JTable.

Suggested List of Experiments

1.	Use java program to demonstrate the OOP concepts.
2.	Demonstrate the file handling using Java

3.	Implement the java programs that uses the concepts of exception handling, multi- threading.
4.	Developing of user interfaces using the swings concepts of Java.

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

1.	Develop classes and apply object-oriented features to solve real world problems.
2.	Develop robust Java programs using exception handling features, implement multiple inheritance using interfaces and organize the application classes using packages.
3.	Develop programs that can run concurrent tasks using multithreading and perform basic file operations.
4.	Develop GUI applications using Java swings and manage various events generated by user interactions with the UI using event handling mechanisms.
5.	Develop type independent classes using generics; Choose and apply the right data structure to manage collection of data using the collections framework.

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
CS2002-1.1	3	1	3	-	1	-	-	-	-	-	-	2	2	3	-
CS2002-1.2	3	1	3	-	2	-	-	-	-	-	-	2	3	3	-
CS2002-1.3	3	1	3	-	3	-	-	-	-	-	-	2	3	3	-
CS2002-1.4	3	1	3	-	3	-	-	-	-	-	-	2	2	3	-
CS2002-1.5	3	1	3	-	-	-	-	-	-	-	-	2	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Herbert Scheldt, Java the Complete Reference, 7th Edition, Tata McGraw Hill, 2007.
2. Jan Graba, An Introduction to Network Programming with Java, 2007, Springer Publications.

REFERENCE BOOKS:

1. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education, 2008, ISBN:9788131720806.
2. Rajkumar Buyya, S Thamarasiselvi, Xingchen chu, Object oriented Programming with Java, Tata McGraw Hill education private limited.
3. Richard A Johnson, Introduction to Java Programming and OOAD, CENGAGE Learning.
4. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.

E Books / MOOCs/ NPTEL

1. Online course material by Oracle: http://docs.oracle.com/javase/tutorial/index.html
2. https://www.udemy.com/courses/search/?q=java&price=pricefree&view=grid
3. Oracle: www.oracle.com/events/global/en/java.../java-a-beginners-guide-1720064.pdf
4. NPTEL:www.nptelvideos.com/java/java_video_lectures_tutorials.php
5. http://agilemanifesto.org/
6. http://www.jamesshore.com/Agile-Book/

DESIGN AND ANALYSIS OF ALGORITHMS

Course Code:	**CS3004-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P):	**3:0:2**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**CS2001-1, CS1001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Understand the notion of algorithms, Algorithm design and analysis process, asymptotic notations and analyze the non-recursive and recursive algorithms and to represent efficiency of these algorithms in terms of the standard asymptotic notations.
2.	Devise the Brute Force and Divide and Conquer techniques to design the algorithms and apply these methods in designing algorithms to solve a given problem.
3.	Apply the Decrease and Conquer, Transform and Conquer algorithm design techniques to solve a given problem.
4.	Get idea of Time versus Space Trade-offs and Apply and Analyze dynamic programming methods in designing algorithms to solve a given problem.
5.	Describe and illustrate the idea of Greedy method, Backtracking and Branch and Bound algorithm design techniques to solve a given problem and to describe P, NP and NP Complete problems.

UNIT-I

15 Hours

INTRODUCTION: What is an Algorithm? Fundamentals of Algorithmic Problem Solving.
FUNDAMENTALS OF THE ALGORITHMS EFFICIENCY: Analysis Framework, Asymptotic Notations and Basic efficiency classes, Mathematical Analysis of Non-recursive and Recursive Algorithms.
BRUTE FORCE: Background, Selection Sort and Bubble sort, Sequential search and Brute-Force String Matching algorithms with complexity analysis, Exhaustive search.
DIVIDE AND CONQUER: General Method, Merge sort, Quick sort, Binary Search algorithms with Complexity analysis.

UNIT-II

15 Hours

DECREASE & CONQUER: General method, Insertion Sort algorithm, Graph algorithms: Depth First Search, Breadth First Search, Topological Sorting with complexity analysis.
TRANSFORM AND CONQUER: General method, Balanced Search Trees: AVL trees, 2-3 trees, Heaps and Heap sort algorithms with complexity analysis.
TIME AND SPACE TRADEOFFS: Sorting by counting, Input Enhancement in String Matching: Horspool's algorithm and analysis.
DYNAMIC PROGRAMMING: General method, The Floyd-Warshall Algorithm, The Knapsack problem, and memory function with complexity study.

UNIT-III

10 Hours

GREEDY TECHNIQUE: General method of Greedy technique, Minimum Spanning Trees: Prim's Algorithm, Kruskal's Algorithm, Single-Source Shortest Paths using Dijkstra's Algorithm, Huffman Trees
BACKTRACKING: General method, State space trees and algorithms for N-Queens problem, Subset-sum problem.
BRANCH AND BOUND: General method, Solving job Assignment Problem, Travelling Salesman

problem, Knapsack Problem using branch and bound method P,NP and NP Complete Problems.

Suggested List of Experiments

1.	Various Sorting/Searching algorithms.
2.	Graph traversals –DFS and BFS, Connectivity and Reachability of graphs.
3.	Topological Sorting.
4.	Descending Priority Queue using Heap.
5.	Horspool string matching algorithm.
6.	Binomial coefficient, Warshall’s algorithm, Floyd’s algorithm, Knapsack problem using Dynamic Programming and by using memory functions.
7.	Prim’s, Kruskal’s, Dijkstra’s algorithms.
8.	N-Queens problem.

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

1.	Analyze the performance of the algorithms, state the efficiency using asymptotic notations and analyze algorithms mathematically for the complexity of the algorithm.
2.	Apply Brute force method, divide and conquer approaches in solving the problems and analyze the same.
3.	Apply the appropriate algorithmic design technique like decrease and conquer approaches, transform, and conquer approaches and compare the efficiency of algorithms to solve the given problem.
4.	Apply and analyze dynamic programming approaches to solve some problems. And improve an algorithm time efficiency by sacrificing space.
5.	Apply and analyze greedy method, backtracking, branch, and bound methods to solve problems and to describe P, NP and NP Complete 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	3
CS3004-1.1	2	3	2	2	-	-	-	-	-	-	-	1	-	2	-
CS3004-1.2	2	2	2	2	-	-	-	-	-	-	-	1	-	3	-
CS3004-1.3	2	3	2	2	-	-	-	-	-	-	-	1	-	3	-
CS3004-1.4	2	2	2	2	-	-	-	-	-	-	-	1	-	3	-
CS3004-1.5	2	3	2	2	-	-	-	-	-	-	-	1	-	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Anany Levitin, “Introduction to the Design & Analysis of Algorithms”, 2nd Edition, Pearson Education, 2011.
2.	Thomas H. Cormen, Charles E.Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, 3rd Edition, PHI, 2014.

REFERENCE BOOKS:

1.	Horowitz E., Sahni S., Rajasekaran S, “Computer Algorithms”, Galgotia Publications, 2001.
2.	R.C.T. Lee, S.S. Tseng, R.C. Chang &Y.T.Tsai, “Introduction to the Design and Analysis of Algorithms A Strategic Approach”, Tata McGraw Hill, 2005.

E Books / MOOCs/ NPTEL

1.	http://www.facweb.iitkgp.ernet.in/~sourav/daa.html
2.	http://nptel.ac.in/courses/106101060/https://www.coursera.org/specializations/algorithms
3.	http://nptel.ac.in/courses/106101060/https://www.coursera.org/specializations/algorithms
4.	http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS43.html
5.	http://elearning.vtu.ac.in/econtent/courses/video/FEP/ADA.html
6.	http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms

FUNDAMENTALS OF MACHINE LEARNING

Course Code:	**AD2001-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P):	**3:0:2**	**Credits:**	**04**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite:	**AD1102-1, AD2601-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Understand the need and basics of machine learning and learn the Decision Tree model.
2.	Learn ANN and Genetic Algorithms along with their applications.
3.	Explore the various learning algorithms using Supervised Learning.
4.	Understand the important aspects of Analytical Learning and the difference between Analytical and Inductive Learning Algorithms.
5.	Analyze the techniques related to reinforcement learning.

UNIT-I

15 Hours

Foundations of Machine Learning: 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, Find S-Version Spaces and Candidate Elimination Algorithm.
Supervised Learning-I: Linear Regression: Introduction, univariate linear regression, gradient descent, multivariate linear regression, regularized regression.

UNIT-II

15 Hours

Supervised Learning- II: Logistic regression: classification, Artificial Neural Networks, Support Vector Machines.
Classification: Introduction, Decision Trees, Linear Discriminant Analysis, K-nearest neighbor model, Locally Weighted Regression, Bayesian Learning, Naive Bayes Classifier, Introduction to Hidden Markov Models and deep learning

UNIT-III

10 Hours

Unsupervised Learning: Clustering: Introduction, K-means, Hierarchical clustering
Evaluation Measures and Combining Learners: Evaluation Measures: Cross-validation and Re-sampling, Measuring Error, Hypothesis Testing.
Reinforcement Learning: Introduction, Learning Task, Q Learning.

Suggested List of Experiments

	PART- A
1.	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2.	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3.	Develop a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4.	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test

	the same using appropriate data sets.
5.	Develop a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6.	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
7.	Implement and demonstrate the working of k-Nearest Neighbor algorithm and apply it to classify the iris data set.
8.	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
9.	Build a model to classify email as spam or ham. First, download examples of spam and ham from Apache Spam Assassin's public datasets and then train a model to classify email.
	PART- B
	Mini Project on Machine Learning: The main goal is to prepare students to apply machine learning algorithms to real-world tasks, or to leave students well-qualified to start machine learning or AI research. The mini project is intended to start in these directions. Students shall carry out one of the following three kinds of projects: 1. Application project. Pick an interesting application and explore how best to apply learning algorithms to solve it. 2. Algorithmic project. Pick a problem or family of problems, and develop a new learning algorithm, or a novel variant of an existing algorithm, to solve it. 3. Theoretical project. Prove some interesting/non-trivial properties of a new or an existing learning algorithm. (This is often quite difficult, and so very few, if any, projects will be purely theoretical.)

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

1.	Explain the fundamental concept and importance of machine learning, and identify, analyze, and categorize applications that can use the machine learning concepts.
2.	Demonstrate the usage of algorithms like Find-S and Linear regression to solve machine learning problems.
3.	Explain and implement supervised learning systems using algorithms related to regression and classification.
4.	Explain and implement supervised learning systems using suitable algorithms. Demonstrate the usage of evaluation methods for algorithms.
5.	Demonstrate the machine learning algorithm using unsupervised learning and reinforcement techniques for solving real-world 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	3
AD2001-1.1	2	2	3	-	-	-	-	-	-	-	-	-	3	3	-
AD2001-1.2	2	2	3	-	-	-	-	-	-	-	-	-	3	3	-
AD2001-1.3	2	2	3	-	-	-	-	-	-	-	-	-	3	3	-
AD2001-1.4	2	3	-	-	-	-	-	-	-	-	-	-	1	3	-
AD2001-1.5	2	2	3	-	-	-	-	-	-	-	-	-	2	3	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. T. M. Mitchell, "Machine Learning", McGraw Hill, 2017.

2. Joel Grus, "Data Science from Scratch", 2ndEdition, O'Reilly Publications.

REFERENCE BOOKS:

1.	Ethem Alpaydin, "Introduction to Machine Learning", Second Edition, The MIT Press, 2004.
2.	C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3.	R. O. Duda, P. E. Hart and D. G. Stork Pattern Classification, Wiley Publications, 2001.
4.	T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008.
5.	P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012.
6.	K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.
7.	M. Mohri, A. Rostamizadeh, and A. Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
8.	S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.
E Books / MOOCs/ NPTEL	
1.	https://nptel.ac.in/courses/106106139
2.	https://archive.nptel.ac.in/courses/106/106/106106202/
3.	https://www.coursera.org/browse/data-science/machine-learning

CLOUD COMPUTING

Course Code:	**AD1002-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P):	**3:0:2**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite:			

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Outline the fundamental ideas behind Cloud computing, and the evolution of the paradigm, its applicability, benefits as well as current and future challenges.
2.	Get the basic idea and principles in Datacenter design and Management and find the importance of Virtualization in the Cloud.
3.	Get an idea of different Cloud deployment models and Cloud Delivery Models and their security issues.
4.	Tell how Cloud Computing solves different problems in the present by considering different Cloud Vendors and their Cloud Design architecture.

UNIT-I

15 Hours

Eras of computing, Parallel vs. Distributed Computing, Elements of Parallel Computing- (What is parallel computing, hardware architecture for Parallel processing, approaches to parallel programming, levels of parallelism, Laws of caution). Elements of Distributed Computing- (General concepts and definitions, components of a distributed system, Architectural styles for distributed computing, models for inter-process communication, Technologies for distributed Computing-Remote procedure call, Service oriented computing). Classic data center, its elements, challenges and benefits. Data center management Steps in transitioning to cloud- consolidation, automation, IT as a service. Cloud computing Architecture: - Introduction, Cloud reference models- (Architecture, Infrastructure/Hardware as a service, Platform as a service, Software as a service), Types of cloud – (Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds), Economics of cloud, Open challenges.

UNIT-II

15 Hours

Virtualization: Introduction, characteristics of virtualized environments, taxonomy of virtualization technique- (execution of virtualization, other types of Virtualization-Computes, Storage, Network, Desktop, Application). Virtualization and cloud computing, Pros and Cons of virtualization, Technology examples- XEN, VMware, Microsoft Hyper-V. Security Concerns, Risk Issues: - Cloud Computing- Security Concerns. A Closer Examination: Virtualization, A Closer Examination: Provisioning. Securing the Cloud: Key Strategies and Best Practices: - Overall Strategy: Effectively
Managing Risk-Risk Management: Stages and Activities. Overview of Security Controls, Cloud Security Controls Must Meet Your Needs, NIST Definitions for Security Controls, Unclassified Models, Classified Model the Cloud Security Alliance Approach. The Limits of Security Controls - Security Exposure Will Vary over Time, Exploits Don't Play Fair. Best Practices: Best Practices for Cloud Computing- First Principles, Best Practices across the Cloud Community. Other Best Practices for Cloud Computing- Cloud Service Consumers, Cloud Service Providers. Security Monitoring.

UNIT-III

10 Hours

The Purpose of Security Monitoring, Transforming an Event Stream, The Need for C.I.A. in Security Monitoring, the Opportunity for MaaS. Case studies: Public cloud- AWS, Windows Azure, Google App Engine. Private CloudOpen stack, Eucalyptus.

Suggested List of Experiments

1.	Install Virtual box/VMware Workstation with different flavors of Linux or windows OS on top of windows7 or 8.
2.	Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3.	Install Google App Engine. Create hello world app and other simple web applications using python/java.
4.	Use GAE launcher to launch the web applications.
5.	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6.	Find a procedure to transfer the files from one virtual machine to another virtual machine.
7.	Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
8.	Install Hadoop single node cluster and run simple applications like wordcount.

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

1.	Define the concept of cloud computing business needs and various networking methods.
2.	Express the infrastructure management for cloud environments.
3.	Describe the Virtualization at all levels used by XEN, Vmware, Hyper-v.
4.	Explain the security concepts in cloud computing.
5.	Practice the case studies of public cloud such as AWS, Google App Engine and private cloud such as Open Stack.

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**
AD1002-1.1	3	3	-	-	-	-	-	-	-	-	-	2	2	1	-
AD1002-1.2	3	3	-	-	-	-	-	-	-	-	-	2	2	1	-
AD1002-1.3	3	3	-	-	-	-	-	-	-	-	-	1	2	1	-
AD1002-1.4	3	3	-	-	-	-	-	-	-	-	-	2	2	1	-
AD1002-1.5	3	3	-	-	-	-	-	-	-	-	-	1	2	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Buyya, Rajkumar, Christian Vecchiola and ThamaraiSelvi, "Mastering Cloud Computing Fundamentals and Applications Programming", McGraw Hill, 2013.

2. Winkler, Vic (J.R), "Securing the Cloud - Cloud Computer Security Techniques and Tactics.",Elsevier Inc, 2012.

REFERENCE BOOKS:

1. Hurwitz, Judith, "Cloud computing for dummies.‖, Wiley India Pvt Ltd, 2011.

2. Rittinghouse, John,"Cloud computing – implementation, management and security",CRC Press, First edition, 2009.

3. Velte, Toby, Anthony Velte and Robert Elsenpete. "Cloud Computing, A Practical Approach.",Tata McGraw-Hill Authors, 2010.

E Books / MOOCs/ NPTEL

1. www.motc.gov.qa/sites/default/files/cloud_computing_ebook.pdf

2. http://eddiejackson.net/web_documents/The_Definitive_Guide_to_Cloud_Comput ing.pdf

3. http://nptel.ac.in/courses/106106129/28

4. https://www.coursera.org/learn/cloud-computing

PRINCIPLES OF ARTIFICIAL INTELLIGENCE

Course Code:	**AD2003-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P):	**3:0:2**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To impart artificial intelligence principles, techniques, and its history.
2.	To access the applicability, strength and weakness of the basic knowledge representation problem solving and learning methods in solving engineering problems.
3.	To develop intelligence systems by assembling solutions to concrete computational problems.

UNIT-I

15 Hours

Introduction: Evolution of Al, State of Art -Different Types of Artificial Intelligence, Applications of Al-Subfields of Al-Intelligent Agents- Structure of Intelligent Agents- Environments.
Problem Solving based on Searching: Introduction to Problem Solving by searching Methods, State Space search, Uninformed Search Methods- Uniform Cost Search, Breadth First Search, Depth First Search-Depth- limited search, Iterative deepening depth-first, Informed Search Methods- Best First Search, A* Search
Local Search algorithms: Hill-climbing search, Simulated annealing, Genetic Algorithm

UNIT-II

15 Hours

Adversarial Search: Game Trees and Minimax Evaluation, Elementary two-players games: tic-tac-toe, Minimax with Alpha-Beta Pruning.
Logic and Reasoning: Introduction to Logic and Reasoning -Propositional Logic-First Order Logic-Inference in First Order Logic- Unification, Forward Chaining, Backward Chaining, Resolution.
Uncertain Knowledge and Reasoning: Quantifying Uncertainty- Bayes Rule -Bayesian Belief Network-Approximate Inference in Bayesian networks

UNIT-III

10 Hours

Planning: Classical planning, Planning as State-space search, Forward search, backward search, Planning graphs, Hierarchical Planning, Planning, and acting in Nondeterministic domains - Sensor-less Planning, Multiagent planning.

Suggested List of Experiments

1.	Implement basic search strategies – 8-Puzzle, 8 - Queens problem, Cryptarithmetic.
2.	Implement A* and memory bounded A* algorithms
3.	Implement Minimax algorithm for game playing (Alpha-Beta pruning)
4.	Solve constraint satisfaction problems
5.	Implement propositional model checking algorithms
6.	Implement forward chaining, backward chaining, and resolution strategies.

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

1.	Evaluate Artificial Intelligence (AI) methods and describe the foundations.
2.	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.

3.	Demonstrate knowledge of reasoning, uncertainty, and knowledge representation for solving real- world problems.
4.	Analyze and illustrate how search algorithms plays a vital role in problem – solving.
5.	Identify the need of Planning states.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO↓**		
↓ Course Outcomes													**1**	**2**	**3**
AD2003-1.1	3	1	3	-	-	-	-	-	2	-	-	1	1	2	-
AD2003-1.2	2	2	1	-	1	-	-	-	2	-	-	1	1	3	-
AD2003-1.3	2	1	2	-	-	-	-	-	2	-	-	2	1	3	-
AD2003-1.4	3	1	2	-	1	-	-	-	2	-	-	2	1	3	-
AD2003-1.5	2	2	2	-	1	-	-	-	3	-	-	2	1	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.

REFERENCE BOOKS:

1.	Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007.
2.	Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008.
3.	Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.
4.	Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/106102220
2.	https://nptel.ac.in/courses/106105077
3.	https://nptel.ac.in/courses/112103280
4.	https://www.pdfdrive.net/artificial-intelligence-a-modern-approach-3rd-editione32618455.html.
5.	https://www.coursera.org/learn/introduction-to-ai.

COMPUTER NETWORKS

Course Code:	**AD1004-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P):	**3:0:2**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Explain the basics of data communication and various types of computer networks.
2.	Demonstration of application layer protocols
3.	Discuss transport layer services and understand UDP and TCP protocols.
4.	Explain the various features of transport layer protocol.
5.	Explain routers, IP and Routing Algorithms in network layer.

UNIT-I

15 Hours

Data Communications and Application Layer: Introduction-Data Communications, Networks, Network Types, Networks Models: TCP/IP Protocol suite, The OSI model
Principles of Network Applications; The Web and HTTP; File Transfer: FTP; Electronic Mail in the Internet; DNS - The Internet's Directory Service.

UNIT-II

15 Hours

Transport Layer: Introduction and Transport-Layer Services; Multiplexing and Demultiplexing; Connectionless Transport: UDP; Principles of Reliable of Data Transfer; Connection-Oriented Transport: TCP; Principles of Congestion Control, TCP Congestion Control.

UNIT-III

10 Hours

Network Layer: Introduction; What is inside a router; Internet Protocol (IP): Forwarding and Addressing in the Internet; Routing Algorithms; Routing in the Internet; Broadcast Routing.

Suggested List of Experiments

1.	Write a program for error detecting code using CRC-CCITT (16-bits)
2.	Write a program for Hamming Code generation for error detection and correction
3.	Write a program for frame sorting techniques used in buffers.
4.	Using TCP/IP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present
5.	Write a program for a distance vector algorithm to find a suitable path for transmission.
6.	Write a program for congestion control using Leaky bucket algorithm.
7.	Simulate a three nodes point-to-point network with duplex links between them. Set the queue size, vary the bandwidth, and find the number of packets dropped.
8.	Simulate a four-node point-to-point network, and connect the links as follows: n0- n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets by TCP/UDP.
9.	Simulate the different types of Internet traffic such as FTP a TELNET over a network and analyze the throughput.
10.	Simulate the transmission of ping messaged over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
11.	Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and determine collision across different nodes.

12.	Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and plot congestion window for different source/destination.

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

1.	Explain the various components of data communication
2.	Describe the features of the application layer and different network applications with its protocols.
3.	Analyze various transport services provided by different transport layer protocols.
4.	Illustrate the concept of congestion control.
5.	Explain the basic concept of network layer such as routers, IP addressing and Routing Algorithms.

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**
AD1004-1.1	3	2	-	-	1	-	-	-	-	1	-	-	2	-	-
AD1004-1.2	3	2	1	-	1	-	-	-	-	1	-	-	2	-	-
AD1004-1.3	1	2	2	-	1	-	-	-	-	1	-	-	3	-	-
AD1004-1.4	1	2	2	-	1	-	-	-	-	1	-	-	3	1	-
AD1004-1.5	2	1	-	2	1	-	-	-	-	1	-	-	2	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. James F. Kurose and Keith W. Ross, "Computer Networking: A top-down approach", Pearson Education, 6th edition. 2012.

2. Behrouz A. Forouzan, Data Communications and Networking 5E, 5th Edition, Tata McGraw-Hill, 2013.

REFERENCE BOOKS:

1. Nader F Mir, Computer and Communication Networks, 2nd Edition, Pearson, 2014.

2. Larry L Peterson and Brusce S Davie, Computer Networks, fifth edition, ELSEVIER

3. Andrew S Tanenbaum, Computer Networks, fifth edition, Pearson

E Books / MOOCs/ NPTEL

1. http://etutorials.org

2. https://www.net.t-labs.tu berlin.de/teaching/computer_networking

4. https://www.coursera.org/browse/information-technology/networking

5. https://www.udemy.com/topic/computer-network/

DATA PRIVACY AND INTERNET SECURITY

Course Code:	**AD2005-1**	**Course Type:**	**IPCC**
Teaching Hours/Week (L: T: P):	**3:0:2**	**Credits:**	**04**
Total Teaching Hours:	**40+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1004-1, AD1102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Identify standard algorithms used to provide confidentiality, integrity, and authenticity for data.
2.	Distinguish key distribution and management schemes.
3.	Deploy encryption techniques to secure data in transit across data networks.
4.	Implement security applications in the field of Information technology.
5.	Demonstrate data privacy.

UNIT-I

15 Hours

Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Mono-alphabetic Cipher, Playfair Cipher, Hill Cipher, Poly alphabetic Cipher, One Time Pad. Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm.

UNIT-II

15 Hours

Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. Public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA.
Other Public-Key Cryptosystems: Diffie Hellman key exchange, The algorithm, key exchange protocols, man in the middle attack, El Gamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Zp, elliptic curves over GF(2m), Elliptic curve cryptography, Analog of Diffie-Hellman key exchange, Elliptic curve encryption/ decryption, security of Elliptic curve cryptography, Pseudorandom number generation based on a asymmetric cipher.

UNIT-III

10 Hours

Privacy-Preserving Data Mining Algorithms, The Randomization Method, Group Based Anonymization. Distributed Privacy-Preserving Data Mining, Privacy-Preservation of Application Results, Limitations of Privacy: The Curse of Dimensionality, Applications of Privacy-Preserving Data Mining.

Suggested List of Experiments

1.	Implement symmetric key algorithms.
2.	Implement asymmetric key algorithms and key exchange algorithms.
3.	Implement digital signature schemes.
4.	Installation of Wire shark, tcpdump and observe data transferred in client-server communication using UDP/TCP and identify the UDP/TCP datagram.
5.	Check message integrity and confidentiality using SSL.
6.	Experiment Eavesdropping, Dictionary attacks, MITM attacks.
7.	Experiment with Sniff Traffic using ARP Poisoning.
8.	Demonstrate intrusion detection system using any tool.
9.	Explore network monitoring tools.
10.	Study to configure Firewall, VPN.

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

1.	Identify the vulnerabilities in any computing system and hence choose a security solution.
2.	Plan to resolve the identified security issues.
3.	Analyze security mechanisms using theoretical approaches.
4.	Recognize the importance of data privacy, limitations, and applications.
5.	Organize privacy preserving algorithms.

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
AD2005-1.1	2	3	2	2	-	-	-	-	-	1	-	1	3	1	1
AD2005-1.2	2	2	2	2	-	-	-	-	-	1	-	1	3	1	1

AD2005-1.3	2	3	2	2	-	-	-	-	-	1	-	1	3	1	1
AD2005-1.4	2	2	2	2	-	-	-	-	-	1	-	1	3	1	1
AD2005-1.5	2	3	2	2	-	-	-	-	-	1	-	1	3	1	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Cryptography and Network Security, William Stallings, Pearson 7th edition.
2.	Privacy Preserving Data Mining: Models and Algorithms, Charu C. Aggarwal, Philip S Yu, Kluwer Academic Publishers, 2008, ISBN 978-0-387-70991-8, DOI 10.1007/978- 0-387-70992-5.

REFERENCE BOOKS:

1.	Cryptography and Network Security, Atul Kahate, McGraw Hill Education, 4th Edition.
2.	Cryptography and Information Security, V K Pachghare, 2nd edition, PHI.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/106105162
2.	https://nptel.ac.in/courses/106105031
3.	https://nptel.ac.in/courses/106106248

Professional Core Courses (Theory)

COMPUTER ORGANIZATION

Course Code:	**AD1101-1**	**Course Type:**	**PCC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Learn the basic structure and operation of a digital computer.
2.	Understand the basic processing unit in terms of control unit, execution of instructions, and write control sequences for instructions. Learn the instruction and thread level parallelism.
3.	Learn arithmetic unit and perform fixed point and floating-point addition, subtraction, multiplication and division in binary 2's complement number system.
4.	Discuss different modes of communication with I/O devices and standard I/O interfaces available.
5.	Explore the design of hierarchical memory systems including cache memories and virtual memory. Compare the performance.

UNIT-I

15 Hours

BASIC COMPUTER ORGANIZATION: Functional units, Basic Operational Concepts, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Instructions execution and straight-line sequencing, Branching, condition codes. Addressing Modes. Subroutines- Subroutine nesting and processor stack, parameter passing.
BASIC PROCESSING UNIT: Some Fundamental Concepts (only single bus), Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control, Micro programmed Control (only basics).
NUMBER SYSTEM: Binary, Octal and Hexadecimal. Conversion – between Decimal, Binary and Hexadecimal number systems.

UNIT-II

15 Hours

ARITHMETIC OPERATIONS: Addition and Subtraction of Signed Numbers, Cascading adders/subtractors, Look ahead carry adder, Multiplication of positive numbers, signed operand multiplication, Fast multiplication, Integer division.
INPUT/OUTPUT ORGANIZATION: Accessing I/O Devices, Interrupts –Interrupt Hardware, Enabling and Disabling Interrupts, Exceptions, Handling Multiple Devices, Direct Memory Access, Buses, PCI Bus, and USB (Basics only).

UNIT-III

10 Hours

MEMORY SYSTEMS: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories –Mapping Functions, LRU replacement policies, Virtual Memories.

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

1.	Outline the basic structure and operation of a digital computer and demonstrate different address modes.
2.	Illustrate the details of the basic processing unit in terms of control unit, execution of instructions and solve problems using IEEE standard number system.
3.	Explain arithmetic units and perform addition, subtraction, multiplication, and division in

	binary 2’s complement number system.
4.	Explain different ways of communication with I/O devices and standard I/O interfaces.
5.	Demonstrate the computer architecture concepts in the design and working of hierarchical memory systems including cache memories and virtual memory.

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
AD1101-1.1	2	1	-	-	-	-	-	-	1	1	-	2	3	1	-
AD1101-1.2	2	1	1	-	-	-	-	-	1	1	-	2	3	1	-
AD1101-1.3	2	2	1	-	2	-	-	-	2	-	-	1	3	1	-
AD1101-1.4	2	1	-	-	2	-	-	-	-	-	-	2	3	1	-
AD1101-1.5	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, “Computer Organization”, 5th Edition, TMH, 2011.

REFERENCE BOOKS:

1. William Stallings, “Computer Organization & Architecture”, 7th Edition, PHI, 2006.
2. Vincent P. Heuring & Harry F. Jordan, “Computer Systems Design and Architecture”, 2nd Edition, Pearson Education, 2004.
3. David A. Patterson, John L. Hennessy, “Computer Organization and Design”, 4th Edition Elsevier, 2012.
4. John P. Hayes, “Computer Architecture”, 2nd edition, McGraw Hill, 1988.
5. John L. Hennessey and David A. Patterson, “Computer Architecture, A Quantitative Approach”, 6th Edition, Elsevier, 2017.
6. Shameem Akhter and Jason Roberts, “Multicore programming- Increasing performance through software multithreading”, Intel press, 2006.

E Books / MOOCs/ NPTEL

1. https://archive.nptel.ac.in/courses/106/105/106105163/
2. http://nptel.ac.in/courses/106103068/
3. https://dcs.abu.edu.ng/staff/sani-ahmad-hassan/course materials/COSC303_LEC.pdf
4. http://www.cse.iitm.ac.in/~vplab/courses/comp_org/
5. http://www.ddegjust.ac.in/studymaterial/msc-cs/ms-07.pdf

FUNDAMENTALS OF DATA SCIENCE

Course Code:	**AD1102-1**	**Course Type:**	**PCC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1. To understand the fundamentals of data science.
2. To learn the process of data collection and preprocessing.
3. To experiment with data analytics and model development.
4. To understand regression and its applications.
5. To implement the process of model evaluation.

UNIT-I

15 Hours

Data Collection and Data Pre-Processing: Introduction to Data Science, Evolution of Data Science, Statistical Inference, Exploratory Data Analysis, and the Data Science Process, Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.
Data Collection Strategies, Data Pre-Processing Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.

UNIT-II

15 Hours

Exploratory Data Analytics and Model Development: Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, Pivot Table, Heat Map, Correlation Statistics, ANOVA. Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot, Polynomial Regression and Pipelines, Measures for In-sample Evaluation, Prediction and Decision Making.

UNIT-III

10 Hours

Model Evaluation: Generalization Error, Out-of-Sample Evaluation Metrics, Cross Validation, Overfitting, Under Fitting and Model Selection, Prediction by using Ridge Regression Testing, Multiple Parameters by using Grid Search.

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

1.	Explain the concepts of data science and demonstrate various stages of a data science project.
2.	Explain the data collections strategies and apply it to a data science project.
3.	Illustrate the mathematical concepts related to data analytics and apply them to a given problem.
4.	Conduct experiment and demonstrate the data analysis and model development along with visualization.
5.	Explain and conduct model evaluation by employing suitable methods.

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**
AD1102-1.1	1	1	2	1	-	-	-	-	3	1	3	2	3	3	1
AD1102-1.2	1	1	2	2	2	-	-	-	2	2	3	2	3	1	1
AD1102-1.3	1	1	3	1	1	-	-	-	2	3	1	1	2	3	1
AD1102-1.4	2	3	1	3	1	-	-	-	3	3	3	3	3	2	2
AD1102-1.5	2	1	1	1	2	-	-	-	3	3	1	3	2	2	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015.
2.	Joel Grus, "Data Science from Scratch", 2ndEdition, O'Reilly Publications.

REFERENCE BOOKS:

1.	David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013
2.	David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
3.	Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2022.

E Books / MOOCs/ NPTEL

1.	https://nptel.ac.in/courses/106106179

2.	https://archive.nptel.ac.in/courses/106/106/106106212/

SOFTWARE ENGINEERING

Course Code:	**AD1103-1**	**Course Type:**	**PCC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

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

15 Hours

Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics, and Case Studies.
Software Processes: Models- Waterfall Model, Incremental Model and Spiral Model; Process activities.
Agile Methods: Scrum, Kanban, Extreme Programming, Test Driven Development, Behavior Driven Development.
Building large software programs: Introduction to Scaled Agile Framework.
Requirements Engineering: Functional and non-functional requirements, Requirements engineering processes, Requirements Elicitation and Analysis, Requirements specification, Software requirements document, Requirements validation & management.

UNIT-II

15 Hours

System Models: Context models, Interaction models, Structural models, and Behavioral models.
Architectural Design: Architectural design decisions. Architectural Views and Patterns, Application Architectures.
Design and implementation: Object-oriented Design using UML.
Software Testing: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object-Oriented Software, Validation Testing, System Testing, The Art of Debugging.

UNIT-III

10 Hours

Project Management: Risk management, Teamwork.
Project Planning: Software pricing, Plan-driven development, Project Scheduling, Configuration management.
Quality Management: Software quality, Reviews and inspections, Software measurement and metrics, and Software standards.

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

1.	Recognize the basics of software systems, components, processes, and requirement specifications to meet desired needs within realistic constraints and outline the professional and

	ethical responsibility.
2.	Ability to practice the waterfall, incremental, iterative models, and agile methods for software development.
3.	Explain the system models and architectural design.
4.	Develop UML models for the software and conduct the testing of the software systems.
5.	Carryout project planning and management and illustrate the quality of software 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
AD1103-1.1	2	3	1	-	-	-	-	2	-	-	-	1	1	2	-
AD1103-1.2	2	3	1	-	-	-	-	-	-	-	-	1	1	2	-
AD1103-1.3	2	1	3	-	-	-	-	-	-	-	-	1	2	3	-
AD1103-1.4	1	3	2	-	-	-	-	-	-	-	-	1	1	2	-
AD1103-1.5	2	1	1	1	2	-	-	-	3	3	1	3	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 Practitioner's approach”, 7th Edition,Tata McGraw Hill, 2017.
2. Pankaj Jalote: “An Integrated Approach to Software Engineering”, Wiley, India, 2010.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/106105182
2. https://archive.nptel.ac.in/courses/106/105/106105218/
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
5. http://agilemanifesto.org/
6. http://www.jamesshore.com/Agile-Book/

DATABASE MANAGEMENT SYSTEMS

Course Code:	**CS2102-1**	**Course Type:**	**PCC**
Teaching Hours/Week (L: T: P):	**3:0:2**	**Credits:**	**04**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**CS1002-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Provide a strong foundation in database concepts, design, and application.
2.	Understand the concepts of relational model and relational algebra in database design.
3.	Learn structured query language (SQL) to an intermediate/advanced level and evaluate the result set.
4.	Understand the use of normalization techniques for building effective database design.
5.	Demonstrate the use of File organization and Indexing, Concurrency Control and transactions in databases.

UNIT-I

15 Hours

Databases and Database Users: Introduction, An Example, Characteristics of the database approach.
Database System Concepts and Architecture: Three-Schema Architecture and data Independence, Database languages and interfaces.
Data Modeling Using the Entity–Relationship (ER) Model: Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design for the COMPANY Database, ER Diagrams, Naming Conventions, and Design Issues. The Relational Data Model and Relational Database Constraints: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, transactions, and dealing with constraint violations.
Relational Algebra and Relational Calculus: Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory. Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations; Examples of Queries in Relational Algebra.
Relational Database Design by ER-to-Relational Mapping: Relational Database Design Using ER- to-Relational Mapping.

UNIT-II

15 Hours

Basic SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic retrieval queries in SQL, Insert, Delete and Update Statements in SQL,
More SQL: Complex Queries, Views, and Schema Modification: More complex SQL retrieval queries, Specifying constraints as assertions and Actions as Triggers, Views in SQL, Schema Change Statements in SQL.
Basics of Functional Dependencies and Normalization for Relational Databases: Informal design guidelines for relation schemas, Functional Dependencies, Normal Forms Based on Primary Keys, general definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.
Relational Database Design Algorithms and Further Dependencies: Inference Rules, Equivalence, and Minimal cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema.

UNIT-III

10 Hours

Storage and Indexing: File Organizations and Indexing, Index Data structures, Comparison of File Organizations.

Tree Structured Indexing: B+ Tree: A Dynamic Index Structure.
Overview of Query Evaluation: Introduction to Query Optimization, what a Typical Optimizer Does.
Overview of Transaction Management: The ACID Properties, Transactions and Schedules. Concurrent Execution of Transactions, Lock-Based Concurrency Control.
Concurrency Control: 2PL, Serializability and Recoverability.

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

1.	Illustrate the concepts of database objects for the given problem.
2.	Identify and enforce integrity constraints on a database using RDBMS and examine the usage of relational algebra in database applications
3.	Apply structured query language for (SQL) for database manipulation.
4.	Model normalized database structures by creating simple database systems and understanding the concepts of relational database designs and dependencies.
5.	Illustrate the concepts of File organization and Indexing, Concurrency Control, and transactions in databases.

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
CS2102-1.1	2	1	-	-	-	-	-	-	-	1	-	1	3	-	-
CS2102-1.2	3	2	-	-	-	-	-	-	-	1	-	1	3	-	-
CS2102-1.3	2	3	-	-	-	-	-	-	-	1	-	1	3	2	-
CS2102-1.4	2	2	3	-	-	-	-	-	-	1	-	1	3	2	-
CS2102-1.5	2	-	-	-	-	-	-	-	-	1	-	1	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Database Systems Models, Languages, Design and Application Programming, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2.	Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, Indian Edition, Mc Graw Hill Education.

REFERENCE BOOKS:

1.	Database Systems: Models, Languages, Design and Application Programming, Ramez Elmasri and Shamkant B. Navathe, 6th Edition, 2017, Pearson.
2.	Database System Concepts, Silberschatz Korth and Sudharshan, 6thEdition, McGraw Hill, 2013.

E Books / MOOCs/ NPTEL

1.	https://www.udemy.com/course/introduction-to-basic-database-concepts/, Introduction to Basic Database Concepts (Udemy).
2.	https://www.udemy.com/course/database-management-systems-mysql/, Database Management Systems – MySQL (Udemy).
3.	https://swayam.gov.in/nd1_noc19_cs46/preview, Database Management System (Swayam).

OPERATING SYSTEM

Course Code:	**AD2104-1**	**Course Type:**	**PCC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite:	**AD1101-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Explain the concepts, principles, and services of operating system.
2.	Identify fundamental operating system abstractions such as Process, Threads, Files, Semaphores, IPC abstractions and demonstrate them.
3.	Assess the benefits of concurrency and synchronization and apply them to write concurrent programs.
4.	Analyze basic resource management technologies in job and process scheduling. Use and compare different memory management techniques.
5.	Analyze features of various RTOS.

UNIT-I

15 Hours

Operating System structure: Operating System Services, User and Operating System interface, System calls, System Services, Linkers and Loaders, Operating System design and implementation, Operating System structure. Process Management: Process concept; Process scheduling; Operations on processes; Inter-process communication. Threads & Concurrency: Multicore Programming, Multithreading Models.

UNIT-II

15 Hours

CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Thread scheduling, Multiple-Processor scheduling. Process Synchronization: The Critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Monitors, Classical problems of synchronization. Deadlocks: System model; Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, avoidance, detection, and recovery from deadlock

UNIT-III

10 Hours

Main Memory: Paging, Structure of page table, Swapping. Virtual Memory: Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing.
RTOS: Introduction to RTOS

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

1.	Recognize the structural components of the operating system and describe a process, its state and process of its creation and termination.
2.	Illustrate concept of threading, multithreaded systems, and process synchronization
3.	Illustrate critical section problems and demonstrate Peterson's solution. Investigate the Deadlock condition and determine the solution to avoid.
4.	Summarize Main memory and Virtual Memory allocation methods and prepare a page replacement schedule to the given set of page requirement requests.
5.	Illustrate the uses of RTOS.

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
AD2104-1.1	3	1	-	-	-	-	-	-	-	1	-	-	3	1	-
AD2104-1.2	3	2	1	-	-	-	-	-	-	1	-	-	3	1	-
AD2104-1.3	3	2	1	-	-	-	-	-	-	1	-	1	3	1	-
AD2104-1.4	3	1	-	-	1	-	-	-	-	1	-	1	3	1	-
AD2104-1.5	3	1	-	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Operating System Concepts, Abraham Silberschatz, Greg Gagne, Peter B. Galvin, 10th Edition, John Wiley & Sons, 2018, ISBN: 9781119320913.

REFERENCE BOOKS:

1. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
3. P.C.P. Bhatt: Operating Systems, 2nd Edition, PHI, 2006.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/106108101
2. https://nptel.ac.in/courses/106106144
3. https://nptel.ac.in/courses/106105214
4. Books / Online Resources: 1. http://www.uobabylon.edu.iq/download/M.S%202013-2014/Operating_System_Concepts,_8th_Edition%5BA4%5D.pdf
5. http://iips.icci.edu.iq/images/exam/Abraham-Silberschatz-Operating-SystemConcepts---9th2012.12.pdf

BIG DATA ANALYTICS

Course Code:	**AD2105-1**	**Course Type:**	**PCC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand how to use Big data frameworks and APIs.
2.	To conceptualize data analysis and to learn about various data processing and pipelining strategies.
3.	To understand and visualize map-reduce computing paradigm.
4.	To learn the intricate and distributed working of Big Data clusters.
5.	To train and impart the skills required for managing and balancing large data clusters.

UNIT-I

15 Hours

Classification of Digital Data, Structured and Unstructured Data, Introduction to Big Data: Characteristics Evolution – Definition, Data Warehouse, Hadoop ecosystem in Brief, Map Reduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression -Terminologies used in Big Data Environments, Functional Programming in Scala: Basic Syntax-type inference- Parameters-Recursive arbitrary collections, ConsList-Arrays-Tail recursion- Higher order functions.

MapReduce Template-Pattern Matching syntax, objects in Scala. Apache Spark: -Resilient Distributed Datasets -Creating RDDs, Lineage and Fault tolerance, DAGs, Immutability, task division and partitions, transformations and actions, lazy evolutions, and optimization -Formatting and housing data from spark RDDs--Persistence.

UNIT-II

15 Hours

HADOOP: Data format, analyzing data with Hadoop, Hadoop streaming, Hadoop pipes –design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface, data flow , Hadoop I/O , data integrity ,compression , serialization – Avro – file-based data structures ,Cassandra – Hadoop integration. Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

UNIT-III

10 Hours

Data frames, datasets, Apache Spark SQL, Setting up a standalone Spark cluster-: spark-shell, basic API, Modules-Core, Key/Value pairs and other RDD features, MLlib-examples for bi-class SVM and logistic regression.

MongoDB: Why Mongo DB - Terms used in RDBMS and Mongo DB - Data Types - MongoDB Query Language. Stream and Graph Processing on Spark.

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

1.	Solve problems through a map-reduce approach.
2.	Implement data analytics solutions using general data pipelining.
3.	Apply scaling up machine learning techniques and associated computing techniques and technologies.

4.	Identify the characteristics of datasets and compare the trivial data and big data for various applications.
5.	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

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
AD2105-1.1	3	3	-	-	-	-	-	-	-	-	-	1	3	2	-
AD2105-1.2	3	3	3	-	-	-	-	-	-	-	-	1	3	2	-
AD2105-1.3	3	3	-	-	-	-	-	-	-	-	-	1	3	2	-
AD2105-1.4	2	2	3	-	-	-	-	-	-	-	-	1	3	2	-
AD2105-1.5	3	3	-	-	-	-	-	-	-	-	-	1	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Learning Spark: Lightning-Fast Big Data Analysis', Holden Karau , Andy Konwinski, Patrick Wendell and MateiZaharia, O′Reilly; 1st edition , 2015.
2.	Eric Sammer, "Hadoop Operations", O'Reilley, 2012.

REFERENCE BOOKS:

1.	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2.	'High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark', Holden Karau, Rachel Warren, O′Reilly; 1st edition, 2017.
	'Programming in Scala: A Comprehensive Step-by-Step Guide', Martin Odersky,Lex Spoon and Bill Venners, Artima Inc; Version ed. edition , 2008.
	"MongoDB: The Definitive Guide", Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, O′Reilly; 3rd edition,2019.

E Books / MOOCs/ NPTEL

1.	ftp://public.dhe.ibm.com/software/pdf/at/SWP10/Big_Data_Analytics.pdf
2.	https://www.wileyindia.com/big-data-analytics-2ed.html
3.	https://www.coursera.org/specializations/big-data
4.	https://nptel.ac.in/courses/106104189

Professional Core Courses (Lab)

PRACTICING DATA SCIENCE WITH MS EXCEL AND PYTHON

Course Code:	**AD2601-1**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P):	**0:0:2**	**Credits:**	**01**
Total Teaching Hours:	**0+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite:	**CS1002-1, CS1005-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand the advanced features of MS Excel
2.	To apply the features of MS Excel for data analysis and related applications.
3.	To learn the libraries of python that are used for data analytics.
4.	To develop programs for data analysis using python libraries

List of Experiments

Part- A: MS- Excel

1	Exploring data using charts and graphs& Calculating summary statistics: • Create a histogram of a dataset to visualize its distribution. • Create a scatter plot to see the relationship between two variables. • Create a line chart to track changes over time. • Calculate the mean, median, and mode of a dataset. • Calculate the standard deviation and variance of a dataset. • Calculate the quartiles and interquartile range of a dataset.
2	Building predictive models: • Use the LINEST function to perform linear regression analysis on a dataset. • Use the FORECAST function to make predictions based on a linear regression model. • Use the TREND function to create a trendline for a dataset.
3	Creating pivot tables: • Create a pivot table to summarize a dataset by different categories. • Create a pivot chart to visualize the data in a pivot table. • Use slicers to filter data in a pivot table.
4	Data cleaning and preprocessing: • Use the TRIM function to remove leading and trailing spaces from text data. • Use the CLEAN function to remove non-printable characters from text data. • Use the SUBSTITUTE function to replace specific text in a dataset.
5	Hypothesis testing: • Use the T.TEST function to perform a t-test on two samples. • Use the ANOVA function to perform an analysis of variance on multiple samples. • Use the CHISQ.TEST function to perform a chi-square test on categorical data.

Part- B: Python

6	Numpy Library: • Create a numpy array from a list, a tuple with float type. • Python program to demonstrate slicing, integer, and Boolean array indexing. • Write a python program to find min, max, sum, the cumulative sum of an array. • Write a Python program to demonstrate use of ndim, shape, size, dtype.
7	Numpy Library: Linear Algebra • Write a python program to find rank, determinant, and trace of an array. • Write a python program to find eigenvalues of matrices.

	• Write a python program to find matrix and vector products (dot, inner, outer, product), matrix exponentiation. • Write a python program to solve a linear matrix equation, or system of linear scalar equations.
8	Pandas Library • Write a python program to implement Pandas Series with labels. • Create a Pandas Series from a dictionary. • Creating a Pandas DataFrame. • Write a program which make use of following Panda's methods. a. describe () b. head () c. tail ()
9 10	Pandas Library: Selection • Write a program that converts Pandas DataFrame and Series into NumPy. Array. • Write a program that demonstrates the column selection, column addition, and column deletion. • Write a program that demonstrates the row selection, row addition, and row deletion. • Get n-largest and n-smallest values from a particular column in Pandas dataFrame.
11 12	Pandas Library: Visualization • Write a program which use pandas inbuilt visualization to plot following graphs: a. Bar plots b. Histograms c. Line plots d. Scatter plots • Write a program to demonstrate use of groupby () method. • Write a program to demonstrate pandas Merging, Joining and Concatenating. • Creating data frames from csv and excel files.
13.	Lab Exam.

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

1.	Demonstrate the advanced features of MS Excel
2.	Analyse the data set using the features of MS Excel
3.	Explain the python libraries and mathematical functions for data analysis.
4.	Implement programs in python to extract information from the given data set using suitable libraries.
5.	Apply the visualization functions of MS Excel and Python for visualization of data.

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**
AD2601-1.1	3	2	1	-	3	-	-	-	-	-	-	1	1	3	1
AD2601-1.2	3	2	1	-	3	-	-	-	-	-	-	1	1	3	1
AD2601-1.3	3	2	1	-	3	-	-	-	-	-	-	1	1	3	1
AD2601-1.4	3	2	1	-	3	-	-	-	-	-	-	1	1	3	1
AD2601-1.5	3	2	1	-	3	-	-	-	-	-	-	1	1	3	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition,2018
2.	Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017.
3.	Microsoft Excel 2019 Data Analysis and Business Modelling (Business Skills), 6th Edition, Wayne L Winston, ISBN-13: 978-1509305889, ISBN-10: 1509305882.

DATA HANDLING AND VISUALIZATION WITH R

Course Code:	**AD1602-1**	**Course Type**	**PCC Lab**
Teaching Hours/Week (L: T: P)	**0:0:2**	**Credits**	**01**
Total Teaching Hours	**0+0+26**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CS1001-1, AD1102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand methods for data preprocessing.
2.	To apply appropriate models for different types of data.
3.	To visualize and present data.
4.	To perform complex data manipulations and automate data analysis tasks.
5.	To develop programs for data manipulation, data cleaning, and implementing algorithms.

List of Experiments

1
2

Program for Data Analysis:
- Read a dataset from a CSV file and perform exploratory data analysis, including summary statistics, data visualization, and identifying missing values.
- Clean the data by removing duplicates, handling missing values, and transforming variables if necessary.
- Perform data manipulation operations such as filtering, sorting, and merging datasets based on certain criteria.
- Conduct statistical analysis, such as hypothesis testing or correlation analysis, to derive insights from the data.
- Generate reports or visualizations to present the analysis results.

3
4

Program for Linear Regression:
- Read a dataset from a CSV file that contains variables for independent and dependent variables.
- Perform linear regression analysis to model the relationship between the variables.
- Calculate the coefficients and intercept of the regression model.
- Evaluate the model's goodness-of-fit using metrics like R-squared and adjusted R-squared.
- Plot the regression line and residuals to visualize the relationship between the variables.

5
6

Program for Web Scraping and Data Extraction:
Use R packages like rvest or httr to scrape data from a specific website or API.
- Define the target website or API endpoints and specify the data to be extracted.
- Retrieve the HTML content or JSON response from the website or API.
- Parse and extract the desired data using CSS selectors, XPath, or JSON parsing techniques.
- Save the extracted data to a file or perform further analysis on it.

7
8

Program for Web Scraping and Data Extraction:
- Install and Load Required Packages:
  - Install the necessary packages for web scraping, such as rvest, xml2, and httr.
  - Load the packages into your R environment using the library() function.
- Specify the Target Website and URL:
  - Identify the website you want to scrape data from.
  - Define the URL of the specific webpage or API endpoint containing the data you need.
- Send HTTP Requests and Handle Authentication (if required):
  - Use the GET() or POST() functions from the httr package to send HTTP

requests to the website.
    - Set headers, parameters, or authentication credentials as needed.
- Retrieve HTML Content and Parse XML/HTML:
    - Use the GET() function to retrieve the HTML content of the webpage.
    - Parse the HTML content using the read_html() function from the rvest package.
- Extract Data from HTML:
    - Inspect the HTML structure of the webpage to identify the elements and attributes containing the desired data.
    - Use functions such as html_nodes() and html_text() from the rvest package to extract specific elements or text from the HTML content.
    - Apply CSS selectors or XPath expressions to target specific elements.
- Perform Data Cleaning and Transformation:
    - Clean the extracted data by removing unwanted characters, handling missing values, or applying regular expressions.
    - Convert the extracted data into appropriate data structures (e.g., data frames, lists, or vectors) for further analysis or storage.
- Save or Analyse the Extracted Data:
    - Save the extracted data to a file (e.g., CSV or Excel) using R functions like write.csv() or write.xlsx().
    - Perform further data analysis or visualization on the extracted data using appropriate R packages and techniques.

9 Program for Data Visualization:

10 Use packages like ggplot2 or plot to create various types of charts, such as bar charts, line plots, scatter plots, or heatmaps.
- Read a dataset from a CSV file or other data sources.
- Customise the charts by adding labels, titles, legends, and adjusting the axis scales.
- Create interactive visualizations with tooltips, zooming, or filtering options.
- Export the visualizations to different file formats or display them within an R notebook or Shiny application.

11 Program for Data Manipulation:

12
- Read multiple datasets from different files or sources.
- Merge or join the datasets based on common variables or keys.
- Perform aggregation operations, such as calculating sums, means, or counts, by groups or categories.
- Filter the data based on specific conditions or criteria.
- Create new variables or transform existing variables using functions or mathematical operations.

13. Lab Exam

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

1.	Apply methods for data preprocessing, exploratory data analysis, and derive meaningful insights from the data.
2.	Select and apply appropriate models for different types of data and problem domains, interpret model outputs, and evaluate model performance.
3.	Effectively visualize and present data using charts, graphs, and other visual representations.
4.	Perform complex data manipulations, handle large datasets, and automate data analysis tasks.
5.	Apply the programming skills in R programming languages for data manipulation, data cleaning, and implementing algorithms.

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**

AD1602-1.1	2	1	-	-	2	-	-	-	-	-	-	1	3	2	-
AD1602-1.2	2	1	-	-	2	-	-	-	-	-	-	1	3	2	-
AD1602-1.3	2	2	1	-	2	-	-	-	-	-	-	1	3	2	-
AD1602-1.4	2	1	1	-	2	-	-	-	-	-	-	1	3	2	-
AD1602-1.5	2	1	-	-	2	-	-	-	-	-	-	1	3	2	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Hadley Wickham, Garrett Grolemund," R for Data Science",OREILLY Publication,2017.
2.	Steven Keller, "R Programming for Beginners", CreateSpace Independent Publishing Platform 2016.
3.	Roger D. Peng,"R Programming for Data Science"Lean Publishing, 2016.

DATABASE MANAGEMENT SYSTEMS LAB

Course Code:	**AD3603-1**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P):	**0:0:2**	**Credits:**	**01**
Total Teaching Hours:	**0+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite:	**CS2102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand the execution of SQL queries for creating tables and insertion of values.
2.	To practice the nested queries and aggregate functions.
3.	To work with various join operations.
4.	To implement data handling using NoSQL tools.
5.	To understand the application of databases system in a real-time project.

List of Experiments

1.	Create table queries and insert queries.
2.	Implementation of select operations with nested queries.
3.	Using aggregate functions in select statements.
4.	Implementing different types of join operations and other clauses.
5.	Working with real-time examples of query solving
6.	Basic commands of NoSQL.
7.	Storing and retrieving data using NoSQL tool - MongoDB, Cassandra.
8.	Working with real-time examples of query solving using NoSQL
9. 10. 11. 12.	Project work and presentation.
13.	Lab Exam

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

1.	Create tables and insert values into a Relational database table.
2.	Design and implement SQL queries to work with the database tables.
3.	Apply the query design and implementation process to a real-time problem.
4.	Explain the operation of NoSQL.
5.	Develop a database system using a NoSql 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**
AD3603-1.1	2	-	-	-	3	2	-	-	2	1	-	1	3	-	-
AD3603-1.2	2	2	-	-	3	2	-	-	2	1	-	1	3	-	-
AD3603-1.3	2	3	-	-	3	2	-	-	2	1	-	1	3	3	-
AD3603-1.4	2	2	3	-	3	2	-	-	2	1	-	1	3	2	-
AD3603-1.5	2		-	-	3	2	-	-	2	1	-	1	3	2	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1. Database Systems Models, Languages, Design and Application Programming, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.

2. Database System Concepts, Silberschatz Korth and Sudharshan, 6th Edition, McGraw Hill, 2013.

E Resources	
1.	https://www.udemy.com/course/introduction-to-basic-database-concepts/, Introduction to Basic Database Concepts (Udemy).
2.	https://www.udemy.com/course/database-management-systems-mysql/, Database Management Systems – MySQL (Udemy).
3.	https://swayam.gov.in/nd1_noc19_cs46/preview, Database Management System (Swayam).

FULL STACK DEVELOPMENT

Course Code:	**AD2604-1**	**Course Type:**	**PCC Lab**
Teaching Hours/Week (L: T: P):	**0:0:2**	**Credits:**	**01**
Total Teaching Hours:	**0+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite:	**CS1001-1, CS1002-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To learn and implement JavaScript features.
2.	To learn the browser-based JavaScript features in a web-based environment.
3.	To understand and develop front end UI development using React JS.
4.	To understand and design back-end development using Node.js and Express.
5.	To learn NoSQL data technologies and data management with web applications.

List of Experiments

1 2	Simple exercises on JavaScript Objects, Generators, advanced iteration, and Modules.
3 4	Working with DOM tree, node properties, browser events, UI Events, Forms, controls, Document and resource loading, Mutation observer, microtasks and macrotasks.
5 6	Front end UI development with React JSX, components, React Classes, Composing Components, React state, Async State, Event Handling, Stateless Components. Working with React Forms - React CSS - React SaaS
7 8 9	Application backend development with Node.js and Express.
10 11 12	Handling NoSQL data using MongoDB and manipulating data and management.
13.	Lab Exam

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

1.	Implement and execute basic JavaScript programs.
2.	Work with react based framework for front end development.
3.	Work with back-end technologies such as NodeJS and express.
4.	Handle data and manage using Mongo DB as a database for enterprise app development.
5.	Get an insight about the advanced features such as routing, Filters, bootstrap.

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**
AD2604-1.1	2	-	-	-	3	-	-	-	-	-	-	1	1	-	3
AD2604-1.2	1	2	3	-	3	-	-	-	1	-	-	1	1	-	3
AD2604-1.3	2	2		-	3	-	-	-	-	-	-	1	1	-	3
AD2604-1.4	1	1	2	-	-	-	-	-	1	-	-	1	1	-	3
AD2604-1.5	2	-	-	-	-	-	-	-	-	-	-	1	1	-	3

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1. Adrian Holovaty, Jacob Kaplan Moss, The Definitive Guide to Django: Web Development Done Right, Second Edition, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG Publishers, 2009.

2.	Jonathan Hayward, Django Java Script Integration: AJAX and jQuery, First Edition, Pack Publishing, 2011.
3.	Aidas Bendroraitis, Jake Kronika, Django 3 Web Development Cookbook, Fourth Edition, Packt Publishing, 2020.
4.	William Vincent, Django for Beginners: Build websites with Python and Django, First Edition, Amazon Digital Services, 2018.
5.	Antonio Mele, Django3 by Example, 3rd Edition, Pack Publishers, 2020.
6.	Arun Ravindran, Django Design Patterns and Best Practices, 2nd Edition, Pack Publishers, 2020.

PRACTICE OF A MODERN TOOL FOR DATA SCIENCE

Course Code:	**AD2605-1**	**Course Type**	**PCC Lab**
Teaching Hours/Week (L: T: P)	**0:0:2**	**Credits**	**01**
Total Teaching Hours	**0+0+26**	**CIE + SEE Marks**	**50+50**
Prerequisite	**AD1102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To list the tools available for working with data.
2.	To select the best possible tool based on the need.
3.	To practice the installation of the tool.
4.	To implement data handling using the tools.
5.	To understand the application of the tool for a real-time project.

Contents

1.	Searching for a suitable tool based on the need.
2.	Installation of the tool.
3.	Learning the functionalities of the tool.
4.	Implementing the solution to selected problem using the tool.
5.	Exam / Project Demo

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

1.	Ability to select the suitable tool for a problem.
2.	Ability to install the tool with the required packages and dependencies.
3.	Model the problem to be feasible to solve using the selected tool.
4.	Implement the solution using the tool.
5.	Presentation of the results.

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**
AD3603-1.1	2	-	-	-	3	2	-	-	2	1	-	1	3	-	-
AD3603-1.2	2	2	-	-	3	2	-	-	2	1	-	1	3	-	-
AD3603-1.3	2	3	-	-	3	2	-	-	2	1	-	1	3	3	-
AD3603-1.4	2	2	3	-	3	2	-	-	2	1	-	1	3	2	-
AD3603-1.5	2		-	-	3	2	-	-	2	1	-	1	3	2	-

1: Low 2: Medium 3: High

Professional Elective Courses

IMAGE AND VIDEO ANALYTICS

Course Code:	**AD1201-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1. To understand the basics of image processing techniques for computer vision.
2. To learn the techniques used for image pre-processing.
3. To discuss the various object detection techniques.
4. To understand the various Object recognition mechanisms.
5. To elaborate on the video analytics techniques.

UNIT-I

15 Hours

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.
Local pre-processing -DCT-DFT- Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models – Edges in multi-spectral images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration. Filters – High pass and low pass.

UNIT-II

15 Hours

Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once (YOLO)-Salient features-Loss Functions-YOLO architectures.
Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition- DeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNet- Gesture Recognition.

UNIT-III

10 Hours

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet Architecture-Improvement in Inception v2-Video analytics-RestNet and Inception v3.

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

1. Explain the basics of image processing techniques for computer vision and video analysis.
2. Apply the techniques for image pre-processing.
3. Used various object detection techniques for project development.
4. Make use of various face recognition mechanisms.
5. Explain deep learning-based video analytics.

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
AD1201-1.1	2	3	2	-	-	-	-	-	-	-	-	1	2	1	-
AD1201-1.2	2	2	2	-	-	-	-	-	-	-	-	1	2	1	-
AD1201-1.3	2	3	2	-	-	-	-	-	-	-	-	1	2	1	-
AD1201-1.4	2	2	2	-	-	-	-	-	-	-	-	1	2	1	-

AD1201-1.5	2	3	2	-	-	-	-	-	-	-	-	1	2	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

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

REFERENCE BOOKS:

1.	Digital Image Processing with Matlab & Labview Vipula Singh Published by Reed Elsevier India Pvt.Ltd
2.	Anil K Jain, "Fundamentals of Digital Image Processing", Prentice-Hall of India Pvt. Ltd., 1997.
3.	Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Thomoson Learning, Brooks/Cole, Second Edition. 2001.
4.	B.Chanda, D Dutta Majumder, "Digital Image Processing and Analysis", Prentice- Hall, India, 2002.
5.	Steven W.Smith, "The Scientist and Engineers Guide to Digital Signal Processing ",California Technical Publishing ,Second Edition , 1999

E Books / MOOCs/ NPTEL

1.	iitlab.bit.edu.cn/HandbookofImageandVideoProcessing.pdf
2.	http://www.cs.ukzn.ac.za/~sviriri/Books/Image-Processing/book4.pdf
3.	https://nptel.ac.in/courses/117105079/
4.	https://swayam.gov.in/nd1_noc19_ee55/preview
5.	https://www.coursera.org/learn/image-processing

KNOWLEDGE ENGINEERING

Course Code:	**AD1202-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand the basics of Knowledge Engineering.
2.	To discuss methodologies and modeling for Agent Design and Development.
3.	To design and develop ontologies.
4.	To apply reasoning with ontologies and rules.
5.	To understand learning and rule learning.

UNIT-I

15 Hours

Reasoning Under Uncertainty: Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering.

Methodology And Modeling: Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

UNIT-II

15 Hours

Ontologies – Design and Development: Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

Reasoning With Ontologies and Rules: Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

UNIT-III

10 Hours

Learning And Rule Learning: Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning.

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

1.	Understand the basics of Knowledge Engineering.
2.	Apply methodologies and modelling for Agent Design and Development.
3.	Design and develop ontologies.
4.	Apply reasoning with ontologies and rules.
5.	Understand learning and rule learning.

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**

AD1202-1.1	2	3	2	1	-	-	-	-	-	-	-	1	1	2	-
AD1202-1.2	2	2	2	1	-	-	-	-	-	-	-	1	1	3	-
AD1202-1.3	2	3	2	1	-	-	-	-	-	-	-	1	1	3	-
AD1202-1.4	2	2	2	2	-	-	-	-	-	-	-	1	1	3	-
AD1202-1.5	2	3	2	2	-	-	-	-	-	-	-	1	1	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016.

REFERENCE BOOKS:

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.

2. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.

3. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.

4. King , Knowledge Management and Organizational Learning , Springer, 2009.

5. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001.

RECOMMENDER SYSTEMS

Course Code:	**AD1203-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand the foundations of the recommender system.
2.	To learn the significance of machine learning and data mining algorithms for Recommender systems
3.	To learn about collaborative filtering.
4.	To make students design and implement a recommender system.
5.	To learn collaborative filtering.

UNIT-I

15 Hours

Introduction: Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems-similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)
Content-Based Recommendation Systems: High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

UNIT-II

15 Hours

Collaborative Filtering: A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection.
Attack-Resistant Recommender Systems: Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

UNIT-III

10 Hours

Evaluating Recommender Systems: Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures.

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

1.	Understand the basic concepts of recommender systems.
2.	Implement machine-learning and data-mining algorithms in recommender systems data sets.
3.	Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.
4.	Design and implement a simple recommender system.
5.	Learn about advanced topics of recommender systems 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**
AD1203-1.1	2	3	2	2	-	-	-	-	-	-	-	1	2	2	-

AD1203-1.2	2	2	2	2	-	-	-	-	-	-	-	1	2	3	-
AD1203-1.3	2	3	2	2	-	-	-	-	-	-	-	1	2	3	-
AD1203-1.4	2	2	2	2	-	-	-	-	-	-	-	1	2	3	-
AD1203-1.5	2	3	2	2	-	-	-	-	-	-	-	1	2	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.

REFERENCE BOOKS:

1. Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich, Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
2. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011).
3. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.

BUSINESS ANALYTICS

Course Code:	**AD2201-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, AD2001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand the Analytics Life Cycle.
2.	To comprehend the process of acquiring Business Intelligence.
3.	To understand various types of analytics for Business Forecasting.
4.	To model the supply chain management for Analytics.
5.	To apply analytics for different functions of a business.

UNIT-I

15 Hours

Introduction To Business Analytics: Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration.

Business Intelligence: Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions.

UNIT-II

15 Hours

Business Forecasting: Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

HR & Supply Chain Analytics: Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT-III

10 Hours

Marketing & Sales Analytics: Marketing Strategy, Marketing Mix, Customer Behavior –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behavior in marketing and sales.

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

1.	Explain the real world business problems and model with analytical solutions.
2.	Identify the business processes for extracting Business Intelligence.
3.	Apply predictive analytics for business fore-casting.
4.	Apply analytics for supply chain and logistics management.
5.	Use analytics for marketing and sales.

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**
AD2201-1.1	2	3	2	2	-	-	-	-	-	-	-	1	2	2	-

AD2201-1.2	2	2	2	2	-	-	-	-	-	-	-	1	2	3	-
AD2201-1.3	2	3	2	2	-	-	-	-	-	-	-	1	2	3	-
AD2201-1.4	2	2	2	2	-	-	-	-	-	-	-	1	2	3	-
AD2201-1.5	2	3	2	2	-	-	-	-	-	-	-	1	2	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017

REFERENCE BOOKS:

1. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016

2. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016

3. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.

4. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.

BUSINESS INTELLIGENCE

Course Code:	**AD2202-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, AD2001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Identify various sources of data and identify the methods to process them.
2.	Explain the ETL process and carry out the ETL process for a given data set.
3.	Design a suitable schema for a given problem and select the performance indicators.
4.	Illustrate the data mining concepts.
5.	Demonstrate the Classification and clustering methods.

UNIT-I

15 Hours

Introduction To Business Intelligence: Types of digital data – Structured, semi-structured and unstructured – sources, characterizes, challenges; Introduction to OLTP, OLAP and Data Mining; BI Definitions & Concepts; BI Framework, Who is BI for, BI Users, BI Applications; BI Roles & Responsibilities. Need for data warehouse – definition, data mart, Approaches for data warehouse, ETL, Basics of Data Integration – approaches, advantages.

UNIT-II

15 Hours

Data Processing: Introduction to data quality, data profiling, Multidimensional data modeling – Basics, types of data model, Concepts of dimensions, facts, cubes, attributes, hierarchies, star and snowflake schema; Dimension model life cycle. Measure, metrics, KPIs and performance management, salient attributes of a good metric, SMART test. Introduction to enterprise reporting – perspectives, standardization and presentation, balanced scorecards. Concepts of dashboards- types, steps.

UNIT-III

10 Hours

Data Mining: On What Kind of Data? Data Mining Functionalities—What Kinds of Patterns Can Be Mined? Mining Association rules: Basic concepts, frequent item set mining methods - Apriori Algorithm, Generating Association Rules from Frequent Item sets.

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

1.	Identify the data sources based on its type for a business application and Apply OLTP, and OLAP operations to the data.
2.	Identify various roles in a BI application and Design the ETL process for handling the data from a given application.
3.	Apply the data warehousing concepts for a business application to design a star/snowflake schema for multi-dimensional data of a given problem and design a suitable evaluation metric
4.	Determine the profile and quality of business data and apply the measures and metrics to the data to design an enterprise report.
5.	Illustrate the data mining concepts using association rules, classification, and clustering with suitable examples.

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**
AD2202-1.1	3	3	-	-	-	-	-	-	-	-	1	2	3	-	-
AD2202-1.2	3	3	2	-	-	-	-	-	-	-	1	2	3	-	2
AD2202-1.3	3	2		-	-	-	-	-	-	-	1	2	3	-	2
AD2202-1.4	3	3	2	-	-	-	-	-	-	-	1	2	3	-	-
AD2202-1.5	3	-	2	-	-	-	-	-	-	-	1	2	-	-	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	R N Prasad and Seema Acharya, “Fundamentals of Business Analytics”, Wiley-India, 2011.
2.	Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques”, Morgan Kaufmann Publishers.

REFERENCE BOOKS:

1.	David Loshin, “Business Intelligence -The Savvy Manager's Guide”, Morgan Kaufmann Publishers,2003.
2.	Carlo Vercellis “Business Intelligence-Datamining and Optimization for Decision Making”, Wiley, 2009,
3.	Uddagiri Chandrasekhar S.K. Shinde,”Data Mining and Business Intelligence”, Dreamtech Press,2015.

E Books / MOOCs/ NPTEL

1.	https://cdn.ttgtmedia.com/searchDataManagement/downloads/Data_Warehouse_Design.pdf
2.	http://download.101com.com/tdwi/ww24/WhatWorks24DigitalEdition.pdf
3.	http://nptel.ac.in/courses/110104086/13
4.	https://freevideolectures.com/course/3635/microsoft-business-intelligence

COGNITIVE SCIENCE

Course Code:	**AD2203 -1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, AD2001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To know the theoretical background of cognition.
2.	To understand the link between cognition and computational intelligence.
3.	To explore probabilistic programming language.
4.	To study the computational inference models of cognition.
5.	To study the computational learning models of cognition.

UNIT-I

15 Hours

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing –Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.

UNIT-II

15 Hours

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making –Learning – Language – Vision.

WebPPL Language – Syntax – Using JavaScript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration.

UNIT-III

10 Hours

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models.

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

1.	Understand the underlying theory behind cognition.
2.	Connect to the cognition elements computationally.
3.	Implement mathematical functions through WebPPL.
4.	Develop applications using cognitive inference models.
5.	Develop applications using cognitive learning models.

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**
AD2203 -1.1	3	1	3	2	2	-	-	-	1	1	1	1	2	2	-
AD2203 -1.2	2	2	1	1	2	-	-	-	3	2	1	1	2	3	-
AD2203 -1.3	1	3	1	3	3	-	-	-	1	3	1	1	2	3	-

AD2203 -1.4	2	1	1	2	3	-	-	-	1	2	1	1	2	3	-
AD2203 -1.5	1	2	3	2	2	-	-	-	1	2	2	1	2	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Vijay V Raghavan,Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016.

2. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015.

REFERENCE BOOKS:

1. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”,The MIT Press, 1999.

2. Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020.

3. Noah D. Goodman, Andreas Stuhlmuller, “The Design and Implementation of Probabilistic Programming Languages”, Electronic version of book, https://dippl.org/.

4. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016.

DATA WRANGLING

Course Code:	**AD2204-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1. Understand the basics of data wrangling.
2. Identify and execute the basic data format.
3. Perform the computations with Excel and pdf files .
4. Understand the concepts of data cleanup.
5. Explore and analyze the Image and video data.

UNIT-I

15 Hours

What Is Data Wrangling? - Importance of Data Wrangling -How is Data Wrangling performed? -Tasks of Data Wrangling-Data Wrangling Tools-Introduction to Python-Python Basics-Data Meant to Be Read by Machines-CSV Data-JSON Data-XML Data.
Installing Python Packages-Parsing Excel Files-Parsing Excel Files -Getting Started with Parsing-PDFs and Problem Solving in Python-Programmatic Approaches to PDF Parsing-Converting PDF to Text-Parsing PDFs Using pdf miner-Acquiring and Storing Data.

UNIT-II

15 Hours

Why Clean Data? - Data Cleanup Basics-Identifying Values for Data Cleanup-Formatting Data-Finding Outliers and Bad Data-Finding Duplicates-Fuzzy Matching-RegEx Matching-Normalizing and Standardizing the Data-Saving the Data-Determining suitable Data Cleanup-Scripting the Cleanup Testing with New Data.

UNIT-III

10 Hours

Exploring Data-Importing Data-Exploring Table Functions-Joining Numerous Datasets-Identifying Correlations-Identifying Outliers-Creating Groupings-Analyzing Data-Separating and Focusing the Data Presenting Data-Visualizing the Data-Charts-Time-Related Data-Maps-Interactives-Words-Images, Video, and Illustrations-Presentation Tools-Publishing the Data-Open-Source Platforms.

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

1. Explore the basics of data wrangling.
2. Identify and execute the basic data format.
3. Perform the computations with Excel and pdf files.
4. Understand the concepts of data cleanup.
5. Explore and analyze the Image and video data.

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**
AD2204-1.1	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2204-1.2	2	2	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2204-1.3	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2204-1.4	2	2	2	2	-	-	-	-	-	-	-	1	3	2	-

AD2204-1.5	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Jacqueline Kazil & Katharine Jarmul,” Data Wrangling with Python”, O’Reilly Media, Inc,2016

REFERENCE BOOKS:

1. Horowitz E., Sahni S., Rajasekaran S, “Computer Algorithms”, Galgotia Publications, 2001.
2. R.C.T. Lee, S.S. Tseng, R.C. Chang &Y.T.Tsai, “Introduction to the Design and Analysis of Algorithms A Strategic Approach”, Tata McGraw Hill, 2005.
3. Dr. Tirthajyoti Sarkar, Shubhadeep,” Data Wrangling with Python: Creating actionable data from raw sources”, Packt Publishing Ltd,2019.
4. Stefanie Molin,” Hands-On Data Analysis with Pandas”, Packt Publishing Ltd,2019.

E Books / MOOCs/ NPTEL

1. http://www.gbv.de/dms/ilmenau/toc/827365454.PDF
2. https://www.udemy.com/course/data-wrangling-with-python/
3. http://www.openculture.com/free-online-data-science-courses
4. https://www.classcentral.com/course/dataanalysiswithpython-11177

HIGH-DIMENSIONAL DATA ANALYSIS

Course Code:	**AD2205 -1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Outline the classical High Dimensional problems.
2.	Explore the Principal component analysis and canonical correlation
3.	Use the Factors and grouping techniques.
4.	Use the Factors and grouping techniques.
5.	Outline the Feature selection and principal component analysis.

UNIT-I

15 Hours

Classical method- Multi variant and High dimensional problems – Visualization – Multi variant Random vector and data- Multi dimensional data.
Discriminant Analysis: Visualizing principal component analysis – Properties of principal component - Standardized data and high dimensional data - Asymptotic results - Number of components and regression - Canonical correlation analysis -Population - sample and properties of canonical correlation, Asymptotic consideration - Canonical correlation and regression.

UNIT-II

15 Hours

Norms proximities, features, and dualities - Vectors and matrix norms, measure of proximity - Features and feature maps, dualities of X and X Transpose - Cluster analysis - Hierarchal agglomerative clusters - 3k means clustering, -Principal component and cluster analysis- Factor Analysis, population k factor model - Sample k factor model - Multidimensional scaling, classical scaling, metric scaling, and nonmetric scaling.

UNIT-III

10 Hours

Factor Analysis - Population k factor model – Sample k factor model - Multidimensional scaling - Towards non Gaussianity - Independent component Analysis -Projection pursuit -Kernal and more independent component methods.
Feature Selection: Introduction-Independent component and feature selection -Variable Ranking and statistical learning - Sparse principle component analysis – Consistency of principle component analysis as dimension grows.

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

1.	Outline the classical High Dimensional problems.
2.	Explore the Principal component analysis and canonical correlation
3.	Use the Factors and grouping techniques.
4.	Use the Factors and grouping techniques.
5.	Outline the Feature selection and principal component 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**
AD2205 -1.1	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-

AD2205 -1.2	2	2	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2205 -1.3	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2205 -1.4	2	2	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2205 -1.5	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Inge Koch , Analysis of Multivariate and High-Dimensional Data",Cambridge University Press ,2014.

REFERENCE BOOKS:

1. Fatemeh Emdad, SeyedZekavat , "High Dimensional Data Analysis: Overview, Analysis, and Applications, VDM Verlag, 2008

E Books / MOOCs/ NPTEL

1. https://www.cambridge.org/core/books/analysis-of-multivariate-and-highdimensionaldata/2BF8DE94

2. https://www.edx.org/course/high-dimensional-data-analysis

NATURAL LANGUAGE PROCESSING

Course Code:	**AD2206-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, AD2001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand the leading trends and systems in Natural Language Processing.
2.	To comprehend the basic representations used in syntax, the semantics of Natural Language Processing.
3.	To understand and explore the models used for word/sentence representations for various NLP applications.
4.	To implement deep learning algorithms in Python and learn how to train deep networks for NLP applications.

UNIT-I

15 Hours

Introduction: Computational linguistics- Introduction, syntax, semantics, morphology, collocation and other NLP problems.

Word representation: One-hot encoding, Bag-of-Words (BoW) Dictionary: Term Frequency – Inverse Document Frequency (TF-IDF), Language Model-n-gram – Neural Network-based word embedding algorithms.

UNIT-II

15 Hours

Sequences and sequential data: Machine learning and deep learning for NLP, Recurrent Neural Network, Long Short-Term Memory networks, Gated Recurrent Unit - Sequence to sequence modelling - Encoder decoder - Attention mechanism, Transformer Networks – BERT, GPT, Graph NLP, Hidden Markov Model, Conditional Random Field, Topic modelling.

UNIT-III

10 Hours

Applications of NLP: Part-of-Speech tagging, Named Entity recognition, Dependency parsing, - Sentiment Analysis, Machine translation, Question answering, Text summarization, Evaluation metrics for NLP models and Visualization.

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

1.	Apply modern tools for solving problems in computational linguistics.
2.	Implement word representation models to solve NLP problems.
3.	Develop deep learning models for solving NLP applications.
4.	Evaluate the performance of NLP models.
5.	To implement deep learning algorithms in Python and learn how to train deep networks for NLP 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
AD2206-1.1	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2206-1.2	2	2	2	2	-	-	-	-	-	-	-	1	3	3	-
AD2206-1.3	2	3	2	2	-	-	-	-	-	-	-	1	3	3	-

AD2206-1.4	2	2	2	2	-	-	-	-	-	-	-	1	3	3	-
AD2206-1.5	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Daniel Jurafsky, James H Martin, Speech & language processing, preparation [cited 2020 June 1] Available from: https://web. stanford. edu/~ jurafsky/slp3 (2018).

REFERENCE BOOKS:

1.	Christopher Manning and Hinrich Schütze, F oundations of Statistical Natural Language Processing, MIT press, 1999.
2.	Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O'Reilly Media, Inc.,2009.
3.	Jason Browlee, Deep Learning for Natural Language Processing: Develop Deep Learning Models for your Natural Language Problems (Ebook), Machine Learning Mastery, 2017.

NEURAL NETWORKS AND DEEP LEARNING

Course Code:	**AD2207-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, AD2001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand and need and principles of deep neural networks
2.	To understand CNN and RNN architectures of deep neural networks.
3.	To comprehend advanced deep learning models
4.	To learn the evaluation metrics for deep learning models

UNIT-I

15 Hours

Deep Networks Basics: Linear Algebra: Scalars - Vectors - Matrices and tensors; Probability Distributions - Gradient-based Optimization - Machine Learning Basics: Capacity - Overfitting and underfitting - Hyperparameters and validation sets - Estimators - Bias and variance - Stochastic gradient descent - Challenges motivating deep learning; Deep Networks: Deep feedforward networks; Regularization - Optimization.
Convolutional Neural Networks: Convolution Operation - Sparse Interactions - Parameter Sharing - Equivariance - Pooling - Convolution Variants: Strided - Tiled - Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions - Loss Functions - Regularization - Optimizers -Gradient Computation.

UNIT-II

15 Hours

Recurrent Neural Networks: Unfolding Graphs - RNN Design Patterns: Acceptor - Encoder - Transducer; Gradient Computation- Sequence Modeling Conditioned on Contexts - Bidirectional RNN - Sequence to Sequence RNN - Deep Recurrent Networks - Recursive Neural Networks - Long Term Dependencies; Leaky Units: Skip connections and dropouts; Gated Architecture: LSTM.
Model Evaluation: Performance metrics - Baseline Models - Hyperparameters: Manual Hyperparameter - Automatic Hyperparameter - Grid search - Random search - Debugging strategies.

UNIT-III

10 Hours

Autoencoders And Generative Models: Autoencoders: Undercomplete autoencoders - Regularized autoencoders - Stochastic encoders and decoders - Learning with autoencoders; Deep Generative Models: Variational autoencoders - Generative adversarial networks.

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

1.	Explain the basics in deep neural networks
2.	Apply Convolution Neural Network for image processing.
3.	Apply Recurrent Neural Network and its variants for text analysis.
4.	Apply model evaluation for various applications.
5.	Apply autoencoders and generative models for suitable 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**
AD2207-1.1	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-

AD2207-1.2	2	2	2	2	-	-	-	-	-	-	-	1	3	3	-
AD2207-1.3	2	3	2	2	-	-	-	-	-	-	-	1	3	3	-
AD2207-1.4	2	2	2	2	-	-	-	-	-	-	-	1	3	3	-
AD2207-1.5	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning", MIT Press, 2016.

2. Andrew Glassner, “Deep Learning: A Visual Approach”, No Starch Press, 2021.

REFERENCE BOOKS:

1. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, ``A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018.

2. Yoav Goldberg, ``Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.

3. Francois Chollet, ``Deep Learning with Python", Manning Publications Co, 2018.

4. Charu C. Aggarwal, ``Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.

SOCIAL AND WEB ANALYTICS

Course Code:	**AD2208 -1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, AD1602-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Understand social media, web and social media analytics, and their potential impact.
2.	Determine how to Leverage social media for better services and Understand usability metrics, web, and social media metrics.
3.	Use various data sources and collect data relating to the metrics and key performance indicators.
4.	Identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators.
5.	Use ready-made web analytics tools (Google Analytics) and be able to understand a statistical programming language (R), also use its graphical development environment (Deduce) for data exploration and analysis.

UNIT-I

15 Hours

Introduction to web and social analytics: Overview of web & social media (Web sites, web apps, mobile apps and social media), Impact of social media on business, Social media environment, , How to leverage social media for better services, Usability, user experience, customer experience, customer sentiments, web marketing, conversion rates, ROI, brand reputation, competitive advantages. Need of using analytics, Web analytics technical requirements., current analytics platforms, Open Source vs licensed platform, choosing right specifications & optimal solution, Web analytics and a Web analytics 2.0 framework (clickstream, multiple outcomes Relevant Data And its Collection using statistical Programming language R.: Data (Structured data, unstructured data, metadata, Big Data and Linked Data), Participating with people centric approach, Data analysis basics (types of data, metrics and data, descriptive statistics, comparing, Basic overview of R:R-Data Types, R-Decision Making, R-Loops, R-functions, R-Strings, Arrays, R-Lists, R-Data Frame, R-CSV Files, RPie Charts, R-Bar charts, R-Barplots. Basic Text Mining in R and word cloud.

UNIT-II

15 Hours

Kpi/Metrics: Understand the discipline of social analytics, Aligning social objectives with business goals, Identify common social business objectives, developing KPIs; Standard vs Critical metrics. PULSE metrics (Page views, Uptime, Latency, Seven-day active users) on business and technical Issues, HEART metrics (Happiness, Engagement, Adoption, Retention, and Task success) on user behaviour issues; Bounce rate, exit rate, conversion rate, engagement, strategically aligned KPIs, Measuring Macro & micro conversions, On-site web analytics, off-site web analytics, the goal-signal-metric process. Case study on Ready-made tools for Web and social media analytics (Key Google Analytics metrics, dashboard, social reports, Tableau Public and KNIME Mining Twitter: Exploring Trending Topics, Discovering What People Are Talking About, and More: Why Is Twitter All the Rage?, Exploring Twitter‘s API, Fundamental Twitter Terminology, Creating a Twitter API Connection, Exploring Trending Topics, Searching for Tweets, Analyzing the 140 Character, Extracting Tweet Entities, Analyzing Tweets and Tweet Entities with Frequency Analysis, Computing the Lexical Diversity of Tweets, Examining Patterns in Retweets, Visualizing Frequency Data with Histograms. Mining Facebook: Analysing Fan Pages, Examining Friendships, and More: Overview, Exploring Facebook‘s Social Graph API, Understanding the Social Graph API, Understanding the Open Graph Protocol, Analyzing Social Graph Connections, Analyzing Facebook Pages, Examining Friendships.

UNIT-III

10 Hours

Data Mining in Social Media: Introduction, Data Mining in a Nutshell, Social Media, Motivations for Data Mining in Social Media, Data Mining Methods for Social Media, Data Representation, Data Mining - A Process, Social Networking Sites: Illustrative Examples, The Blogosphere: Illustrative Examples, Related Efforts, Ethnography and Netnography, Event Maps.

Text Mining in Social Networks: Introduction, Keyword Search, Query Semantics and Answer Ranking, Keyword search over XML and relational data, Keyword search over graph data, Classification Algorithms, Clustering Algorithms, Transfer Learning in Heterogeneous Networks.

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

1.	Understand social media, web and social media analytics, and their potential impact.
2.	Identify and explain ready-made web analytics tools (Google Analytics) and able to understand a statistical programming language (R).
3.	Identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators.
4.	Determine how twitter mining can be done for better services.
5.	Explain text mining and data mining in social networks.

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**
AD2208 -1.1	2	2	-	-	-	-	-	-	-	-	-	1	3	1	-
AD2208 -1.2	3	2	3	-	-	-	-	-	-	-	-	1	3	1	-
AD2208 -1.3	2	3	-	-	-	-	-	-	-	-	-	1	3	1	-
AD2208 -1.4	1	2	-	-	-	-	-	-	-	-	-	1	3	1	-
AD2208 -1.5	2	2	-	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Matthew A. Russell,‖ Mining of Social web, O′Reilly‖, Second Edition ,ISBN-13: 978-1449367619, 2013.
2.	Charu C Agarwal, ―Social Network Data Analytics‖, Springer; October 2014.

REFERENCE BOOKS:

1.	Hand, Mannila, and Smyth,‖Principles of Data Mining‖, Cambridge, MA: MIT Press, ISBN: 026208290X, 2001.
2.	Avinash Kaushik, ―Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity‖, John Wiley &Sons; Pap/Cdr Edition, 2009.
3.	Tom Tullis, Bill Albert, ―Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics‖, First Edition, Morgan Kaufmann ,2008.
4.	Jim Sterne, Social Media Metrics: ―How to Measure and Optimize Your Marketing Investment‖, John Wiley & Sons ,2010.
5.	Brian Clifton, ―Advanced Web Metrics with Google Analytics‖, Third Edition, John Wiley & Sons ,2012.

SOFT COMPUTING

Course Code:	**AD2209-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, AD2001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
2.	To provide the mathematical background for carrying out the optimization associated with neural network learning.
3.	To learn various evolutionary Algorithms.
4.	To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
5.	To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.

UNIT-I

15 Hours

Introduction To Soft Computing and Fuzzy Logic: Introduction - Fuzzy Logic - Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems.

Neural Networks: Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

UNIT-II

15 Hours

Genetic Algorithms: Chromosome Encoding Schemes -Population initialization and selection methods - Evaluation function - Genetic operators- Cross over – Mutation - Fitness Function – Maximizing function.

Neuro Fuzzy Modeling: ANFIS architecture – hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modeling – Framework – Neuron functions for adaptive networks – Neuro fuzzy spectrum - Analysis of Adaptive Learning Capability.

UNIT-III

10 Hours

APPLICATIONS: Modeling a two-input sine function - Printed Character Recognition – Fuzzy filtered neural networks – Plasma Spectrum Analysis – Hand written neural recognition - Soft Computing for Color Recipe Prediction.

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

1.	Understand the fundamentals of fuzzy logic operators and inference mechanisms.
2.	Understand neural network architecture for AI applications such as classification and clustering.
3.	Learn the functionality of Genetic Algorithms in Optimization problems.
4.	Use hybrid techniques involving Neural networks and Fuzzy logic.
5.	Apply soft computing techniques in real world 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	3
AD2209-1.1	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2209-1.2	2	2	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2209-1.3	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2209-1.4	2	2	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2209-1.5	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. SaJANG, J.-S. R., SUN, C.-T., & MIZUTANI, E. (1997). Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. Upper Saddle River, NJ, Prentice Hall,1997
2. Himanshu Singh, Yunis Ahmad Lone, Deep Neuro-Fuzzy Systems with Python

REFERENCE BOOKS:

1. Raj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
3. Samir Roy, Udit Chakraborthy, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013.
4. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019.
5. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP Professional, Boston, 1996 Edition,2001.

STATISTICAL INFERENCE FOR DATA SCIENCE

Course Code:	**AD2210-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, AD2001-1, MA2001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand the exploratory analysis
2.	To understand the various distribution and sampling.
3.	To understand various types of Hypothesis Testing.
4.	To understand statistical inference for Regression and Classification.

UNIT-I

15 Hours

Elements of Structured, Estimates of Location - Mean, Median, Mode, Outliers, Estimates of Variability-Standard Deviation, Z-Score, Frequency Table and Histograms, Correlation.
Normalization, Sampling Data-Simple Random sampling, Stratified, Cluster Sampling, Sampling Error/Bias. Bootstrapping, Central Limit Theorem, Confidence intervals, Normal distribution, Binomial distribution, Poisson distribution.

UNIT-II

15 Hours

A/B Testing, Hypothesis Tests- null, one-way, two-way, P-value, Type 1 & 2 errors, t-tests, multiple testing, degrees of freedom, ANOVA, Chi-Square Tests, Power, and Sample Size.
Simple Linear Regression, Multiple Linear Regression, Confidence and Prediction Intervals, Categorical Variables, Multicollinearity, Polynomial Regression.

UNIT-III

10 Hours

Naive Bayes, Discriminant Analysis, Logistic Regression, Evaluating Classification Models, Strategies for Imbalanced Data.

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

1.	Perform exploratory analysis on the datasets.
2.	Understand the various distribution and sampling.
3.	Perform Hypothesis Testing on datasets.
4.	Apply statistical inference for Regression.
5.	Apply statistical inference for Classification.

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
AD2210-1.1	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-
AD2210-1.2	2	2	2	2	-	-	-	-	-	-	-	1	3	3	-
AD2210-1.3	2	3	2	2	-	-	-	-	-	-	-	1	3	3	-
AD2210-1.4	2	2	2	2	-	-	-	-	-	-	-	1	3	3	-
AD2210-1.5	2	3	2	2	-	-	-	-	-	-	-	1	3	2	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Bruce, Peter, and Andrew Bruce. Practical statistics for data scientists: 50 essential concepts. " O'Reilly Media, Inc.", 2017.
REFERENCE BOOKS:	
1.	Dodge, Yadolah, ed. Statistical data analysis and inference. Elsevier, 2014.
2.	Ismay, Chester, and Albert Y. Kim. Statistical Inference via Data Science: A Modern Dive into R and the Tidyverse. CRC Press, 2019.
E Books / MOOCs/ NPTEL	
1.	https://leanpub.com/LittleInferenceBook
2.	https://www.coursera.org/learn/statistical-inference
3.	https://www.datacamp.com/community/open-courses/statistical-inference-and-data-analysis

STREAM PROCESSING

Course Code:	**AD2211 -1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, CS2102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Introduce Data Processing terminology, definition & concepts.
2.	Define different types of Data Processing.
3.	Explain the concepts of Real-time Data processing.
4.	Select appropriate structures for designing and running real-time data services in a business environment.
5.	Illustrate the benefits and drive the adoption of real-time data services to solve real world problems.

UNIT-I

15 Hours

Foundations Of Data Systems, Real-Time Data Processing: Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges.

Real-Time Data Processing: Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing, Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage

UNIT-II

15 Hours

Data Models and Query Languages, Event Processing With Apache Kafka: Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Manyto-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL.

Event Processing with Apache Kafka: Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API.

UNIT-III

10 Hours

Real-Time Processing Using Spark Streaming: Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication

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

1.	Understand the applicability and utility of different streaming algorithms.
2.	Describe and apply current research trends in data-stream processing.
3.	Analyze the suitability of stream mining algorithms for data stream systems.
4.	Program and build stream processing systems, services and applications.

5.	Solve problems in real-world applications that process data streams.

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	PSO↓ 2	PSO↓ 3
AD2211 -1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2211 -1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2211 -1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2211 -1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD2211 -1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Streaming Systems: The What, Where, When and How of Large-Scale Data Processing by Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication.

2. Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media.

REFERENCE BOOKS:

1. Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing.

E Books / MOOCs/ NPTEL

1. https://spark.apache.org/docs/latest/streaming-programming-guide.html

2. Kafka.apache.org

TEXT AND SPEECH ANALYSIS

Course Code:	**AD2212-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, AD2001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Understand natural language processing basics.
2.	Apply classification algorithms to text documents.
3.	Build question-answering and dialogue systems.
4.	Develop a speech recognition system.
5.	Develop a speech synthesizer.

UNIT-I

15 Hours

Natural Language Basics: Foundations of natural language processing – Language Syntax and Structure-Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model.

Text Classification: Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models.

UNIT-II

15 Hours

Question Answering and Dialogue Systems: Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems.

Text-To-Speech Synthesis: Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems.

UNIT-III

10 Hours

Automatic Speech Recognition: Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems.

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

1.	Explain existing and emerging deep learning architectures for text and speech processing.
2.	Apply deep learning techniques for NLP tasks, language modelling and machine translation.
3.	Explain coreference and coherence for text processing.
4.	Build question-answering systems, chatbots and dialogue systems.
5.	Apply deep learning models for building speech recognition and text-to-speech 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**
AD2212-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2212-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2212-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-

AD2212-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD2212-1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.

REFERENCE BOOKS:

1. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.
2. Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
4. Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.

TIME SERIES ANALYSIS

Course Code:	**AD2213-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, AD2001-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand the tools and techniques required to analyze time series data.
2.	To focus on the linear time series analysis, nonlinear time series analysis and ML/DL methods for predictive analytics.
3.	To understand generating models from non-stationary and stationary time series data.

UNIT-I

15 Hours

Introduction – Review of basic statistics – Stationarity – Ergodicity – Autocorrelation – Partial Autocorrelation – Linear Models – Autoregressive Models – Moving Average Models.

UNIT-II

15 Hours

ARMA – ARIMA – SARIMA – VAR – Conditional Heteroscedastic Models – ARCH Model – GARCH Model
Nonlinear Models – Tests for Stationarity – Tests for nonlinearity – State Space Models

UNIT-III

10 Hours

Machine Learning Models – Deep Learning Models –Precursors for Catastrophic Transitions.

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

1.	Analyze linear time series data.
2.	Analyze nonlinear time series data.
3.	Analyze stationary and non-stationary time series data.
4.	Apply ML/DL models to perform predictive analytics on time series data.

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**
AD2213-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2213-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2213-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2213-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Robert H Shumway & David S Stoffer, Time Series Analysis and Its Applications with R examples, Third Edition, Springer,2011

REFERENCE BOOKS:

1. G E P Box, G M Jenkins, G C Reinsel, G M Ljung, Time Series Analysis: Forecasting and Control, fifth edition,Wiley, 2016

2. Aileen Nielsen, Practical Time Series Analysis Prediction with Statistics and Machine Learning,

	O'Reilly, first edition, 2019
3.	VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010. Jonathan D Cryer & Kung Silk Chan, Time Series Analysis With Applications in R, Second Edition, Springer,2008.

AUGMENTED REALITY/VIRTUAL REALITY

Course Code:	**AD1301-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To impart the fundamental aspects and principles of AR/VR technologies.
2.	To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
3.	To learn about the graphical processing units and their architectures.
4.	To gain knowledge about AR/VR application development.
5.	To know the technologies involved in the development of AR/VR based applications.

UNIT-I

15 Hours

Introduction: Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.
VR Modeling: Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT-II

15 Hours

VR Programming: VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D.
Applications: Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR.

UNIT-III

10 Hours

Augmented Reality: VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

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

1.	Understand the basic concepts of AR and VR.
2.	Understand the tools and technologies related to AR/VR.
3.	Know the working principle of AR/VR related Sensor devices.
4.	Design of various models using modeling techniques.
5.	Develop AR/VR applications in different domains.

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**

AD1301-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD1301-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD1301-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD1301-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD1301-1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018.

REFERENCE BOOKS:

1. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016.
2. John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
3. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003.

MULTIMEDIA DATA COMPRESSION AND STORAGE

Course Code:	**AD1302-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Understand the basic ideas of compression algorithms related to multimedia components.
2.	Understand the principles and standards of Text and Audio Compression Techniques.
3.	Understand the principles and standards of Image and Video Compression Techniques.
4.	To know about basics of consistency of data availability in storage devices.
5.	To understand the concepts of data streaming services.

UNIT-I

15 Hours

Basics Of Data Compression: Special features of multimedia-Graphics, Image and Video representations, Fundamental concepts of video, digital audio, Storage requirements of multimedia applications, Need for compression, Taxonomy of compression Algorithms, Error Free Compression, Lossy Compression.
Text Compression: Compression principles-source encoders and destination encoders- entropy encoding –source encoding- text compression –static Huffman coding dynamic Huffman coding –arithmetic coding – Lempel Ziv-Welsh Compression- Shannon Fano coding.

UNIT-II

15 Hours

Audio compression: DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding code excited LPC-perpetual coding. Audio compression Techniques – μ Law and A Law companding - Speech compression - Frequency domain and filtering – Basic sub band coding – Application to speech coding – G.722 –Application to audio coding – MPEG audio.
Image Compression: Fundamentals — Compression Standards – JPEG Standard –Sub-band coding – Wavelet Based compression – Implementation using Filters – EZW, SPIHT coders – JPEG 2000 Text Audio Image Multimedia Video Coding -Static Huffman -Dynamic Huffman -Dynamic Coding Standards -G.722 -MPEG Coding -APC -LPC -Perpetual Coding -Sub-Band Coding Coding -Sub-Band Coding -Lossless Coding -Hierarchical Coding Standards JPEG JPEG2000 JBIG JBIG2 -DVI Technology -Current Trends Standards MPEG1 MPEG2 MPEG3 MPEG4 standards – JBIG and JBIG2 standards. Discrete cosine Transform. Sequential and Progressive DCT based encoding algorithms, lossless coding, hierarchical coding.

UNIT-III

10 Hours

Data Placement on Disks: Statistical placement on Disks – Striping on Disks – Replication Placement on Disks – Constraint allocation on Disks – Tertiary storage Devices – Continuous Placement on Hierarchical storage system – Statistical placement on Hierarchical storage systems – Constraint allocation on Hierarchical storage system.
Disk Scheduling Methods: Scheduling methods for disk requests – Feasibility conditions of concurrent streams– Scheduling methods for request streams.

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

1.	Understand the basics of text, Image and Video compression.
2.	Understand the various compression algorithms for multimedia content.

3.	Explore the applications of various compression techniques.
4.	Explore knowledge on multimedia storage on disks.
5.	Understand scheduling methods for request streams.

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
AD1302-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD1302-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD1302-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD1302-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD1302-1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Series in Multimedia Information and Systems, 2018, 5th Edition.
2. Philip K.C.Tse, Multimedia Information Storage and Retrieval: Techniques and Technologies, 2008
3. Fred Halshall "Multimedia Communication - Applications, Networks, Protocols and Standards", Pearson Education, 2007.

REFERENCE BOOKS:

1. David Salomon, A concise introduction to data compression, 2008
2. Lenald Best, Best's Guide to Live Stream Video Broadcasting, BCB Live Teaching series, 2017
3. Yun-Qing Shi, Image and Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards, Taylor& Francis,2019
4. Tay Vaughan, "Multimedia: Making it Work", 7 th Edition, TMH 2008 98.

OPERATIONS RESEARCH

Course Code:	**AD1303-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

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

UNIT-I

15 Hours

Introduction: Evolution of OR Definitions of OR Scope of OR Applications of OR Phases in OR study. Characteristics and limitations of OR, models used in OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).

LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two-Phase Simplex Method, Degeneracy in LPP.

UNIT-II

15 Hours

Concept of Duality, writing Dual of given LPP. Solutions to LPP by Dual Simplex Method.

Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem.

UNIT-III

10 Hours

Assignment Problem: Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP). Difference between assignment and T.S.P, Finding best route by Little's method. Numerical Problems

Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn m and mX2 games by graphical method. Formulation of games.

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**
AD1303-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD1303-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD1303-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD1303-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD1303-1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Ramamurthy P, "Operations Research", 2nd Edition, New Age International (P) Ltd., Publishers, 2007.

2. S. D. Sharma, "Operations Research", Kedar Nath Ram Nath Publishers, 2015.

REFERENCE BOOKS:

1. Taha, H.A., "Operations Research: An Introduction", 8 th 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/

SAS PROGRAMMING

Course Code:	**AD1304-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Use various components of an INPUT statement to process raw data files in SAS.
2.	Remember how to Create and Manipulate the temporary and permanent datasets contents from the data set values.
3.	Perform data processing using conditional processing & iterative processing and looping.
4.	Use SAS functions to manipulate character data, numeric data, arrays and SAS date values.
5.	Apply the SAS Output Delivery System to prepare detailed reports and Generate summary.

UNIT-I

15 Hours

Introduction To Sas & Data Step Processing, Sas Data Sets, Labels And Formats: What is SAS – Writing Your First SAS Program - Reading Raw Data from External Files – Introduction - Reading Data Values Separated by Blanks - Specifying Missing Values with List Input - Reading Data Values Separated by Commas from CSV files -Using an alternative Method to Specify an External File - Reading Data Values Separated by Delimiters Other Than Blanks or Commas - Specifying INFILE Options with the DATALINES Statement - Reading Raw Data from Fixed Columns—Method 1: Column Input - Reading Raw Data from Fixed Columns—Method 2: Formatted Input - Using a FORMAT Statement in a DATA Step versus in a Procedure - Using Informats with List Input.
Creating Permanent SAS Data Sets - SAS Libraries—The LIBNAME Statement - Why Create Permanent SAS Data Sets? -Examining the Descriptor Portion of a SAS Data Set Using PROC CONTENTS - Listing All the SAS Data Sets in a SAS Library Using PROC CONTENTS - Viewing the Data Portion of a SAS Data Set Using PROC PRINT - Using a SAS Data Set as Input to a DATA Step -Creating Labels and Formats - Reading and Writing Data from an Excel Spreadsheet.

UNIT-II

15 Hours

Looping And Sas Functions: Introduction Performing Conditional Processing - If-else, if-else with do statement, Select When - Performing Iterative Processing: Looping – Do-loop Statement - Managing SAS Dataset using set statement - Working with Dates -How SAS Stores Dates - Reading Date Values from Text Data - Demonstrating a Date Constant - Computing the Current Date - Extracting the Day of the Week, Day of the Month, Month, and Year from a SAS Date.
Sas Functions: Working with Character Functions - Numeric Functions - Combining data set-one to one reading, concatenation, and merge - Array-single and multi-dimensional array.

UNIT-III

10 Hours

Presenting And Summarizing the Data: Descriptive Statistics-Proc means and proc freq - Proc report-column, define, headline, head skip, compute, order and group - Proc tabulate, Proc - Proc print to, proc import and proc export - Introducing the Output Delivery System.

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

1.	Use various components of an INPUT statement to process raw data files in SAS.

2.	Remember how to Create and Manipulate the temporary and permanent datasets contents from the data set values.
3.	Perform data processing using conditional processing & iterative processing and looping.
4.	Use SAS functions to manipulate character data, numeric data, arrays and SAS date values.
5.	Apply the SAS Output Delivery System to prepare detailed reports and Generate summary.

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
AD1304-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD1304-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD1304-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD1304-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD1304-1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Ron Cody, " Learning SAS by Example: A Programmer's Guide " ,2nd Edition. Cary, NC: SAS Institute Inc,2018.

REFERENCE BOOKS:

1. Geoff Der , Brian S. Everitt, " A Handbook of Statistical Analyses using SAS ", 2nd Edition, Library of Congress Cataloging-in-Publication Data,2002.

E Books / MOOCs/ NPTEL

1. https://support.sas.com/content/dam/SAS/support/en/books/learning-sas-by-example-aprogrammers-guide-second-edition/71442_excerpt.pdf

2. https://www.sas.com/storefront/aux/en/splsb/65423_excerpt.pdf

3. https://www.dermepi.eu/wpcontent/uploads/2017/04/Little.SAS_.Book_.A_Primer.Third_.Edition.pdf

4. https://www.coursera.org/courses?query=sas

ADVANCED JAVA PROGRAMMING

Course Code:	**AD2301-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**CS2002-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1. Understand the basics of servlets and JSP.
2. Understand the concepts of Hibernate.
3. To implement programs using Servlet and JSP.
4. To know the applications of Spring Boot.
5. To implement programs using Spring Boot.

UNIT-I

15 Hours

Servlets - What are Servlets? What can they do? Why are they needed? How do Servlets look in code? HTTP Methods: GET, POST, PUT, DELETE, TRACE, OPTIONS GET/POST request; differences between the two. Servlet Lifecycle Servlet Context and Servlet Config Forwarding and Redirection of requests.
Session Management- Session information passing between client and server, Session information passing mechanisms - Cookies, Rewriting.
JSP - Introduction to JSP and the need for JSPs, Basic HTML tags, JSP Lifecycle, and JSP Elements.
Struts framework, Struts 1 overview, Struts 1 and Struts 2 comparison, Struts 2 Architecture, To build Action class, Defining data and business logic in Action class, Struts 2 Interceptors.

UNIT-II

15 Hours

Hibernate Architecture, Hibernate CRUD. Introduction to spring. Introduction to all modules of Spring, Bootstrapping, Setting up Spring, Introduction to Spring Boot, Project Components, Tool Suite, Spring Boot AOP, Spring Boot Database

UNIT-III

10 Hours

Building and consuming restful web services, logging. exception handling, file handling, enabling https, service components, email, WebSockets, and cloud connectivity examples.

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

1. Explain the concepts of servlet and JSP.
2. Implement the programs using Servlet and JSP.
3. Develop web programs using the Hibernate concept.
4. Explain the concept and structure of the Spring boot program.
5. Develop applications using Spring boot.

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
AD2301-1.1	3	2	2	-	-	-	-	-	-	-	1	2	3	-	-
AD2301-1.2	3	3	1	-	-	-	-	-	-	-	1	2	3	-	-
AD2301-1.3	3	3	2	-	-	-	-	-	-	-	1	2	3	-	-
AD2301-1.4	3	2	3	-	-	-	-	-	-	-	1	2	3	-	-

AD2301-1.5	3	3	1	-	-	-	-	-	-	-	1	2	3	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Jim Keogh, Java 2EE Complete reference, McGraw Hill, July 2017

REFERENCE BOOKS:

1.	Herbert Schildt, Java: The Complete Reference, Eleventh Edition, McGraw Hill, March 2019

E Books / MOOCs/ NPTEL

1.	https://www.tutorialspoint.com/spring_boot/spring_boot_tutorial.pdf

MOBILE APPLICATION DEVELOPMENT

Course Code:	**AD2302-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**CS2002-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Describe the fundamentals of the Flutter framework and DART programming.
2.	Develop a mobile application and incorporate widgets and state into the app.
3.	Build an application using Forms and Gestures and Animation.
4.	Demonstrate Asnyc Dart and Flutter and Infinite Scrolling and state management.
5.	Develop applications to file handling, using SQLite database, RESTful API calls, and Firebase.

UNIT-I

15 Hours

Introduction: What is Flutter, Why Flutter? The other options, Native solutions, What is Dart. Basics of Dart.

Basics of Dart: Keywords, built-in types, functions, operators, control flow statements, exceptions, classes, generics, libraries and visibility, asynchrony support, generators, callable classes, isolates, typedefs, metadata, comments Setting up Flutter development environment.

The basics of writing Flutter code Hello World Flutter App Basic Widgets such as App bar, Column, Row, Container, Image, Icon, Buttons, and Text.

UNIT-II

15 Hours

Flutter UI: Important widgets, themes, and Layout, The base features of the Flutter app. User Interaction: Forms and Gestures. Pushing pixels: Flutter Animation and using the canvas, Painting to the canvas and details of using flutter animation.

Async Dart and Flutter and Infinite Scrolling, Flutter state management.

UNIT-III

10 Hours

Working with files, including libraries in your Flutter app, including a file with your app, Reading/Writing to files, Using JSON, Using Shared Preferences

Working with SQLite Database, Making RESTful API Calls with HTTP, Using Firebase/Firestore with Flutter.

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

1.	Explain the Flutter Platform and the basics of Dart programming.
2.	Design the user interface using the Flutter essential UI components and widgets.
3.	Apply the flutter UI concepts such as Layouts, Themes, Forms, Gestures and Animation.
4.	Develop a flutter application using Asnyc Dart and Flutter and Infinite Scrolling and state management.
5.	Apply the file handling, using SQLite database, RESTful API calls, and Firebase in app development.

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**
AD2302-1.1	3	3	-	-	-	-	-	-	-	-	-	1	-	3	-

AD2302-1.2	2	3	2	-	-	-	-	-	-	-	-	1	-	3	2
AD2302-1.3	3	3	-	-	-	-	-	-	-	-	-	1	-	3	2
AD2302-1.4	3	3	2	-	-	-	-	-	-	-	-	1	-	3	-
AD2302-1.5	3	3	2	-	-	-	-	-	-	-	-	1	-	3	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Eric Windmill, “Flutter in Action”, Manning Publications, January 2020.
2. Rap Payne, “Beginning App Development with Flutter: Create Cross-Platform Mobile Apps”, Apress Publisher, December 2019.
3. Ed Freitas, “Flutter Succinctly”, 2019.

REFERENCE BOOKS:

1. Marco L. Napoli, “Beginning Flutter: A Hands-On Guide to App Development”,2019. .
2. Kevin David Moore, Michael Katz, and Vincent Ngo “Flutter Apprentice (First Edition): Learn to Build Cross-Platform Apps”,2021

E Books / MOOCs/ NPTEL

1. https://dart.dev/guides/language/language-tour
2. https://flutter.dev/docs
3. https://onlinecourses.nptel.ac.in/noc20_cs52/preview
4. The Complete Flutter Development Bootcamp with Dart offered by Udemy

CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES

Course Code:	**AD2303-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand the basics of Blockchain.
2.	To learn Different protocols and consensus algorithms in Blockchain.
3.	To learn the Blockchain implementation frameworks.
4.	To understand the Blockchain Applications.
5.	To experiment the Hyperledger Fabric, Ethereum networks.

UNIT-I

15 Hours

Introduction To Blockchain: Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

Bitcoin And Cryptocurrency: A basic crypto currency, Creation of coins, Payments, and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT-II

15 Hours

Bitcoin Consensus: Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

Hyperledger Fabric & Ethereum: Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT-III

10 Hours

Blockchain Applications: Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, etc.,- Case Study.

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

1.	Understand emerging abstract models for Blockchain Technology
2.	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
3.	How consensus on their contents is achieved, and the new applications that they enable.
4.	Apply Hyperledger Fabric and Ethereum platform to implement the Block chain Application.
5.	Apply blockchain 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**
AD2303-1.1	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2303-1.2	3	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2303-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-

AD2303-1.4	3	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD2303-1.5	3	1	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017

REFERENCE BOOKS:

1. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016.
2. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016.
3. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
4. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.

CYBER SECURITY

Course Code:	**AD2304-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1101-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To learn cybercrime and cyberlaw.
2.	To understand the cyber-attacks and tools for mitigating them.
3.	To understand information gathering.
4.	To learn how to detect a cyber-attack.
5.	To learn how to prevent a cyber-attack.

UNIT-I

15 Hours

Introduction: Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes - A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

Attacks and Countermeasures: Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.

UNIT-II

15 Hours

Reconnaissance: Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.

Intrusion Detection: Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

UNIT-III

10 Hours

Intrusion Prevention: Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.

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

1.	Explain the basics of cyber security, cyber crime and cyber law.
2.	Classify various types of attacks and learn the tools to launch the attacks.
3.	Apply various tools to perform information gathering.
4.	Apply intrusion techniques to detect intrusion.
5.	Apply intrusion prevention techniques to prevent intrusion.

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
AD2304-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2304-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2304-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2304-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD2304-1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021.
2. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley Publishers, 2011.

REFERENCE BOOKS:

1. David Kim, Michael G. Solomon, “Fundamentals of Information Systems Security”, Jones & Bartlett Learning Publishers, 2013
2. Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy”, Elsevier, 2011
3. William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, Third Edition, Pearson Education, 2015
4. Kimberly Graves, “CEH Official Certified Ethical hacker Review Guide”, Wiley Publishers, 2007

ETHICS AND AI

Course Code:	**AD2305-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**HU1004-1, AD1102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Study the morality and ethics in AI.
2.	Learn about the Ethical initiatives in the field of artificial intelligence.
3.	Study about AI standards and Regulations.
4.	Study about social and ethical issues of Robot Ethics.
5.	Study about AI and Ethics- challenges and opportunities.

UNIT-I

15 Hours

Introduction: Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust.
Ethical Initiatives In AI: International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.

UNIT-II

15 Hours

AI Standards and Regulation: Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems
Roboethics: Social And Ethical Implication Of Robotics: Robot-Roboethics- Ethics and Morality-Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.

UNIT-III

10 Hours

AI and Ethics- Challenges and Opportunities: Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.

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

1.	Learn about morality and ethics in AI.
2.	Acquire the knowledge of real time application ethics, issues, and its challenges.
3.	Understand the ethical harms and ethical initiatives in AI.
4.	Understand the concepts of Roboethics and Morality with professional responsibilities.
5.	Learn about the societal issues in AI with National and International Strategies on AI.

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**
AD2305-1.1	3	1	1	-	-	-	-	3	1	-	-	1	3	1	-
AD2305-1.2	3	1	1	-	-	-	-	3	1	-	-	1	3	1	-
AD2305-1.3	3	1	2	-	-	-	-	3	1	-	-	1	3	1	-
AD2305-1.4	3	1	3	-	-	-	-	3	1	-	-	1	3	1	-
AD2305-1.5	3	3	1	-	-	-	-	3	1	-	-	1	3	1	-

	1: Low 2: Medium 3: High
TEXTBOOKS:	
1.	Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield,” The ethics of artificial intelligence: Issues and initiatives”, EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020.
2.	Patrick Lin, Keith Abney, George A Bekey,” Robot Ethics: The Ethical and Social Implications of Robotics”, The MIT Press- January 2014.
REFERENCE BOOKS:	
1.	Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017.
2.	Mark Coeckelbergh,” AI Ethics”, The MIT Press Essential Knowledge series, April 2020.

INTELLIGENT DATABASE SYSTEM

Course Code:	**AD2306-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, CS2102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Understand the concepts of Intelligent database.
2.	Make study of the Database installation then create the database with user and apply SQL.
3.	Understand the concepts of knowledge-based systems and apply with AI.
4.	Design and create small applications.
5.	Analyze and implement for various real-time applications in Intelligent Database System.

UNIT-I

15 Hours

Informal definition of the domain - General characteristics of IDBSs - Data models and the relational data model - A taxonomy of intelligent database systems - Guidelines for using intelligent database systems. Nested and semantic data models – Introduction - The nested relational model - Semantic models - Hyper-semantic data models - Object-oriented approaches to semantic data modeling - Object oriented database systems - Basic concepts of a core object-oriented data model - Comparison with other data models - Query languages and query processing - Operational aspects – Systems - The ODMG standard - The object-relational data model - Java and databases – Conclusions - Active database systems - Basic concepts – Issues – Architectures - Research relational prototypes—the Starburst Rule System - Commercial relational approaches.

UNIT-II

15 Hours

Characteristics and classification of the knowledge-based systems – Introduction - The resolution principle - Inference by inheritance – Conclusion - Deductive database systems - Basic concepts - DATALOG language - Deductive database systems and logic programming systems—differences - Architectural approaches - Research prototypes - Updates in deductive databases - Integration of deductive database and object database technologies - Constraint databases - Conclusions.
Introduction - Architectural solutions - The 'general bridge' solution - Extending a KBS with components proper to a DBMS - The 'tight coupling' approach – Conclusion - Advanced solutions: Introduction - A 'knowledge level' approach to the interaction with an IAS- TELOS - a language for implementing very large 'integral approach' systems- The CYC project - Other projects based on a 'conceptual representation' approach - Lexical approaches to the construction of large KBs.

UNIT-III

10 Hours

Introduction - Temporal databases - Basic concepts - Temporal data models - Temporal query languages – Ontologies -Ontology theoretical foundations - Environments for building ontologies - Structured, semi-structured and unstructured data - Multimedia database - Semi-structured data - Mediators – Motivation – Architecture - Application of mediators to heterogeneous systems – Proposals - Multi-Agents systems - Main issues in designing a multi-agent system - Open problems. Internet indexing and retrieval - Basic indexing methods - Search engines or meta-searchers - Internet spiders - Data mining - Data mining tasks - Data mining tools - Medical and legal information systems - Medical information systems - Legal information systems – Conclusions.

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

1.	Understand the concepts of Intelligent database.
2.	Make study of the Database installation then create the database with user and apply SQL.
3.	Understand the concepts of knowledge-based systems and apply with AI.
4.	Design and create the small applications.
5.	Analyze and implement for various real-time applications in Intelligent Database System.

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
AD2306-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2306-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2306-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2306-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD2306-1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Elisa Bertino, Barbara Catania, GianPieroZarri, “Intelligent Database Systems”,Collection ACM Press.

REFERENCE BOOKS:

1. Ngoc Thanh Nguyen, Radoslaw Katarzyniak,and Shyi-Ming Chen (Eds.), "Advances inIntelligent Information and Database Systems ", Springer, 2010.

E Books / MOOCs/ NPTEL

1. https://www.eyrolles.com/Informatique/Livre/intelligent-database-systems-9780201877366/

2. https://www.coursera.org/learn/database-management

INTERNET OF THINGS

Course Code:	**AD2307-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**EC1001-1, AD1101-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Learn the IoT Definitions, Design aspects.
2.	Identify the IoT hardware and software requirements.
3.	Describe IoT logical and physical design concepts.
4.	Implement Arduino based IoT Projects.
5.	Implement Raspberry Pi Based IoT Projects.

UNIT-I

15 Hours

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

UNIT-II

15 Hours

IoT Logical Design: IoT Physical Design, Basic building blocks, Raspberry Pi, Linux on Raspberry Pi, Interfaces, Programming on Raspberry Pi with Python.

Arduino Based IoT Projects Development: Arduino for Project development using components such as LED/Buzzer, Push button/Digital sensor (IR/LDR), Interface motor using relay, Sensing Temperature and Humidity smart phone using Bluetooth.

Raspberry: Pi Raspberry Pi for Project Development: Raspberry Pi platform, GPIO.

UNIT-III

10 Hours

Raspberry Pi based IoT Project Implementation: Developing projects using components such as LED/Buzzer, Push button/Digital sensor (IR/LDR), Interface motor using relay, Sensing Temperature and Humidity smart phone using Bluetooth

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

1.	Explain IoT Definitions, Requirements, Systems Design, Sensors, Tags, security communications
2.	Apply IoT knowledge in understanding IoT systems and applications
3.	Outline IoT systems Logical and Physical Design Aspects, Develop Arduino simple programs for LED, Buzzer, Push button, Digital sensors
4.	Develop and Implement simple IoT projects using Arduino boards.
5.	Develop and implement the simple IoT projects using Raspberry Pi boards.

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**

AD2307-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2307-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2307-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2307-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD2307-1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

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.	Srinivasa K G, "Internet of Things",CENGAGE Learning India, 2017
	Arshdeep Bahga, Vijay Madisetti, ―Internet of Things: A Hands-On Approach,Vijay Madisetti‖, 2014.

OBJECT ORIENTED MODELLING AND DESIGN

Course Code:	**AD2308-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**CS2001-1, CS2002-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Recall the object-oriented concepts, three pillars of object-orientation and their benefits.
2.	Illustrate the various models that can be used to demonstrate the object-oriented design of any real-world software systems.
3.	Make use of use-cases for interpreting the requirements and develop class diagrams that model both the domain state model and design model of a software system.
4.	Examine the dynamic aspects of a software system, model the interaction diagrams to justify those aspects.
5.	Relate how the UML constructs are used to represent various models.

UNIT-I

15 Hours

Introduction: What is Object Orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modeling history. Modeling as Design Technique: Modeling; abstraction; The three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips. Advanced Class Modeling: Advanced object and class concepts; Association ends; Nary associations.
Advanced Class Modeling: Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages; Practical tips. State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior; Practical tips.
Advanced State Modeling: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models; Practical tips.
Interaction Modeling: Use case models; Sequence models; Activity models; Use case relationships; Procedural sequence models; Special constructs for activity models.

UNIT-II

15 Hours

Process Overview, System Conception: Development stages; Development life cycle, Devising a system concept; Elaborating a concept; Preparing a problem statement.
Domain Analysis: Overview of analysis; Domain class model; Domain state model; Domain interaction model; Iterating the analysis.
Application Analysis: Application interaction model; Application class model; Application state model; Adding operations.
System Design: Overview; Estimating performance; Making a reuse plan; Breaking a system in to sub-systems; Identifying concurrency; Allocation of sub-systems; Management of data storage; Handling global resources; Choosing a software control strategy; Handling boundary conditions; Setting the trade-off priorities; Common architectural styles; Architecture of the ATM system as the example.

UNIT-III

10 Hours

Class Design: Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Re-cursing downwards, Re-factoring; Design optimization; Reification of behavior; Adjustment of inheritance; Organizing a class design; ATM example.

Implementation Modeling: Overview of implementation; Fine- tuning classes; Finetuning generalizations; Realizing associations; Testing.
Legacy Systems: Reverse engineering; Building the class models; Building the interaction model; Building the state model; Reverse engineering tips; Wrapping; Maintenance.

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

1.	Acquire Knowledge about different software systems modelling techniques, class design and associations by making use of concept diagrams
2.	Illustrate Advanced Class, State and Interaction models of software systems utilizing class, state and interaction diagrams
3.	Outline the system concepts, Development Life Cycle, Analyze and Define Problem Statement, Analyze the system domain, application, class, state and interaction models
4.	Overview of system design, estimate performance, divide it into subsystems, managing resources, selecting appropriate architectural styles
5.	Describe class design, Implementation modelling, Legacy systems and Reverse engineering concepts, realizing use cases, associations, Fine Tuning Classes, Constructing Interaction and State models.

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**
AD2308-1.1	2	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2308-1.2	2	2	1	3	-	-	-	-	-	-	-	1	3	1	-
AD2308-1.3	2	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2308-1.4	2	2	3	3	-	-	-	-	-	-	-	1	3	1	-
AD2308-1.5	1	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Object-Oriented Modeling and Design with UML, Michael Blaha, James Rumbaugh, 2 nd Edition, Pearson Education, 2005

REFERENCE BOOKS:

1. Object-Oriented Analysis and Design with Applications, Grady Booch et al, 3rd Edition, Pearson Education, 2007.
2. Practical Object-Oriented Design with UML, Mark Priestley, 2nd Edition, Tata McGraw-Hill, 2003.
3. Object-Oriented Design with UML and JAVA, K. Barclay, J. Savage, Elsevier, 2008.
4. The Unified Modeling Language User Guide, Booch, G., Rumbaugh, J., and Jacobson I, 2nd Edition, Pearson, 2005.
5. Object-Oriented Systems Analysis and Design Using UML, Simon Bennett, Steve McRobb and Ray Farmer, 2nd Edition, Tata McGraw-Hill, 2002.

ROBOTIC PROCESS AUTOMATION & DEVELOPMENT

Course Code:	**AD2309-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1102-1, CS2002-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand the basic concepts of Robotic Process Automation
2.	To expose to the key RPA design and development strategies and methodologies.
3.	To learn the fundamental RPA logic and structure.
4.	To explore the Exception Handling, Debugging and Logging operations in RPA.
5.	To learn to deploy and maintain the software bot.

UNIT-I

15 Hours

What is Robotic Process Automation: Scope and techniques of automation-Robotic process automation-About UiPath.
Record and Play: UiPath Stack-Downloading and installing UiPath Studio-Learning UiPath Studio-Task Recorder-Step-by-step examples using the recorder.
Sequence, Flowchart, and Control Flow: Sequencing the workflow-Activities-Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart-Step-by-step example using Sequence and Control flow.

UNIT-II

15 Hours

Data Manipulation: Variables and scope-Collections-Arguments-Data table usage with examples-Clipboard Management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example).
Taking Control of the Controls: Finding the control-Techniques for waiting for a control-Act on controls-Screen Scraping-When to use OCR-Types of OCR available-How to use OCR-Avoiding typical failure points.

UNIT-III

10 Hours

Exception Handling, Debugging, and Logging: Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots- Debugging techniques- Collecting crash dumps- Error reporting.
Deploying and Maintaining the Bot: Publishing using publish utility- Overview of Orchestration Server- Using Orchestration Server to control bots- Using Orchestration Server to deploy bots- License management- Publishing and managing updates.

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

1.	Enunciate the key distinctions between RPA and existing automation techniques and platforms.
2.	Use UiPath to design control flows and workflows for the target process.
3.	Implement recording, web scraping and process mining by automation.
4.	Use UiPath Studio to detect, and handle exceptions in automation processes.
5.	Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.

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	PSO↓ 2	PSO↓ 3
AD2309-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2309-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2309-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2309-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD2309-1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Alok Mani Tripathi, “Learning Robotic Process Automation”, Packt Publishing, 2018.

REFERENCE BOOKS:

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13(electronic):978-7-4842-5729-6, Publisher : A press.
2. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018.
3. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018.
4. A Gerardus Blokdyk, “Robotic Process Automation Rpa A Complete Guide “, 2020.

SOFTWARE TESTING

Course Code:	**AD2310-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1103-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Explain the concept of testing and the testing life cycle.
2.	Use the testing frameworks, process, and test management to generate the test plans.
3.	Generate the test plans for a business.
4.	Illustrate the use of automation in testing.
5.	Perform defect management and data management.

UNIT-I

15 Hours

Introduction To Testing – Why and What: Why is testing necessary? What is testing? Role of Tester, Testing and Quality, Overview of STLC SOFTWARE TESTING LIFE CYCLE – V MODEL: SDLC vs STLC, different stages in STLC, document templates generated in different phases of STLC, different levels of testing, different types of testing: Functional Testing, API Testing, Usability Testing, Exploratory Testing, Ad-hoc Testing. Static Testing: Static techniques, reviews, walkthroughs BASICS OF TEST DESIGN TECHNIQUES: Various test categories, test design techniques for different categories of tests. Designing test cases using MS-Excel.

UNIT-II

15 Hours

Test Management: Documenting test plan and test case, effort estimation, configuration management, project progress management. Use of Testopia for test case documentation and test management. DEFECT MANAGEMENT: Test Execution, logging defects, defect lifecycle, fixing / closing defects. Use of Bugzilla for logging and tracing defects. TEST DATA MANAGEMENT: Test Data Management – Overview, Why Test Data Management, Test Data Types, Need for Test Data Setup, Test Data Setup Stages, Test data management Challenges. Creating sample test data using MS-Excel.

UNIT-III

10 Hours

Basics of Automation Testing: Introduction to automation testing, why automation, what to automate, tools available for automation testing. BASICS OF AUTOMATION TESTING USING SELENIUM: Introduction to Selenium, using Selenium IDE for automation testing, using Selenium Web driver for automation testing, understanding TestNG framework with Selenium Web driver for automation testing, Introduction to Maven automation tool.

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

1.	Apply the knowledge of engineering to understand the various terms and techniques used in testing domain.
2.	Identify the different phases of software testing life cycle and types of testing.
3.	Analyze test management and test data management processes.
4.	Analyze defect management life cycle and use open-source tool for defect management.
5.	Design test case and formulate automation testing with demonstration of open-source testing tool.

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
AD2310-1.1	2	2	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2310-1.2	2	2	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2310-1.3	2	3	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2310-1.4	2	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2310-1.5	2	2	2	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Rex Black , —Managing the Testing Process‖,2nd edition, John Wiley & Sons, 2001
2. Dorothy Graham, Erik van Veenendaal, Isabel Evans, Rex Black,‖ Foundations of software testing‖, Cengage Learning EMEA, 2008.
3. Elfriede Dustin, —Implementing Automated Software Testing: How to Save Time and Lower Costs While Raising Quality‖, Addison-Wesley Professional,2009.

REFERENCE BOOKS:

1. Paul C. Jorgensen,‖ Software Testing, A Craftsman‘s Approach‖, Third Edition, Auerbach Publications, 2008.
2. Mauro Pezze, Michal Young,‖ Software Testing and Analysis –Process‖, Principles and Techniques, Wiley India, 2009.

E Books / MOOCs/ NPTEL

1. https://www.softwaretestinghelp.com/selenium-tutorial-1/
2. http://softwaretestingfundamentals.com/software-testing-methods/
3. https://www.tutorialspoint.com/software_testing/software_testing_tutorial.pdf
4. http://docs.seleniumhq.org/docs/
5. http://www.seleniumhq.org/download/

STORAGE TECHNOLOGIES

Course Code:	**AD2311-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**CS1002-1, CS2102-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Characterize the functionalities of logical and physical components of storage.
2.	Describe various storage networking technologies.
3.	Identify different storage virtualization technologies.
4.	Discuss the different backup and recovery strategies.
5.	Understand common storage management activities and solutions.

UNIT-I

15 Hours

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data centers and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.
Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale- out storage Architecture.

UNIT-II

15 Hours

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fiber Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fiber Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.
Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication.

UNIT-III

10 Hours

Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).
Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

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

1.	Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment.
2.	Illustrate the usage of advanced intelligent storage systems and RAID.

3.	Interpret various storage networking architectures - SAN, including storage subsystems and virtualization.
4.	Examine the different roles in providing disaster recovery and remote replication technologies.
5.	Infer the security needs and security measures to be employed in information storage management.

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	PSO↓ 2	PSO↓ 3
AD2311-1.1	3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2311-1.2	2	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2311-1.3	3	1	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2311-1.4	2	1	3	-	-	-	-	-	-	-	-	1	3	1	-
AD2311-1.5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. EMC Corporation, Information Storage and Management, Wiley, India.

REFERENCE BOOKS:

1. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017.

2. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, Storage Networks Explained, Second Edition, Wiley, 2009.

SUPPLY CHAIN MANAGEMENT AND ENTERPRISE RESOURCE PLANNING

Course Code:	**AD2312-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**AD1103-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Outline the concepts of a supply chain with various case studies and explain the strategic framework to analyze supply chains and their management.
2.	Illustrate the role of transportation and coordination in a supply chain with design and comparison of various transportation modes and coordination methodologies.
3.	Analyze the role of pricing and revenue management in a supply chain with key factors, tactics and get the idea of role of IT in a supply chain.
4.	Understand and Analyze ERP.
5.	Apply ERP to the Supply Chain Management.

UNIT-I

15 Hours

Building A Strategic Framework to Analyze Supply Chains: Supply chain stages and decision phases process view of a supply chain. Supply chain flows. Examples of supply chains. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers Inventory, Transportation, Facilities, Information. Obstacles to achieving fit. Case discussions.

Transportation In a Supply Chain: Roles of transportation in a supply chain, modes of transportation and their performance characteristics, transportation infrastructure and policies, design option for a transportation network, trade-offs in transportation design, tailored transportation, role of IT in transportation, risk management in transportation, Indian transportation system-in need of innovations to propel economic growth, making transportation decisions in practice.

UNIT-II

15 Hours

Coordination In a Supply Chain: Lack of supply chain coordination and bullwhip effect, the effect on performance of lack of coordination, Obstacles to coordination in supply chain, managerial levels to achieve coordination, building strategic partnerships and trusts within, continuous replenishment and vendor managed inventories, collaborative planning, forecasting and replenishment(CPFR), collaborative planning, forecasting and replenishment-Indian experiences, the role of IT in coordination.

Total Distribution Cost Analysis: Total cost concept, principles of logistic costing, logistics and bottom line, logistics and shareholder value, customer profitability analysis, direct product profitability, cost drivers and activity-based costing.

UNIT-III

10 Hours

IT Enabled Supply Chain: Introduction, changing role of IT, IT solution options, Electronic Data Interchange (EDI).

ERP Overview: Benefits, business engineering, ERP and management concerns, Business Modeling for ERP. ERP implementation, customization, post implementation options.

ERP and Competitive Advantage: Marketing of ERP, ERP domain: SAP, BAAN, SAP r/3 MGF/PRO, IFS/Avalon.

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

1.	Illustrate the supply chains in the real world and methodologies for the supply chain profitability
2.	Demonstrate the relation between concepts and activities of the supply chain to actual organizations.
3.	Apply a good pricing and revenue management system for a successful supply chain
4.	Explain the role of technology in logistics and supply chain management.
5.	Apply Information Technology and ERP in a supply chain.

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
AD2312-1.1	2	3	-	-	-	-	-	-	-	-	-	1	3	1	-
AD2312-1.2	2	3	-	-	-	-	-	-	-	-	-	1	3	1	-
AD2312-1.3	2	2	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2312-1.4	2	2	2	-	-	-	-	-	-	-	-	1	3	1	-
AD2312-1.5	2	3	-	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Sunil Chopra, Peter Meindl, supply chain management strategy, planning, and operation, Pearson Education 2003.

REFERENCE BOOKS:

1. Martin Christopher, Logistics, and supply chain management.

2. Vinod Kumar Garg, N.K. Venkatakrishnan, Enterprise Resource planning concepts and Practice, PHI 1999.

UI AND UX DESIGN

Course Code:	**AD2313-1**	**Course Type:**	**PEC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**
Prerequisite	**CS2002-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To provide a sound knowledge in UI & UX.
2.	To understand the need for UI and UX.
3.	To understand the various Research Methods used in Design.
4.	To explore the various Tools used in UI & UX.
5.	Creating a wireframe and prototype.

UNIT-I

15 Hours

Foundations Of Design: UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy.

Foundations Of UI Design: Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides.

UNIT-II

15 Hours

Foundations Of UX Design: Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals.

Wireframing, Prototyping and Testing: Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.

UNIT-III

10 Hours

Research, Designing, Ideating, & Information Architecture: Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture.

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

1.	Build UI for user Applications.
2.	Evaluate UX design of any product or application.
3.	Demonstrate UX Skills in product development.
4.	Implement Sketching principles.
5.	Create Wireframe and Prototype.

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**
AD2313-1.1	3	1	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2313-1.2	2	3	1	-	-	-	-	-	-	-	-	1	3	1	-
AD2313-1.3	1	3	3	-	-	-	-	-	-	-	-	1	3	1	-

AD2313-1.4	1	2	3	-	-	-	-	-	-	-	-	1	3	1	-
AD2313-1.5	1	2	3	-	-	-	-	-	-	-	-	1	3	1	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Joel Marsh, “UX for Beginners”, O’Reilly , 2022.
2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021.

REFERENCE BOOKS:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020.
2. Steve Schoger, Adam Wathan “Refactoring UI”, 2018.
3. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015.

E Books / MOOCs/ NPTEL

1. https://nptel.ac.in/courses/124107008
2. https://www.coursera.org/specializations/ui-ux-design?

Ability Enhancement Courses / Vocational Education Courses

INNOVATION AND DESIGN THINKING

Course Code:	**ME1654-1**	**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**
Prerequisite:	**---**		

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. Lecturer method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes. Show Video/animation films to explain concepts. Encourage collaborative (Group Learning) Learning in the class. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking. 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. Topics will be introduced in multiple representations. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

UNIT-I

Design Thinking	**03 Hours**

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

UNIT-II

Design Thinking for Strategic Innovations	**05 Hours**

Design Thinking in IT: Design Thinking to Business Process modeling – Scenario-based Prototyping
Design Thinking 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

UNIT-III

Design Thinking Workshop	**07 Hours**
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: At the end of the course student will be able to

1.	Explain various design process procedure
2.	Generate and develop design ideas through different techniques
3.	Explain 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	-	1
ME1654-1.2	-	-	-	-	-	-	2	2	-	-	-	-	1	-	1
ME1654-1.3	-	-	-	-	-	-	-	-	-	3	3	-	1	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
2.	Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
3.	Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve– Apply", Springer, 2011.
4.	Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.
5.	Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.
6.	Jeanne Liedtka, Andrew King and Kevin Bennett, "Solving Problems with Design Thinking - Ten Stories of What Works", Columbia Business School Publishing, Sep 2013.

E Books / MOOCs/ NPTEL

1.	www.tutor2u.net/business/presentations/. /productlifecycle/default.html
2.	https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
3.	www.bizfilings.com › Home › Marketing › Product Developmen
4.	https://www.mindtools.com/brainstm.html
5.	https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit
6.	www.vertabelo.com/blog/documentation/reverse-engineering
7.	https://support.microsoft.com/en-us/kb/273814
8.	https://support.google.com/docs/answer/179740?hl=en
9.	https://www.youtube.com/watch?v=2mjSDIBaUlM
10.	thevirtualinstructor.com/foreshortening.html
11.	https://dschool.stanford.edu/.../designresources/.../ModeGuideBOOTCAMP2010L.pdf
12.	https://dschool.stanford.edu/use-our-methods/ 6. https://www.interactiondesign. org/literature/article/5-stages-in-the-design-thinking-process 7.
13.	http://www.creativityatwork.com/design-thinking-strategy-for-innovation/ 49 8.
14.	https://www.nngroup.com/articles/design-thinking/ 9.
15.	https://designthinkingforeducators.com/design-thinking/ 10.

BUILDING RESPONSIVE AND ACCESSIBLE WEB INTERFACES

Course Code:	**AD2551-1**	**Course Type**	**VEC**
Teaching Hours/Week (L: T: P) :	**0:0:2**	**Credits**	**01**
Total Teaching Hours:	**0+0+26**	**CIE + SEE Marks**	**50+50**
Prerequisite	**CS1001-1, CS1002-1,**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	Develop a simple web application.
2.	Understand the fundamentals of java script.
3.	Learn the libraries of angular and react JS.
4.	Apply the features of java script.
5.	Develop a responsive web application.

List of Experiments

1	Create a registration page and login form with input fields for username and password using basic HTML concepts.
2	Two-way Data Binding: ● Create a new AngularJS application with an input field and a paragraph element. ● Use ng-model directive to bind the input field value to a variable in the controller. ● Display the value of the input field in the paragraph element using the same variable. ● Update the paragraph element whenever the input field value changes, and vice versa.
3	Controllers and Scopes: ● Create an AngularJS application with a controller named "User Controller." ● Inside the controller, define a scope variable called "username" and set it to your name. ● Display the value of the "username" variable in the HTML using data binding. ● Add a button to the HTML that calls a function in the controller when clicked. ● Inside the function, update the value of the "username" variable. ● Observe the changes in the HTML after clicking the button.
4	Events and Event Handling: ● Create an AngularJS application with a button element. ● Use the ng-click directive to bind a function in the controller to the button's click event. ● Inside the function, update a variable in the scope to indicate that the button was clicked. ● Display the value of the variable in the HTML to show the button click event was handled.
5	Services: ● Create an AngularJS application with two controllers: "FirstController" and "SecondController." ● Define a service called "DataSharingService" that has a shared variable and a method to update the variable. ● Inject the service into both controllers. ● In the "FirstController," update the shared variable using the service method. ● Display the value of the shared variable in the "SecondController" to verify that the data is shared between controllers.
6	Filters: ● Create an AngularJS application with an array of objects in the controller. ● Use ng-repeat directive to display the objects in a list. ● Apply different filters (e.g., uppercase, lowercase, currency) to the displayed data. ● Experiment with custom filters to perform custom data manipulations.
7	Creating a Basic React Component:

	• Set up a new React project using Create React App or any other preferred method. • Create a new file called "HelloWorld.js" and define a functional component. • Inside the component, return a JSX element with a simple "Hello, World!" message. • Import and render the component in the main App.js file. • Verify that the "Hello, World!" message is displayed in the browser.
8	State and Props • Create a new file called "Counter.js" and define a class component. • Inside the component, define a state variable called "count" and initialize it to 0. • Render a button and a paragraph element that displays the current value of "count." • Implement event handlers for incrementing and decrementing the count. • Pass the count value as a prop to another component called "DisplayCount.js" and display it there. Import and render both components in the main App.js file.
9	Handling Forms in React • Create a new file called "LoginForm.js" and define a class component. • Inside the component, define form fields for username and password. • Implement event handlers to update the component state when the form fields change. • Add a submit button and handle the form submission event. • Display a success message if the form is submitted successfully. • Import and render the Login Form component in the main App.js file.
10	API Integration with React: • Create a new file called "UserList.js" and define a class component. • Inside the component, define an empty array state variable called "users." • Use the useEffect hook to fetch user data from an API (e.g., JSONPlaceholder). • Update the "users" state with the fetched data. • Render the list of users in a table or list format. • Import and render the UserList component in the main App.js file.
11	Routing in React: • Install the react-router-dom package. • Create multiple components representing different pages (e.g., Home, About, Contact). • Define routes for each page using the BrowserRouter and Route components. • Set up navigation links using the Link component from react-router-dom. Import and render the BrowserRouter component in the main App.js file.
12	Mini Project.
13.	Lab Exam.

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

1.	Develop front-end for the web pages using suitable web development technologies.
2.	Utilize frameworks and libraries of angular JS for building responsive web interfaces.
3.	Implement features of react JS for developing web pages.
4.	Use JavaScript for building interactive web pages.
5.	Develop a responsive and user-friendly interface for a website.

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**
AD2551-1.1	2	1	-	-	2	2	-	-	2	2	2	1	3	1	-
AD2551-1.2	2	3	-	-	2	2	-	-	2	2	2	1	3	1	-
AD2551-1.3	2	2	-	-	2	2	-	-	2	2	2	1	3	1	-
AD2551-1.4	2	2	2	-	2	2	-	-	2	2	2	1	3	1	-
AD2551-1.5	2	2	1	-	2	2	-	-	2	2	2	1	3	1	-

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Angular: Up and Running Learning Angular, Step by Step - Shyam Seshadri O'Reilly Media 2018.
2.	Programming the World Wide Web, by Robert W. Sebesta, 7th Edition, Pearson Education.
3.	Fullstack React The Complete Guide to ReactJS and Friends: Written by Anthony Accomazzo, Nate Murray, Ari Lerner, Clay Allsopp, David Gutman, and Tyler McGinn, published by Fullstack.io, 2020.

C++ AND UNIX PROGRAMMING

Course Code:	**AD2651-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P):	**1:0:2**	**Credits:**	**02**
Total Teaching Hours:	**13+0+26**	**CIE + SEE Marks:**	**50+50**
Prerequisite:	**CS1001-1, AD2104-1**		

Teaching Department: Artificial Intelligence & Data Science

Course Objectives:

1.	To understand object-oriented programming and Gain knowledge about the capability to store information together in an object using C++ language.
2.	To understand the implementation of operator overloading, and inheritance concepts in C++ language.
3.	To implement exception handling concept in C++.
4.	To understand basic commands of shell and its usages.
5.	To implement shell scripts and work with advanced commands of Unix.

List of Experiments

1	Input and output statements of C++, Declaration of classes, objects, constructors and member functions. Visibility, static members.
2	Functions, parameter passing method, different types of inheritance, function overloading, inline function.
3 4	Operator overloading, friend functions, Exception handling, template functions.
5	Basic commands ls, cat, cal, date, calendar, who, printf, tty, sty, uname, passwd, echo, tput, and bc. Home directory, absolute pathnames, using absolute pathnames for a command, cd, mkdir, rmdir, Relative pathnames.
6	Filters-The Grep Family-Other Filters-The Stream Editor Sed-The AWK Pattern Scanning and processing Language-Good Files and Good Filters.
7	File handling in Unix - File permissions, file attributes, commands related to files, C programs for Read and write operations on files using suitable functions.
8	Mechanism of process creation. Parent and child process. Working with processes using fork and exec functions.
9	Signals and IPC - Implementing signals in Unix.
10	Programs on inter-process communication using pipe, fifo, and sockets.
11	Writing shell scripts - Basic statements and arithmetic and logic operations, Shell variable.
12	Control flow statements, command line arguments, Expr and Eval commands.
13.	Lab Exam.

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

1.	Use C++ language to implement solutions for Object Oriented programming problems.
2.	Demonstrate the implementation of inheritance and operator overloading concepts in C++.
3.	Work with the Unix operating system by making use of basic Unix commands.
4.	Perform file and process handling in the Unix platform. Implementation of inter-process communication and signal handling in Unix.
5.	Develop shell scripts to solve the given problem.

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO↓**		
↓ Course Outcomes													**1**	**2**	**3**
AD2651-1.1	2	2	2	-	-	-	-	-	-	-	-	2	3	-	1

AD2651-1.2	2	2	2	-	-	-	-	-	-	-	-	2	3	-	1
AD2651-1.3	2	2	2	-	-	-	-	-	-	-	-	2	3	-	1
AD2651-1.4	2	2	2	-	-	-	-	-	-	-	-	2	3	-	1
AD2651-1.5	2	2	2	-	-	-	-	-	-	-	-	2	3	-	1

1: Low 2: Medium 3: High

REFERENCE BOOKS:

1.	Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional, 2005.
2.	Yashavant P. Kanetkar "Unix Shell Programming", BPB Publications.
3.	Sumitab Das, "Unix Concept & Application", TMH.
4.	R. Stones, N. Matthew, ―Beginning Linux Programming‖, Wrox publication, Fourth Edition,2007.
5.	UreshVahalia, UNIX Internals, Pearson Education‖, ASIA, 2001.

E Resources

1.	http://www.codeman.net/wp-content/uploads/2014/04/APUE-3rd.pdf
2.	Richard.esplins.org/static/downloads/linux_book.pdf
3.	http://nptel.ac.in/courses/106101163/56

RESEARCH METHODOLOGY

Course Code:	**HU1010-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P):	**2:0:0**	**Credits:**	**02**
Total Teaching Hours:	**30:0:0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Respective Department

Course Objectives:

1.	Understand Research Formulation and Design.
2.	Inculcate the ability to collect Data and its analysis.
3.	Enhance knowledge of Soft Computing.
4.	Comprehend Research Ethics and the art of publishing.
5.	Develop Interpretative Skills and write reports.

UNIT-I

Research Formulation and Design — **6 Hours**

Motivation and Objectives – Research methods vis-a-vis Methodology. Types of research – Descriptive vis-a-vis Analytical, Applied vis-a-vis Fundamental, Quantitative vis-a-vis Qualitative, Conceptual vis-a-vis Empirical, concept of applied and basic research process, Criteria of good research.

Defining and formulating the research problem, Selecting the problem, Importance of Literature Review, Literature Review - Primary and Secondary sources, reviews, monograph, patents, research databases, Web as a source, Critical literature review, Identifying gap areas from Literature Review, Development of working hypothesis.

Data Collection and Analysis — **6 Hours**

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT-II

Soft Computing — **6 Hours**

Computer and its role in research, Use of statistical software SPSS, GRETL in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

Research Ethics and Scholarly Publishing — **6 Hours**

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility, and accountability

UNIT-III

Interpretation and Report Writing — **6 Hours**

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.	Formulate and design the research problem.
2.	Interpret and Analyze the Data for research.
3.	Identify and interpret the Data with Soft Computing.
4.	Apply research ethics and develop the art of publishing.

5.	Integrate interpretative skills and write reports.

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	-	-	-	-	-	-	-	-	-	2	-	3	-	3	1
ME1659-1.2	-	-	-	-	-	-	-	-	-	3	-	3	-	3	1
ME1659-1.3	-	-	-	-	-	-	-	-	-	3	-	3	-	3	1
ME1659-1.4	-	-	-	-	-	-	-	-	2	2	-	2	-	3	1
ME1659-1.5	-	-	-	-	-	-	-	-	1	2	-	2	-	3	1

1: Low 2: Medium 3: High

REFERENCES:

1.	Garg, B.L., Karadia, R., Agarwal, F., & Agarwal, “An introduction to Research Methodology”, RBSA Publishers, 2002.
2.	Wadehra, B.L., “Law relating to patents, trademarks, copyright designs and geographical indications” Universal Law Publishing, 2000.
3.	Kothari, C.R., “Research Methodology: Methods and Techniques”, New Age International, 1990.
4.	Trochim, W.M.K. “Research Methods: the concise knowledge base”, Atomic Dog Publishing, 2005.
5.	Sinha, S.C., & Dhiman, A.K., “Research Methodology”, EssEss Publications. (2 volumes), 2002.
6.	Satarkar, S.V., “Intellectual property rights and copyright”, EssEss Publications, 2000.
7.	Coley, S.M., & Scheinberg, C.A. “Proposal Writing”, Sage Publications, 1990.
8.	Day, R.A. “How to Write and Publish a Scientific Paper”, Cambridge University Press, 1992.
9.	Anthony, M., Graziano, A.M., & Raulin, M.L., “Research Methods: A Process of Inquiry”, Allyn and Bacon, 2009.

SOCIAL CONNECT AND RESPONSIBILITY

Course Code:	**HU1007-1**	**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: 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	3
HU1007-1.1	-	-	-	-	-	-	-	-	2	-	2	3	-	2	1
HU1007-1.2	-	-	-	-	-	-	-	-	2	-	2	3	-	2	1
HU1007-1.3	-	-	-	-	-	-	-	-	2	-	2	3	-	2	1

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 FOR ENGINEERS

Course Code:	**HU1008-1**	**Course Type:**	**AEC**
Teaching Hours/Week (L: T: P):	**1:0:0**	**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 Teamwork
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

Teamwork – 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**	**3**
HU1008-1.1	-	-	-	-	-	-	-	-	-	2	1	3	-	2	3
HU1008-1.2	-	-	-	-	-	-	-	-	-	3	2	3	-	2	3
HU1008-1.3	-	-	-	-	-	-	-	-	-	3	1	3	-	2	3
HU1008-1.4	-	-	-	-	-	-	-	-	2	2	1	2	-	2	3
HU1008-1.5	-	-	-	-	-	-	-	-	1	2	1	2	-	2	3

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)	**1:0:0**	**Credits**	**00**
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	-	-	-	3
UM1003-1.2	3	3	-	-	-	-	-	-	2	2	1	-	-	-	3
UM1003-1.3	3	3	2	-	-	-	-	-	2	2	1	-	-	-	3
UM1003-1.4	3	3	2	-	-	-	-	-	2	2	1	-	-	-	3
UM1003-1.5	3	3	2	-	-	-	-	-	2	2	1	-	-	-	3

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 & Management Courses

ENHANCING SELF-COMPETENCE

Course Code:	**HU2001-1**	**Course Type:**	**HSMC**
Teaching Hours/Week (L: T: P)	**2:0:0**	**Credits:**	**02**
Total Teaching Hours:	**26+0+0**	**CIE + SEE Marks:**	**50+50**

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.

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**
Prerequisite			

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. S N Raju, “English –Kannada Rapidex Dictionary of Spoken Words”, Bengaluru
2. D K Bharadwaj “English Kannada Standard Dictionary”, 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.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ (SAMSKRITHIKA KANNADA)			
Course Code:	**HU1003-1**	**Course Type:**	**MNC**
Teaching Hours/Week (L: T: P):	**1:0:0**	**Credits:**	**0**
Total Teaching Hours:	**15+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 ಅವುಗಳ ನಿವಾರಣೆ.
4.	ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಡಿಸುವುದು.
5.	ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡ ದಪದಗಳ 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: ಸಿದ್ದಲಿಂಗಯ್ಯ **ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ** 1. ಡಾ. ಸ ಎಂ 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 ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು ಮತ್ತು ಕನ್ನಡ ಭಾಷಾ ರಚನೆಯಲ್ಲಿನ ನಿಯಮಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
3.	ಕನ್ನಡ ಭಾಷಾ ಬರೆಹದಲ್ಲಿ ಕಂಡು ಬರುವ ದೋಷಗಳು ಹಾಗು ಅವುಗಳ ನಿವಾರಣೆ.
4.	ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆಸರ್ಕಾರಿ 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	-	-	1
HU1003-1.2	-	-	-	-	-	-	-	2	-	-	1	1	-	-	1
HU1003-1.3	-	-	2	-	-	-	1	2	-	-	1	1	-	-	1
HU1003-1.4	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
HU1003-1.5	-	-	1	-	-	-	-	3	-	-	1	1	-	-	1

1: Low 2: Medium 3: High

REFERENCE MATERIALS:

1.	ಸಂಕ್ಷಿಪ್ತ ಕನ್ನಡ ನಿಗಂಟು (ಪರಿಷ್ಕೃತ), ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್, ಬೆಂಗಳೂರು.
2.	ಆಡಳಿತ ಪದ ಕೋಶ, ಕನ್ನಡಅಭಿವೃದ್ಧಿಪ್ರಾಧಿಕಾರ, ಬೆಂಗಳೂರು.
3.	ಕಾನೂನು ಪದಕೋಶ (ಪರಿಷ್ಕೃತ) ಕನ್ನಡ- ಇಂಗ್ಲಿಷ್, ಕನ್ನಡಮತ್ತುಸಂಸ್ಕೃತಿನಿರ್ದೇಶನಾಲಯ, ಬೆಂಗಳೂರು.
4.	ಡಿ.ಎನ್. ಶಂಕರ ಭಟ್, ಕನ್ನಡ ವಾಕ್ಯಗಳಬಳರಚನೆ, ೨೦೦೬, ಭಾಷಾ ಪ್ರಕಾಶನ, ಮೈಸೂರು.
5.	ಕನ್ನಡಭಾಷಿಕ (ಅವಿಸ್ತರ)- ಪ್ರಬಂಧಮತ್ತುಆಡಳಿತಕನ್ನಡ, ಕರ್ನಾಟಕರಾಜ್ಯಮುಕ್ತವಿಶ್ವವಿದ್ಯಾಲಯ, ಮೈಸೂರು.
6.	ಆಡಳಿತಕನ್ನಡ, ಎಚ್ಚೆಸ್ಕೆ, ಚೇತನಬುಕ್ಹೌಸ್, ಮೈಸೂರು.

ESSENCE OF INDIAN CULTURE

Course Code:	**HU1005-1**	**Course Type:**	**HEC**
Teaching Hours/Week (L: T: P):	**1:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Humanities

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	3
HU1005-1.1	-	-	-	-	-	-	-	-	-	2	2	3	-	-	1
HU1005-1.2	-	-	-	-	-	-	-	-	-	3	2	3	-	-	1
HU1005-1.3	-	-	-	-	-	-	-	-	-	3	2	3	-	-	1
HU1005-1.4	-	-	-	-	-	-	-	-	2	2	2	2	-	-	1

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

UNIVERSAL HUMAN VALUES

Course Code:	**HU1004-1**	**Course Type:**	**HSMC**
Teaching Hours/Week (L: T: P)	**1:0:0**	**Credits:**	**01**
Total Teaching Hours:	**15+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Any

Course Objectives:

1.	Enable students appreciate values, skills and behavior 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):	**1:0:0**	**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	3
HU1006-1.1	-	-	-	-	-	-	-	-	-	2	-	3	-	2	2
HU1006-1.2	-	-	-	-	-	-	-	-	-	3	-	3	-	2	2
HU1006-1.3	-	-	-	-	-	-	-	-	-	3	-	3	-	2	2
HU1006-1.4	-	-	-	-	-	-	-	-	2	2	-	2	-	2	2
HU1006-1.5	-	-	-	-	-	-	-	-	1	2	-	2	-	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):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40**	**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:	**04 Hours**

Nature, Importance and Purpose of Planning, Types of Plans, Steps in Planning, Limitations of Planning, Decision Making – Meaning, Types of Decisions- Steps in Decision Making.

Organizing and Staffing	**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**	**3**
MG1003-1.1	3	-	-	-	-	-	-	2	2	-	3	2	-	1	3
MG1003-1.2	3	-	-	-	-	-	-	2	2	-	3	2	-	2	3
MG1003-1.3	3	-	-	-	-	-	-	2	2	-	3	2	-	2	3
MG1003-1.4	3	-	-	-	-	-	-	2	2	-	3	2	-	2	3
MG1003-1.5	3	-	-	-	-	-	-	2	2	-	3	2	-	2	3

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	P. C. Tripathi, P. N. Reddy, "Principles of Management", McGraw Hill, 6th Edition, 2017.
2.	Poornima M. Charanthimath, "Entrepreneurship Development and Small Business Enterprises", Pearson 2nd Edition, 2014.
3.	W.D Stevenson, "Elements of Power System Analysis", 4th edition, TMH, 2001.

REFERENCE BOOKS:

1.	Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 2007.
2.	Harold Koontz, Heinz, Weihrich, "Essentials of Management: An International, Innovation and Leadership perspective", McGraw Hill, 10th Edition, 2016.

FINANCIAL MANAGEMENT

Course Code:	**MG1002-1**	**Course Type:**	**HSMC**
Teaching Hours/Week (L: T: P):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Any

Course Objectives:

1.	Develop basic financial management knowledge essential to make a managerial career in professional life.
2.	Impart some of the crucial and basic skills required to work in the area of budgeting, investment and financial decision making.
3.	Enable in making a right decision on selection of projects for investment.
4.	Understand the basics of finance and financial markets, project evaluation and selection.

UNIT-I

Time Value of Money — **15 Hours**

Financial Management: Concepts and Meaning – Introduction to Finance; Objectives of Financial Management; Profit Maximization; EVA; Changing Role of Financial Managers.
Time Value of Money: Techniques and Applications of Compounding and Discounting.

UNIT-II

Capital Budgeting and Working Capital — **15 Hours**

Capital Budgeting (Investment Evaluation Techniques): Payback Period Method; Present Worth Method; Annual Worth Method; Profitability index method; Estimation of IRR.
Cost of Capital: Sources of various Types of Capital; Cost of Debenture Capital; Cost of Preferential Capital; Cost of Term Loans; Cost of Equity Capital.
Working Capital: Factors influencing Working Capital Requirements.

UNIT-III

Inventory Management and Break-Even Analysis — **10 Hours**

Inventory Management: Techniques of Inventory Management and Control – EOQ, ABC Analysis, Just-in-Time (JIT) System
Break Even Analysis: Estimation of Break-Even Point and Values.

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

1.	Describe the basic financial management skills required for a professional.
2.	Explain techniques and applications of compounding and discounting and calculate compounded/discounted amount for the given proposal.
3.	Evaluate the given investment option by capital budgeting techniques.
4.	Describe the basics of cost of capital and working capital. Determine the cost of capital for the given investment option.
5.	Describe the basics of inventory management and calculate the economic order quantity and reorder point for the given conditions. Calculate breakeven point for the given manufacturing setup.

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
MG1002-1.1	3	-	-	-	-	-	-	-	1	1	-	1	-	1	2
MG1002-1.2	1	3	-	-	-	-	-	-	1	1	-	1	-	2	2
MG1002-1.3	2	3	-	-	-	-	-	-	1	1	-	1	-	1	2
MG1002-1.4	2	3	-	-	-	-	-	-	1	1	-	1	-	1	2
MG1002-1.5	1	3	-	-	-	-	-	-	1	1	-	1	-	1	2

	1: Low 2: Medium 3: High
TEXTBOOKS:	
1.	M Y Khan, P K Jain , “Financial Management – Text, Problems & Cases”,7th Edition, 2015; McGraw Hill Education (India) Pvt. Ltd, New Delhi.
2.	I M Pandey, "Financial Management", 11th Edition, 2015; Vikas Publishing House Pvt. Ltd. (UP) India.
3.	James L. Riggs, David D. Bedworth and Sabah U. Randhawa, “Engineering Economics”, 4th Edition, Tata McGraw Hill Edition.
REFERENCE BOOKS:	
1.	Prasanna Chandra, “Financial Management”, 6th Edition, 2004; Tata McGraw Hill Publishing Company Ltd, New Delhi.
2.	S. D. Sharma, “Operation Research” , Kedar Nath Ram Nath Publishers, 2015.

INDIAN KNOWLEDGE SYSTEMS

Course Code:	**HU1009-1**	**Course Type:**	**HEC**
Teaching Hours/Week (L: T: P):	**1:0:0**	**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→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO↓**		
↓ Course Outcomes													**1**	**2**	**3**
HU1009-1.1	-	-	-	-	-	-	-	-	-	-	2	3	-	1	2
HU1009-1.2	-	-	-	-	-	-	-	-	-	-	3	3	-	1	2
HU1009-1.3	-	-	-	-	-	-	-	-	-	-	2	3	-	1	2
HU1009-1.4	-	-	-	-	-	-	-	-	-	-	2	2	-	1	2
HU1009-1.5	-	-	-	-	-	-	-	-	-	-	2	2	-	1	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.

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):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**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):	**3:0:0**	**Credits:**	**03**
Total Teaching Hours:	**40+0+0**	**CIE + SEE Marks:**	**50+50**

Teaching Department: Biotechnology

Course Objectives:

1.	To learn types of solid wastes, collection, treatment and disposal methods.
2.	To understand various processing techniques and regulations of treatment and disposal.

UNIT-I

Introduction to Solid Wastes 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):	**3:0:0**	**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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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):	**3:0:0**	**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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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 Wastewaters, 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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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+0+0**	**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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
↓ Course Outcomes												

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. garwal, "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)	**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 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→ / **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**2:0:2**	**Credits**	**03**
Total Teaching Hours	**27+0+26**	**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

1	Starting MATLAB and familiarization with its user interface, syntax and semantics, ways in which MATLAB provides help, create plots in MATLAB.
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.
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.
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

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.
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.
7	The for-loop and the while-loop, how the break-statement works, nested loops, logical indexing and implicit loops.
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.
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.
10	Reading an image, saving, basic manipulation of images, arithmetic operations
11	Pre-processing – conversion of color image to gray scale image, decomposition of color images to single color component image.
12	Histogram processing.
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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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)	**1:0:4**	**Credits**	**03**
Total Teaching Hours	**15+0+52**	**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

	Exploring the Kicad Schematic and layout tool
	Developing a schematic circuit for microphone preamplifier
	Designing a single side PCB layout for microphone preamplifier
	Developing a schematic circuit for a microcontroller development board
	Designing a double side PCB layout for a microcontroller development board
	Choosing a new sensor/display module and building a schematic circuit for the user level application
	Building a layout using single or double side PCB for the sensor/display module
	Preparing the film for the bottom copper, solder mask and top silk (legend) to fabricate a single side PCB using chemical process
	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
)	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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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)	**3:0:0**	**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 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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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→	1	2	3	4	5	6	7	8	9	10	11	12

↓ Course Outcomes												
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)	**3:0:0**	**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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**CIE + SEE Marks**	**50+50**
Prerequisite	**EE1001-1**		

Teaching Department: Electrical & Electronics Engineering

Course Objectives:

1.	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)	**3:0:0**	**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 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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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→ ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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

LINGUISTICS & LANGUAGE TECHNOLOGY

Course Code	**HU2501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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→	1	2	3	4	5	6	7	8	9	10	11	12
↓ Course Outcomes												
HU2501-1.1	-	1	-	-	1	1	-	-	1	-	-	2
HU2501-1.2	-	-	2	-	-	-	-	-	2	2	-	-

HU2501-1.3	2	3	-	3	-	-	-	-	3	2	-	-
HU2501-1.4	-	-	-	-	2	-	-	-	1	2	-	-
HU2501-1.5	-	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.

PROFESSIONAL & COGNITIVE COMMUNIQUÉ

Course Code	**HU2502-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+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
HU2502-1.1	-	3	-	-	-	-	-	-	3	3	-	3
HU2502-1.2	-	2	-	-	-	-	-	3	2	3	-	2
HU2502-1.3	-	3	-	-	-	-	-	-	2	2	-	3

HU2502-1.4	-	3	-	-	-	-	-	-	2	2	-	3
HU2502-1.5	-	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/>.

INTRODUCTION TO CYBER SECURITY

Course Code:	**IS2501-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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 Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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 Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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 co mponents, 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, si mple 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 m esh 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→ ↓ **Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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.

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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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.

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

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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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.

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

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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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.

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.

ENGINEERING ECONOMICS & FINANCIAL MANAGEMENT

Course Code:	**MG1507-1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Mechanical Engineering

Course Objectives:

1.	Analyse the time value of money.
2.	Evaluate the worth of creations, by comparing the alternatives visa, vis the cost (cost- benefit analysis).
3.	Take decisions with the limited resources, the relevant course of action, with the help of suitable tools.
4.	Determine the depreciated values of assets and also cost involved in each operation, a product should undergo with an aim to fix suitable selling price for the products.
5.	Know the fundamentals of Financial Management.

UNIT-I

Fundamental economic concepts	**07 Hours**
Consumer goods, Producer goods, Factors of production, Economy of organization, Demand theory, Law of demand, Exceptions to law of demand, Law of supply, Determinants of supply, Law of increasing returns and law of diminishing returns(No exercises)	
Interest	**07 Hours**
Rate of interest, Determining rate of interest, Time value of money, Simple interest, Compound interest, Nominal and effective interest rate, Equivalence involving interest, Interest formulae [single payment, uniform series and arithmetic gradient only], problems using interest formulae [discrete compounding only].	

UNIT II

Economic Analysis of Alternatives	**09 Hours**
Analysis based on: Present Worth [equal life and unequal life situations], Future Worth, Equivalent Annual Worth, Exercises. Analysis based on Rate of Return, Exercises.	
Depreciation	**04 Hours**
Causes of depreciation, Depletion, Methods of depreciation [Straight line, Declining balance, Double declining balance] Exercises.	
Estimating and Costing	**03 Hours**
Components of cost [Material cost, Labour cost, Overhead expenses, Prime cost, Factory cost, Total cost], Determination of selling price of a product, Exercises.	

UNIT III

Financial management	**05 Hours**
Terminologies used in accounting, Journal and ledger, Profit and loss statement, Balance sheet, Understanding basic financial ratios, Simple exercises.	
Working Capital Management	**05 Hours**
Factors influencing working capital requirement, determination of operating cycle and working capital. **Capital Budgeting:** Risk analysis in Capital Budgeting	

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

1.	Explain the fundamental economic concepts.

2.	Use simple interest and compound interest to determine compounded and discounted amount.
3.	Compare the alternatives using Present Worth, Equivalent Annual Worth, Future Worth and IRR methods.
4.	Calculate the depreciated amount of a given assets using Straight line, Declining balance, Double declining g balance method. Estimate the selling price of given product.
5.	Prepare Balance Sheet & Profit and Loss account for given data of a firm. Estimate working capital. Explain capital budgeting.

Course Outcomes Mapping with Program Outcomes

Program Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
MG1507-1.1	3	1	-	-	-	1	-	-	1	1	-	1
MG1507-1.2	2	3	-	-	-	1	-	-	1	1	-	1
MG1507-1.3	2	3	-	-	-	1	-	-	1	1	-	1
MG1507-1.4	2	3	-	-	-	1	-	-	1	1	-	1
MG1507-1.5	2	3	-	-	-	1	-	-	1	1	-	1

1: Low 2: Medium 3: High

TEXTBOOKS:

1.	Riggs J.L., “Engineering Economics”, 4th edition, Tata McGraw-Hill, 2004.
2.	Banga and Sharma, “Mechanical Estimating and Costing”, 16th edition, Khanna Publishers, 2012.
3.	I M Pandey, “Financial Management”, Vikas Publishing House, 2002.

REFERENCE BOOKS:

1.	E Paul Degarmo, “Engineering Economy”, Macmillan Publishing, 2001.
2.	Gerald J Thuesen & W J Fabrycky, “Engineering Economy”, Prentice Hall of India, 9th ed.
3.	Tarachand, “Engineering Economics”, Nemchand & Bros, 1996.

E Books / MOOCs/ NPTEL

1.	http://nptel.ac.in/courses/112107209/

NANOTECHNOLOGY

Course Code:	**PH2501 -1**	**Course Type**	**OEC**
Teaching Hours/Week (L: T: P)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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 requirerment 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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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 Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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**	**OEC**
Teaching Hours/Week (L: T: P)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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 Outcomes→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**40+0+0**	**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→ **↓ Course Outcomes**	1	2	3	4	5	6	7	8	9	10	11	12
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

University Core Courses (UCC)

INTERNSHIP-I			
Course Code	**UC1001-1**	**CIE Marks**	**100**
Teaching Hours/Week (L: T: P)	-	**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→ / ↓ Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓ 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**

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**
UC3001-1/UC3002-1.1	-	1	-	-	2	2	3	1	-	-	-	1	1	2	2
UC3001-1/UC3002-1.2	-	1	2	1	1	-	1	2	1	-	1	1	1	2	2
UC3001-1/UC3002-1.3	-	1	2	2	1	-	1	1	1	1	1	1	1	2	2
UC3001-1/UC3002-1.4	1	3	2	2	1	2	2	3	3	3	3	2	1	2	2
UC3001-1/UC3002-1.5	-	1	1	-	1	2	2	3	3	3	3	1	1	2	2

1: Low 2: Medium 3: High