CURRICULUM & SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

FOR

BACHELOR OF TECHNOLOGY (B.Tech.)

(4 Year Undergraduate Degree Programme)

IN

COMPUTER SCIENCE AND ENGINEERING

In Cyber Security

(In Alignment with National Education Policy, 2020)

[w. e. f. 2025-2026]

FACULTY OF ENGINEERING AND TECHNOLOGY
SRM UNIVERSITY DELHI-NCR, SONEPAT
39, Rajiv Gandhi Education City, Sonepat
Haryana-131029

ENGINEERING POST GRADUATES EMPLOYABILITY ATTRIBUTES

Sound Knowledge and Skills of Basic Sciences & Engineering Sciences	An Engineer should be able to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
Problem Formulation, Analysis & Solving	An Engineer should be able to identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using principles of mathematics, natural sciences, and engineering sciences.
Design and Development of a Solution	An Engineer must be able to 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.
Investigation	An Engineer should 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.
Modern Tools Usage	An Engineer should be able to 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.
The Engineer and the Society	An Engineer should be able to 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.
Environment and Sustainability	An Engineer must understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
Ethics	An Engineer should be able to apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.
Individual and Teamwork	An Engineer should be able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Effective Communication	An Engineer should be able to 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.
Project Management and Finance	An Engineer must demonstrate knowledge and understanding of the engineering and management principles and apply these to Engineering work environment, as a member and leader in a team, to manage projects and in multidisciplinary environments.
Lifelong Learning	An Engineer must 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.

SRM UNIVERSITY DELHI-NCR, SONEPAT FACULTY OF

ENGINEERING AND TECHNOLOGY

FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES (FEPEOs)

1. Advancement to a professional position by virtue of their knowledge, skills and attitude.
2. Recognition for solving engineering problems and developing design solutions that consider safety and sustainability.
3. Work as successful professionals in diverse engineering disciplines and enterprises;
4. Increasing responsibilities of technical and managerial leadership in their work organizations;
5. Professional development through a commitment to career-long learning.

FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES (FEPLOs)

1. An ability to identify, formulate, and solve real time engineering & socio-economic problems by applying principles of engineering, science, mathematics, humanities and social sciences
2. An ability to use the advanced skill enhancement techniques and modern engineering tools as per industry 4.0 necessary for engineering practice.
3. An ability to apply engineering design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability
4. an ability to adapt and work with multidisciplinary teams and communicate effectively;
5. An ability to function effectively on a team whose members together provide leadership, to create a collaborative environment, to establish goals and to execute plan tasks.
6. an understanding of professional and ethical responsibility;
7. An ability to acquire and apply new knowledge using appropriate learning strategies with an inner quest to learn, unlearn and relearn.

MAPPING OF FACCULTY OF ENGINEERING PROGRAM EDUCATIONAL

OBJECTIVES AND FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES

FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES	FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES
Advancement to a professional position by virtue of their knowledge, skills and attitude.	1. An ability to identify, formulate, and solve real time engineering and socio-economic problems by applying principles of engineering, science, mathematics, humanities and social sciences 2. An ability to use the advanced skill enhancement techniques and modern engineering tools as per industry 4.0 necessary for engineering practice.
Recognition for solving engineering problems and developing design solutions that consider safety and sustainability	3. An ability to use the advanced skill enhancement techniques and modern engineering tools as per industry 4.0 necessary for engineering practice. 4. An ability to apply engineering design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability
Work as successful professionals in diverse engineering disciplines	5. An ability to apply engineering design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability 6. an ability to adapt and work with multidisciplinary teams and communicate effectively;
Increasing responsibilities of technical and managerial leadership in their work organizations;	7. an ability to adapt and work with multidisciplinary teams and communicate effectively; 8. An ability to function effectively on a team whose members together provide leadership, to create a collaborative environment, to establish goals and to execute plan tasks. 9. an understanding of professional and ethical 10. responsibility;
Professional development through a commitment to career-long learning.	11. an understanding of professional and ethical responsibility; 12. An ability to acquire and apply new knowledge using appropriate learning strategies with inner quest to learn, unlearn and relearn.

MAPPING MATRIX OF FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES AND ENGINEERING PROGRAM LEARNING OUTCOMES
(TABULAR FORMAT)

MAPPING	FEPELO1	FEPLO2	FEPLO3	FEPLO4	FEPLO5	FEPLO6	FEPLO7
FEPEO1	✔	✔					
FEPEO2		✔	✔				
FEPEO3			✔	✔			
FEPEO4				✔	✔	✔	
FEPEO5						✔	✔

B.TECH - COMPUTER SCIENCE AND ENGINEERING GRADUATES EMPLOYABILITY ATTRIBUTES

EA 1: Sound Knowledge & Skill of Domain Area: Ability to demonstrate problems related with mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program

EA 2: Problem solving skills: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.

EA 3: Cognitive and Analytical skills: Cognitive& Analytical skills help engineering graduates interpret data, remember team goals. These skills help them recall previous information that may relate to their organization's goals and help them make important connections between old and new information so that they can work more effectively.

EA 4: Design Thinking: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, economic, environmental, cultural and societal considerations.

EA 5: **Transferrable Skills:** Transferable skills are skills and abilities that are relevant and helpful across different areas of life: socially & professionally.

- **Interpersonal skills to work in diverse group:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
- **Communication Skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such abilities include reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
- **Positive attitude and thinking:** An ability to have a positive attitude and thinking in challenging situations.
- **Adaptability:** Adapts learning strategies to new conditions. Recognizes parallels, analogies or similarities of new situations to more familiar situations.
- **Learn to Learn:** Learn ⟶ Unlearn ⟶ Relearn: An ability to identify and to address their own educational needs in a changing world, sufficiently to maintain their competence and contribute to the advancement of knowledge.

EA6: Information technology skills: An ability to create, select, adapt, and extend appropriate techniques, resources, and modern ICT tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.

EA7: Sustainable Consumption and Production: the demands for system upgrades (domestic and commercial) as well as the move to continuous provision of service (e.g. domestic devices that are always powered and available) needs to be balanced with the views of sustainable consumption and production. Server based solutions – such as Google Docs (Google Docs, 2009) 0– can be considered as one way of addressing such concerns where individuals need not upgrade their own machines as regularly and install local applications (with subsequent updates).

B.TECH - COMPUTER SCIENCE AND ENGINEERING PROGRAMME EDUCATIONAL OBJECTIVES

PEO1. To nurture strong understanding in logical, mathematical and analytical reasoning among students coupled with a problem solving attitude that prepares them to productively engage in research and higher learning.

PEO2. To build a strong foundation in the field of Computer Science and Engineering among students to be creative and innovative.

PEO3. To prepare students capable of designing and developing real-world computing applications with high societal influence and impact.

PEO4. To provide students with an academic environment that enables them to understand the significance of life-long learning in varied situations and teams in a global perspective.

PEO5. To inculcate ethical practices, professionalism and environmental awareness for sustainable development among students enabling them for prospective employment in their chosen line of profession globally.

PEO6. To instill communication and management skills that generate entrepreneurship and / or leadership qualities.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROGRAMME LEARNING OUTCOMES (PLOs)

PLO1-Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and IC design and technology concepts towards modelling and prototyping Integrated systems.

PLO2-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.

PLO3-Design/development of solutions: Design methodology to offer hardware solutions to public health, safety and agriculture, consumer electronics along with cultural, societal, and environmental considerations.

PLO4-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.

PLO5-Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PLO6-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.

PLO7-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.

PLO8-Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PLO9-Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PLO10-Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend, write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PLO11-Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PLO12-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.

MAPPING MATRIX OF PROGRAM EDUCATIONAL OBJECTIVES (PEO) AND PROGRAM LEARNING OUTCOMES (PLO)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO8	PLO 9	PLO10	PLO11	PLO12	PLO13
PEO1	✔	✔											
PEO2			✔	✔									
PEO3					✔	✔							
PEO4							✔	✔					
PEO5									✔				
PEO6										✔	✔	✔	
PEO7													✔

B.TECH COMPUTER SCIENCE AND ENGINEERING

PROGRAMME SPECIFIC OUTCOMES

PSO1: The ability to demonstrate competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.

PSO2: The ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering or domain specific problems in order to reach substantiated conclusions.

PSO3: The ability to employ modern technological concepts, languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

MAPPING MATRIX OF PROGRAM SPECIFIC OUTCOMES (PSOs) AND PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO / PSO	PEO1	PEO2	PEO3	PEO4	PEO5	PEO6	PEO7
PSO1	✔						
PSO2		✔	✔	✔			
PSO3					✔	✔	✔

B.TECH COMPUTER SCIENCE AND ENGINEERING PROGRAMME STRUCTURE

The Computer Science and Engineering curriculum is geared towards providing the student with a strong foundation in the discipline and the tools and competence to address new and challenging problems that they have not seen before. In order to earn a B. Tech. degree in Computer Science and Engineering, a student should earn 180 credits in the course of their study. The credit requirements for their program of study is comprised of the following Programme Structure:

- **Basic Applied Sciences (BAS) and Engineering Science (ES):**
  The purpose of Basic Applied Sciences in Engineering study is to lay a strong foundation of basic principles of various disciplines such as Mathematics, Physics, Chemistry in the minds of the learners, so that they proceed to the rest of their years of study with up-to-date knowledge and training of basic engineering skills. The Engineering Sciences requirements support multiple objectives: first, the courses provide a strong foundation in the basic tools and methodologies common to all engineering disciplines; second, all students are exposed to basics of each discipline allowing for cross-disciplinary competencies; last, there is a multi- disciplinary project component where students from different engineering disciplines come together on a design project, allowing for practice in collaborative team work.

- **Professional Core Courses (PC):** The Professional core courses are aimed at providing the student with a solid foundation in their chosen field of study as per Industry 4.0 skills and knowledge.

- **Professional Electives (PE)-Programme specific Specialization Electives:**
  The Professional electives, on the other hand, provide the student with an option to gain exposure to different specializations within the discipline, or an opportunity to study one of the subfields in some depth.

- **Open Electives-Courses from other Technical areas and Emerging fields:**
  The open subject elective courses provide the student wide latitude to pursue their interests, be it in humanities, arts, their chosen field of study, a related discipline, or use it towards developing a concentration in another field as a Minor.
  Students have choice to select Advanced Undergraduate Subjects, from other technical areas and Emerging fields for acquiring sound holistic multidisciplinary knowledge & Skills. The students can elect to consider these additional options upon joining the university.

- **Skill Enhancement Courses (SEC)-Technical & Soft Skills:**
    - **Technical Skills:** Under Technical Skills Broad categories of training to be imparted in Engineering Graduates of various disciplines with common nomenclature. The training is categorized into three categories: Elementary, Intermediate & Advanced keeping in view interdisciplinary approach. (One Credit Each from 3rd semester to 6th semester)

    - **Soft Skills:** Under Soft skills training five soft skill courses with defined Nomenclature and course content common to all Engineering disciplines introduced to inculcate Group Dynamics, Team work &Leadership Traits by engaging students for interactive sessions through Role Play, Group Discussions and for improving presentation &Communication skills of engineering graduates. (One Credit Course from 3rd Semester to 7th semester).

- **Practicals (P):**

  The labs are fully furnished and well equipped with latest software to conduct practical work as per the requirement of the University Curriculum.

- **Live Projects (LP):**

  Live Projects is being introduced for all Engineering disciplines from 4th semester - 7th Semester to develop an ability in engineering graduates to apply skills and knowledge attained to solve real life complex problems. (One Credit each semester).

  ❖ A student may create a live project as an internship project. In that case, the student will be monitored on a periodic basis, both by the Industry Expert and the Faculty In-charge. The Industry In-charge will submit the Mid-Term and End-Term Evaluation report. However, the faculty In-charge will take periodic presentations to keep a check on the progress of students.

  ❖ A student may also create a live project under the supervision of Institutional faculty (in-house or other institutes of repute). Six step comprehensive approach is introduced for Identification of Projects, Allocation & Monitoring of projects through digital platform.

- **Humanities and Social Sciences including Management Courses (HSS)**

❖ Under this category for holistic development of engineering graduates following courses have been introduced in various engineering Programme:

✔ Communicative English/ Indian Constitution & Polity

✔ Communicative English Lab/ NSS-Yoga-NCC

✔ Management and Organizational Behavior

B.TECH COMPUTER SCIENCE AND ENGINEERING IN CYBER SECURITY

PROGRAMME STRUCTURE

Category of Courses	Category	No. of Courses	
Basic Applied Sciences	BAS	7	
Engineering Sciences	ES	10	
Professional Core Courses	PC	13	
Professional Electives-Program Specific Specialization Electives	PE	12	
Ability Enhancement Courses	AEC	4	
Skill Enhancement Courses (Technical &Soft Skills)	SEC	Technical Skills	4
		Soft Skills	5
Value Added Courses	VAC	3	
Practicals / Workshops	P/W	10	
Live Project & Industrial Visit and Summer Internship	LP/SI	Live Project and Industrial Visit	4
		Minor Project	1
		Major Project	1
Multidisciplinary Courses (Humanities and Social Science Courses) (HSS)	MDC	3	
TOTAL		**77**	

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: CYBER SECURITY

DEGREE COURSE

PROGRAMME CREDIT STRUCTURE SEMESTERWISE

SEMESTER → / COURSES	CATEGORY	I	II	III	IV	V	VI	VII	VIII	TOTAL	%AGE
Basic Applied Sciences	BAS	9	9	3	-	-	-	-	-	**21**	**11.7**
Engineering Sciences	ES	9	9	-	-	-	-	-	-	**18**	**10.0**
Professional Core Courses	PC	-	-	10	10	7	7	11	-	**45**	**25.0**
Professional Electives- Program Specific Specialization Electives	PE	-	-	4	8	10	9	4	-	**35**	**19.4**
Ability Enhancement Courses	AEC	5	2	-	-	-	-	-	-	**7**	**3.9**
Supportive Courses (Skill Development: Technical &Soft Skills)	SEC	-	-	2	2	2	2	1	-	**9**	**5.0**
Value Added Courses	VAC	2	2	2	-	-	-	-	-	**6**	**3.3**
Practical/Workshop	P/W	-	-	3	2	1	2	2	-	**10**	**5.6**
Live Project & Industrial Visit and Summer Internship	LP/SI	-	-	-	1	1	1	5	12	**20**	**11.1**
Humanities And Social Sciences Including Management Courses	MDC	-	-	-	3	3	3	-	-	**9**	**5.0**
TOTAL		**25**	**22**	**24**	**26**	**24**	**24**	**23**	**12**	**180**	**100.0**

COURSE CURRICULUM

BACHELOR OF TECHNOLOGY

(COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: CYBER SECURITY

DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – I

Code	Category	Course Name	Hours per week				Credits
			L	T	P	Total Hours	
Theory							
25AS101	(BAS)	Engineering Mathematics-I	3	1	1	0	4
OR							
25AS104	(BAS)	Mathematics-I (For BME students)	2	0	0	2	2
25AS109	(BAS)	Biology (For BME students)	1	1	0	2	2
25AS103/ 25AS105	(BAS)	Quantum Computing/ Applied Chemistry	3	1	2	6	5
25EE101/ 25EC101	(ES)	Basic Electrical Engineering / Basic Electronics Engineering	3	0	2	5	4
25ME101/	(ES)	Fundamentals of Robotics and AI	3	0	0	3	3
25ME151	(ES)	Design thinking and Engineering practices Lab	0	0	2	2	1
OR							
25CS101/25CS151	(ES)	Fundamentals of Computer & C Programming	3	0	2	5	4
2XHS101	(AEC)	Communicative English	2	0	2	4	3

25ME153	(ES)	Engineering Graphics & Design Lab	0	0	2	2	1
25HIN-101-I / 25FLGR101-I / 25FLFR101-I	(AEC)	Hindi-I/German-I/French-I	2	0	0	2	2
2XESEB101/ 2XVAC102	(VAC)	Environmental Bioengineering / Indian Constitution and Polity	2	0	0	2	2
Total Credits (Theory + Practical)			**18/16**	**2**	**8**	**28/26**	**24/22**

** 1 Credit practical i.e 24CAM101 - INDUSTRIALl SESSION - I will be offered to IBM Specialization students

SEMESTER – II

Course Code	Category	Course Name	Hours per week				Credits
			L	T	P	Total Hours	
Theory							
25AS201	(BAS)	Engineering Mathematics-II	3	1	0	4	4
25AS204	(BAS)	Mathematics-II (For BME students)	3	1	0	4	4
25AS206/ 2XAS208	(BAS)	Quantum Computing/ Applied Chemistry	3	1	2	6	5
25EE202/ 25EC202	(ES)	Basic Electrical Engineering / Basic Electronics Engineering	3	0	2	5	4
25ME202/	(ES)	Fundamentals of Robotics and AI	3	0	0	3	3
25ME252	(ES)	Design thinking and Engineering practices Lab	0	0	2	2	1
OR							
25CS201/25CS251	(ES)	Fundamentals of Computer & C Programming	3	0	2	5	4
25HS202	(AEC)	Communicative English	2	0	2	4	3
25ME252	(ES)	Engineering Graphics & Design Lab	0	0	2	2	1
25HIN-201-I / 25FLGR201-I / 25FLFR201-I	(AEC)	Hindi-I/German-I/French-I	2	0	0	2	2

2XESEB101/ 2XVAC102	(VAC)	Environmental Bioengineering / Indian Constitution and Polity	2	0	0	2	2
Total Credits (Theory+Practical)			**18/16**	**2**	**8**	**28/26**	**24/22**

BACHELOR OF TECHNOLOGY

(COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: CYBER SECURITY

DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – III

Course Code	Course Name	Category	Hours per week				Credits
			L	T	P	Total Hours	
Theory							
25AS301	Engineering Mathematics-III	BAS	3	0	0	3	3
25CCS2009	Cryptography Fundamentals	PC	3	1	0	4	4
25CS2001	Data Structures	PC	3	0	0	3	3
25CSPEXXX	Professional Elective -I	PE	3	1	0	4	4
25CS2005	Database Management Systems	PC	3	0	0	3	3
Total Credits(Theory)			**15**	**2**	**0**	**17**	**17**
Practical							
25CS2113	Data Structures LAB	P	0	0	2	2	1
25CS2111	Database Management Systems Lab	P	0	0	2	2	1
25CCS2117	Cryptography Lab	P	0	0	2	2	1
25VACXXX	Sports, Yoga & Fitness	VAC	1	0	2	3	2
Total Credits (Practical)			**1**	**0**	**8**	**9**	**5**
Skill Enhancement							
25CS0201C	Digital Marketing	SEC	0	0	2	2	1
25SS351	Effective Communication Skills	SEC	0	0	2	2	1
Total Credits (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total Credits (Theory+ Practical+ Skill Enhancement)			**16**	**2**	**12**	**30**	**24**

NOTE: At the end of the semester, students will undergo a training and create a project which will be evaluated in the next semester (Live Project-I)

The XX parts of the course code will depend upon the elective chosen by the student

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: CYBER SECURITY

DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – IV

Course Code	Course Name	Category	Hours per week				Credits
			L	T	P	Total Hours	
Theory							
25MDCXXX	Multi-Disciplinary Elective - I	MDC	3	0	0	3	3
25CS2004	Discrete Structures	PC	3	1	0	4	4
25CCS2006	Database Security	PC	3	0	0	3	3
25CS2006	Operating Systems	PC	3	0	0	3	3
25CSPExx	Professional Elective –II	PE	3	1	0	4	4
25CSPExx	Professional Elective –III	PE	3	0	0	3	3
Total Credits (Theory)			**18**	**2**	**0**	**20**	**20**
Practical							
25CCS2118	Database Security Lab	P	0	0	2	2	1
25CS2114	Operating Systems Lab	P	0	0	2	2	1
25CSPExx	Professional Elective –III Lab	PE	0	0	2	2	1
25CS0204	Live Project-I and Industrial Visit	LP**	0	0	2	2*	1
Total Credits (Practical)			**0**	**0**	**8**	**8***	**4**
Skill Enhancement							
25CS0202A	Introduction to SPSS	SEC	0	0	2	2	1
25SS452	Teamwork & Interpersonal Skills	SEC	0	0	2	2*	1
Total Credits (Skill Enhancement)			0	0	4	4*	2
Total Credits (Theory+ Practical+ Skill Enhancement)			**18**	**2**	**12**	**30***	**26**

NOTE: At the end of the semester, students will undergo a training and create a project which will be evaluated in the next semester (Live Project-II)

**** To be evaluated in the current semester.**

The XX parts of the course code will depend upon the elective chosen by the student

BACHELOR OF TECHNOLOGY

COMPUTER SCIENCE AND ENGINEERING

SPECIALIZATION: CYBER SECURITY

DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – V

Course Code	Course Name	Category	Hours per week				Credits
			L	T	P	Total Hours	
Theory							
25MDCXXX	Multi-Disciplinary Elective - II	MDC	3	0	0	3	3
25CCS3001	Network Security	PC	3	0	0	3	3
25CCS3005	Kali Linux	PC	3	1	0	4	4
25CSPExxx	Professional Elective -IV	PE	3	1	0	4	4
25CSPExxx	Professional Elective - V	PE	3	1	0	4	4
Total Credits(Theory)			**15**	**3**	**0**	**18**	**18**
Practical							
25CCS3115	Network Security Lab	P	0	0	2	2	1
25CSPExxx	Professional Elective –V Lab	PE	0	0	2	2	1
25CSPExxx	Professional Elective – IV Lab	PE	0	0	2	2	1
25CS0303	Live Project-II & Industrial Visit	LP**	0	0	2	2	1
Total Credits (Practical)			**0**	**0**	**10**	**8**	**4**
Skill Enhancement							
	Introduction to Hardware Description Language	SEC	0	0	2	2	1
25SS553	Presentation Skills	SEC	0	0	2	2	1

Total Credits (Skill Enhancement)	**0**	**0**	**4**	**4**	**2**
Total Credits (Theory+ Practical+ Skill Enhancement)	**15**	**3**	**14**	**30**	**24**

NOTE: The XX parts of the course code will depend upon the elective chosen by the student Students may opt one course in 5th semester and one course in 6th semester apart from the elective list (as elective) from NPTEL on recommendation of the departmental committee.

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: CYBER SECURITY

DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – VI

Course Code	Course	Category	Hours per week				Credits
			L	T	P	Total Hours	
Theory							
25MDCXXX	Multi-Disciplinary Elective – III	MDC	3	0	0	3	3
25CCS3002	Penetration Testing	PC	3	0	0	3	3
25CCS3010	Android Security	PC	3	1	0	4	4
25CSPExxx	Professional Elective – VI	PE	3	1	0	4	4
25CSPExxx	Professional Elective – VII	PE	3	1	0	4	4
Total Credits (Theory)			**15**	**3**	**0**	**18**	**18**
Practical							
25CCS3116	Penetration Testing Lab	P	0	0	2	2	1
25CSPExxx	Professional Elective – VI Lab	PE	0	0	2	2	1
25CCS3014	Network Programming Lab	P	0	0	2	2	1
25CS0304	Live Project-III & Industrial	LP**	0	0	2	2	1

	Visit						
Total Credits (Practical)			**0**	**0**	**8**	**8**	**4**
Skill Enhancement							
25CS0301A	Wearable Technologies	SEC	0	0	2	2	1
25SS654	Professional Skills	SEC	0	0	2	2	1
Total Credits (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total Credits (Theory+ Practical+ Skill Enhancement)			**15**	**3**	**12**	**30**	**24**

NOTE: The XX parts of the course code will depend upon the elective chosen by the student

Students may opt one course in 5th semester and one course in 6th semester apart from the elective list (as elective) from NPTEL on recommendation of the departmental committee.

BACHELOR OF TECHNOLOGY

(COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: CYBER SECURITY

DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – VII

Course Code	Course	Category	Hours per week				Credits
			L	T	P	Total Hours	
Theory							
25CCS4003	Cloud Security	PC	3	1	0	4	4
25CCS4005	Quantum Cryptography	PC	3	1	0	4	4
25CCS4011	Hardware Security	PC	3	0	0	3	3
25CSPExxx	Professional Elective – VIII	PE	3	1	0	4	4
Total Credits (Theory)			**11**	**3**	**0**	**15**	**15**
Practical							
25CCS4007	Cloud Security Lab	P	0	0	2	2	1
25CCS4009	Quantum Cryptography Lab	P	0	0	2	2	1
25CS4115	Live Project-IV & Industrial Visit	LP**	0	0	2	2	1
25CS4117	Minor Project	LP	0	0	8	8	4
Total Credits (Practical)			**0**	**0**	**14**	**14**	**7**
Skill Enhancement							
25AR755	Aptitude and Reasoning	SEC	0	0	2	2	1
Total Credits (Skill Enhancement)			**0**	**0**	**2**	**2**	**1**
Total Credits (Theory+ Practical+ Skill Enhancement)			**11**	**3**	**16**	**30**	**23**

NOTE: The XX parts of the course code will depend upon the elective chosen by the student

**** To be evaluated in the current semester.**

BACHELOR OF TECHNOLOGY

(COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: CYBER SECURITY

DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – VIII

Course Code	Course	Category	Hours per week				Credits
			L	T	P	Total Hours	
25CS4114	Major Project	LP	0	0	24	24	12
Total Credits (Theory+ Practical+ Skill Enhancement)			0	0	24	24	12

** To be monitored at the Institute Level*

*** Teaching Load*

LIST OF ABILITY ENHANCEMENT COURSES

Course Code	Course	Category	L	T	P	Credits
25AEC101/25AEC151	Professional English/Communicative English Lab	AEC	2	0	2	3
25AEC102/ 25AEC103/ 25AEC104	Hindi-I/FRENCH-I/GERMAN-I	AEC	2	0	0	2
25AEC202/ 25AEC203/ 25AEC204	Hindi-II/ FRENCH-II/GERMAN-II	AEC	2	0	0	2

LIST OF SKILL ENHANCEMENT COURSES

Course Code	Course	Category	L	T	P	Credits
TECHNICAL TRAINING						
25CS0201A/ 25ME0201/ 25CS0201B/ 25CE0201	Data Structure and Algorithms using C or C++/ Industry Automation Level-I/ Digital Marketing/ Fundamentals of CAD for Engineers	SEC	0	0	2	1
25CS0202A/ 25CS0202B/	Design Thinking and Augmented Virtual Reality/ Programming Using Python for Engineers	SEC	0	0	2	1
25CS0301A/ 25CS0301B/ 25CS0301C/ 25ME0301/ 25CE0301	Wearable Technology /Big Data Analytics, Tools and Techniques/ Machine Learning using Python/ Industry Automation Level-II/ RCC Structure Drawing Training	SEC	0	0	2	1
25CS0302A/ 25EC0302/ 25CE0302/	Artificial Intelligence and Machine Learning/ MATLAB for Engineers/	SEC	0	0	2	1

25CS0302B	Structural Analysis using FEM-based Tools/ Data Analytics Tools					
SOFT SKILL						
25SS351	Effective Communication Skills	SEC	0	0	2	1
25SS452	Teamwork & Interpersonal Skills	SEC	0	0	2	1
25SS553	Presentation Skills	SEC	0	0	2	1
25SS654	Professional Skills	SEC	0	0	2	1
25AR755	Aptitude and Reasoning	SEC	0	0	2	1

LIST OF VALUE ADDED COURSES

Course Code	Course	Category	L	T	P	C
25VAC101/25VAC201	Environment protection and sustainable development	VAC	2	0	0	2
25VAC102/202	Indian Constitution and Polity	VAC	2	0	0	2
25VAC103	Sports, Yoga and Fitness	VAC	2	0	0	2

LIST OF MULTIDISCIPLINARY COURSES (MDC)

Total: 9 (3*3) Credits						
Code	**Category**	**Course**	**L**	**T**	**P**	**C**
23MDC101/24MDC101A/24MDC101B/24MDC101C/24MDC101D	(MDC-I)	Statistical Methods/Computer-Based Numerical and Statistical Technique/Probability and Random Process/Biostatistics/Numerical Methods	3	0	0	3
23MDC102		Environmental Geosciences & Disaster Management	3	0	0	3
23MDC301		IPR in Business	3	0	0	3
23MDC302		Library Information Sciences & Media Literacy	3	0	0	3
23MDC401		Management Process & Organizational Behaviour	3	0	0	3
23MDC103	(MDC-II)	Photonics	3	0	0	3
23MDC104		Chemistry & Society	3	0	0	3
23MDC303		Psychology and Emotional Intelligence	3	0	0	3
23MDC304		Indian Economy	3	0	0	3
23MDC402		Creating an Entrepreneurial Mind	3	0	0	3
24MDC 106A/24MDC 106B		Numerical Methods in BME/Discrete Mathematics	3	0	0	3
23MDC105	(MDC-III)	Life Sciences & Public Health	3	0	0	3
23MDC305		Electoral Literacy in India	3	0	0	3
23MDC403		Personal Financial Planning	3	0	0	3
23MDC404		Interior Design	3	0	0	3
24MDC107		Probability & Statistics	3	0	0	3

Note

1. These courses will be of introductory level and shall have 3 credits.
2. Students will not be allowed to choose or repeat the courses already gone through in class XII and present in Program core and specialization.
3. Students will have the option to choose any 3 out of the pool.

*The course shall be based on applications, tools and techniques.

LIST OF DEPERTMENTAL ELECTIVE COURSES

1. Specialization-I

Elective	Course Code	Course	Category	L	T	P	C
I	25CSPE2007	Computer Architecture & Organization	PE	3	1	0	4
II	25CSPE2004	Theory of Computation	PE	3	1	0	4
III	25CSPE2008/ 25CSPE2118	Analysis and Design of Algorithms /Lab	PE	3	0	1	4
IV	25CSPE3001/ 25CSPE3117	Compiler Design/Lab	PE	3	1	1	5
V	25CSPE3003/ 25CSPE3113	Computer Networks/Lab	PE	3	1	1	5
VI	25CSPE3004/ 25CSPE3118	Software Engineering/Lab	PE	3	0	1	4
VII	25CSPE3030	Neural Networks & Fuzzy Logic	PE	3	1	0	4
	25CSPE3038	Business Intelligence	PE	3	1	0	4
	25CSPE4037	NASSCOM Associate Analytics – II	PE	3	1	0	4
	25CSPE3032	Cyber Security	PE	3	1	0	4
VIII	25CSPE4025	Data Warehousing & Data Mining	PE	3	1	0	4
	25CSPE4039	NASSCOM Associate Analytics – III	PE	3	1	0	4
	25CSPE4019	Network Security & Cryptography	PE	3	1	0	4

2. Specialization-II

Elective	Course Code	Course	Category	L	T	P	C
I	25CSPE200	Computer Architecture &	PE	3	1	0	4

	7	Organization					
II	25CSPE2004	Theory of Computation	PE	3	1	0	4
III	25CSPE2008/ 25CSPE2118	Analysis and Design of Algorithms /Lab	PE	3	0	1	4
IV	25CSPE3001/ 25CSPE3117	Compiler Design/Lab	PE	3	1	1	5
V	25CSPE3003/ 25CSPE3113	Computer Networks/Lab	PE	3	1	1	5
VI	25CSPE3004/ 25CSPE3118	Software Engineering/Lab	PE	3	0	1	4
VII	25CSPE3024	Software Project Management	PE	3	1	0	4

VIII	25CSPE3028	Object Oriented Analysis & Design	PE	3	1	0	4
	25CSPE3034	Design Thinking	PE	3	1	0	4
IX	25CSPE4033	Software Testing	PE	3	1	0	4
	25CSPE4031	Open Source Software	PE	3	1	0	4

3. Specialization-III

Elective	Course Code	Course	Category	L	T	P	C
I	25CSPE2007	Computer Architecture & Organization	PE	3		0	4
II	25CSPE2004	Theory of Computation	PE	3	1	0	4
III	25CSPE2008/25CSPE2118	Analysis and Design of Algorithms /Lab	PE	3	0	1	4
IV	25CSPE3001/25CSPE3117	Compiler Design/Lab	PE	3	1	1	5
V	25CSPE3003/25CSPE3113	Computer Networks/Lab	PE	3	1	1	5
VI	25CSPE3004/ 25CSPE3118	Software Engineering/Lab	PE	3	0	1	4

VII	25CSPE3020	Distributed Operating System	PE	3		0	4
	25CSPE3026	Grid Computing	PE	3		0	4
	25CSPE3040	Internet of Things	PE	3		0	4
VIII	25CSPE4023	Wireless Adhoc and Sensor Network	PE	3		0	4
	25CSPE4035	Advanced Java Programming	PE	3		0	4
	25CSPE4027	Mobile Computing	PE	3		0	4

EVALUATION SCHEMES

The bifurcation of Continuous Evaluation (Internal) and End Semester Evaluation marks are as under:

S.No	Course	Continuous Evaluation (Internal)	End Semester
1	Professional (PC) : Theory	30	70
2	Professional Electives –Programme Specific Electives-Theory	40	60
3	Open Electives-Theory	40	60
4	Humanities & Social Sciences including Management Courses (HSS)-Theory	40	60
5	Practical /Workshop - Practical	60	40
6	Skill Enhancement Courses (SEC)	70	30
7	Technical Enhancement Courses (TEC)	70	30
8	Live Projects & Industry Visits (LP/IV) and Internship	60	40
9	Dissertation/Project	60	40

SEMESTER - I & SEMESTER – II

FUNDAMENTALS OF COMPUTER & C PROGRAMMING	
Course Code: 25CS101/25CS202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To familiarize and understand the basic concepts of digital computers and computer programming.
2. To impart adequate knowledge on the need of programming languages and problem solving techniques.
3. To analyze and construct effective algorithms.
4. To develop problem solving ability using programming.
5. To employ good programming practices such as incremental development, data integrity checking and adherence to style guidelines.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the fundamental concepts of computers, both hardware and software.
2. Learn and understand the major system software that helps in developing an application.
3. Apply and analyse the basic programming constructs in context of C programming language.
4. Analyse and evaluate the derived datatypes (array) and the operations that can be performed on them, along with the concept of modularity through functions
5. Create and manipulate a database or data storage through files.
6. Learn a programming approach to solve problems.

MAPPING MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

COs/CLOs	CLO1	CLO2	CLO3	CLO4	CLO 5	CLO 6
CO1	x	x				
CO2		x	x			
CO3			x	x		
CO4					x	
CO5						x

MAPPED SDGs: SDG-4, SDG-9

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**INTRODUCTION OF COMPUTER SYSTEM** Anatomy of a digital Computer, Different Units of Computer, System, Hardware & Software, Classification of Computer Systems, Number systems, Operating System: Definition, working & its functions, Basic concepts of Computer Networks, Network Topologies.	9
UNIT-II	**INTRODUCTION TO SYSTEM SOFTWARE** Programming language- Definition, types; Syntax & Semantics, Type of programming errors, Assembler, Linker, Loader, Compiler, Interpreter, debuggers, Algorithms, flowcharts and their symbols.	9
UNIT-III	**BASICS OF 'C' LANGUAGE** C Fundamentals, Basic data types, variables and scope, storage classes, operators and expressions, formatted input/ output, expressions, selection statements, loops and their applications.	9
UNIT-IV	**ARRAY & FUNCTION** Arrays, functions, recursive functions, pointers and arrays. Strings literals, arrays of strings; applications. Storage Classes and Pre-processor Directives.	9
UNIT-V	**STRUCTURE & FILE SYSTEM** Structures, declaring a Structure, Accessing Structure Elements, Storing Structure elements, Array of Structures, Unions and Enumerations, Dynamic memory allocation. File Input/Output, Data Organization, File Operations, opening a File, reading from a File, Closing the File, Writing to a File, File Opening Modes.	9

TEXT BOOKS

1. The C Programming Language by Dennis M Ritchie, Brian W. Kernigham, 1988, PHI.
2. Computer System & Programming in C by S Kumar & S Jain, Nano Edge Publications, Meerut.
3. Fundamentals of Computing and C Programming, R. B. Patel, Khanna Publications, 2014, New Delhi.
4. Let Us C, YashwantKanetkar, 20th Edition, BPB Publications, 2024.
5. Computer Fundamentals and Programming in C, ReemaTheraja, 2nd Edition, Oxford, 2016.

OPEN EDUCATIONAL RESOURCES

1. **Programming in C:** https://en.wikibooks.org/wiki/C_Programming
2. **C Programming and Data Structures:** https://nptel.ac.in/courses/106/105/106105171/
3. **Harvard's CS50 (Introduction to Computer Science):** https://cs50.harvard.edu/x/

REFERENCE BOOKS

1. Information technology, Dennis P. Curtin, Kim Foley, KunalSen, Cathleen Morin, 1998, TMH.
2. Theory and problem of programming with C, Byron C Gottfried, TM

C PROGRAMMING LAB	
Course Code: 25CS151/25CS252	**Continuous Evaluation:** 40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To develop problem solving ability using programming.
2. To impart adequate knowledge on the need of programming languages and problem-solving techniques.
3. To develop a methodological way of problem solving.
4. To learn a programming approach to solve problems.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in alignment with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the Typical C Program Development Environment, compiling, debugging, Linking and executing.
2. Introduction to C Programming using Control Statements and Repetition Statement.
3. Apply and practice logical formulations to solve some simple problems leading to specific applications.
4. Design effectively the required programming components that efficiently solve computing problems in the real world.
5. Employ good programming practices such as incremental development, data integrity checking and adherence to style guidelines.

MAPPING MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

COs/CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	√				
CO2		√	√		
CO3				√	
CO4					√

MAPPED SDGs: SDG-4, SDG-9

LIST OF EXPERIMENTS

1. Implement a C program to determine the largest of three numbers using the if-else construct
2. Implement a program to find the largest among ten numbers using for-statement.
3. Design a program to compute average height by gender based on inputs of sex code and height.
4. Implement a function-based program to find the roots of a quadratic equation using a **switch-case** construct.
5. Implement logic to find the largest and second largest in an array of 50 integers.

6. Implement matrix multiplication using nested loops and two-dimensional array.
7. Implement a sorting algorithm to arrange a list of numbers in ascending order.
8. Develop an ATM simulation system that supports balance, deposit, withdraw options using switch-case.
9. Implement a recursive program to generate Fibonacci series.
10. Implement a program to swap two numbers using both call by value and call by reference.
11. Implement string operations to check whether a given string is a palindrome.
12. Develop a structure-based program to manage student records with add, view, and update functionality.
13. Implement file handling operations to create a file and write user input to it.
14. Write a program which manipulates structures into files (write, read, and update records).
15. Mini Project –Write a program to develop a small application using functions, arrays, structures, and file handling. Choose one of the following:
    i) Student Record Management System
    ii) Quiz Game
    iii) Hospital Patient Entry System
    iv) Railway Reservation System

TEXT BOOKS

1. C Programming Language by Dennis M Ritchie, Brian W. Kernigham, 2nd Edition, Pearson.
2. Computer System & Programming in C by S Kumar & S Jain, Nano Edge Publications, Meerut.
3. Fundamentals of Computing and C Programming, R. B. Patel, Khanna Publications, 2010, New Delhi.

REFERENCE BOOKS

1. Let Us C, Yashwant Kanetkar, 20th Edition, BPB Publications.
2. Computer Fundamentals and Programming in C, Reema Theraja, Oxford
3. Information technology, Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin, 1998, TMH.

OPEN EDUCATIONAL RESOURCES

1. MIT Open Course ware: https://ocw.mit.edu/courses/6-087-practical- programming-in-c-january-iap-2010/resources/mit6_087iap10_lec01

ENGINEERING MATHEMATICS-I	
Course Code: 25AS101	**Continuous Evaluation:** 30 Marks
Credits: 4	**End Semester Examination:** 70 Marks
L T P : 3 1 0	
Prerequisite: 12th Mathematics	

COURSE OBJECTIVES (COs)

1. To provide students the understanding of matrices and its applications.
2. To introduce the concept of functions of several variables, Partial differentiation, and its applications.
3. To demonstrate the applications of Multiple Integrals.
4. To describe the concepts of vector calculus.
5. To illustrate the concept of convergence, divergence of sequences and series of real numbers and improper integration.

COURSE LEARNING OUTCOMES (CLOs)The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Apply the techniques of matrices to real-world mathematical and computational problems.
2. Apply the knowledge of partial differentiation in engineering problems.
3. Calculate line, surface, and volume integrals.
4. Illustrate different real-world problems related to vector calculus
5. Explain convergence behaviour of sequences and series of real numbers and improper integration.

MAPPING MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

COs/CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	x				
CO2		x			
CO3			x		
CO4				x	
CO5					x

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Matrix**: Types of Matrices, Elementary Transformations, Inverse of a square matrix by elementary transformation, Rank of a matrix (Echelon and Normal forms), Linear Dependence & Independence of vectors, Solution of system of linear equations (AX = 0 and AX = B), Eigenvalues and Eigenvectors, Cayley Hamilton theorem. **Application domain problems**: Cryptography (Coding and Decoding), Image and Image Processing, data storage and	12

	analysis.	
UNIT-II	Functions of several variables, Partial Derivatives, Homogenous function, Euler's theorem for homogenous functions, Deductions from Euler's theorem, Total Derivatives, Chain Rule, Composite function of two variables, Differentiation of implicit functions, Applications of Partial Derivatives- Taylor's theorem for two variables, Maxima and minima for two variables, Jacobians. **Application domain problems**: Approximations and error analysis	12
UNIT-III	**Multiple integral**: Evaluation of Double integrals, Change of Order of Integration, Double integration in polar coordinates, Change of Variables, Triple integrals - Evaluation of triple integrals over a given region, Applications of Multiple Integrals – Area (Cartesian Coordinates). Beta and Gamma functions and their properties. **Application domain problems**: Centre of Mass, Moment of Inertia, Solid of revolution and Kinetic energy	12
UNIT-IV	**Vector calculus**: Differentiation of vectors, Scalar and vector point functions, Gradient, Divergence, Curl, Directional derivatives, Vector Integration- Line, Surface and Volume integrals, Green's Theorem, Gauss' divergence theorem and Stroke's theorem (without proof). **Application domain problems**: Equation of continuity, Equation of motion, Inverse square law of force	12
UNIT-V	**Sequence & Series:** Convergence, divergence and oscillation of a series, Geometric Series, General properties of series, Test of convergence – Comparison test, Integral test, Comparison of Ratios, D'Alembert's Ratio test, Cauchy root test. **Application domain problems**: Computational geometry, Image processing.	12

TEXT BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 45 th Edition, 2020.
2. Jain R. K., Iyengar S. R. K., Advanced Engineering Mathematics, 7th Edition, Narosa Publishing House, 2021.
3. Kreyszig. E, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons. Singapore, 2017.
4. Bali N.P., Goyal M, Advanced Engineering Mathematics, Laxmi Publications, New Delhi, 2018.

REFERENCE BOOKS

1. Bali N.P., Goyal M, Advanced Engineering Mathematics, Laxmi Publications, New Delhi, 2018.
2. Dass H. K., Advanced Engineering Mathematics, Sultan Chand Publication, Delhi, 2018.

ENGINEERING MATHEMATICS-II (COMMON TO ALL BRANCHES EXCEPT BIO MEDICAL ENGINEERING)	
Course Code:25AS201	**Continuous Evaluation:** 30 Marks
Credits: 4	**End Semester Examination:** 70Marks
L T P : 3 1 0	
Prerequisite: Engineering Mathematics-I	

COURSE OBJECTIVES (COs):

1. To enable students to have skills that will help them to solve real-world problems based on different types differential equations.
2. To explain basics of vector spaces and linear transformations.
3. To describe Laplace and inverse Laplace transforms with their properties.
4. To understand Analytic functions, Construction of Analytic Functions
5. To equip the students with concept of Complex Integration, Tayler's and Laurent's Expansions, Residues and Singularities.

COURSE LEARNING OUTCOMES (CLOs):

1.The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:
2. Interpret various physical models through higher order differential equation and solve such linear ordinary differential equation.
3. Describe the basics of vector spaces and linear transformations.
4. Apply Laplace transforms to find the solution of initial value problems.
5. Demonstrate the concept of Analytic functions & its constructions.
6. Evaluate Complex Integration, Taylor's and Laurent's Expansion, Singularities and Residues.

MAPPING MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

COs/CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	
CO5					✔

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Linear differential equation with constant Coefficient, Complimentary Functions, Particular Integrals, Euler – Cauchy differential equations, Second order linear differential equations – Variation of Parameters & Method of undetermined coefficient.	12

	Application domain problems: Electric field, rate of growth and decay of population dynamic, Antenna Design	
UNIT-II	Binary composition, internal and external composition, Vector Spaces- Definition and Examples, Vector subspaces, Linear combination of Vectors, Basis and Dimension of Vector Spaces. Linear transformations, Properties of Linear Transformation, Null space and range of linear Transformation, Matrix representation of linear transformation. Application domain problems: Image processing, Creating and manipulating 3D models	12
UNIT-III	Laplace Transforms, Existence theorem, Standard Properties, Laplace transforms of Derivatives and Integrals, Unit Step Function, Laplace Transform of Periodic functions, Inverse Laplace Transforms, Convolution theorem, Applications of Laplace transforms for solving IVP. Application domain problems: Signal transformation and control systems	12
UNIT-IV	Function of complex variables: Limit, continuity, Differentiability and Analyticity of functions, Cauchy-Riemann Equations (Cartesian and polar forms), Harmonic functions, Construction of Analytic Function, Determination of Harmonic conjugate, Milne-Thomson's method. Application domain problems: Special functions and error functions, Computer graphics for rendering images, modeling surfaces, and creating visual effects.	12
UNIT-V	Line integral, Cauchy's Integral Theorem, Cauchy's Integral Formula, Cauchy's Integral Formula for Derivatives, Cauchy's Inequality, Taylor's, and Laurent's Expansions (statements only), Singularities, Poles and Residues, Cauchy's residue Theorem, Applications - Evaluation of real integrals f (sin θ, cos θ) over (0, 2π). Application domain problems: Electrical circuits, Image processing and communication system, Diffraction on a flat screen.	12

TEXT BOOKS/REFERENCE BOOKS

1. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford first edition, 2015.
2. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2017
3. S. H. Friedberg, Arnold J. Insel, E. S.Lawrence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
4. E. Kreyszig, Advanced Engineering Mathematics, Wiley-India, 10th Edition, 2017
5. Kandasamy P et al. Engineering Mathematics, S. Chand & Co., New Delhi, revised edition.
6. Dass H. K., Advanced engineering Mathematics, Sultan Chand Publication, Delhi, 2013.

ENGINEERING PHYSICS (COMMON TO ALL BRANCHES)	
Course Code: 24AS102/202	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

1. To provide students with the knowledge of variety of important concepts of Physics and their applications in Engineering and Technology
2. To enhance the understanding of the concepts found in Mechanics, Harmonic Oscillations, wave Optics, Lasers, Fiber Optics.
3. To familiarize the quantum mechanical approach and its application in engineering.
4. To develop necessary understand on semiconductors and their applications in devices; Apply theory learnt to correlate with the environmental issues such as the use of solar cells

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. The student is expected to be familiar with broader areas of Physics such as mechanics of solids, optics, mechanical and electromagnetic waves oscillations and their relevance in Engineering.
2. An understanding of Physics also helps engineers understand the working and limitations of existing devices and techniques, which eventually leads to new innovations and improvements.
3. The student would be able to learn the fundamental concepts on Quantum behavior of matter in its micro state.
4. The course also helps the students to be exposed to the phenomena of electromagnetism and also to have exposure to semiconductor devices such as solar cells

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES	COURSE LEARNING OUTCOMES			
	CLO1	CLO2	CLO3	CLO4
CO1	✔			
CO2		✔		
CO3			✔	
CO4				✔

COURSE CONTENTS

Unit-I: OSCILLATIONS & ULTRASONIC WAVES

Oscillations: Simple Harmonic Motion (SHM), Differential Equation of SHM and its Solutions, Conservation of Energy. Mass-string System. Damped Harmonic Oscillator-Over damped, Critically Damped, Under Damped motions, Relaxation Time, Forced vibrations. Resonance & Quality Factor. **Ultrasonic Waves:** Methods of production-Magnetostriction & Piezoelectric, Applications of Ultrasonic.

Unit-II: OPTICS

Interference: Interference due to division of wavefront: Fresnel's Bi-prism, Interference due to division of amplitude: wedge shaped film, Newton's rings. **Diffraction**: Fresnel's Diffraction and Fraunhofer's diffraction, single slit diffraction, transmission diffraction grating, absent spectra. **Laser:** Spontaneous and stimulated emission, Einstein's coefficients, Characteristics of laser, semiconductor laser. **Fiber optics:** Structure of optical fiber, Principle of propagation and numerical aperture, acceptance angle, classification of optical fiber (Single mode and Multimode).

Unit-III: ELECTROMAGNETIC THEORY

Mathematical Background: Gradient, Divergence, curl (Physical Significance), Irrotational & Solenoidal Field, Gauss Divergence and Stoke's Theorem, Important Vector Identities. **Maxwell's Equations**: Modification in Ampere's Circuital Law, Maxwell's Equation in Integral & Differential forms. Wave equation for Electromagnetic (EM) Waves-Propagation in free space, Characteristic Impedance, Poynting Vector (simple numerical), EM Energy Density

Unit-IV: STATISTICAL MECHANICS & QUANTUM MECHANICS:

Macrostate, Microstate, Density of states, Qualitative treatment of Maxwell Boltzmann, Fermi-Dirac and Bose-Einstein statistics.

Quantum Mechanics: Black body problem, Photoelectric effect and Compton scattering (For concept), de Broglie Hypothesis of matter waves, Davison Germer experiment, Uncertainty Principle, Application of Uncertainty Principle, Basic Features of Quantum Mechanics: Transition from deterministic to Probabilistic, wave function, probability density, Normalization of wave function, operators, expectation values, Schrodinger equation-Time dependent and time independent equation Application: Particle in a box (1-D).

Unit-V : SEMICONDUCTOR:

Intrinsic & Extrinsic Semiconductors (p and n- type)- Expression for the Density of Electrons in Conduction Band & Holes in Conduction band, Fermi level Dependence on Temperature and Carrier Concentrations. Semiconductor p-n Junction: Energy Band Diagram, p-n Junction with Forward & Reverse bias. I-V Characteristics, Zener & Avalanche breakdown. Tunnel Diode. Hall Effect: Experimental Determination of Hall Coefficient, Mobility of p and n- type Semiconductors. Photovoltaic effect and Solar Cell.

TEXT BOOKS

1. Beiser A, Concepts of Modern Physics, 5th Ed., McGraw Hill International, 2003.
2. AjoyGhatak, Optics, 5th Ed., Tata McGraw Hill, 2012.
3. David J. Griffiths, Introduction to Electrodynamics, Pearson Education Limited, London, 2015.
4. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker , Wiley
5. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press
6. Engineering Mechanics (SIE), S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati , McGraw Hill

REFERENCE BOOKS

1. Arumugam, M., Engineering Physics, 2nd edition, Anuradha Publishers, KumbaKonam, 2003.
2. Gaur and Gupta, Engineering Physics, 7th edition, Dhandapani and Sons, New Delhi, 1997.
3. N. Subrahmanyam and Brij Lal, Waves and Oscillations.
4. David J. Griffiths, , Introduction to Quantum Mechanics, Pearson Education Limited.

ENGINEERING PHYSICS LAB (COMMON TO ALL BRANCHES)	
Course Code: 24AS152/252	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Examination: 40 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

1. To gain practical knowledge by applying the experimental methods to correlate with the Physics theory
2. To learn the usage of electrical and optical systems for various measurements.
3. Apply the analytical techniques and graphical analysis to the experimental data

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Use the different measuring devices and meters to record the data with precision
2. Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results
3. Apply the mathematical concepts/equations to obtain quantitative results

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES	COURSE LEARNING OUTCOMES		
	CLO1	CLO2	CLO3
CO1	✔	✔	
CO2		✔	
CO3			✔

LIST OF EXPERIMENTS

Experiment 1: To determine the dispersive power of a given prism

Experiment 2: To determine the width of single slit by diffraction

Experiment 3: To determine the wavelength of the given laser source using standard grating

Experiment 4: To determine Planck's Constant (h)

Experiment 5: To determine the attenuation, numerical aperture and acceptance angle of the given optical fiber

Experiment 6: To determine the velocity of ultrasonic waves in liquids

Experiment 7: To determine the wavelength of sodium light by Newton's ring experiment

Experiment 8: To determine the moment of inertia of the disc and rigidity modulus of the wire by torsional pendulum

Experiment 9: To determine the specific rotation of sugar solution by polarimeter.

Experiment 10: Study of Hall Effect.

Experiment 11: Energy gap determination by Four-Probe method

Experiment 12: Determination of unknown resistance using Meter Bridge

Experiment 13: Plotting the characteristic curve of a PN junction diode.

Experiment 14: Verification of laws of vibration of string using sonometer.

Experiment 15: Determination of acceleration due to gravity by Bar pendulum.

TEXT BOOKS

1. Chattopadhyay, D., Rakshit, P. C and Saha, B., "An advanced Course in Practical Physics", 2nd edition, Books & Allied Ltd, Calcutta, 1990.
2. Chauhan and Singh, "Advanced practical physics", Revised edition, Pragati Prakashan Meerut, 1985.

REFERENCE BOOKS

1. Thiruvadigal. J. D., Ponnusamy S. Vasuhi, P. S. and Kumar. C, "Hand Book of Practical physics", 5th edition, Vibrant Publication, Chennai, 2007.
2. Engineering Practical Physics, by S. Panigrahi and B. Mallick, (CENGAG eLearning)

ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES)	
Course Code: 23AS103/203	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

1. The knowledge of water quality parameters and the treatment of water.
2. To predict the bulk properties and processes using thermodynamic considerations
3. To learn various types of fuels and their properties, and to understand the basics of spectroscopy.
4. To learn an introductory idea about new materials.
5. To understand the fundamental concepts on fuels and corrosion chemistry.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand how to identify the quality of water and how to improve the quality of water.
2. Rationalize bulk properties and processes using thermodynamic considerations.
3. Get preliminary understanding on introductory ideas about nano materials.
4. Analyze the quantitative aspects of fuel combustion, spectroscopy and the mechanism of corrosion.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE LEARNING OUTCOME / COURSE OBJECTIVES	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✔			
CO 02		✔	✔	
CO 03			✔	
CO 04				✔

COURSE CONTENTS

Unit-I

Water Technology: Reasons for hardness-units of hardness-determination of hardness and alkalinity - Water for steam generation-Boiler troubles -Scale, Sludge formation, Boiler corrosion, Caustic embrittlement-Internal treatments- Softening of Hard water : Lime-Soda process and numerical problems based on these processes and Ion Exchange process

-Water for drinking purposes- Purification -Sterilization and disinfection: Chlorination, Break point chlorination and other methods - Reverse Osmosis and Electro Dialysis.

Unit-II

The phase rule: Statement of Gibb's phase rule and explanation of the terms involved, Phase diagram of one component system – water and sulfur system, Condensed phase rule, Phase diagram of two component system – Eutectic Bi-Cd, Pb- Ag system.

Unit-III

Fuels: Classification of fuels, calorific value. G.C.V. and N.C.V., Solid fuels, Analysis of coal. Liquid fuels: Classification of petroleum, Refining of petroleum, Cracking, Knocking and anti-knocking, cetane and octane numbers.

Spectroscopy: Lambert Beer's Law, Principles and applications of UV-Visible Molecular Absorption Spectroscopy; Chromophores, effect of conjugation on chromophores.

Unit-IV

Corrosion: Electrochemical theory of corrosion, galvanic series, Types of corrosion; Differential metal corrosion, Differential aeration corrosion (Pitting and water line corrosion), Stress corrosion (caustic embrittlement in boilers), Factors affecting, metal coatings – Galvanizing and Timing, Corrosion inhibitors, cathodic protection.

Unit-V

New Materials: Introduction to nanomaterials, classification (0D, 1D, 2D) with examples, size dependent properties, Top- down and Bottom-up approaches of nanomaterial synthesis. Introductory idea on synthesis of nanomaterials via green synthetic route. Application of nanomaterials in environmental fields and electronic devices.

TEXT BOOKS

1. Engineering Chemistry (NPTEL web-book) by B. L. Tembe, Kamaludddin and M. S. Krishan.
2. Text Book in Applied Chemistry by A. N. Acharya and B. Samantaray, Pearson India.
3. Fundamentals of Molecular Spectroscopy by Banwell, Tata McGraw Hill Education.
4. Textbook of nanoscience and Nanotechnology, McGraw Hill Education (India) Pvt. Ltd., 2012.
5. Engineering Chemistry by Jain and Jain, Dhanpat Rai Publication.
6. Engineering Chemistry by Prasanta Rath, Cenage Learning India Private Ltd., 2015.
7. A text book of Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co. 2020
8. Inorganic Chemistry by Donald A. Tarr, Gary Miessler, Pearson India, Third Edition.
9. Molecular Spectroscopy, Ira N. Levine, John Wiley and Sons.
10. Modern Spectroscopy – A Molecular Approach, by Donald McQuarrie and John Simon, published by University Science Books.

REFERENCE BOOKS

1. Inorganic Chemistry by W. Overton, Rounk and Armstrong, Oxford Univesity Press, 6th edition.
2. Advanced Engineering Chemistry by M. R. Senapati, University Science Press, India.
3. A Textbook of Engineering Chemistry by S.S. Dara, 10^{th} Edition, S. Chand & Company Ltd., New Delhi, 2003

ENGINEERING CHEMISTRY LAB (COMMON TO ALL BRANCHES)	
Course Code: 23AS153/253	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Examination: 40 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

An integrated laboratory course consists of experiments from applied chemistry and is designed:

1. To impart the knowledge and understanding of principles of measurement techniques.
2. To understand the route involved in the synthesis of chemical compounds, dynamics and related chemical transformation.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the basic concepts of measurement techniques.
2. The synthesis, dynamics, chemical transformation and their applications

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE LEARNING OUTCOME / COURSE OBJECTIVES	CLO 01	CLO 02
CO 01	✔	
CO 02		✔

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform minimum 10 of experiments)

1. Determination of total hardness of water by EDTA method.
2. Determination of dissolved oxygen in a sample of water.
3. Determination of percentage of available chlorine in a sample of bleaching powder.
4. Standardization of KMnO4 using sodium oxalate. Determination of ferrous iron in Mohr's salt by potassium permanganate.
5. Determination of Viscosity of addition polymer by Ostwald Viscometer.
6. Determination of amount of sodium hydroxide and sodium carbonate in a mixture.
7. Estimation of calcium in limestone.
8. Proximate analysis of coal.

9. Determination of cell constant and conductance of solutions.
10. Determination of partition coefficients of iodine between benzene and water.
11. Determination of rate constant of acid catalysed hydrolysis reaction.
12. Acid-Base Titration by Potentiometry.
13. Preparation of colloidal/nano particle solutions

TEXT BOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (Latest ed.), Revised by G.H. Jeffery, J. Bassett, J. Mendham & R.C. Denney, Longman Scientific & Technical, England
2. Applied Chemistry: Theory and Practice (Latest ed.), by O.P. Vermani & A.K. Narula, New Age International Publications.

REFERENCE BOOKS

1. Dara, S.S.; A text book on Experiments and Calculations in Engineering Chemistry (ninthedition); S. Chand, 2003.
2. Rani, S.; Laboratory Manual on Engineering Chemistry; Dhanpat Rai, 1998
3. Department Laboratory Manual

BASIC ELECTRONICS ENGINEERING	
Course Code: 25EC101/25EC202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

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

1. Analyse the characteristics and applications of semiconductor diodes, including Zener diodes, and their role in power supply and wave-shaping circuits.
2. Understand the operation, biasing, and characteristics of BJT, and apply them in amplification and switching circuits.
3. Understand the operation, biasing, and characteristics of FETs, and apply them in amplification and switching circuits
4. Design and implement analog circuits using op-amps for integration, differentiation, and signal conditioning applications.
5. Understand and simplify digital logic expressions using Boolean algebra, and design combinational digital circuits.

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course, students would be able to:

1. Understand and analyze the operation and characteristics of semiconductor diodes and their applications in rectifiers, clippers, and voltage regulators.
2. Demonstrate and evaluate the working principles, biasing, and applications of BJTs in switching and amplifier circuits.
3. Design and simulate analog electronic circuits using FET and Op-amps for real-time signal processing.
4. Comprehend and apply the fundamental concepts of digital logic, Boolean algebra, and combinational circuits.
5. Interpret electronic component datasheets, test devices using multimeters, and troubleshoot circuits effectively.

MAPPING MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

COs/CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT NO.	COURSE CONTENTS	HOURS
UNIT-I	**DIODE THEORY AND APPLICATIONS:** Overview of p-n junction diode structure, Basic idea of forward and reverse biasing in diodes, VI characteristics of p-n junction diode under various biasing conditions, Ideal diode characteristics and assumptions, Second approximation (with cut-in voltage), Third approximation (including forward resistance and reverse leakage current), Structure and working principle of Zener diode, VI characteristics of Zener diode in breakdown region, Zener diode as a voltage regulator, half and Full Wave Rectifier: Circuit diagram, operation, and waveform analysis, Calculation of average and RMS output voltage, Ripple factor and efficiency, Transformer requirements and peak inverse voltage (PIV) analysis. **Wave Shaping Circuits:** Clipping Circuits, Clamping Circuits.	9
UNIT-II	**BIPOLAR JUNCTION TRANSISTORS AND ITS BIASING:** BJT structure and working principle (NPN/PNP),CE, CB, and CC configurations: input/output characteristics and applications, BJT current and voltage relations, Switching operation of BJT: cutoff, active, and saturation regions, DC load line: operating point (Q-point) determination, Biasing methods: base bias, emitter feedback bias, collector feedback bias, voltage divider bias, Thermal runaway and stability factor	9
UNIT-III	**FIELD EFFECT TRANSISTORS (FET) AND ITS BIASING:** Introduction to JFET: structure, operation, and characteristics, Comparison of BJT and FET: input impedance, noise, gain, power usage, JFET transfer and drain characteristics, pinch-off voltage, Biasing methods for JFET: self-bias, voltage-divider bias, current source bias, FET operation in ohmic and active regions, Introduction to MOSFETs: D-type and E-type structures and operation, MOSFET as a switch: operation, input/output characteristics , E-MOSFET biasing technique: self-bias, voltage-divider bias, current source bias	9
UNIT-IV	**OP-AMP: OP-AMP:** Ideal op-amp characteristics and internal block diagram, Op-amp equivalent circuit model, Comparator circuit using op-amp: zero crossing detector, Inverting and non-inverting op-amp configurations: gain expressions and phase relations, summing amplifier using op-amp (inverting and non-inverting), Differential amplifier, integrator and differentiator circuits: design and waveforms.	9
UNIT-V	**DIGITAL ELECTRONICS:** Number systems: Binary, Decimal, Octal, Hexadecimal and their conversions. Basic logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR – symbols, truth tables, logic expressions, Consensus theorem , Boolean algebra: laws, identities, and logic simplification, De Morgan's Theorems and duality principle, Transposition theorem, Consensus	9

	theorem , Universal gates and their use in implementing any logic function, Algebraic simplification using Boolean laws and Karnaugh Maps (K-Maps upto three variable), NAND and NOR based gate implementation techniques, Combinational circuits: Half adder and Full adder, Half Subtractor, Full Subtractor design and logic expressions,	

TEXT BOOKS

1. Electronic Devices and Circuit Theory - by Rober L. Boylestad 11th Edition, Pearson Publication, 2014
2. Digital Design by M. Morris Mano, 5th Edition, Pearson Publication, 2016
3. Floyd T.L., Buchla D.L., "Electronics Fundamentals: Circuits, Devices and Applications", 8th 2010 Edition
4. Stallings, W., "Computer Organization and Architecture", 5th Ed., 2001 Pearson Education

REFERENCE BOOKS

1. Millman J., Halkias C.C., Jit S., "Electronic Devices and Circuits", Tata McGraw-Hill, 2nd 2007 Edition
2. Muthu subramanian.R, Salivahanan. S, Muraleedharan. K. A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw - Hill, 1999.
3. Microelectronic Circuits by A. S. Sedra and Kenneth C. Smith 7th Edition, Oxford University, Press. 2017

BASIC ELECTRONICS ENGINEERING LAB	
Course Code: 25EC151/25EC252	**Continuous Evaluation:**40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To understand semiconductor device Characteristics.
2. To design and evaluate rectifier circuits.
3. To characterize transistor and FET operation.
4. To design and test OP-AMP circuits.
5. To demonstrate digital logic design.

COURSE LEARNING OUTCOMES (CLOs)

1. To analyze PN junction, Zener diodes, and their applications in circuits.
2. To construct and compare half-wave, full-wave, and bridge rectifiers with filters.
3. To investigate BJT (CB), JFET, and MOSFET configurations and their regions of operation.
4. To implement and verify analog circuits (voltage follower, inverting/summing amplifiers).
5. To build and validate combinational circuits (logic gates, adders) and Boolean theorems.

MAPPING MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

COs/CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

LIST OF EXPERIMENTS

1. To study and analyse the V-I characteristics of a PN junction diode in both forward and reverse bias conditions using Silicon and Germanium diodes.
2. To examine the V-I characteristics of a Zener diode in forward and reverse bias, and to observe the Zener breakdown phenomenon and its application in voltage regulation.
3. To study the output waveform of a half-wave rectifier with and without a filter capacitor, and to observe how the capacitor smooths the pulsating DC output by reducing ripple.
4. To analyse the characteristics of a full-wave centre-tapped rectifier, observe its output waveform, and evaluate the effect of filter capacitors of varying values on ripple reduction and waveform smoothness.
5. To construct and test a bridge rectifier circuit, monitor its output waveform, and investigate the improvement in waveform smoothness with the use of different filter capacitor values.

6. To study the input and output characteristics of a transistor in Common Base (CB) configuration.
7. To study the output characteristics of an N-channel JFET, and to observe the behavior of the JFET in ohmic and saturation regions.
8. To study the output characteristics of an N-channel MOSFET and to analyze the MOSFET's behavior in the ohmic and saturation regions.
9. To design and analyse a voltage follower circuit using an operational amplifier (OP-AMP) and verify that the output voltage exactly follows the input voltage with a unity gain (A=1).
10. To design and verify the operation of an inverting amplifier using an OP-AMP, and to measure the output voltage for a given input voltage with a known gain, validating the relationship: $Vo=-A\cdot V_i$.
11. To design and verify the operation of a summing amplifier using an operational amplifier (OP-AMP) and to measure the output voltage for different input voltages, demonstrating linear summation with unity gain.
12. To design and verify the truth tables of basic logic gates (AND, OR, NAND, NOR, XOR, and XNOR) using digital ICs on a breadboard.
13. To experimentally **verify the Consensus Theorem** of Boolean algebra using logic gates and validate its application in simplifying digital circuits.
14. To design and verify the working of a **half adder circuit** using basic logic gates (AND and XOR).
15. To design and verify the working of a **full adder circuit** using basic logic gates (AND, OR and XOR).

REFERENCE: LABORATORY MANUAL

BASIC ELECTRICAL ENGINEERING	
Course Code:25EE101/25EE202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To impart knowledge about the electrical quantities and to understand the impact of electricity in a global and societal context.
2. To introduce the fundamental concepts relevant to DC and AC circuits and network theorems.
3. To understand the concept of electrical machines in real-life applications.
4. To familiarize the sources of renewable energy and electric vehicles and their progress in recent years

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course, students would be able to:

1. To apply various network laws and theorems in DC circuits.
2. To compute different AC quantities with phasor representation.
3. To realize the operation of single-phase circuits and induction motors
4. To understand the basic concept of a poly-phase system.
5. To define various renewable resources available in power generation.

MAPPING MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

COs/CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	x				
CO2			x		
CO3		x	x	x	
CO4					x

- **COURSE CONTENTS**

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**DC Circuits** Ohm's Law and Kirchhoff's Laws, Analysis of Series, parallel, and series-parallel circuits excited by independent voltage sources, Star-delta transformation, Mesh current Analysis, Node voltage analysis, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem	**9**
UNIT-II	**Single-Phase A.C. Circuits** Sinusoidal signal, instantaneous and peak values, RMS and average values, crest and peak factor, Concept of phase, Analysis with phasor diagrams of R-L, R-C and R-L-C circuits; Real power, reactive power, apparent power	**9**

	and power factor, Resonance in series R-L-C circuit, Quality factor and Bandwidth, Introduction to earthing.	
UNIT-III	**Electrical Machines** **A. Transformers:** Magnetic circuits, Review of laws of electromagnetism, Flux, MMF and their relation, analysis of magnetic and electric circuits, Principle of operation and construction of single-phase transformers (core and shell types). EMF equation, losses, efficiency, and voltage regulation. **B. Three-Phase Induction Motor:** Concept of rotating magnetic field; Principle of operation, types and constructional features, Slip and its significance; Applications of squirrel cage and slip ring motors; Torque-speed characteristics of 3-phase induction motor.	**9**
UNIT-IV	**Poly-Phase System***:* Advantages of 3-phase system, Generation of 3-phase voltages, Voltage, current, and power in a star and delta connected systems, 3-phase balanced and unbalanced circuits, Power measurement in 3-phase circuits using the two-wattmeter method.	**9**
UNIT-V	**Renewable Sources:** Sources of Electrical Power, Introduction to Wind, Solar, Fuel cell, Tidal, Geothermal, Hydroelectric, Thermal-steam, diesel, gas power plants **Electric Vehicles:** What is an EV, Benefits of EVs, EV and its types: BEV, PHEV, HEV, and FCEV, EV scenario in India.	**9**

TEXT BOOKS

1. Fundamental of Electric Circuits by Charles K Alexander and Matthew N.O.Sadiku,TMH Publication.
2. Electrical Engineering Fundamentals by Vincent DelToro, PHIPublication.
3. Basic Electrical Engineering by V N Mittal & Arvind Mittal, TMHPublication.
4. Basic Electrical Technology by A.E.Fitzgerald, McGrawHillPublication.

REFERENCE BOOKS

1. Kothari DP and NagrathIJ,"BasicElectricalEngineering",TataMcGrawHill, 1991.

BASIC ELECTRICAL ENGINEERING LAB	
Course Code: 23EE151/23EE252	**Continuous Evaluation:**40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To impart basic knowledge of electrical quantities such as current, voltage, power, energy etc.
2. To familiarize students with basic circuit components and their connections.
3. To explain working principle of transformer and electrical measuring instruments such as ammeter, voltmeter, wattmeter, energy meter, digital storage oscilloscope etc.

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course, students would be able to:

1. Verify fundamental laws like Ohm's Law, KCL, KVL, etc.
2. Understand the calibration of the energy meter.
3. Understand open circuit and short circuit test of single-phase transformer.
4. Analyse RLC series and parallel circuits.

MAPPING MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

COs/CLOs	CLO1	CLO2	CLO3	CLO4
CO1	x	x		x
CO2	x			x
CO3	x	x	x	x

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform minimum **10** experiments)

1. To verify Kirchhoff's voltage and Current Laws
2. To verify Superposition Theorem
3. To verify Thevenin's Theorem
4. To verify Maximum Power Transfer Theorem
5. To verify Norton's Theorem
6. To measure power and power factor in a single phase AC circuit.
7. To verify Series and parallel RLC circuit
8. To conduct open circuit and short circuit test on a single-phase transformer
9. To perform Load test on single phase transformer
10. Calibration of Single Phase & Three Phase Energy Meter
11. To study Digital Storage Oscilloscope
12. To study the balanced three phase system for star and delta connected load
13. To study about earthing and their types.

TEXT BOOKS

1. Handbook of Laboratory Experiments in Electronics and Electrical Engineering by A M Zungeru, J M Chuma, H U Ezea
2. Electrical Measurements & Measuring Instruments by E.W. Golding & F.C. Widdis
3. Electronic Measurement & Instrumentation by H.S. Kalsi
4. Electrical & Electronic Measurement & Instrumentation by A.K. Sawhney ,E. Fitzgerald, C. Kingsley and S. Umans, Electric Machinery, McGraw-Hill Co. Inc.
5. D. P. Kothari and I. J. Nagrath, Electrical Machines, Tata McGraw-Hill.

REFERENCE BOOKS

1. M.G. Say, Alternating Current Machines, Pitman Publishing.
2. Alexander S. Langsdorf, Theory of Alternating Current Machinery, Tata McGraw-Hill

ENGINEERING MECHANICS (Common to all Branches)	
Course Code: 23ME101/201	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

1. To familiarize students with basic concepts and terms associated with thermodynamics.
2. To impart students with the application of thermodynamics in real engineering application.
3. To familiarize students with the working principle and application of power transmission systems.
4. To make students aware of terms associated with robots and automation.
5. To acquaint students with basic measuring tools and instruments used in mechanical engineering.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the concepts of thermodynamics.
2. Apply principles of thermodynamics to real engineering problems.
3. Understand the basics of powertrain applications.
4. Grasp the elements of robotics.
5. Understand the working principles of various measuring tools and devices.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES	COURSE LEARNING OUTCOMES				
	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	
CO5					✔

COURSE CONTENTS

UNIT-I - Thermodynamics:

Systems, Properties, Process, State, Cycle, Internal energy, Enthalpy, Zeroth Law, First law and Second Law of Thermodynamics, Basic Concept of Entropy, Properties of ideal gas., Properties of pure substances, Steam formation, Types of Steam, Enthalpy, Specific volume,Internal energy

and dryness fraction of steam, use of Steam tables. Related numericals.

UNIT –II - Application of Thermodynamics:
Air compressors, Steam Power Plant, Refrigerators and Heat pump, I.C. Engines (Brief Description of different components of above mentioned systems and working principles withSchematic diagram only)

UNIT –III- Basic Power transmission devices:
Belt, Rope, Gear drives. Coupling, clutch, brakes. (Working principle only)

UNIT –IV- Mechanical Measurements:
Temperature, pressure, velocity, flow, strain, force, torque measurements. (Working principle only).

UNIT- V - Introduction to Robotics:
Robot anatomy, joints and links and common robot configurations

TEXT BOOKS

1. Basic Mechanical Engineering by Pravin Kumar, Pearson
2. Basic Mechanical Engineering by A R Israni, P K Shah, BS Publications
3. Text book of Elements of Mechanical Engineering, S T Murthy, Universities press
4. Basic and applied Thermodynamics by P. K. Nag, Tata McGraw Hill

REFERENCE BOOKS

1. Basic Mechanical Engineering by .D. Mishra, P.K Parida, S.S.Sahoo, India Tech Publishing company
2. Elements of Mechanical Engineering by J K Kittur and G D Gokak, Willey
3. Basic Mechanical Engineering by Basant Agrawal, C M Agrawal, Willey
4. Engineering Thermodynamics by P. Chattopadhaya, Oxford University Press

BASIC MECHANICAL ENGINEERING LAB (Common to all Branches)	
Course Code: 23ME151/251	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Examination: 40 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

1. To acquaint students with the working of thermal power plants.
2. To make students understand the working of 2 and 4 stroke IC engines.
3. To familiarize students with the working of Refrigeration and Air Conditioning cycles.
4. To acquaint students with different automobile parts, gears and gear trains.
5. To familiarize students with flow meters and U-tube manometers.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. The working of thermal power plants.
2. The working of 2 and 4 stroke IC engines.
3. Different automobile parts, gears and gear trains.
4. The working of Refrigeration and Air Conditioning cycles.
5. The working principles of flow meters and U-tube manometers.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES	COURSE LEARNING OUTCOMES				
	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3				✔	
CO4			✔		
CO5					✔

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform minimum of 5 experiments)

1. Model study of Steam Power Plant
2. Model study of Two stroke and Four stroke I.C. Engine
3. Model study of Refrigerator & Air conditioners
4. Model study of Automobile Parts
5. Determination of velocity ratio of belt drive
6. Study of Gears and Gear trains
7. Verification of Bernoulli's Theorem and its application to the Venturi meter.
8. Calibration of Bourdon Tube Pressure gauge and measurement of pressure using manometers.

TEXT BOOKS

1. Laboratory Manual

REFERENCE BOOKS

1. Power Plant Engineering, P.K Nag, Tata McGraw Hill, ISBN- 0070435993.
2. Ramalingam, K. K., Internal Combustion Engines- Theory and practice, Scitech publications India Pvt. Ltd., Chennai, 2000.
3. Khurmi R.S., and Gupta, J. K., A text book of Refrigeration and Air Conditioning, Eurasia Publishing housing (P) Ltd, New Delhi, 2002.
4. Rao, J. S., and Dukkipati, R.V., Mechanism and Machine Theory, Wiley–Eastern Ltd., New Delhi, 1995.
5. Dr. R.K. Bansal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publications (P) Ltd.

MECHANICAL WORKSHOP LAB (Common to all Branches)	
Course Code: 23ME152/252	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Examination: 40 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

1. Study and practice on machine tools and their operations.
2. Practice on manufacturing of components using workshop trades including fitting,
3. To study the basics of carpentry, foundry and welding.
4. Identify and apply suitable tools for machining processes including turning, facing.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Use different manufacturing (Fitting, carpentry, sheet metal, welding, smithy working etc.)processes required to manufacture a product from the raw materials.
2. Use different measuring, marking, cutting tools used in the workshop.
3. Be aware of the safety precautions while working in the workshop.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES	COURSE LEARNING OUTCOMES		
	CLO1	CLO2	CLO3
CO1	✔	✔	✔
CO2	✔	✔	✔
CO3	✔	✔	
CO4			✔

LIST OF EXPERIMENTS

Fitting Practice:

Use of hand tools in fitting, preparing a male and female joint of M.S. or making a paperweight of M.S.

Carpentry Practice:

Study of Carpentry Tools, Equipment and different joints. Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint

Smithy

Tools and Equipments –Simple exercises based on smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging, Making simple parts like hexagonal headed bolt, chisel

Welding Practice (Basic Theory to be explained prior to practice):

Gas Welding& Electric Arc welding Practice. A joint such as a Lap joint, a T-joint or a Butt joint is to be prepared or to make furniture.

Machining (Basic Theory to be explained prior to practice):

(i) Stepped cylindrical Turning of a job and Thread-cutting in lathe. (ii) Shaping (iii) Milling

TEXT BOOKS

1. Laboratory Manual
2. Gopal, T.V., Kumar, T., and Murali, G., "A first course on workshop practice –Theory, practice and workbook", Suma Publications, 2005

REFERENCE BOOKS

1. Kannaiah,P. & Narayanan,K.C. —Manual on Workshop Practice", Scitech Publications, Chennai, 1999.
2. Venkatachalapathy, V.S. —First year Engineering Workshop Practice", Ramalinga Publications, Madurai, 1999

ENGINEERING GRAPHICS & DESIGN LAB	
Course Code: 25ME153/25ME254	**Continuous Evaluation:** 40 Marks
Credits: 1	**End Semester Examination:**60 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (COs)

1. To draw orthographic projections of lines, planes and solids.
2. To construct isometric scale, isometric projections and views.
3. To draw sections of solids including cylinders, cones, prisms and pyramids.
4. To draw projections of lines, planes, solids, isometric projections

COURSE LEARNING OUTCOMES (CLOs)

Once the course is completed, the students will be able to

1. Understand orthographic projections of points and lines in any position through Auto CAD.
2. Imagine and convert isometric views into orthographic projections and vice versa.
3. Understand the simple machine components and draw its projections

MAPPING MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

COs/CLOs	CLO1	CLO2	CLO3
CO1	√		
CO2		√	
CO3			√
CO4			√

LIST OF EXPERIMENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**INTRODUCTION TO ENGINEERING GRAPHICS AND AUTOCAD** Principles of Engineering Graphics and its significance - Usage of drawing instruments -Lettering and Dimensioning Standards - The concepts of Computer Aided Drafting for Engineering Drawing - Introduction to AutoCAD software - AutoCAD commands, tools and its usage - Geometrical Constructions	3
UNIT-II	**ORTHOGRAPHIC PROJECTIONS** Orthographic Projections - First angle projections - Visualization concepts and principles - Layout of views - Conversion of pictorial diagram into orthographic projections	3
UNIT-III	**PROJECTION OF PLANES AND SOLIDS** Projections of Planes (polygonal and circular surfaces) inclined to the HP only - Projection of simple solids like Prisms, Pyramids, Cylinders, and Cones (Axis inclined to the HP only) by change of position method. .	3

UNIT-IV	**SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES** Sectioning of Simple solids in a simple vertical position using a cutting plane inclined to the HP only, and obtaining the true shape of the section - Development of the lateral surfaces of simple solids like Prisms, Pyramids, Cylinders, and Cones.	3
UNIT-V	**ISOMETRIC PROJECTIONS AND CAD APPLICATIONS** Principles of Isometric projections - Isometric scale and view - Isometric view of simple solids (Prisms, Pyramids, Cylinders, and Cones) - Combination of two solids in simple vertical positions - Applications of CAD software in drafting real-world scenarios.	3

TEXT BOOKS:

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, Charotar Publishing House, Gujarat.
2. Computer Aided Engineering Drawing S. Trymbaka Murthy, 4th Ed, University Press
3. Engineering Drawing by N. S. Parthasarathy and Vela Murali Oxford University Press

REFERENCE BOOKS:

1. Engineering Graphics - K.R. Gopala Krishna, Subash Publishers Bangalore.
2. Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, Prentice-Hall of India Pvt. Ltd.,New Delhi.
3. Computer Aided Engineering drawing, Prof. M. H. Annaiah, New Age International Publisher

SEMESTER – III

ENGINEERING MATHEMATICS – III	
Course Code: 25AS301	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 3 0 0	
Credits: 3	

COURSE EDUCATIONAL OBJECTIVES (CEO)

1. To familiarize the students with concepts of Fourier series.
2. To familiarize the students with partial differential equations and their solution.
3. To solve boundary value problems, Heat and Wave equations.
4. To gain good knowledge in the application of Fourier transform.
5. To demonstrate understanding of the Z-transform.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Demonstrate Fourier series in engineering applications.
2. Elaborate different types of partial differential equations.
3. Find solutions of boundary value problems including heat and wave equations.
4. Apply and analyze Fourier transforms with different applications.
5. Evaluate the problems using Z-transforms.

MAPPING COURSE EDUCATIONAL OBJECTIVES & COURSE LEARNING OUTCOMES

CLO / CEO	CLO1	CLO2	CLO3	CLO4	CLO5
CEO1	✓				
CEO2		✓			
CEO3			✓		
CEO4				✓	
CEO5					✓

COURSE CONTENTS

Unit-I

Periodic functions, Fourier Series, Dirichlet's Conditions for a Fourier Series, Fourier Series of discontinuous functions, Even and Odd functions, Half-range series (Period 0 to p), Change of Interval and Functions having arbitrary Period, Half-period Series, Parseval's Formula, Practical Harmonic Analysis.

Application domain problems: Signal and vibration analysis

Unit-II

Introduction, Partial Differential Equations, Order, Method of Formation of Partial Differential Equations, Solution of Equation by Direct Integration, Lagrange's Linear Equation of first order. Solution of Linear Partial Differential Equations with Constant Coefficients.

Application domain problems: Scientific computing of modelling problem in real world scenario

Unit-III

Classification of Partial Differential Equations, Method of Separation of Variables, Solution of One - Dimensional Wave Equation, Solution of One- Dimensional Heat Equation.

Application domain problems: Modelling problem of mechanics

Unit – IV

Introduction, Linear Property, Shifting Property, Change of Scale Property, Modulation Theorem, Fourier Transform of Derivatives, Fourier transform of Integrals, Fourier Transform of Dirac-Delta Function, Fourier Cosine Transform, Fourier Sine Transform, Fourier Sine and Cosine Transforms of Derivatives, Finite Fourier cosine Transform, Finite Fourier sine Transform, Convolution Theorem , Parseval's Identity (without proof)- applications.

Application domain problems: Analyzing and processing signals in the time and frequency domains.

Unit-V

Introduction, Definition of Z- transform, Linear property , Frequency Shifting , First Shifting, Second Shifting, Differentiation in z-domain, Initial and Final value theorems, Convolution theorem, Z-transforms of basic functions, Inverse Z – transform using partial fraction and long division methods. Simple applications of Z – transform to different equations.

Application domain problems: Analyzing frequency responses of discrete system

TEXT BOOKS/REFERENCE BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 45th Edition, 2020.
2. Raisinghania M.D., Advanced Differential Equations, S. Chand Publishing, 2018.
3. Ramana B.V., Higher Engineering Mathematics, McGraw Hill Education, 2017.
4. Churchill R.V. and Brown J., Fourier series and Boundary Value Problems, McGraw-Hill Book Education, 8th Edition, 2017.
5. Kreyszig, E., Advanced Engineering Mathematics, Wiley-India, 10th Edition, 2017.

CRYPTOGRAPHY FUNDAMENTALS	
Course Code: 25CCS2009	Continuous Evaluation (Internal): 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisites: NIL	

COURSE OBJECTIVE

1. To introduce the basic concepts and goals of cryptography.
2. To provide foundational knowledge of classical and modern symmetric encryption techniques.
3. To explain the working principles of asymmetric cryptographic algorithms.
4. To expose students to the use of cryptographic hash functions and digital signatures.
5. To explore real-world applications of cryptography and the protocols used for providing security.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the fundamental goals and types of cryptographic attacks and classical cryptographic techniques.
2. Apply symmetric encryption algorithms like DES and AES to encrypt and decrypt messages.
3. Demonstrate the use of public key algorithms such as RSA and Diffie-Hellman for secure key exchange and encryption.
4. Analyze the role of hash functions and digital signatures in ensuring data integrity and authentication.
5. Evaluate various cryptographic protocols and their practical applications in modern secure communication systems.

COURSE LEARNING OUTCOME (CLO)-COURSE OBJECTIVE (CO) MAPPING

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	
CO5					✔

Mapped SDGs: SDg-4, SDG-8, SDG-9

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION:** Introduction to Security Goals: Confidentiality, Integrity, and Authentication.; Cryptography and Cryptanalysis Basics; Attacks on Cryptographic Systems. Symmetric and Asymmetric key cryptography; Classical Cryptography: Caesar Cipher, Monoalphabetic & Polyalphabetic Ciphers; Substitution and Transposition Techniques
UNIT-II	**SYMMETRIC KEY CRYPTOGRAPHIC ALGORITHMS:** Introduction to Symmetric Key Algorithms Differential and Linear Crypt Analysis, Modular arithmetic – Euclidean algorithm, Fermet's and Euler's theorem, Data Encryption Standard (DES): Structure, Encryption & Decryption,Advanced Encryption Standard (AES): Structure, Key Expansion, Rounds, Digital signature, Modes of Operation: ECB, CBC, CFB, OFB, and CTR, Block vs Stream Ciphers.
UNIT-III	**ASYMMETRIC KEY CRYPTOGRAPHIC ALGORITHMS:** Public Key Cryptography: Principles and Applications RSA Algorithm: Key Generation, Encryption & Decryption Diffie–Hellman Key Exchange Elliptic Curve Cryptography (Basics) Comparison of Symmetric and Asymmetric Cryptography
UNIT-IV	**CRYPTOGRAPHIC HASH FUNCTIONS AND DIGITAL SIGNATURES:** Hash Functions: Properties and Applications Message Digest Algorithms: MD5, SHA-1, SHA-256 HMAC and Applications Digital Signature Digital Signature Standards (DSS) Digital Certificates and Certificate Authorities
UNIT-V	**APPLICATIONS AND PROTOCOLS:** Authentication Protocols, Secure Email: Pretty Good Privacy (PGP) and S/MIME. IP SECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management. Case Studies: Real-life Use of Cryptography in E-Commerce, Blockchain, and IoT

TEXT BOOKS

1. Cryptography and Network Security, 2nd Edition by Atul Kahate, TMH
2. Network Management Principles & Practices by Subramanian, Mani (AWL)
3. SNMP, Stalling, Willian (AWL)

REFERENCE BOOKS

1. SNMP: A Guide to Network Management (MGH)
2. Telecom Network Management by H.H. Wang (MGH)
3. Network Management by U. Dlack (MGH)
4. Spoken Tutorials

CRYPTOGRAPHY LAB	
Course Code: 25CCS2117	Continuous Evaluation (Internal): 40 Marks
Credits: 1	End Semester Examination: 60 Marks
L T P : 0 0 2	
Prerequisites: Cyber Security	

COURSE OBJECTIVE (COs)

1. To provide hands-on experience in implementing classical and modern cryptographic algorithms using programming concepts.
2. To strengthen students' understanding of symmetric and asymmetric encryption techniques through coding practice.
3. To demonstrate secure communication techniques and authentication protocols via lab-based cryptographic simulations.
4. To enable students to apply number theory and modular arithmetic in real-world cryptographic systems.
5. To build practical skills in developing secure digital systems including hashing, digital signatures, and secure key exchange.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Implement and compare classical cryptographic algorithms such as Caesar, Monoalphabetic, and Vigenère Ciphers using C.
2. Apply symmetric key algorithms like S-DES and AES to encrypt and decrypt data in a secure manner.
3. Demonstrate secure communication using asymmetric encryption algorithms such as RSA and Diffie–Hellman.
4. Generate and verify hash values and digital signatures to ensure message integrity and authenticity.
5. Design and simulate real-time secure systems and protocols like SSL/TLS, authentication protocols, and secure IoT applications.

COURSE LEARNING OUTCOME (CLO)-COURSE OBJECTIVE (CO) MAPPING

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	
CO5					✔

Mapped SDGs: SDG-4

LIST OF EXPERIMENTS:

1. Implement Caesar Cipher for encryption and decryption.
2. Develop a program for Monoalphabetic Substitution Cipher encryption and decryption.
3. Design a Polyalphabetic Cipher (e.g., PlayFair, Hill, Vigenère Cipher) and implement encryption and decryption.
4. Create a program to implement Transposition Cipher (Columnar or Rail Fence).
5. Implement the Euclidean Algorithm to find GCD and multiplicative inverse (modular arithmetic).
6. Simulate a simplified DES (S-DES) for encryption and decryption.
7. Implement a basic AES round (SubBytes, ShiftRows, AddRoundKey) with fixed key length and plaintext.
8. Implement RSA algorithm: Key generation, encryption and decryption.
9. Simulate the Diffie–Hellman Key Exchange Algorithm.
10. Generate a hash value using MD5 and SHA-256 for a given message/file.
11. Generate and verify a digital signature using RSA.
12. Implement the Signature Scheme - Digital Signature Standard.
13. Implement a basic Authentication Protocol (Challenge–Response protocol simulation).
14. Demonstrate SSL/TLS handshake using tools like OpenSSL or browser inspection.
15. Build a use-case simulation such as secure transaction signing, secure login for IoT device, or e-commerce payment encryption.

TEXT BOOKS

1. Cryptography and Network Security, 2nd Edition by Atul Kahate, TMH
2. Network Management Principles & Practices by Subramanian, Mani (AWL)
3 William Stallings, Cryptography and Network Security: Principles and Practice, Pearson
4 Behrouz A. Forouzan, Cryptography and Network Security, McGraw Hill

REFERENCE BOOKS

1. SNMP: A Guide to Network Management (MGH)
2. Telecom Network Management by H.H. Wang (MGH)
3. Network Management by U. Dlack (MGH)
4. Spoken Tutorials
6. Bruce Schneier, *Applied Cryptography*
7. Atul Kahate, *Cryptography and Network Security*

DATA STRUCTURE	
Course Code: 25CS2001	Continuous Evaluation: 30 Marks
Pre-Requisite: NIL	End Semester Examination: 70 Marks
L T P: 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. To understand the concepts of ADTs.
2. To understand sorting, searching and hashing algorithms.
3. To Learn linear data structures – stacks, and queues.
4. To understand non-linear data structures – trees.
5. To understand non-linear data structures – graphs.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Define linear and non-linear data structures.
2. Analyze the various searching and sorting algorithms.
3. Implement linear data structure operations.
4. Use appropriate non–linear data structure operations for solving a given problem of trees.
5. Apply appropriate graph algorithms for graph applications.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	√				
CO2		√			
CO3			√		
CO4				√	
CO5					√

Mapped SDGs: SDG-4,SDG-8,SDG-9,SDG-12

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT
UNIT-I	**Linear Data Structures & ADTs** Introduction to Data Structures: Abstract Data Types (ADTs): Array-based and Linked List Implementations-Singly, Doubly, and Circular Linked Lists; Applications – Polynomial operations;Dynamic arrays; Multilists;Representation and real-world application in sparse data processing (e.g., Big Data pipelines)
UNIT-II	**Searching, Sorting & Hashing** Searching – Linear and Binary Search; Sorting – Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort;Heap Sort;Radix Sort, Shell Sort; Hashing – Hash Functions, Collision Resolution (Chaining, Open Addressing); Bloom Filters; Applications in Symbol Tables & Indexing.
UNIT-III	**Stacks, Queues & Recursion** Stack ADT – Operations and Applications; Expression Evaluation – Infix to Postfix, Prefix; Function Call Stack; Recursion fundamentals – Stack frames, Backtracking, Tail recursion; Queue ADT – Linear Queue, Circular Queue, Double-Ended Queue; Applications of Queues.
UNIT-IV	**Tree and its Applications** Tree ADT; Binary Tree – Traversals (Preorder, Inorder, Postorder, Level-order); Binary Search Tree (BST); AVL Trees; Heaps and Priority Queues; Segment Trees and Applications;Expression Trees;Red-Black Tree;Minimum Spanning Tree – Prim's Algorithm, Kruskal's Algorithm;Union-Find / Disjoint Set Union (DSU);B-Trees, B+ Trees; M-Way Search Tree;Red Black trees.
UNIT-V	**Graphs** Graph Representation – Adjacency Matrix, Adjacency List; Graph Traversals – BFS, DFS; Topological Sort;Connected Components, Bi-connectivity.

TEXT BOOKS

1. Narasimha Karumanchi "Data Structures and Algorithms Made Easy" 6th Edition (2023) Publisher: CareerMonk Publications ISBN: 978-8193245279
2. Seymour Lipschutz – Data Structures with C “Data Structures with C” Publisher: McGraw Hill Education
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
4. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007.

REFERENCE BOOKS

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser "Data Structures and Algorithms in Python" 2nd Edition (2024) Publisher: Wiley ISBN: 978-1119860917
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein "Introduction to Algorithms" Edition: 4th Edition (2022) Publisher: The MIT Press ISBN: 978-0262046305
3. Mark Allen Weiss "Data Structures and Algorithm Analysis in C++" 4th Edition (2023) Publisher: Pearson ISBN: 978-0132847377
4. Bradley N. Miller, David L. Ranum "Problem Solving with Algorithms and Data Structures Using Python" 3rd Edition (2023) Publisher: Franklin, Beedle & Associates ISBN: 978-1590284079
5. Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.

Open Sources for Learning

1. https://www.youtube.com/c/takeUforward
2. https://www.youtube.com/c/CodeWithHarry
3. https://www.youtube.com/c/GeeksforGeeksVideos
4. https://www.youtube.com/c/ApnaCollegeOfficial

Other Sources

1. https://dl.acm.org/journal/talg
2. https://link.springer.com/journal/453
3. https://www.journals.elsevier.com/theoretical-computer-science
4. https://dl.acm.org/journal/csur
5. https://dl.acm.org/journal/jacm
6. https://www.journals.elsevier.com/information-processing-letters

DATABASE MANAGEMENT SYSTEMS	
Course Code: 25CS2005	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. To understand the basic concepts and the applications of database systems.
2. To master the basics of SQL and construct queries using SQL.
3. To understand the relational database design principles.
4. To familiarize with the basic issues of transaction processing and concurrency control.
5. To understand several database concepts like Object Database, Distributed Database, Mobile Database, Temporal Database.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Understand the Information Systems as socio-technical systems, its need and advantages as compared to traditional file based systems.
2. Design the database schema with the use of appropriate data types for storage of data in database
3. Apply relational database theory and be able to describe relational algebra expression, tuple and domain relation expression for queries.
4. Apply and create a Relational Database Design process with Normalization and Denormalization of data. Also, formulate SQL queries on the respective data into RDBMS and on the data.
5. Understand and apply the concept of transaction, concurrency control and recovery in database.
6. Understand some current advance trends including Object DBMS, Distributed Database, Mobile database, Data Warehousing and Data Mining.

COURSE LEARNING OUTCOME (CLO) - COURSE OBJECTIVE (CO) MAPPING

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	✔	✔				
CO2			✔			
CO3				✔		
CO4					✔	
CO5						✔

Mapped SDGs: SDG-4,SDG-8,SDG-9,SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT
UNIT-I	**Introduction** Database System and its Applications, Purpose of Database Systems, Abstraction, Instances and Schemas, Data Models, Database Languages - DDL, DML, Database Architecture,, Types of Database Users, Database design , ER diagrams,, Entities, Attributes and Entity sets, Relationships and Relationship sets, Degree of Relationship, Conceptual Design with the ER Model, Relational Model: Integrity Constraints over Relations, Querying relational data, Logical database Design, Introduction to Views: Altering Tables and Views.
UNIT-II	**RELATIONAL ALGEBRA AND CALCULUS** Relational Algebra - Selection and Projection, Renaming, Joins, Division, Examples of Algebra Queries, Relational calculus: Tuple and Domain relational calculus. Basic SQL Queries, Nested Queries, Correlated Nested Queries. Set operations - Comparison Operators, Aggregate Operators, NULL values - Logical connectives - AND, OR and NOT - Impact on SQL Constructs, Outer Joins, Complex Integrity Constraints in SQL, Triggers and Active Databases
UNIT-III	**UNIT - III NORMALIZATION:** Introduction to Normalization and Schema - Types of Keys, Concept of Redundancy, Decompositions - Problem related to decomposition, Functional Dependencies - Normal Forms and Dependencies- FIRST, SECOND, THIRD, BCNF and FOURTH, FIFTH NF. Types of Decomposition- Lossless and Lossy Join Decomposition, Functional Dependency Preservation, Irreducible Set of Functional Dependencies, Schema Refinement in Database Design - Multi valued Dependencies.
UNIT-IV	**TRANSACTIONS & RECOVERY:** Transaction management: ACID Properties, Transaction states, Concurrency control: Concurrency Control –Overview, Concurrency control problems, Locks, Locking Protocols, Deadlocks, Serializability, Recovery System: Types of Failures, Recovery Techniques.
UNIT-V	**Unit - V CURRENT TRENDS:** Types of Databases: Object Oriented DBMS, Distributed Database, Parallel Database, Mobile database, Geographic Information System-Multimedia Database, Temporal Database, Data Warehousing and Data Mining.

TEXT BOOKS

1. S.K. Singh, Database Systems: Concepts, Design and Applications, Pearson Education India, 2009
2. Greg Turnquist Fundamentals of a Relational Database — 2024.
3. Elvis C. Foster & Shripad V. Godbole**,** Database Systems: A Pragmatic Approach –3rd Edition, CRC Press / Taylor & Francis, 2022.
4. Thomas Connolly, Carolyn Begg. Database Systems, 3rd Edition – Pearson Education.
5. Korth, Silberschatz, Database System Concepts, 4th Ed., TMH, 2000.
6. Date C. J., An Introduction to Database Systems , 7th Ed., Narosa Publishing, 2004.

REFERENCE BOOKS

1. Elmasri Navathe, Fundamentals of Database Systems, 5th Edition Pearson Education.
2. Distributed Database Systems by Chhanda Ray — 1st Edition (May 2024).
3. M.Tamer Ozsu , Patrick Ualduriel, "Principles of Distributed Database Systems", Second Edition, Pearson Education, 2003.
4. Vipin.C.Desai , An introduction to Database System , West Pub. Co

OPEN EDUCATIONAL RESOURCES (OER)

1. NPTEL: NPTEL DBMS Course (Prof. P. Dasgupta, IIT KGP).
   Link: https://nptel.ac.in/courses/106105175.
2. MIT OpenCourseWare – Database Systems (6.830)
   Link: https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/
3. Introduction to Database Systems – IIT Madras (NPTEL, 2025),
   Link: https://onlinecourses.nptel.ac.in/noc25_cs40/preview?utm_source=chatgpt.com

COMPUTER ARCHITECTURE & ORGANIZATION	
Course Code: 25CSPE2007	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

1. To impart knowledge of computer architecture and system organization.
2. To explain instruction sets, addressing modes, and instruction cycles.
3. To develop understanding of ALU design and arithmetic operations.
4. To introduce control unit design: hardwired and microprogrammed**.**
5. To examine memory systems and I/O interfacing with performance metrics.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Identify the components and architecture of a computer system.
2. Differentiate and evaluate RISC and CISC architectures.
3. Perform binary arithmetic operations using algorithms.
4. Analyze control unit design using hardwired and microprogramming.
5. Evaluate memory systems and caching techniques.
6. Explain and analyze I/O subsystems and interfacing mechanisms.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**	**CLO6**
CO1	√					
CO2		√	√			
CO3				√		
CO4					√	
CO5						√

Mapped SDGs: SDG-4, SDG-8, SDG-9

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** Evolution and types of computer systems, Functional units. Bus structures-location and addresses, memory operations, Addressing modes, Design of a computer system- Memory Instruction and instruction format and sequencing, RISC versus CISC.
UNIT-II	**CENTRAL PROCESSING UNIT** Introduction-Arithmetic Logic Unit - Fixed point arithmetic, floating point arithmetic- Execution of complete instruction Cycle-Basic concepts of pipelining and hazards, register organization, status flags.
UNIT-III	**CONTROL UNIT DESIGN** Introduction-Instruction cycle, Control Transfer, Fetch cycle,, Hardwired control, Micro-programmed control, horizontal vs vertical microinstructions.
UNIT-IV	**MEMORIES AND SUBSYSTEMS** Semiconductor memory - Static and Dynamic RAM, ROM types, Associative memory, Cache memory,Mapping techniques and replacement policies, Virtual Memory,Secondary memories:Optical magnetic tape & magnetic disks & controllers.
UNIT-V	**I/O PROCESSING** Introduction-Data transfer techniques- Bus Interface- I/O Channel-I/O Processor, I/O devices -Direct memory access, interrupt handling, performance metrics, and buffering strategies.

TEXT BOOKS

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, *Computer Organization and Embedded Systems*, 6th Edition, McGraw Hill, 2021.
2. David A. Patterson and John L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface*, 6th Edition, Morgan Kaufmann, 2021.
3. William Stallings, *Computer Organization and Architecture: Designing for Performance*, 11th Edition, Pearson, 2023.

REFERENCE BOOKS

1. Morris Mano, *Computer System Architecture*, 4th Edition, Pearson, Reprint 2022.
2. John L. Hennessy and David A. Patterson, *Computer Architecture: A Quantitative Approach*, 6th Edition, Morgan Kaufmann, 2020.
3. Tanenbaum and Austin, *Structured Computer Organization*, 6th Edition, Pearson, 2021.

Open Educational Resources (OERs)

1. MIT OpenCourseWare – Computer System Architecture, https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-004-computation-structures-spring-2017/
2. IIT Bombay FOSSEE – Digital Systems & Computer Organization https://nptel.ac.in/courses/106101098

Open-Access Journals and Research Repositories

1. **International Journal of Computer Architecture and Mobility (IJCAM)** https://www.csejournal.com/
2. **arXiv.org – Computer Architecture (cs.AR)** https://arxiv.org/list/cs.AR/recent
3. **Journal of Computer Architecture and High Performance Computing** https://ijcaonline.org.

DATABASE MANAGEMENT SYSTEMS LAB	
Course Code: 25CS2111	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

1. To explain the basic database concepts, applications, data models, schemas and instances.
2. To demonstrate the use of constraints and relational algebra operations. And describe the basics of SQL and construct queries using SQL.
3. To emphasize the importance of normalization in databases.
4. To facilitate students in Database design.
5. To familiarize issues of concurrency control and transaction management.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Transform an information model into a relational database schema and to use a data definition language and/or utilities to implement the schema using a DBMS.
2. Use an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and query a database.
3. Formulate query, using SQL, solutions to a broad range of query and data update problems.
4. Design and implement database applications on their own.
5. Understand various advanced queries execution such as relational constraints, joins, set operations, aggregate functions, trigger, views and embedded SQL.
6. Analyze and Select storage and recovery techniques of database systems.

COURSE LEARNING OUTCOME (CLO) - COURSE OBJECTIVE (CO) MAPPING:

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	√					
CO2		√	√			
CO3			√			
CO4				√		
CO5					√	√

Mapped SDGs: SDG-4,SDG-8,SDG-9,DSG-17

LIST OF EXPERIMENTS

1. To study SQL and implement Basic SQL commands (create database, create table, use , drop, insert) and execute the queries using these commands.
2. To Implement the viewing commands (select , update) and execute the queries using these commands.
3. To implement the commands to modify the structure of the table (alter, delete, drop, add, modify) and execute the queries using these commands.
4. Write a program which involves compound conditions (and, or, in , not in, between ,not between , like , not like) and execute the queries using these commands.
5. To Implement the aggregate functions (sum, count, max, min, average) and execute the queries using these commands.
6. To Implement the grouping commands (group by, order by)
7. To Implement the commands involving data constraints.
8. To Implement the commands for aliasing and renaming and execute the queries using these Commands.
9. Write a program to execute the queries for joins (cross join, inner join, outer join)
10. To Implement Integrity Constraints in SQL.
11. Write a program to implement the Use of Group By and Having Clause.
12. Write a program to perform the queries for triggers (Creation of insert trigger, delete trigger, update trigger).

Note: At least 5 to 10 more exercises to be given by the teacher concerned.

TEXT BOOKS

1. Cathy Tanimura , SQL for Data Analysis: Advanced Techniques for Transforming Raw Data into Insights , 2025.
2. Anthony Molinaro, SQL Cookbook: Query Solutions and Techniques,2020
3. S.K. Singh, Database Systems: Concepts, Design and Applications, Pearson Education India, 2009
4. Thomas Connolly, Carolyn Begg. Database Systems, 3rd Edition – Pearson Education.
5. Korth, Silberschatz, Database System Concepts, 4th Ed., TMH, 2000.
6. Date C. J.An Introduction to Database Systems , 7th Ed., Narosa Publishing, 2004.

REFERENCE BOOKS

1. Elmasri Navathe, Fundamentals of Database Systems, 5th Edition Pearson Education.
2. Alan Beaulieu, Learning SQL, 3rd Edition (2020)
3. Vipin.C.Desai , An introduction to Database System , West Pub. Co

OPEN EDUCATIONAL RESOURCES (OER):

1. MIT OpenCourseWare – Database Systems (6.830)
   Link: https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/
2. Introduction to Database Systems – IIT Madras (NPTEL, 2025),
   https://onlinecourses.nptel.ac.in/noc25_cs40/preview?utm_source=chatgpt.com
3. NPTEL: **Database Management System** – IIT Kharagpur
   Link: https://onlinecourses.nptel.ac.in/noc22_cs91/preview?utm_source=chatgpt.com

DATA STRUCTURES LAB	
Course Code: 25CS2113	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE

1. To demonstrate array implementation of linear data structure algorithms.
2. To implement the applications using Stack & Queue.
3. To implement Binary search tree and AVL tree algorithms.
4. To implement Prim's algorithm.
5. To implement Sorting, Searching and Hashing algorithms.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Implement Linear data structure algorithms.
2. Implement applications using Stacks and Linked lists
3. Implement Binary Search tree and AVL tree operations.
4. Implement graph algorithms.
5. Analyze the various searching and sorting algorithms.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	√				
CO2		√			
CO3			√		
CO4				√	
CO5					√

Mapped SDGs: SDG-4,SDG-9,SDG-11

LIST OF PROGRAMS

1. Implement the basic operations (insertion, deletion, traversal, and search) on a singly linked list. Understand dynamic memory allocation and pointer manipulation.
2. Represent polynomials using linked lists. Perform polynomial addition and multiplication. Understand how linked structures enable dynamic term representation.
3. Develop linked list-based implementations for Stack and Linear Queue ADTs. Perform operations such as push, pop, enqueue, dequeue, and display.
4. Implement Stack, Linear Queue, and Circular Queue using arrays.
5. Implement a transformation of stack to queue (and vice versa) using arrays and linked lists to understand data structure interconversion logic.
6. Implement an algorithm to convert an infix expression to postfix and evaluate a postfix expression using stack data structures. Understand expression parsing and operator precedence.
7. Implement linear and binary search on both arrays and linked lists. Compare time complexity and discuss feasibility of binary search on linked structures.
8. Implement Insertion Sort and Selection Sort on arrays. Analyze their time complexity and behavior on partially sorted data.
9. Implement Merge Sort and Quick Sort for both arrays and linked lists. Understand divide-and-conquer strategies and compare performance in different cases.
10. Create a binary search tree and implement operations such as insertion, deletion, traversal (inorder, preorder, postorder), and search.
11. Extend the BST to support AVL Trees with self-balancing logic. Implement insertion and observe how balancing (rotations) maintains optimal tree height.
12. Implement a min-heap or max-heap to represent a priority queue. Perform insert, delete, and heapify operations to maintain heap properties.
13. Implement Dijkstra's algorithm for computing the shortest path from a source node to all other nodes in a weighted graph using an adjacency matrix or list.
14. Implement Prim's algorithm to generate a minimum spanning tree for a connected, weighted, undirected graph. Explore greedy strategies in graph processing.

TEXT BOOK

1. Narasimha Karumanchi "Data Structures and Algorithms Made Easy" 6th Edition (2023) Publisher: CareerMonk Publications ISBN: 978-8193245279
2. Seymour Lipschutz – Data Structures with C "Data Structures with C" Publisher: McGraw Hill Education
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson, Education, 2005.
4. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007

REFERENCE BOOKS

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser "Data Structures and Algorithms in Python" 2nd Edition (2024) Publisher: Wiley ISBN: 978-1119860917
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein "Introduction to Algorithms" Edition: 4th Edition (2022) Publisher: The MIT Press ISBN: 978-0262046305
3. Mark Allen Weiss "Data Structures and Algorithm Analysis in C++" 4th Edition (2023) Publisher: Pearson ISBN: 978-0132847377
4. Bradley N. Miller, David L. Ranum "Problem Solving with Algorithms and Data Structures Using Python" 3rd Edition (2023) Publisher: Franklin, Beedle & Associates ISBN: 978-1590284079
5. Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.
6. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
7. Alfred V. Aho, Jeffrey D. Ullman,John E. Hopcroft ,Data Structures and Algorithms, 1st edition, Pearson, 2002.
8. Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006.

Open Sources for Learning

1.https://www.youtube.com/c/takeUforward
2.https://www.youtube.com/c/CodeWithHarry
3.https://www.youtube.com/c/GeeksforGeeksVideos
4.https://www.youtube.com/c/ApnaCollegeOfficial

Others Resources

1.https://dl.acm.org/journal/talg
2.https://link.springer.com/journal/453
3.https://www.journals.elsevier.com/theoretical-computer-science
4.https://dl.acm.org/journal/csur
5.https://dl.acm.org/journal/jacm
ttps://www.journals.elsevier.com/information-processing-letters

Note: Students may be asked to create a small project individually to show the application of data structures.

ESSENTIALS OF BLOCKCHAIN & IOT – LEVEL-I	
Course Code: 23CS0201	Continuous Evaluation: 70 Marks
Pre-Requisite : NIL	End Semester Examination:30 Marks
L T P : 0 0 2	
Credits: 1	

TRAINING OBJECTIVES

1. To familiarise the students with functional/operational aspects of cryptocurrency ECOSYSTEM.
2. To understand emerging abstract models for Blockchain Technology.
3. To learn various protocols of IoT.

TRAINING LEARNING OUTCOMES (TLOS)

After the completion of training students will be able to:

1. Understand how bitcoin and other coins work in the real world.
2. Analyse the properties of Block Chain models.
3. Understand the vision of IoT and communication protocols from a global context.
4. Design portable IoT using appropriate boards.

TRAINING LEARNING OUTCOMES (TLO)-TRAINING OBJECTIVES (TO) MAPPING

	TLO1	TLO2	TLO3	TLO4
TO1	✔			
TO2		✔		
TO3			✔	✔

TRAINING CONTENTS

UNIT	TRAINING CONTENT	STUDENTS ENGAGEMENT ACTIVITY
I	**CONSENSUS** The consensus problem, Abstract Models for BLOCKCHAIN GARAY model, RLA Model, liveness and fairness, Proof of Stake (PoS) based Chains, Hybrid models (PoW + PoS)	Perform Mapping of coins and Blockchain Models

II	**BITCOIN** Bitcoin Introduction, Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.	To identify the type of wallet used in a specific application.

UNIT	**TRAINING CONTENT**	**STUDENTS ENGAGEMENT ACTIVITY**
III	**Introduction to IoT:** Definition, Characteristics, Applications, Connectivity Layers, Addressing, Networking, Sensing: Sensors and Transducers, Sensor Classes, Sensor Types, Actuation: Actuator Basics, Actuator Types. **Connectivity Technologies:** ZigBee, 6LoWPAN, RFID, HART, NFC, Bluetooth, ISA100.11a.	To identify the types and characteristics of Sensors
IV	**Introduction to Arduino**: Basic Concepts of Arduino Platform, Examples of Arduino Programming, Integration of Sensors and Actuators with Arduino, **Introduction to Raspberry Pi**, Implementation of IoT with Raspberry, Software Defined Networking, Software Defined IoT Networking	To design a simple application of LED lightning using Arduino and Raspberry Pi.
V	**HANDS ON ACTIVITY** The students will design an application for a smart irrigation system, smart healthcare system. In this activity students will identify the major components required for building a smart application and design the architecture and application accordingly.	Complete the Assigned Activity

LEARNING RESOURCES

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
2. Honbo Zhou, "The Internet of Things in the Cloud:A Middleware Perspective" –– CRC Press-2012
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.
4. https://eprint.iacr.org/2014/349.pdf
5. https://eprint.iacr.org/2012/718.pdf
6. https://github.com/ElementsProject/lightning/blob/master/doc/deployable-lightning.pdf
7. https://www.hyperledger.org/use/tutorials
8. https://docs.soliditylang.org/en/latest
9. https://github.com/ethereum/wiki/wiki/White-Paper
10. http://gavwood.com/paper.pdf
11. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
12. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.

SEMESTER – IV

DISCRETE STRUCTURES	
Course Code: 25CS2004	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. Apply principles of propositional and predicate logic to construct formal arguments and validate algorithms using inference and proof techniques.
2. Demonstrate understanding of sets, relations, and functions, and utilize them to describe and analyse mathematical and computational structures.
3. Use counting principles, permutations, combinations, recurrence relations, and generating functions to solve combinatorial problems and analyse algorithms.
4. Analyze and model real-world problems using graph theoretical concepts such as graph coloring, planarity, Eulerian and Hamiltonian paths.
5. Understand and apply algebraic structures and number theory concepts, including groups and modular arithmetic, in the context of cryptography and formal systems.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Model logic statements arising in algorithm correctness and real-life situations and manipulate them using the formal methods of propositional and predicate logic.
2. Relate the ideas of mathematical induction to recursion and recursively defined structures.
3. Establish and solve recurrence relations that arise in counting problems including the problem of determining the time complexity of recursively defined algorithms.
4. Deduce properties that establish particular graphs as Planar, Eulerian, and Hamiltonian.
5. Formalizes the sets with the binary operations.
6. Understand the application of number theory in cryptography.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	✔	✔				
CO2			✔			
CO3				✔	✔	
CO4						✔
CO5						

Mapped SDGs: SDG-4,SDG-8,SDG-9,SDG-16

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT
UNIT-I	**INTRODUCTION TO LOGIC** Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy, Mathematical Induction: examples, strong Induction, well ordering principle, invariants.
UNIT-II	**BASIC MATHEMATICAL STRUCTURES** **Sets,** definition, types of sets, Venn Diagram, using set notation with Quantifier, Set Operations, Set Identities and their proofs. Fuzzy sets. **Functions,** definition and properties, types of functions, comparing infinite sets using functions, countable and countably infinite sets. **Relation:** equivalence relations and partitions of a set, partial order relations, posets, Hasse diagram, chains, anti-chains, Lattices.
UNIT-III	**COUNTING TECHNIQUES** **Basic Counting Techniques:** product and sum principles, the bijection principle, division rule, double counting, Handshake lemma, Pascal's triangle, permutations and combinations with and without repetitions. **Advanced counting Techniques:** Sequences: Sum of sequences and product of sequences, estimating factorials, recurrence relations, Counting techniques: Pigeon-hole principle (PHP), its variants and its application.
UNIT-IV	**GRAPH THEORY** Basic terminology, Konigsberg bridge problem, Types of graphs: ,Eulerian, Hamiltonian, Bipartite, Planar; Graph isomorphism and Homomorphism, Subgraphs, cliques and independent sets, large bipartite subgraphs, connected components, cut edges, Matchings, Perfect and maximum matchings.
UNIT-V	**ALGEBRAIC SYSTEMS & NUMBER THEORY** **Algebraic systems:** Semigroup, Monoid, Groups, Abelian group, Cyclic Group, Subgroup, order of a group and subgroups, Lagrange's theorem, group isomorphism and homomorphism. **Number Theory:** Modular arithmetic and applications to cryptography, Chinese Remainder theorem.

TEXT BOOKS

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 8th Edition, McGraw-Hill Education, 2019.
2. C. L. Liu and D. P. Mohapatra, Elements of Discrete Mathematics: A Computer-Oriented Approach, 4th Edition, McGraw Hill Education, 2020.
3. N. L. Biggs, Discrete Mathematics, Revised Edition, Oxford University Press, 2002.
4. Douglas B. West, Introduction to Graph Theory, 2nd Edition, Pearson Education, 2001. (Reprinted by PHI Learning Pvt. Ltd., Eastern Economy Edition)

REFERENCE BOOKS

1. J. A. Bondy and U. S. R. Murty, Graph Theory, Graduate Texts in Mathematics, Springer, 2008. (Reprint of the 2008 edition in 2013)
2. J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Reprint Edition, McGraw Hill Education, 2017.
3. Ronald L. Graham, Donald E. Knuth, and Oren Patashnik, Concrete Mathematics: A Foundation for Computer Science, 2nd Edition, Addison-Wesley, 1994.
4. Ivan Niven, Herbert S. Zuckerman, Hugh L. Montgomery, An Introduction to the Theory of Numbers, 5th Edition, Wiley India, 2008.
5. G. H. Hardy and E. M. Wright, An Introduction to the Theory of Numbers, 6th Edition, Oxford University Press, 2008.
6. Peter J. Cameron, Combinatorics: Topics, Techniques, Algorithms, Cambridge University Press, 1994. (Latest reprints available)
7. J. H. van Lint and R. M. Wilson, A Course in Combinatorics, 2nd Edition, Cambridge University Press, 2001.
8. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 5th Edition, Pearson, 2003

OPEN EDUCATIONAL RESOURCES (OER's)

1. Oscar Levin, Discrete Mathematics: An Open Introduction, 3rd Edition, 2023, Available at: https://discrete.openmathbooks.org
2. Eric Lehman, F. Thomson Leighton, Albert R. Meyer, Mathematics for Computer Science, MIT OpenCourseWare, 2005, Available at: https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2005/
3. Prof. Kamala Krithivasan, Discrete Structures, NPTEL Online Course, IIT Madras, Available at: https://nptel.ac.in/courses/106106094
4. David Liben-Nowell, Discrete Mathematics, Carleton College, 2020, Available at: https://cs.carleton.edu/faculty/dln/book/

DATABASE SECURITY	
Course Code: 25CCS2006	Continuous Evaluation: 30 Marks
Credits: 3	End Semester Examination: 70 Marks
L T P: 3 0 0	
Prerequisite: Database Management System	

COURSE OBJECTIVES (COs)

1. To introduce students to the fundamentals of database security and the types of threats databases face in cyber environments.
2. To provide in-depth knowledge of core security mechanisms like authentication, authorization, firewalls, VPNs, and intrusion detection in databases.
3. To equip students with techniques for managing user credentials and privileges, and to secure access through strong password and authentication practices.
4. To enable the use of security tools and techniques to detect, monitor, and mitigate attacks such as SQL injection and insider threats.
5. To explore advanced security models and practices like VPD, LBAC, data masking, and compliance frameworks in modern database environments.

COURSE LEARNING OUTCOMES (CLOs)

1. Understand the common internal and external database threats and categorize database models and architectures relevant to cybersecurity.
2. Apply core database security mechanisms and tools such as firewalls, VPNs, IDS/IPS, and PKI to protect sensitive data.
3. Implement authentication methods and password policies, manage user privileges, and secure database access points like listeners.
4. Evaluate and use database security tools for detecting and mitigating SQL injection, privilege escalation, and misconfigurations.
5. Design and enforce advanced security policies using VPD, LBAC, and data protection techniques in compliance with standards like GDPR and HIPAA.

COURSE LEARNING OUTCOME (CLO)-COURSE OBJECTIVE (CO) MAPPING

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	✔
CO5					✔

Mapped SDGs: SDG-4, SDG-8, SDG-9

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**Introduction to Database Security** Importance of Database Security in Cybersecurity Threats to Databases: Internal and External Attacks Roles of Hackers, Social Engineers, End-Users, and Administrators Malware Targeting Databases: Viruses, Worms, Trojans, Bots Threat Vectors: Emails, Web Apps, Messaging Services (Tweets, IMs) Database System Architecture and Security Considerations Overview of Database Types and Models: OLTP vs OLAP/DSS Relational, Object-Oriented, and Object-Relational Databases Key Database Components and Relationships
UNIT-II	**Core Database Security Mechanisms** Security Softwares: Authentication, authorization and administration, firewalls, Virtual Private networks, Intrusion Detection and Prevention, Vulnerability assessment and patch management, security management, antivirus; Security parameters for Intrusion detection and intrusion prevention systems; securing core; application security; public key infrastructure; Vulnerability Management: Why so many vulnerabilities, vulnerability scanner, monitoring and baselining; patch management; incident management: Detection, Response, and Recovery.
UNIT-III	**Authentication, Authorization & Password Security** Anatomy of Authentication-Related Vulnerabilities Authentication Types: Basic, Strong, Multifactor Role & Privilege Management: Assigning DBA Rights Password Security Best Practices: Complexity, Storage, Expiry Lockout Policies and Session Management Securing Oracle Listener and Similar Interfaces Implementation Practices: Hardening User and System Access
UNIT-IV	**Database Security Tools & Attack Detection** Granular Access Control (Granular Security): Role-Based, Attribute-Based, and Context-Based Access Securing DB-to-DB Communication SQL Injection Attacks: Detection, Prevention, and Mitigation Introduction to Database Security Tools: Database Activity Monitoring (DAM) Vulnerability Scanners: Nessus, DBScan, AppDetective Log Analysis & Audit Trail Tools Real-world Attack Scenarios and Case Studies

UNIT-V	**Advanced Database Security Concepts** Virtual Private Database (VPD) Concepts: Row-Level and Column-Level Security Policy Enforcement in VPD Label-Based Access Control (LBAC): Label Types, Label Policies Mandatory Access Enforcement Secure Data Masking and Tokenization Techniques Secure Data Sharing in Multi-Tenant Cloud Environments Compliance-Oriented Security: GDPR, HIPAA, ISO 27001 Considerations

Text Books:

1. Ron Ben Natan, "Implementing database security and auditing," Elsevier.
2. Alfred Basta, Melissa Zgola, Dana Bullaboy, Thomas L. Whitelock Sr., "Database security," Course Technology, Cengage Learning
3. Database Security by Silvana Castano et al.
4. *Database System Concepts* by Abraham Silberschatz et al. (Security Chapters)

Reference Books:

1. Peter A. Carter, "Securing SQL Server: DBA defending the database," 2nd ed., Apress.
2. Oracle/Microsoft SQL Server Security Docs
3. IEEE/ACM Journals on DB Security

THEORY OF COMPUTATION	
Course Code: 25CSPE2004	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. Understand the foundations of formal languages and finite automata to model computational systems.
2. Develop the ability to construct and analyze regular expressions and grammars for language representation.
3. Gain proficiency in designing and simplifying context-free grammars, and identifying ambiguity.
4. Learn to model context-free languages using pushdown automata and simulate language recognition.
5. Explore Turing machines and foundational concepts of computability and undecidability in computation.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Explain the foundational concepts of formal languages, grammars, and automata.
2. Design and analyze finite automata, regular expressions, and context-free grammars for language recognition.
3. Construct and simulate pushdown automata and Turing machines for appropriate language classes.
4. Apply theoretical tools like pumping lemmas and closure properties to classify languages.
5. Evaluate the power and limitations of computational models through concepts of decidability and undecidability.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔	✔		✔	
CO2		✔		✔	
CO3	✔	✔		✔	
CO4			✔		
CO5			✔		✔

Mapped SDGs: SDG-4, SDG-9, SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Unit 1: Introduction to Formal Languages and Finite Automata** Alphabets, strings, languages, operations on languages Finite Automata (DFA, NFA, ε-NFA) Conversion: ε-NFA → NFA → DFA Equivalence of Finite Automata Minimization of DFA
UNIT-II	**2: Regular Languages and Grammars** Regular Expressions and their equivalence with FA Regular grammar (right-linear, left-linear) Closure properties of Regular Languages Pumping Lemma for Regular Languages Decision properties
UNIT-III	**Unit 3: Context-Free Grammars and Languages** CFG: Definition, Derivations, Parse Trees Ambiguity in CFGs Simplification: Removing null, unit, useless productions Normal forms: CNF, GNF Pumping Lemma for CFLs Closure properties
UNIT-IV	**Unit 4: Pushdown Automata and CFLs** Pushdown Automata (PDA): Definition, transition diagrams Acceptance by final state and empty stack Design of PDA for CFGs Deterministic v/s Non-deterministic PDA Applications of PDA
UNIT-V	**Unit 5: Turing Machines and Undecidability** Turing Machine: Basic model, design of TM Variants of TM: Multi-tape, non-deterministic Recursive and Recursively Enumerable Languages Church-Turing Thesis Undecidability: Halting Problem, Post Correspondence Problem, Rice's Theorem Closure properties of Turing machines.

TEXT BOOKS

1. Peter Linz, *An Introduction to Formal Languages and Automata*, 6th Edition, Jones and Bartlett, 2016.
2. Dexter C. Kozen., Automata and Computability, 1st Edition, Ronald F. Clayton, Springer-Verlag New York Inc, 2016.
3. Anil Maheshwari and Michiel Smid., Theory of Computation, 1st Edition, Carleton University, 2016.
4. Vivek Kulkarni., Theory of Computation, 4th Edition, Oxford University Press, 2013.
5. Hopcroft J.E., Motwani R., Ullman J.D., *Introduction to Automata Theory, Languages and Computation*, 3rd Edition, Pearson Education, 2008.

REFERENCE BOOKS

1.Martin J.C., Introduction to Languages and the Theory of Computation, 4th Edition, McGraw-Hill Education, 2010.
2. Lewis H.R. and Papadimitriou C.H., Elements of the Theory of Computation, 2nd Edition, Pearson Education, 2001.

Open Sources for Learning

1.Introduction to Theory of Computation - GeeksforGeeks
2.Theory of Computation (TOC) for GATE - GeeksforGeeks
3.Theory of Computation | Mathematics | MIT OpenCourseWare

Other Links

1.https://www.journals.elsevier.com/theoretical-computer-science.
2.https://www.journals.elsevier.com/information-and-computation.
3.https://toct.acm.org/.
4.https://lmcs.episciences.org/. https://theory of computing. org/.

OPERATING SYSTEMS	
Course Code: 25CS2006	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. To understand the main components of an OS & their functions.
2. To study process management and scheduling.
3. To understand various issues in Inter Process Communication (IPC) and the role of OS in IPC.
4. To understand the concepts and implement Memory management policies and virtual memory.
5. To understand the working of an OS as a resource manager, file system manager, process manager, memory manager and I/O manager and methods used to implement the different parts of OS

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Understand the basic operating system concepts such as overall architecture, interrupts, APIs, user mode and kernel mode.
2. Understand the process management policies and scheduling of processes by CPU .
3. Distinguish between concepts related to concurrency including synchronization primitives, race conditions, critical sections and multi-threading.
4. Describe and analyze the memory management and its allocation policies.
5. Identify use and evaluate the storage management policies with respect to different storage management technologies.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	√				
CO2		√	√		
CO3		√	√		
CO4				√	√
CO5					√

Mapped SDGs: SDG-4, SDG-9 & SDG-12

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** **Operating System Overview**-Definition and functions, Types of Operating Systems, Various Operating system services. **Operating System Structure-** Layered structure approach, kernel Approach and Virtual machine approach.
UNIT-II	**PROCESSES & SCHEDULING** **Process concept**- Process State Diagram- PCB, Concept of Threading and Multithreading, Operation on processes, Scheduling criteria, CPU scheduling algorithms- FCFS, SJF, SRTF, RR, PRIORITY, HRRN. **Deadlock:** System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock.
UNIT-III	**CONCURRENCY** Process Synchronization- Critical Section Problem, Classical Synchronization Problem.Principles of concurrency - mutual exclusion, semaphores, monitors, Readers/Writers problem, Producers/Consumers problem. Inter Process Communication models and Schemes, Process generation.
UNIT-IV	**MEMORY MANAGEMENT STRATEGIES** Address Binding, Logical-Physical Address Space, swapping, contiguous memory allocation, non- contiguous memory allocation technique, Virtual Memory Management - Demand Paging & Page-Replacement Algorithms, Demand Segmentation. Thrashing, Cache memory organization, Locality of reference.
UNIT-V	**FILE SYSTEMS** File system Concepts, Disk scheduling Algorithms, File management – organization, Directories, file sharing, Record blocking, Secondary storage management, Disk Management- I/O Systems, System Protection and management.

TEXT BOOKS

1. William Stallings, “Operating Systems – internals and design principles”, Prentice Hall India, 10th Edition, 2018.
2. Design of the Unix Operating System By Maurice Bach, PHI. Andrew S. Tanenbaum, Herbert Bos,5th Ed.
3. Silberschatz, Peter Galvin, “Operating System Concepts”, AWL 10th Edition, 2021.

REFERENCE BOOKS

1. Andrew S. Tannenbaum & Albert S. Woodhull, “Operating System Design and Implementation”, Prentice Hall India, 2nd Edition, 2018.
2. Ida M. Flynn, Ann Mclver McHoes, “Understanding Operating Systems”, 3rd Ed. (2017).
3. Gary Nutt, “Operating System - A Modern Perspective”, Pearson Education Asia, 2nd Edition 2000. Harvey .M. Deitel, “Operating Systems”.

OPEN EDUCATION RESOURCES

1. https://pages.cs.wisc.edu/~remzi/OSTEP/
2. https://open.umn.edu/opentext
3. https://ocw.mit.edu/courses/6-828-operating-system-engineering-fall-2012/
4. https://www.udacity.com/course/introduction-to-operating-systems--ud923

ANALYSIS AND DESIGN OF ALGORITHMS	
Course Code: 25CS**PE2008**	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. To analyze the asymptotic performance and correctness of algorithms.
2. To explore key algorithm design strategies: divide and conquer, dynamic programming, and greedy methods.
3. To understand and implement graph algorithms and optimization techniques.
4. To solve computational problems using state space search, backtracking, and branch-and-bound.
5. To classify computational problems as tractable/intractable and explore NP-completeness and approximation algorithms.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Analyze and compare the efficiency and correctness of algorithms using asymptotic notations.
2. Apply divide and conquer strategy and recurrence relation techniques to design and analyse algorithms.
3. Solve real-world problems using dynamic programming and greedy methods effectively.
4. Implement graph-based algorithms for traversal, path finding, and network flow problems.
5. Design solutions for complex optimization problems using backtracking, branch and bound, and approximation methods.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

CLO's / CO's	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

Mapped SDGs: SDG-4, SDG-9, SDG-12

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** **Algorithm analysis:** Time and space complexity - Asymptotic Notations and its properties- Best case, Worst case and average case analysis – Recurrence relation Solving Method: Substitution Method, Recurrence Tree Method, Master's Methods Complexity Analysis of Searching & Sorting Algorithms. **Pattern Matching**: The naïve string-matching algorithm,Rabin-Karp algorithm - Knuth-Morris-Pratt algorithm.
UNIT-II	**GRAPH ALGORITHMS** **Graph algorithms:** Graph Fundamentals , shortest path: Bellman-Ford algorithm, Dijkstra's algorithm, Floyd-Warshall algorithm **Network flow:** Flow networks, Ford-Fulkerson method – Matching: Maximum bipartite matching.
UNIT-III	**ALGORITHM DESIGN TECHNIQUES** **Divide and Conquer methodology:** Finding maximum and minimum - Merge sort - Quick sort , Applications **Dynamic programming:** Elements of dynamic programming, Matrix-chain multiplication, Multi stage graph, Optimal Binary Search Trees. Greedy Technique: Elements of the greedy strategy - Activity-selection problem – Optimal Merge pattern — Huffman coding.
UNIT-IV	**STATE SPACE SEARCH ALGORITHMS** **Backtracking:** n-Queens problem, Hamiltonian Circuit Problem, Subset Sum Problem, Graph colouring problem, Branch and Bound: Solving 15-Puzzle problem, Assignment problem, Knapsack Problem, Travelling Salesman Problem.
UNIT-V	**NP-COMPLETE AND APPROXIMATION ALGORITHM** **Tractable and intractable problems:** Polynomial time algorithms - NP-hardness and NP-completeness– Bin Packing problem - Problem reduction: TSP – 3-CNF problem. **Approximation Algorithms:** TSP - **Randomized Algorithms:** concept and application - primality testing - randomized quicksort - Finding kth smallest number.

TEXT BOOKS

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein *Introduction to Algorithms*, 4th Edition, MIT Press, 2022.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, *Fundamentals of Computer Algorithms*, 2nd Edition (Revised), Universities Press, 2021.
3. Richard Johnsonbaugh, Marcus Schaefer *Algorithms*, 4th Edition, Pearson Education, 2020

REFERENCE BOOKS

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, *The Design and Analysis of Computer Algorithms*, Pearson, Reprint Edition, 2022.
2. Anany Levitin *Introduction to the Design and Analysis of Algorithms*, 4th Edition, Pearson, 2019.
3. Sara Baas, Allen Van Gelder *Computer Algorithms: Introduction to Design and Analysis*, 3rd Edition, Pearson, 2021.
4. S. Sridhar *Design and Analysis of Algorithms*, Oxford University Press, 2021.

Open Educational Resources (OERs)

1. MIT OpenCourseWare – Design and Analysis of Algorithms, https://ocw.mit.edu/search/?q=and+Analysis+of+Algorithms
2. Khan Academy – Algorithms, https://www.khanacademy.org/computing/computer-science/algorithms
3. Coursera (Audit Free) – Algorithmic Toolbox by UC San Diego, https://www.coursera.org/specializations/algorithms?
4. VisuAlgo, https://visualgo.net/en

Open Access Journals and Repositories

1. Journal of Computer Science (Science Publications)https://thescipub.com/journal/jcs
2. International Journal of Computer Applications (IJCA)https://www.ijcaonline.org
3. International Journal of Computer Science and Information Security (IJCSIS) https://sites.google.com/site/ijcsis/
4. arXiv.org – Computer Science > Data Structures and Algorithms https://arxiv.org/list/cs.DS/recent
   Research preprints on latest algorithm techniques.
5. DOAJ (Directory of Open Access Journals) https://www.doaj.org

OPERATING SYSTEMS LAB	
Course Code: 25CS2114	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

1. To understand the operating system principles and its implementations.
2. To understand the main components of an OS & their functions.
3. To provide necessary skills for developing and debugging programs in order to optimize performance of OS.
4. To study process management and scheduling.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students will be able to:

1. Demonstrate the various operations of the file system.
2. Understand and Implement Memory management schemes, Thread and synchronization
3. Implement Deadlock algorithms and page replacement algorithms.
4. Apply the process synchronous concept using message queue, shared memory, semaphore for given situation.
5. Implement Scheduling algorithms.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

CLO's / CO's	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	√				
CO2		√			
CO3			√	√	
CO4					√

Mapped SDGs: SDG-4,SDG-9,SDG-11,SDG-12,SDG-16

LIST OF PROGRAMS

1. Implement CPU scheduling for first come first serve and shortest job first.
2. Implement priority scheduling and Round Robin Algorithms for CPU Scheduling.
3. Implementation of Demand Paging using Least Recently Used (LRU) Page Replacement Algorithm.
4. Implementation of Demand Paging using First in First Out (FIFO) Page Replacement Algorithm.
5. Implementation of Demand Paging using Optimal Page Replacement Algorithm.
6. Implement first fit, best fit and worst fit algorithms for Memory management.
7. Implementation of resource allocation graph (RAG)
8. Implement reader/writer problem using semaphore.
9. Implement the solution for Bounded Buffer (producer-consumer) problem using inter process communication techniques by Semaphores
10. Implement Banker's algorithm for deadlock avoidance.

TEXT BOOKS

1. Abraham Silberschatz Peter B. Galvin and Greg Gagne, Operating System Concepts,Wiley 10th Ed.

2. Garry. J. Nutt, Operating Systems: A Modern Perspective, Addison-Wesley
3. Andrew S. Tanenbaum and Herbert Bros, Modern Operating Systems (4th Edition), Pearson.

REFERENCE BOOKS

1. William Stallings, "Operating Systems – internals and design principles", Prentice Hall India, 9th ed., 2017.

OPEN EDUCATIONAL RESOURCES (OER's)

1. https://www.geeksforgeeks.org/
2. https://pages.cs.wisc.edu/~remzi/OSTEP
3. Visualization tools for page replacement

DATABASE SECURITY LAB	
Course Code: 25CCS2118	Continuous Evaluation: 60 Marks
Credits: 1	End Semester Examination: 40 Marks
L T P: 0 0 2	
Prerequisite: Databases	

Course Objectives (CO)
1. To impart the knowledge of practical implementation of various files and databases. 2. To learn the proxy configuration. 3. To learn working with privileges and policies.

Course Learning Outcomes (CLO)
1. To be able to create various files and databases. 2. To be able to configure proxy authentication. 3. To be able to work with the privileges and policy. 4. To be able to enhance the security of the databases.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	**CLO2**	**CLO3**	**CLO4**
CO1	✔			
CO2		✔		✔
CO3			✔	✔

List of Programs:

1. Design sample OLTP and OLAP databases using MySQL/PostgreSQL.
2. Write the query to list table spaces, redo log and backup files.
3. Write the query to Assign roles with permissions and simulate privilege misuse.
4. Write the query to Create users and roles with GRANT/REVOKE.
5. Configure a Basic Database Firewall or Security Rules.
6. Simulate patching a vulnerable MySQL/PostgreSQL system.
7. Implement Multi-Factor Authentication (MFA) for DB Access (Use OTP-based or Google Authenticator method for DB login).
8. Write the query to Configure and Enforce Password Policies.
9. Write the query for creating common database accounts and pluggable database.
10. Write the query for creating named accounts in a pluggable database.
11. Write the query to configure Oracle Proxy Authentication.

12. SQL Injection Attack Simulation and Mitigation.
13. Write the queries to enable, disable and test the VPD policy and policy groups.
14. Write the query to create and verify the Row-Level Security and Column-Level Security (VPD Simulation) in Oracle.
15. Study the Real-world case study project on a major DB breach (e.g., Equifax)

Note: 4 to 5 more programs should be conducted in the lab.

Learning Resources	
Reference Book and other materials	**1.** Laboratory Manual

ANALYSIS AND DESIGN OF ALGORITHM LAB	
Course Code: 25CS2118	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE

1. To understand and apply the algorithm analysis techniques on searching and sorting algorithms.
2. To critically analyze the efficiency of graph algorithms.
3. To understand different algorithm design techniques.
4. To solve programming problems using a state space tree.
5. To understand the concepts behind NP Completeness, Approximation algorithms and randomized algorithms.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus adheres to all Bloom's Taxonomy Levels and has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Analyze the efficiency of algorithms using various frameworks.
2. Apply graph algorithms to solve problems and analyze their efficiency.
3. Implement various techniques like divide and conquer, dynamic programming and greedy techniques to solve problems.
4. Analyze & Use the state space tree method for solving problems.
5. Apply problems solving using approximation algorithms and randomized algorithms.

COURSE LEARNING OUTCOME (CLO)-COURSE OBJECTIVE (CO) MAPPING

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	√				
CO2		√			
CO3			√		
CO4				√	
CO5					√

Mapped SDGs: SDG-4, SDG-8,SDG-9, SDG-12

LIST OF EXPERIMENTS

1. Implement Linear and Binary Search to search a contact in an unsorted vs. alphabetically sorted phone book.
2. Implement Quick Sort using Divide and Conquer to prioritize emergency-room patients based on urgency (pivot-based triage).
3. Implement Merge Sort using Divide and Conquer to merge two sorted online shopping order queues efficiently.
4. Find Minimum and Maximum using Divide and Conquer to identify highest and lowest temperatures from sensor data.
5. Implement Fractional Knapsack using Greedy Method to optimally load a drone with medical supplies based on value-to-weight ratio.
6. Implement Prim's Algorithm using Greedy Method to connect computers in a lab using minimum total wire length.
7. Implement Kruskal's Algorithm using Greedy Method to plan road construction between towns minimizing total cost.
8. Implement Warshall's Algorithm to compute Transitive Closure and determine multi-step reachability in a social network.
9. Implement Dijkstra's Algorithm for Shortest Path to compute fastest routes from a driver to all customer locations in a ride-hailing app.
10. Solve the 8-Queens Problem using Backtracking to schedule 8 non-conflicting events in different time slots and halls.
11. Implement All-Pairs Shortest Path using Dynamic Programming (Floyd-Warshall) to find minimum delivery costs between all warehouse pairs.
12. Implement 0/1 Knapsack using Dynamic Programming to choose the most beneficial set of projects under a fixed budget
13. Implement Travelling Salesman Problem to find the shortest path of two cities.
14. Implement randomized algorithms for finding the kth smallest number.

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++" Orient Blackswan, 2nd Edition, 2019.
3. Richard Johnsonbaugh, Marcus Schaefer, " Algorithms ", Pearson Education, 2006 3rd edition

REFERENCE BOOKS

1. Aho, Ullman & Hopcraft, “The Design and Analysis of Algorithms”, Pearson Education, 2001
2. S.E.Goodman, S.T.Hedetniemi, “Introduction to the Design and Analysis of Algorithms”, McGraw Hill , 2006
3. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3rd Edition, Pearson Education, 2012.

OPEN EDUCATIONAL RESOURCES

1. https://youtu.be/uJUBd_3C12w?list=PL_uaeekrhGzJZz9-D3-J8kJqg8ZEODt4y

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING-LEVEL-II	
Course Code: 25CS0202	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination:70 Marks
L T P : 0 0 2	
Credits: 1	

TRAINING OBJECTIVES

1. To understand the need of AI
2. To describe basic AI algorithms (e.g., standard search algorithms).
3. To learn about one of the learning methods of AI that is Machine Learning.
4. To identify potential application domains of AI and machine learning in practice.

TRAINING LEARNING OUTCOMES (TLOS): -

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of training the students will be able to:

1. Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem
2. Understands the basics and need of AI and Machine learning in a global view.
3. Understands, apply and evaluate the supervised learning techniques.
4. Design and implement the different applications using the concepts of AI and ML

TRAINING LEARNING OUTCOME (TLO)-TRAINING OBJECTIVE (TO) MAPPING

	TLO1	**TLO2**	**TLO3**	**TLO4**
TO1	√			
TO2		√		
TO3		√	√	
CO4			√	√

MAPPED SDGs: SDG-3, SDG-4, SDG-9

TRAINING CONTENTS

MODULE	TRAINING CONTENTS	STUDENTS ENGAGEMENT ACTIVITY
I	**INTRODUCTION:** Introduction to AI: Definitions, Historical foundations, Basic Elements of AI, Characteristics of intelligent algorithm, AI application Area**.**	Classification of AI Problems into AI task Domains
II	**PROBLEM SOLVING:** Depth-first, breadth-first search, Problem Reduction, Constraint Satisfaction , Means-End Analysis.	Solving manually constraint satisfaction problem

MODULE	TRAINING CONTENTS	STUDENTS ENGAGEMENT ACTIVITY
III	**INTRODUCTION TO MACHINE LEARNING** Machine Learning Basics, Need of Machine Learning, Application Domains, Basic Learning Techniques.	Identification of ML Model based on Application
IV	**CLASSIFICATION PROBLEM** Machine learning Algorithms for classification problem	Design decision trees
V	**HANDS ON ACTIVITY :** Students will apply the methods learnt to design applications for a) Constraint Satisfaction Problem b) Robot Traversal c) Classification problems like COVID Detection, Spam classification etc.	Implement the given activity.

Learning Resources

1. Introduction to Machine Learning, E. Alpaydin. MIT Press
2. Machine Learning, T.M. Mitchell, Mc-Graw Hill
3. Stuart Russell, Peter Norvig, Artificial intelligence : A Modern Approach, Prentice Hall, Fourth edition, 2020.
4. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill.

LIVE PROJECT-I & INDUSTRIAL VISIT	
Course Code: 25CS0204	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE

To provide hands-on experience at sites where Computer Science and engineering projects are executed.

COURSE LEARNING OUTCOMES:

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Gather first-hand experience on sites.
2. Apply the concepts learnt to design and create an application.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	**CLO2**
CO1	√	√

LIVE PROJECT- I

Students have to undergo three weeks practical training at the end of third semester in Computer Science and Engineering related project sites or with the faculty members of parent or any other institute of repute. At the end of the training they have to submit a report together with a certificate in the format prescribed and make a power point presentation which shall be evaluated.

SEMESTER – V

NETWORK SECURITY	
Course Code: 25CCS3001	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To teach the concepts of securing computer network protocols, based on the application of cryptography techniques. 2. To learn & implement the various concepts of network security 3. To understand the basics of cloud and IoT security.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to: 1. Understand the theory of fundamental cryptography, encryption, decryption and symmetric and public key cryptographic algorithms.. 2. Demonstrate the various authentication applications and its requirements. 3. Comprehend different mechanisms related to network security, IP, cloud, IOT security and application privacy. 4. Interpret and apply the functionalities of firewall

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4
CO1	✔	✔	✔	
CO2	✔	✔	✔	✔
CO3			✔	

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT
UNIT-I	**Introduction:** Basic of cryptography, including conventional and public-key cryptography, hash functions, authentication, and digital signatures. Key Management and Distribution: Symmetric Key Distribution, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure.

UNIT-II	User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption Malicious Software: Viruses, Worms, System Corruption, Attack Agents, Information Theft, Keyloggers, Phishing, Spyware Payload Stealthing, Backdoors, Rootkits, Distributed Denial of Service Attacks
UNIT-III	Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control.

	IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange (IKE).
UNIT-IV	Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application. Electronic Mail Security: Pretty Good Privacy, S/MIME, DomainKeys Identified Mail.
UNIT-V	Firewalls and Intrusion Detection Systems: Intrusion Detection Password Management, Firewall Characteristics Types of Firewalls, Firewall Basing, Firewall Location and Configurations. Introduction to Blockchains, Cloud Security and IoT security.

TEXT BOOKS

1. William Stallings, “Cryptography And Network Security – Principles and Practices”, Prentice Hall of India, Third Edition, 2003
2. Behrouz A. Frouzan: Cryptography and Network Security, TMH

REFERENCE BOOKS

1. Matt Bishop ,“Computer Security art and science ”, Second Edition, Pearson Education, 2002
2. Bruce Schiener, “Applied Cryptography”. John Wiley & Sons.
3. Atul Kahate, “Cryptography and Network Security”, TMH.
4. M. Y. Rhee, Cryptography and Secure communication, McGraw-Hill
5. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.

KALI LINUX	
Course Code: 25CCS3005	Continuous Evaluation: 40 Marks
Pre-Requisite : Networking	End Semester Examination: 60 Marks
L T P : 2 0 0	
Credits:2	

COURSE OBJECTIVE (COs)

1. To learn the fundamentals of Kali Linux
2. To understand the search which is the first building block of security and its applications.
3. To understand and analyze the second building block of security that is knowledge representation and handling uncertainty.
4. To understand the concepts of planning and learning to create secure applications.
5. To learn the applications of secure designing.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Identify problems that are amenable to solution by secure methods, and which secure methods may be suited to solving a given problem.
2. Solve problems like brute force attacks.
3. Deduce through logic and reasoning algorithms.
4. Handle viruses.
5. Understand the role of security in automated control and smart applications.
6. Formalize a given problem in the framework of different network methods.
7. Design and carry out an empirical evaluation of different cryptographic algorithms on a problem formalization

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
CO1	✔						
CO2		✔					
CO3			✔	✔			
CO4					✔		
CO5						✔	✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT
UNIT-I	**Introduction:** Access the internal VPN lab network, kali virtual machine, metasploit usage, Kali documentation, SSH service, HTTP service, apt commands, text searching and manipulation, grep, sed, cut and awk

UNIT NUMBER	COURSE CONTENT
UNIT-II	**Command line:** The bash environment, environment variables, Tab completion, Bash history tricks, piping and redirection, redirecting to a new file, redirecting to an existing file, redirecting from a file, redirecting STDERR, comm, diff, vimdiff, file and command monitoring
UNIT-III	**Practical Tools:** NetCat, Socat, Powershell and Powercat, Wireshark, TcpDump, loops and functions in bash scripting
UNIT-IV	**Information Gathering -** website recon, whois enumeration, netcraft, Recon-ng, Security Headers Scanner, SSL server test, Pastebin, email harvesting, password dumps, stack overflow, DNS enumeration, Port Scanning, SMTP enumeration
UNIT-V	**Web Application Attacks** Inspecting URL, viewing response headers, inspecting sitemaps, locating administration consoles, DIRB, Burp Suite, Nikto, exploiting admin consoles, cross-site scripting, directory traversal vulnerabilities, file inclusion vulnerabilities, SQL injection

TEXT BOOKS
1. Ric Messier, " Learn Kali Linux : Security Testing, Penetration Testing and Ethical Hacking, O'Reilly.
2. Raphael Hertzog, Mati Aharoni and Jim O' Gorman, Mastering the Penetration Testing Distribution
REFERENCE BOOKS
1. Security in computing by Charles P Pfleeger

COMPILER DESIGN	
Course Code: 25CS3001	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. To introduce the major concept areas in compiler design and understand the structure of compilers.
2. To explore the working of lexical analysis, parsing, and syntax-directed translation.
3. To provide skills for intermediate code generation and effective use of symbol tables.
4. To impart knowledge of optimization techniques used in compilers for performance improvement.
5. To design efficient code generation strategies for target architectures.

COURSE LEARNING OUTCOMES (CLO)

The syllabus adheres to all Bloom's Taxonomy Levels and has been prepared in accordance with National Education Policy (NEP). After completion of course, students will be able to:

1. Understand the structure and phases of a compiler including the tools used for development.
2. Apply lexical and syntax analysis techniques using tools.
3. Generate intermediate code and handle backpatching for control flow constructs.
4. Perform code optimization using basic block transformations and global data flow analysis.
5. Design and implement target code generation and perform optimization.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

Mapped SDGs: SDG-4, SDG-9, SDG-12

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	Compilers and their structure - Phases of a compiler - Cousins of the Compiler - Grouping of Phases - Compiler construction tools - Lexical Analysis - Role of Lexical Analyzer - Input Buffering - Specification of Tokens, Lex specification.
UNIT-II	Parsing Techniques- Context-Free Grammars - Top-Down parsing - Recursive Descent Parsing - Predictive Parsing - Bottom-up parsing - Shift Reduce Parsing - Operator Precedent Parsing - LR Parsers - SLR Parser - Canonical LR Parser - LALR Parser
UNIT-III	Syntax Directed Translation – Intermediate representations Intermediate languages - Back patching - Procedure calls and Declarations - Assignment Statements - Boolean Expressions - Case Statements
UNIT-IV	Introduction - Principal Sources of Optimization - Optimization of basic Blocks - DAG representation of Basic Blocks - Introduction to Global Data Flow Analysis - Runtime Environments. Code Optimization – Basic Block formation – DAG for block optimization – Global data flow analysis – Runtime environments – Stack allocation – Parameter passing – Access to non-local names.
UNIT-V	Code Generation – Target machine model - Basic Blocks and Flow Graphs - Next-use Information - A simple Code generator - DAG based code generation - Peephole Optimization- Register allocation and instruction selection.

TEXT BOOKS

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman Compilers: Principles, Techniques, and Tools, 2nd Edition, Pearson, 2020 (a.k.a. the "Dragon Book")
2. Keith D. Cooper and Linda Torczon Engineering a Compiler, 3rd Edition, Morgan Kaufmann, 2022

REFERENCE BOOKS

1. Andrew W. Appel Modern Compiler Implementation in C (or Java, ML), Cambridge University Press, 2nd Ed. (latest reprint 2022)
2. Charles N. Fischer, Ron K. Cytron, Richard J. LeBlanc Jr. Crafting a Compiler, 2nd Edition, Pearson, 2022
3. Sridhar Iyer Compiler Design, Tata McGraw Hill, 2020

Open educational Resources

1. MIT OpenCourseWare – Compilers (6.035), https://ocw.mit.edu/courses/6-001-structure-and-interpretation-of-computer-programs-spring-2005/pages/lecture-notes/
2. Stanford CS143: Compilers, https://web.stanford.edu/class/archive/cs/cs143/cs143.1128/
3. NPTEL – Compiler Design (Prof. Partha Pratim Das / Prof. R. Ramasubramanian) https://nptel.ac.in/courses/106105190
4. LLVM Project (for Intermediate Representation and Code Gen) https://llvm.org/docs?

Open Access Journals and Research Repositories

1. **Journal of Computer Languages (Elsevier)**
   https://www.sciencedirect.com/journal/journal-of-computer-languages
2. **ACM Digital Library (Access through institutional login)**
   https://dl.acm.org
3. **arXiv.org – Programming Languages (cs.PL)**
   https://arxiv.org/list/cs.PL/recent
4. **International Journal of Computer Applications (IJCA)**
   https://www.ijcaonline.org/
5. **"Crafting Interpreters" by Bob Nystrom** (Free Online)
   https://craftinginterpreters.com/
6. **Compiler Explorer (Godbolt)**
   https://godbolt.org/

COMPUTER NETWORKS	
Course Code: 25CSPE3003	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES (COs)

1. Understand the fundamentals of computer networks, reference models, types of networks and topologies, and analyse the characteristics of physical layer signals and transmission media.
2. Understand and apply error detection/correction techniques, framing, flow control, and media access control methods in the data link layer.
3. Understand IP addressing (IPv4 & IPv6), packet structures, and routing protocols used in the network layer.
4. Understand and analyse routing mechanisms, interconnecting devices, and key transport/application layer protocols.
5. Demonstrate understanding of network security principles, encryption techniques, and secure communication protocols.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Describe and analyse the Internet's evolution, network standards, OSI & TCP/IP models, types of networks, topologies, signal properties, and transmission techniques.
2. Explain data link layer functions including framing, error handling, and protocols like ALOHA, CSMA, and channelization methods such as TDMA, FDMA, and CDMA.
3. Differentiate IPv4 and IPv6 addressing schemes, explain packet formats, and analyse routing concepts and protocols such as RIP, OSPF, and BGP.
4. Describe network devices, explain routing and forwarding, and understand the working of TCP/UDP, congestion control, and common application layer protocols (SMTP, FTP, DNS, etc.)
5. Explain symmetric/asymmetric encryption, PKI, hash functions, digital signatures, and secure communication using SSL/TLS.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	√				
CO2		√			
CO3			√		
CO4				√	
CO5					√

Mapped SDGs: SDG-4, SDG-9,SDG-11, SDG-16,SDG-17

COURSE CONTENT

UNIT NUMBER	COURSE CONTENT
UNIT-I	**INTRODUCTION**: A brief History; Internet Standards and Standards organization; OSI Reference Model; TCP/IP Model; Types of Networks : Local Area Networks, Metropolitan Area Networks, Wide Area Network; Topologies: Bus, Star, Ring, Hybrid, Tree, Complete, Irregular - Topology; Addressing. **Physical Layer** – Analog and digital signal properties: Sinewave, phase, wavelength, Bit rate, Transmission Impairment, Performance measures: Bandwidth, Throughput, Latency, Jitter; Guided and unguided transmission media; Circuit Switching, Packet Switching.
UNIT-II	**DATA LINK LAYERS** Data link Layer design issues: Framing, Error Detection & Correction: Byte and Bit stuffing, Checksum, CRC, Hamming codes; Elementary Data link Protocols- Sliding window Protocols; Media access control – Random Access: Aloha, CSMA, CSMA/CD; Controlled Access: Token Passing, Polling, Reservation; Channelization: TDMA, FDMA, CDMA; Ethernet Standard;
UNIT-III	**NETWORK LAYERS PROTOCOLS** IPV4 Addressing – classful and classless, Network Address Translation, IPV4 Packet format- IPV6 Addressing, IPV6 Packet format. **NETWORK ROUTING** Routing Concepts: Routing and Forwarding, Intra- and inter-domain routing, Distance vector routing, DVR Instability problem and solutions, RIP, Link State Routing, OSPF, Path Vector Routing, BGP.
UNIT-IV	**TRANSPORT & APPLICATION LAYER** **Transmission Control Protoco**l: User Datagram Protocol; Congestion control mechanisms; **Application Layer:** Email – SMTP, POP, IMAP; FTP, NNTP, HTTP, DNS, World Wide Web (WWW), Firewall.
UNIT-V	**PRESENTATION AND SESSION LAYER** Network Security Basics: Introduction to Cryptography, Symmetric and Asymmetric Encryption, Public Key Infrastructure (PKI), Hash Functions (SHA, MD5), Digital Signatures, SSL/TLS protocols for secure communication, Session and dialogue control. NetBIOS, RPC etc.

TEXT BOOKS

1. Andrew S. Tanenbaum, “Computer Networks”, Pearson Fourth Edition, 2005
2. Computer Networking: A Top-Down Approach, Global Edition 8th Edition June 17, 2021
3. James F. Kurose,Keith W. Ross “COMPUTER NETWORKING-A Top-Down Approach” Pearson 8th Edition 31/05/2022

REFERENCE BOOKS

1. Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw-Hill, 2004.
2. Data Communications and Networking with TCP/IP Protocol Suite, 6th Edition By Behrouz A. Forouzan © 2022
3. James F. Kurose and Keith W. Ross, “Computer Networking:A Top-Down Approach Featuring the Internet”, Pearson Education, Third Edition 2003/ 8th Edition (Global) 2020
4. William Stallings, “Data and Computer Communication”, Seventh Edition, Pearson Education,2003.
5. Data and Computer Communications (William Stallings Books on Computer and Data Communications) 10th Edition by William Stallings (Author) 2013/2014

OPEN EDUCATIONAL RESOURCES(OERs)

1. NPTEL-Computer Networks and Internet Protocol, IIT Kharagpur Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty https://nptel.ac.in/courses/106105183
2. NIELIT Academy (Kishor S. Chaudhari, Principal Technical Officer) https://www.nielit.gov.in/content/certified-system-and-networking-specialist
3. Cisco Networking Academy https://www.netacad.com/networking
4. https://www.geeksforgeeks.org/computer-networks/computer-network-tutorials/

NETWORK SECURITY LAB	
Course Code: 23CCS3115	Continuous Evaluation: 60 Marks
Pre-Requisite : Basics of Computer Networking	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES (CO)

1. To understand the security issues and vulnerability in e-mail systems.
2. To learn about the packet sniffer tools like Wireshark.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the requirement of network-based tools for network analysis.
2. Understand the use techniques for Network scanning.
3. Learn and identify network vulnerability.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3
CO1	✔	✔	
CO2			✔

Mapped SDGs: SDG-4, SDG-9

LIST OF PROGRAMS

1. Configuring Windows Firewall
2. Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome).
3. Study of packet sniffer tools like wireshark, ethereal, tcpdump etc
4. Installation of Wireshark
5. Explain Wireshark Graphical User Interface
6. Using Wireshark to capture the FTP password.
7. Download and install nmap. Use it with different options to scan open ports,perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, etc.
8. Detects ARP spoofing using open source tool ARPWATCH.
9. Use the Nessus tool to scan the network for vulnerabilities.
10. Install IDS (e.g. SNORT) and study the logs.

Learning Resources	
Reference Book and other materials	1. Laboratory Manual 2. Behrouz A. Frouzan: Cryptography and Network Security, TMH

Note:

1. **Students will create a project in teams to analyse and apply the concepts learnt.**

KALI LINUX LAB	
Course Code: 25CCS3113	Continuous Evaluation: 40 Marks
Pre-Requisite : Linux Programming and Computer Networks	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES (CO)

1. To implement concepts of backtracking through Kali Linux.
2. To understand the role of each component of each tool in security testing.
3. To learn network programming in linux.
4. To learn various tools for security testing.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the requirement of security testing.
2. Understand and implement the concepts of computer networking.
3. Design the application while deciding the level of requirement of each Linux component.
4. Learn and understand the mapping and interaction among various Linux components for a secure application.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4
CO1	✔	✔		✔
CO2	✔		✔	✔
CO3	✔	✔	✔	✔
CO4		✔		✔

Mapped SDGs: SDG-4

LIST OF PRACTICALS

1. Implementation of basic commands on kali.

2. File handling commands in kali.

3. Network analysis and file transfer with Netcat and Socat.

4. Implementation of Powercat and Powershell

5. Network analysis using wireshark.

6. Functions and loops in bash scripting in Kali Linux.

7. Passive Information gathering for a website.

8. Active information gathering for a website.

9. Implementation of SQL injection attack.

10. Implementation of buffer overflow attacks.

Note:

1. **Students can attempt the Kali Linux certification exam.**
2. **Students are expected to stay updated with documentation of kali tools at https://www.kali.org/tools/.**
3. **Kali Linux can work both on virtual machines and as a dual boot.**

Learning Resources	
Reference Book and other materials	1. Laboratory Manual 2. https://www.kali.org/docs/. 3. "Hands-on Penetration Testing for Web Applications: Run Web Security Testing on Modern Applications Using Nmap, Burp Suite and Wireshark", by Richa Gupta, BPB Publications.

COMPUTER NETWORKS LAB	
Course Code: 25CSPE3113	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES (COs)

1. Demonstrate the use of basic network commands and hardware functionalities through practical experiments with real or simulated networking devices.
2. Analyze packet transmission, flow control, and routing protocol performance, including OSPF configurations in single and multi-area environments.
3. Configure and secure routers and switches by setting passwords, enabling WEP, and managing Ethernet, serial, and wireless interfaces.
4. Design and implement network addressing schemes and DHCP services to enable structured and dynamic IP allocation in various network scenarios.
5. Develop and simulate core network services and protocols, including DNS resolution, TCP/UDP behavior, and congestion control mechanisms.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Use basic network commands and demonstrate the working of essential networking hardware components.
2. Analyze packet transmission and evaluate routing protocols and flow control mechanisms using real or simulated network environments.
3. Configure routers, switches, and wireless devices, including setting passwords, enabling WEP, and managing interfaces.
4. Design subnet-based IP addressing schemes and configure DHCP services for dynamic IP allocation.
5. Develop and simulate core network services such as DNS, and evaluate transport layer protocols and congestion control techniques

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	√	√			
CO2		√	√		
CO3			√		
CO4				√	
CO5					√

Mapped SDGs: SDG-4, SDG-9, SDG-11, SDG-12, SDG-16

LIST OF PROGRAMS

1. Demonstrate the use of basic network commands and conduct a demo session on various networking hardware and their functionalities.
2. Observe and analyze packet flow across the network and evaluate the performance of different routing protocols.
3. Configure a basic router setup including setting passwords and configuring interfaces.
4. Study and implement various flow control mechanisms in computer networks.
5. Design and implement an appropriate IP addressing scheme for a given network scenario.
6. Simulate transport layer protocols (e.g., TCP, UDP) and analyze congestion control techniques used in networking.
7. Develop a DNS client-server application to resolve a given hostname or IP address.
8. Implement and analyze Single-Area and Multi-Area OSPF, focusing on link costs and interface configurations.
9. Configure WEP (Wired Equivalent Privacy) security on a wireless router and test its connectivity.
10. Configure Ethernet and serial interfaces on network devices and verify successful communication.
11. Configure a Cisco router as a DHCP server to dynamically allocate IP addresses.

Note:
Tools: ns-2/ns-3, Omnet++, Wireshark/Cisco packet tracer. 5 or more exercises can be given by the Faculty.

TEXT BOOKS
1. Andrew S. Tanenbaum, "Computer Networks", Pearson Fourth Edition, 2005 2. Computer Networking: A Top-Down Approach, Global Edition 8th Edition June 17, 2021,James F. Kurose,Keith W. Ross "COMPUTER NETWORKING-A Top-Down Approach" Pearson 8th Edition 31/05/2022
REFERENCE BOOKS
1. Computer Networks: A Systems Approach, 4th Ed. (2007), by Larry Peterson and Bruce Davie. Covers background networking material with which students should have familiarity.

LIVE PROJECT-II & INDUSTRIAL VISIT	
Course Code: 25CS0303	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE

1. To provide hands-on experience at sites where Computer Science and engineering projects are executed.

COURSE LEARNING OUTCOMES:

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Gather first-hand experience on sites.
2. Apply the concepts learnt to design and create an application.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs COs	CLO1	CLO2
CO1	√	√

MAPPED SDGs: SDG-4,SDG-8,SDG-9

LIVE PROJECT - II

Students have to undergo six weeks practical training at the end of fourth semester in Computer Science and Engineering related project sites or with the faculty members of parent or any other institute of repute. At the end of the training they have to submit a report together with a certificate in the format prescribed and make a power point presentation which shall be evaluated.

COMPILER DESIGN LAB	
Course Code: 25CS3117	Continuous Evaluation: 30 Marks
Pre-Requisite : NIL	End Semester Examination: 70 Marks
L T P : 0 0 2	
Continuous Evaluation: 30 Marks	
End Semester Examination: 70 Marks	

COURSE OBJECTIVES

1. To be practically exposed to the compiler writing tools.
2. To be able to design and analyze the compiler.
3. To design a symbol table.
4. To implement various Parsing techniques.
5. To understand the basic steps for designing a compiler.

COURSE LEARNING OUTCOMES (CLOs):-

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Acquire the generic skills to design and implement a compiler along with analysis of practical aspects.
2. Learn application of different compiler writing tools to implement the different Phases of compiler.
3. Work on developing new computer languages in the industry and designing symbol tables.
4. Design Top-down, Bottom-up parsing Techniques.
5. Learn the process of translating a modern high-level language to executable code

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	√	√			
CO2		√	√		
CO3			√		
CO4				√	
CO5					√

Mapped SDG Goals: SDG -4,SDG-9, SDG-12, SDG- 17

LIST OF PROGRAMS

1. **Lexical Analyzer Generator**
   Implement a lexical analyzer that identifies tokens (keywords, identifiers, operators) from a C source file and generates symbol table entries.
2. **Operator Precedence Parser**
   Implement operator precedence parsing for arithmetic expressions with error handling for syntax violations.
3. **Recursive Descent Parser**
   Build a recursive descent parser for a subset of the C language (if-else, while loops) with parse tree generation.
4. **LR Parser Simulator**
   Simulate SLR parsing for grammar rules and display parsing tables with shift/reduce actions.
5. **Syntax-Directed Translator**
   During parsing, convert infix expressions to postfix notation using syntax-directed translation.
6. **Symbol Table Manager**
   Using hashing, Implement a hierarchical symbol table with scope management (insert, search, delete).
7. **Intermediate Code Generator**
   Generate three-address code for control structures (if, for) with basic block identification.
8. **DAG Optimizer**
   Construct a Directed Acyclic Graph (DAG) for basic blocks and eliminate common subexpressions.
9. **Peephole Optimizer**
   Implement peephole optimization techniques (constant folding, strength reduction) on assembly-like code.
10. **Register Allocator**
    Simulate graph-coloring register allocation for a set of virtual machine instructions.
11. **Code Generator**
    Generate x86 assembly snippets from three-address code for arithmetic operations.
12. **Error Recovery Mechanism**
    Implement panic-mode error recovery in a parser with meaningful error messages and line tracking.

TEXT BOOKS

1. N. Sandler, Writing a C Compiler. San Francisco, CA, USA: No Starch Press, 2024.
2. S. Chattopadhyay, Compiler Design, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2022.
3. D. Thain, Introduction to Compilers and Language Design, 2nd ed. (Online Book), 2020/2021. Available: https://www.compilerbook.com/
4. Alfred V. Aho, Jeffrey D Ullman, “Compilers: Principles, Techniques and Tools”, Pearson Education Asia, 2012.

REFERENCE BOOKS

1. Engineering a Compiler, Second Edition, Keith D. Cooper & Linda Torczon., Morgan Kaufmann, Elsevier.
2. Compiler Design, Sandeep Saxena, Rajkumar Singh Rathore, S.Chand Publications
3. T. Parr, The Definitive ANTLR 4 Reference. Raleigh, NC, USA: Pragmatic Bookshelf, 2013.
4. A. Møller and M. I. Schwartzbach, Static Program Analysis. Aarhus University, 2025. [Online]. Available: https://cs.au.dk/~amoeller/spa/spa.pdf

ONLINE EDUCATIONAL RESOURCES

1. Compiler Design (NPTEL - noc21_cs07) S. Chattopadhyay, “Compiler Design,” NPTEL, IIT Kharagpur. [Online]. Available: https://onlinecourses.nptel.ac.in/noc21_cs07/preview
2. Compiler Design (NPTEL - 106104123) S. K. Aggarwal, “Compiler Design,” NPTEL, IIT Kanpur. [Online]. Available: https://nptel.ac.in/courses/106104123
3. Computation Structures (MIT OpenCourseWare) C. Terman, “6.004 Computation Structures,” MIT

OpenCourseWare, Electrical Engineering and Computer Science, Spring 2017. [Online]. Available: https://ocw.mit.edu/courses/6-004-computation-structures-spring-2017/pages/c11/

4. 15-411 Compiler Design (Carnegie Mellon University) F. Pfenning, "15-411 Compiler Design," Carnegie Mellon University, Fall 2008. [Online]. Available: https://www.cs.cmu.edu/~fp/courses/15411-f08/

DESIGN THINKING AND AUGMENTED VIRTUAL REALITY	
Course Code: 25CS0202B	Continuous Evaluation: 70 Marks
Prerequisite: NIL	End Semester Examination:30 Marks
L T P : 0 0 2	
Credits: 1	

TRAINING OBJECTIVES (CO)
1. To recognize the importance of DT.
2. To explain the phases in the DT process.
3. To familiarize the students with the Augmented Virtual Reality Environment.
4. To establish and cultivate a broad and comprehensive understanding of this rapidly evolving and commercially viable field of Computer Science

TRAINING LEARNING OUTCOMES (TLOS) The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of training the students will be able to:
1. Understand and critically apply the concepts and methods of business processes.
2. Understand and analyze design thinking history and its various concepts.
3. Understand, analyze and create models with user collaboration to apply design thinking concepts.
4. Understand the role and importance of graphics in VR, AR and MR.
5. Understand the technical and experiential design foundation required for the implementation of immersive environments in current and future virtual, augmented and mixed reality platforms.

TRAINING LEARNING OUTCOME (TLO)-TRAINING OBJECTIVE (TO) MAPPING

	TLO1	**TLO2**	**TLO3**	**TLO4**	**TLO5**
TO1	√				
TO2		√	√		
TO3				√	
TO4					√

TRAINING CONTENTS

MODULE	TRAINING CONTENT	STUDENTS ENGAGEMENT ACTIVITY
UNIT-I	**INTRODUCTION TO DT** Recognize the importance of Design Thinking, Identify the steps in the DT process, Recognize the steps in the empathize phase of DT, Identify the steps required to conduct an immersion activity. **Student Activity:** *Product You Loved/Hated* – Reflective discussion.	Product that you loved and hated activity.
UNIT-II	**DEFINE PHASE OF DT** Conduct an immersion activity and fill up the DT question template, Recognize the steps to create personas in the define phase of DT, Recognize the steps to create problem statements in the define phase of DT, Define the problem statements in the define phase of DT **Student Activity:** Interview people and fill the DT Question template-*User Interview + Template Fill-up*	Interview people and fill the DT Question template
UNIT-III	**IDEATE PHASE OF DT** Recognize the steps in the ideate phase of DT, Apply the steps in the ideate phase of DT, Recognize how doodling can help to express ideas, Recognize the importance storytelling in presenting ideas and prototypes, Recognize the importance of the prototype phase in DT. **Student Activity:** Ideate a solution for a Given problem-Rapid prototyping ,Redesign a Flawed Experience-doodling, storytelling, importance of prototyping.	Ideate a solution for a given problem.
UNIT-IV	**INTRODUCTION TO VR and AR** Historical Overview, Current Trends and Future applications of Immersive Technologies, Best practices in VR, AR and Mixed Reality (MR), Categorization of VR and AR techniques, Input and Output devices used in AR and VR. Case Study : Google Lens, ARCore **Student Activity:**Case studies: Google Lens, ARCore, Explore and compare AR/VR apps.	To study various AR and VR based existing applications.
UNIT-V	**HANDS ON ACTIVITY** This activity will help the students to identify the importance of an innovative approach : a) Discuss about a product that you like or dislike and identify what they need in a bad product to make it good. b) Design a prototype of how AR and VR can be used in Education.	Designing of Solution to the Problem.

	Student Activity: Designing of Solution to the Problem**.**Test and refine prototype, Team project with prototype demo	

Text and Reference Books:

1. *Hooked* – Nir Eyal
2. *The Art of Creative Thinking* – Rod Judkins
3. *Start With Why* – Simon Sinek
4. *Start-Up Nation* – Dan Senor and Saul Singer
5. *Handbook of Virtual Environments* – Kelly S. Hale, Kay M. Stanney
6. *Real Virtuality: A Code of Ethical Conduct* – Michael Madary & Thomas K. Metzinger
7. *The VR Book: Human-Centered Design for Virtual Reality* – Jason Jerald

Open Educational Resources (OERs):

1. XR-Ed Framework (2020) – Design guidelines for educational XR environments Wikipedia+2Formosa Publisher+2Scribd+2dl.gi.de+3arXiv+3IRRODL+3
2. Open XR for Education Framework – Usable for curriculum unit planning WIRED+8ERIC+8IRRODL+8
3. FrontiersEdu (2024) – AR/STEAM study with OER emphasis Frontiers+1Medium+1
4. Scribd Student Handbook Level-2 AR/VR – Interactive design-thinking prompts

Key Journal Articles

1. "Design Thinking Testing of AR/VR Application for Bali's Lontar Prasi Preservation" – 2022 Formosa Publisher Demonstrates DT phases applied to AR/VR cultural app.
2. Frontiers in Virtual Reality (2023) – Design-thinking skill enhancement in VR Frontiers A thorough literature survey of VR enhancing DT abilities.
3. Journal of Physical Prototyping (Taylor & Francis) – Ongoing journal on VR rapid prototyping (OA, IF 10.2) Frontiers+1Frontiers+1Wikipedia
4. IEEE TVCG – Monthly journal on VR/AR visualization and UX methods
5. Kelly S. Hale (Editor), Kay M. Stanney (Editor). 2014. Handbook of Virtual Environments: Design, Implementation, and Applications, Second Edition (Human Factors and Ergonomics) ISBN-13: 978-1466511842
6. Michael Madary and Thomas K. Metzinger. 2016. Real Virtuality: A Code of Ethical Conduct.Recommendations for Good Scientific Practice and the Consumers of VR-Technology. Frontiers in Robotics and AI 3, February: 1–23. http://doi.org/10.3389/frobt.2016.00003
7. Jason Jerald. 2015. The VR Book: Human-Centered Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool Publishers. http://doi.org/10.1145/2792790

SEMESTER – VI

PENETRATION TESTING	
Course Code: 23CCS3002	Continuous Evaluation: 30 Marks
Pre-Requisite : Python	End Semester Examination: 70 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE
1. To learn the fundamentals of penetration testing using python.
2. To understand the search which is the first building block of penetration testing and its applications.
3. To understand and analyze the second building block of penetration testing that is security.
4. To understand the concepts of planning and learning to create secure applications.
5. To learn the applications of secure system designing.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Identify problems that are amenable to solution by python.
2. Solve problems like different types of attacks using python.
3. Deduce through logic and reasoning algorithms.
4. Handle uncertainty.
5. Understand the role of planning and learning in secure applications using python.
6. Formalize a given problem in the language/framework of different security methods.
7. Design and carry out an empirical evaluation of different algorithms using Python.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
CO1	✔						✔
CO2		✔					
CO3			✔	✔			
CO4					✔		
CO5			✔			✔	✔

Mapped SDGs: SDG-4, SDG-9

UNIT NUMBER	COURSE CONTENT
UNIT-I	**Introduction** Setting up python on kali linux, Python network programming, TCP Cient, UDP client, TCP server, replacing NETCAT, building a TCP proxy, SSH with paramiko, SSH tunnelling.

UNIT-II	**Network Layer in Python** Building a UDP Host directory tool, Packet sniffing on windows and linux, Decoding the IP layer, the ctypes Module, the struct module, writing the IP decoder, Decoding ICMP
UNIT-III	**SCAPY** Email credentials, ARP Cache poisoning with Scapy, PCAP Processing

UNIT NUMBER	**COURSE CONTENT**
UNIT-IV	**WEB** Web libraries in Python, mapping open source web applications, directories and file locations, HTML form authentication
UNIT-V	**Extending BRUP** Setting up, Brup Fuzzing, Bing for Brup, turning website content into password, Use of Github

Text Book:

1. Black Hat Python, Second Edition, Justin Seitz and Tim Arnold, No Starch Press, 2021 edition.

Reference Book:

1. Mastering Python for Networking and Security, Second Edition, Jose Manual Ortega, Packt Publishing, 2021.

ANDROID SECURITY	
Course Code: 25CCS3010	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE
1. To learn the setting up of the Android common development environment and tools.
2. To understand the manual inspection and usage of the security-relevant tools and services used to protect applications and their interaction with the operating system.
3. To understand to set up, run, and extend the hacking and reverse engineering on Android security assessment tools.
4. To understand the data transmitted and to stronger validation to the SSL communications.
5. To understand how to use the Android Device Administration API to implement and enforce enterprise security policies.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Understand how to set up, run the tools, and to develop Android applications on the Android platform.
2. Identify the security relevant problem and to protect the applications.
3. Known to examine Android application component types for security risk in source code and inter-application context.
4. Understand the Secure Sockets Layer communications
5. Formalize to protect from memory corruption and race condition exploitation.
6. Understand how to use encryption and develop device administration policies.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	✔					
CO2		✔				
CO3			✔			
CO4				✔		
CO5					✔	✔

Mapped SDGs: SDG-4, SDG-9

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT
UNIT-I	Android Development Tools – Installing the Android Development Tools, Installing the Java Development Kit, Updating the API sources, Alternative installation of the ADT, Installing the Native Development Kit, Emulating Android, Creating Android Virtual Devices (AVDs), Using the Android Debug Bridge (ADB) to interact with the AVDs, Copying files off/onto an AVD, Installing applications onto the AVDs via ADB, Engaging with Application Security – Inspecting application certificates and signatures, Signing Android applications, Verifying application signatures, Inspecting the AndroidManifest.xml file, Interacting with the activity manager via ADB, Extracting application resources via ADB.
UNIT-II	Android Security Assessment Tools – Introduction, Installing and setting up Santoku, Setting up drozer, Running a drozer session, Enumerating installed packages, Enumerating activities, Enumerating content providers, Enumerating services, Enumerating broadcast receivers, Determining application attack surfaces, Launching activities, Writing a drozer module – a device enumeration module, Writing an application certificate enumerator. Exploiting Applications – Introduction, Information disclosure via logcat, Inspecting network traffic, Passive intent sniffing via the activity manager, Attacking services, Attacking broadcast receivers, Enumerating vulnerable content providers, Extracting data from vulnerable content providers, Inserting data into content providers, Enumerating SQL-injection vulnerable content providers, Exploiting debuggable applications, Man-in-the-middle attacks on applications.
UNIT-III	Protecting Applications – Introduction, Securing application components, Protecting components with custom permissions, Protecting content provider paths, Defending against the SQL-injection attack, Application signature verification (anti-tamper), Tamper protection by detecting the installer, emulator, and debug flag, Removing all log messages with ProGuard, Advanced code obfuscation with DexGuard. Reverse Engineering Applications – Introduction, Compiling from Java to DEX, Decompiling DEX files, Interpreting the Dalvik bytecode, Decompiling DEX to Java, Decompiling the application's native libraries, Debugging the Android processes using the GDB server.
UNIT-IV	Secure Networking – Introduction, Validating self-signed SSL certificates, Using StrongTrustManager from the OnionKit library, SSL pinning.

UNIT-V	Native Exploitation and Analysis – Introduction, Inspecting file permissions, Cross-compiling native executables, Exploitation of race condition vulnerabilities, Stack memory corruption exploitation, Automated native Android fuzzing. Encryption and Developing Device Administration Policies – Introduction, Using cryptography libraries, Generating a symmetric encryption key, Securing Shared Preferences data, Password-based encryption, Encrypting a database with SQLCipher, Android KeyStore provider, Setting up device administration policies.

TEXT BOOKS

1. Keith Makan, Scott Alexander, Android Security Cookbook, Packt Publishing, First edition, 2013.
2. Nikolay Elenkov, Android Security Internals: An In-Depth Guide to Android's Security Architecture, no starch press, First edition, 2015.

REFERENCE BOOKS

1. Jeff Six, Application Security for the Android platform, O'Reilly, First Release, 2012.
2. Abhishek Dubey, Anmol Mishra, Android Security Attacks and Defenses, CRC Press, 2013.
3. Pragati Ogal Rai, Android Application Security Essentials, Packt Publishing, 2013.
4. Sheran Gunasekera, Android Apps Mitigate Hacking Attacks and Security Breaches, Apress, Second Edition, 2020.

SOFTWARE ENGINEERING	
Course Code: 25CS**3004**	Continuous Evaluation: 30 Marks
Pre-Requisite : Concept of OOP and Methodology	End Semester Examination: 70 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

1. To introduce and implement Modern software process models (agile, scrum framework, sprint planning). AI transforms software development; DevOps integrates security into the development life cycle.
2. To extract and analyze software requirements specifications for different projects.
3. To develop the ability to design software systems using object-oriented principles, UML modelling, and architectural patterns.
4. To understand and apply various software testing techniques, verification methods, and behavior-driven development practices.
5. To evaluate software maintenance strategies, reliability issues, and deployment models used in real-world software systems.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Analyze software development process models, including agile models and traditional models like waterfall.
2. Apply functional and non-functional requirement gathering techniques and estimate project cost using COCOMO or Agile metrics.
3. Design software solutions using SOLID principles, UML diagrams, and appropriate architectural styles like MVC or micro services.
4. Analyze and apply white-box and black-box testing strategies, including TDD and BDD, to ensure software correctness.
5. Evaluate maintenance approaches, software reliability concepts and apply CASE Tools.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3		✔	✔		
CO4			✔	✔	
CO5					✔

Mapped SDGs: SDG-4, SDG-8, SDG-9

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software life cycle models: Build and Fix Waterfall, Prototype, Iterative Enhancement Model, Evolutionary and Spiral model, V Model & RAD Model. Modern software process models (agile, scrum framework, sprint planning). AI transforms software development; DevOps integrates security into the development life cycle.
UNIT-II	**SOFTWARE REQUIREMENTS & QUALITY ASSURANCE** Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model. Delphi and Basic COCOMO, Staffing Level Estimation, Staffing and sprint management. Introduction to agile roles: scrum master, product owner, developer.
UNIT-III	**SOFTWARE DESIGN CONCEPT** Basic Concept of Software Design, Architectural Design: MVC, Monolithic, Client-Server and micro-services. Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Abstraction, and Top-Down and Bottom-Up Design. Domain-driven design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs. SOLID principles, class and sequence diagrams using UML
UNIT-IV	**SOFTWARE TESTING** Software Testing: Testing functions, Test case design, White Box testing: cyclomatic complexity, Black box testing: Boundary value Analysis, Equivalence class partitioning, Unit testing, Integration Testing, System testing, Alpha Testing, Beta Testing and Acceptance Testing. Automation tools like Selenium. Introduction to TDD (test driven development), BDD (Behaviour-Driven Development).
UNIT-V	**SOFTWARE MAINTENANCE & RELIABILITY ISSUES** Need for Maintenance, Categories of Maintenance, The Maintenance Process, Maintenance Models: Quick fix, Iterative Enhancement, Reuse Oriented. Reverse Engineering, Software RE-engineering, Configuration Management. Software Reliability: Failure and Faults, Software reliability Vs Hardware reliability, Classification of Failures, Software reliability metrics. CASE tools.

TEXT BOOKS

1. Richard Fairley, “Software Engineering Concepts”, 1st edition, McGraw Hill, 2017.
2. Eric Evans, “Domain-Driven Design”, 1st edition, Addison-Wesley Professional, 2003.
3. Robert Martin, “Agile Software Development, Principles, Patterns, and Agile Software Development, Principles, Patterns, and Practices”, 1st edition, Pearson, 2002.
4. Roger S. Pressman, “Software Engineering A Practitioner Approach”, 4th edition, McGraw Hill, 1999.
5. Erich Gamma, Richard Helm, Ralph Johnson, “Design Patterns: Elements of Reusable Object- Oriented Software”, 1st edition, Addison-Wesley Professional, 1994.

REFERENCE BOOKS

1. Rubin Kenneth S. “Essential Scrum: A Practical Guide to the Most Popular Agile Process”, 1st edition, Addison-Wesley Professionals, 2012.
2. Fundamentals of Software Engineering by Rajib Mall,–PHI-3rd Edition, 2009.
3. Ian Somerville, Software engineering, Pearson education Asia, 6th edition, 2000.
4. Pankaj Jalote-An Integrated Approach to Software Engineering, Springer Verlag, 1997.
5. Shooman, Software Engineering, McGraw Hill, 1983.

OPEN EDUCATIONAL RESOURCES

1. Software Engineering Tutorial – Geeks for Geeks
2. https://medium.com/towards-data-engineering/software-engineering-list-of-concepts-tools-sectors-and-learning-resources.
3. Top Software Architecture Courses Online - Updated [July 2025].
4. Software Testing Techniques – Geeks for Geeks
5. 15 Free Software Engineering Courses & Certificates 2025
6. ttps://www.bing.com/videos/riverview/relatedvideo?q=software+maintenance+open+sources+for+learning+&mid
7. https://www.bing.com/videos/riverview/relatedvideo?q=software+maintenance+open+s

Penetration Testing Lab	
Course Code: 25CCS3116	Continuous Evaluation: 60 Marks
Pre-Requisite : Python	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES (CO)

1. To implement concepts of backtracking and penetration testing through Python.
2. To understand the role of each component of each tool in python.
3. Learn python network programming.
4. Learn security testing with python

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the requirements of python.
2. Understand and implement the concepts of python networking.
3. Learn to design the application while deciding the level of requirement of each security component.
4. Learn and understand the mapping and interaction among various Python components for a secure application.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4
CO1	✔	✔		✔
CO2	✔		✔	✔
CO3	✔	✔		✔
CO4	✔		✔	✔

Mapped SDGs: SDG-

LIST OF PRACTICALS

1. Implementation of basic commands on Python.
2. Network analysis with Python
3. The Network: Raw Sockets and sniffing
4. Owning the Network with Scapy
5. Web Penetration testing

6. Extending Brup Proxy

7. Github Command and Control

8. Windows Privilege escalation

Note:

1. Students can attempt the Python certification exam.
2. Students are expected to stay updated with documentation of python at The Python Tutorial Python 3.10.4 documentation.
3. Kali Linux with Python can work both on virtual machines and as a dual boot.

Learning Resources	
Reference Book and other materials	1. Laboratory Manual 2. Black Hat Python, Second Edition, Justin Seitz and Tim Arnold, No Starch Press, 2021 edition. 3. Mastering Python for Networking and Security, Second Edition, Jose Manual Ortega, Packt Publishing, 2021.

SOFTWARE ENGINEERING LAB	
Course Code: 25CS3118	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits:1	

COURSE OBJECTIVES

1. To understand the concepts and implement the software engineering methodologies in the list of applications given below. Each UML diagram is designed to let developers and customers view a software system from a different perspective and in varying degrees of abstraction. UML diagrams commonly created in RSA visual modeling tools.
2. To have hands-on experience in developing a software project by using various software engineering principles and methods in each of the phases of software development.
3. To Understand the User requirements through different software design components like DFD's, ER Diagram, Activity Diagram, Class Diagram, State Transition Diagram and Deployment Diagram etc.
4. To understand the concepts of SDLC Models like waterfall model, spiral model, prototyping model and Agile model specially.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP).After completion of course, students would be able to:

1. Able to prepare SRS document, design document, test cases and software configuration management and risk management related documents.
2. Ability to translate end-user requirements into system and software requirements.
3. Understand and develop various structure and behavior UML diagrams
4. Develop function oriented and object oriented software design using tools like rational rose, Umbrello and free on-line tools like Star umbrello and Visual Paradigm.
5. Generate a high-level design of the system from the software requirements

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3		✔	✔		
CO4			✔	✔	
CO5	CLO1	CLO2	CLO3	CLO4	CLO5

Mapped SDGs: SDG-4,SDG-9,SDG-11,SDG-1

LIST OF EXPERIMENTS

Structure Diagram:

1. To display a relationship among the various structures using a Class diagram.
2. Manifestation concept of Component Diagram.
3. Network architect process using the Deployment Diagram.

Behavior Diagram:

1. Use-Case Diagram–To display the relationship among actors & Use-cases.
2. Activity Diagram–To display the action states & source transition states.
3. State Machine Diagram– sequence of state response & action on the interaction.

Interaction Diagram:

1. Sequence Diagram – To display the time sequence of object interactions.
2. Communication Diagram – To display the elements of frame, lifeline, messages.

Case Study:

1. UML interaction overview diagram for online shopping.
2. Bank ATM behavioral using state machine diagram.
3. Library Domain model using Class diagram.

TEXT BOOKS
1. Roger S. Pressman, "Software Engineering A Practitioner Approach" 4th edition, McGraw Hill, 1999. 2. Software Engineering-Sommerville,7thedition,PearsonEducation 3. The unified modeling language user guide Grady Booch, James Rambaugh, Ivar Jacobson, Pearson Education
REFERENCE BOOKS
1. Ian Somerville, Software engineering, Pearson education Asia, 6th edition, 2000. 2. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiley. 3. Software Engineering principles and practice-Waman S Jawadekar
OPEN EDUCATIONAL RESOURCES
1. https://staruml.io/ 2. https://plantuml.com/ 3. https://www.geeksforgeeks.org/system-design/tools-for-designing-and-drawing-uml-diagrams/ 4. https://www.visual-paradigm.com/VPGallery/import/Rose.html 5. https://apps.kde.org/umbrello/

NETWORK PROGRAMMING LAB	
Course Code: 25CCS3014	Continuous Evaluation: 40 Marks
Pre-Requisite: Basics of any Programming Language	End Semester Examination: 60 Marks
L T P: 0 0 2	
Credits: 1	

COURSE OBJECTIVES (CO)

1. To learn about the concepts of socket programming.
2. To familiarize about the different ways for designing concurrent applications.
3. To learn how to write their own network programs using API.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand and apply the concepts of socket programming to design client-server based applications.
2. Understand and apply the concepts of concurrent socket programming to design client-server based applications.
3. Understand and learn to create event based network programs.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	**CLO2**	**CLO3**
CO1	✔		
CO2		✔	
CO3			✔

Mapped SDGs: SDG-4

LIST OF PROGRAMS

1. Introduction to Socket Programming.
2. Study of Network Commands.
3. Write a simple client-server program for exchanging messages using TCP.
4. Write a simple client-server program for exchanging messages using UDP.
5. Write a simple client-server program for exchanging messages using UDP with connect.
6. Write a concurrent TCP client-server program using fork.
7. Write a client-server program using Unix Domain Stream sockets.
8. Write a concurrent TCP client-server program using select and without using fork.
9. Write a concurrent TCP and UDP client-server program using select.
10. Write a client-server program using Unix Domain Datagram sockets.
11. Write a server program handling SIGCHLD signal using waitpid() in handler:
    a. 1 client w/o while loop in handler
    b. 3 clients w/o while loop in handler
    c. 3 clients with waitpid() in while loop
12. Write a client-server program to implement an alarm in read.
13. Write a UDP client-server program to verify received responses.

Note:

1. Faculty members may give additional programs to understand the concepts.
2. Students can choose any programming language for implementation like Python, C, C++, Java etc.
3. Students can create a project in teams to analyse and apply the concepts learnt.

Learning Resources	
Reference Book and other materials	1. Laboratory Manual

BIG DATA ANALYTICS, TOOLS AND TECHNIQUES- LEVEL-III	
Course Code: 25CS0302	**Continuous Evaluation:** 70 Marks
Prerequisite: NIL	**End Semester Examination:** 30 Marks
L T P: 0 0 2	
Credits: 1	

TRAINING OBJECTIVES

1. To provide an overview of an exciting field of big data analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSQL & MapReduce.
3. To learn the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.

TRAINING LEARNING OUTCOMES (TLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of training the students will be able to:

1. Understand the vision of Big Data from a global context.
2. Understand and apply Hadoop in the Market perspective of Big Data.
3. Evaluate the application of Big Data in Industrial and Commercial Building Automation, evaluating Big Data performance using MapReduce and Real-World Design Constraints.
4. Apply and analyze architecture and APIs with use of Devices, Gateways and Data Management in Big data.

TRAINING LEARNING OUTCOME (TLO) -TRAINING OBJECTIVE (TO) MAPPING:

	TLO1	TLO2	TLO3	TLO4
TO1	✔			
TO2		✔	✔	
TO3				✔

Mapped SDGs: SDG-3, SDG-4, SDG-8, SDG-9, SDG-11.

TRAINING CONTENTS:

MODULE	TRAINING CONTENTS	STUDENT'S ENGAGEMENT ACTIVITY
I	**BIG DATA** Definition with Real Time Examples, How Big Data is generated with Real Time Generation, Use of Big Data-How Industry is utilizing Big Data, Future of Big Data.	**Case Study Discussions:** Analyze big data use in industries like healthcare (e.g., disease prediction), finance (fraud detection), and retail (customer behavior). **Hands-On Activity:** Use Google Trends, Twitter API, or Kaggle datasets to explore and present patterns in real-world data.

		Mini Project Idea: "Tracking real-time data from COVID-19 APIs and visualizing trends using Tableau or Power BI."
II	**HADOOP** Why Hadoop? What is Hadoop? Hadoop vs RDBMS, Hadoop vs BigData, Anatomy of a Hadoop cluster, Hadoop Commands.	**Lab Exercise:** Set up a single-node Hadoop cluster using Docker or on AWS EMR. **Practical Activity:** Ingest a large dataset (e.g., web server logs) and perform basic HDFS operations and data manipulation. **Real-Time Task:** Compare performance of batch vs stream processing with a discussion on when Hadoop is suitable vs modern frameworks like Spark or Flink.

III	**MAPREDUCE** Theory, Data Flow (Map – Shuffle - Reduce), MapRed vs MapReduce APIs, Mapper & Reducer Commands.	**Coding Assignment:** Implement a word count, log analyzer, or weather data summarizer using MapReduce (Java or Python). **Industry Example Analysis:** Explore how Netflix or Amazon uses MapReduce for customer recommendations or operational analytics. **Mini Hackathon:** Students build a MapReduce job that summarizes and ranks large datasets from open sources (e.g., Common Crawl, YouTube comments, or product reviews).
IV	**HIVE AND PIG** Architecture, Installation, Configuration, Hive vs RDBMS, Why Pig, Use case of Pig, Pig Components, Data Model.	**Hands-on Activity:** Create and query Hive tables over structured data such as CSV from a public dataset. **Use Case Simulation:** Design a data pipeline using Pig Latin for preprocessing log files and Hive for analytics. **Project Work:** "Build a Sales Data Analytics Dashboard using Hive over Hadoop and visualized via Google Data Studio or Power BI."

LEARNING RESOURCES

1. Gelman, Andrew, and Jennifer Hill. Data Analysis Using Regression and Multilevel/Hierarchical Models. 1st ed. Cambridge, UK: Cambridge University Press, 2006. ISBN: 9780521867061.
2. Gelman, Andrew, John B. Carlin, Hal S. Stern, and Donald B. Rubin. Bayesian Data Analysis. 2nd ed. New York, NY: Chapman & Hall, 2003. ISBN: 9781584883883
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data" by EMC Education Services
4. Analytics: Data Science, Data Analysis and Predictive Analytics for Business" by Daniel Covington.
5. Machine Learning for Big Data: Hands-On for Developers and Technical Professionals" by Jason Bell.

OPEN EDUCATIONAL RESOURCES (OER's)

1. NPTEL Course by Prof. Rajiv Misra, Big Data Computing, IIT Patna, 2022. https://nptel.ac.in/courses/106105254
2. IBM SkillsBuild, Data Analysis and Visualization with Python, 2023. https://skillsbuild.org/
3. MIT OpenCourseWare, Statistics for Applications (18.650), Fall 2020 https://ocw.mit.edu/courses/18-650-statistics-for-applications-fall-2020/
4. EdX Course by UC San Diego, Big Data Analytics Using Spark, 2023. https://www.edx.org/course/big-data-analytics-using-spark

LIVE PROJECT - III & INDUSTRIAL VISIT	
Course Code: 25CS0304	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES:

1. To provide hands-on experience at sites where Computer Science and engineering projects are executed.

COURSE LEARNING OUTCOMES:

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Gather first-hand experience on sites.
2. Apply the concepts learnt to design and create an application.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	**CLO2**
CO1	√	√

LIVE PROJECT-III:

Students have to undergo three weeks practical training at the end of fifth semester in Computer Science and Engineering related project sites or with the faculty members of parent or any other institute of repute. At the end of the training they have to submit a report together with a certificate in the format prescribed and make a power point presentation which shall be evaluated.

SEMESTER – VII

CLOUD SECURITY	
Course Code: 25CCS4003	Continuous Evaluation: 40 Marks
Pre-Requisite: NIL	End Semester Examination: 60 Marks
L T P: 3 1 0	
Credits: 4	

COURSE OBJECTIVE
1. Compare modern security concepts as they are applied to cloud computing
2. Assess the security of virtual systems
3. Evaluate the security issues related to multi-tenancy
4. Appraise compliance issues that arise from cloud computing

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Understand core cloud computing concepts and fundamental principles, including standard delivery models
2. Understand the foundational security practices that are required to secure modern cloud computing infrastructures.
3. Understand the complexity of cloud threat actors and techniques used to attack a cloud computing infrastructure
4. Understand the regulatory requirements needed to secure data in the cloud and the difficulties in meeting those requirements
5. Understand how to protect data-at-rest, data-in-transit, and data-in-use within a cloud environment.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔	✔			
CO2		✔	✔		
CO3				✔	
CO4				✔	
CO5				✔	✔

Mapped SDGs: SDG-4,SDG-9,SDG-12,SDG-16, SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT
UNIT-I	**Security Concepts:** Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud; Cryptographic Systems- Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL
UNIT-II	**Multi-Tenancy Issues:** Isolation of users/VMs from each other. How the cloud provider can provide this; Virtualization System Security Issues- e.g. ESX and ESXi Security, ESX file system security, storage considerations, backup and recovery; Virtualization System Vulnerabilities- Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, guest VM vulnerabilities, hypervisor vulnerabilities, hypervisor escape vulnerabilities, configuration issues, malware (botnets etc).
UNIT-III	**Virtualization System-Specific Attacks:** Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyper jacking
UNIT-IV	**Technologies For Virtualization-Based Security enhancement:** IBM security virtual server protection, virtualization-based sandboxing; Storage Security- HIDPS, log management, Data Loss Prevention. Location of the Perimeter.
UNIT-V	**Legal And Compliance Issues:** Responsibility, ownership of data, right to penetration test, local law where data is held, examination of modern Security Standards (eg PCIDSS), how standards deal with cloud services and virtualization, compliance for the cloud provider vs. compliance for the customer.

TEXT BOOKS

1. Tim Mather, Subra Kumaraswamy, ShahedLatif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" O'Reilly Media; 1 edition [ISBN: 0596802765], 2009.
2. Ronald L. Krutz, Russell Dean Vines, "Cloud Security" [ISBN: 0470589876], 2010.

REFERENCE BOOKS

1. John Rittinghouse, James Ransome, "Cloud Computing" CRC Press; 1 edition [ISBN: 1439806802], 2009.

QUANTUM CRYPTOGRAPHY	
Course Code: 25CCS4005	Continuous Evaluation (Internal): 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisites: Cryptography Fundamentals	

COURSE OBJECTIVE
1. The student should be able to list the postulates of quantum physics and apply them in specific cases
2. The student should be able to work with quantum bits.
3. The student should be able to distinguish between separable states and entangled states.
4. Students must be able to apply entangled states in teleporting and dense coding.
5. Students must be able to describe the logic of quantum algorithms of academic interest: Deutsch, Deutsch-Jozsa generalizations and Vazirani.
COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:
1. The basic principles of quantum computing.
2. The fundamental differences between conventional computing and quantum computing.
3. Several basic quantum computing algorithms.
4. The classes of problems that can be expected to be solved well by quantum computers.
5. Understand the Quantum security techniques on real applications.

COURSE LEARNING OUTCOME (CLO)-COURSE OBJECTIVE (CO) MAPPING

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	

CO5					✔

Mapped SDGs: SDG-4, SDG-9,SDG-16,SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**QUANTUM PHYSICS.** Brief introduction to quantum physics and its importance in the microcosm world, The historical motivation is given and deepens especially in the wave-particle duality, The postulates of quantum physics are introduced, with special emphasis on the Schrödinger equation and the probabilistic nature of the measure, The solution to the Schrödinger equation for a potential well of infinite-dimensional is presented, The example contains all the basic ingredients for understanding the stationary states and also the superposition of states, which will have a prominent role for the description of quantum bits.
UNIT-II	**QUBITS.** Systems of two states: quantum bits (qubits). The basic operations through Kets and bras are introduced, the brackets as scalar products, superpositions of base's states.
UNIT-III	**QUANTUM CRYPTOGRAPHY**. The basic principles of quantum cryptography are outlined. Protocols that use entanglement, such as Eckert's one and others, based on the measure's postulate such as BB84 and B92,
UNIT-IV	**QUANTUM LOGIC. GATES AND SIMPLE QUANTUM ALGORITHMS.** A description is given of a) The temporal evolution of the qubits is given in terms of unitary operators and their connection with quantum logic gates, b) The minimal set of quantum logic gates that allows any computation performed on any system implying an arbitrary number of qubits. c) Quantum gate diagrams, as a flowchart of the computation. d) The evaluation of quantum functions, implemented by unitary operators. e) Simple quantum algorithms of academic interest are worked out.
UNIT-V	**SHOR'S FACTORING ALGORITHM.** From the foundations of the classical RSA encryption's algorithm, the Shor's quantum factoring algorithm is introduced. A detailed description is given, distinguishing those parts of the purely classical algorithm, requiring concepts of number theory, modular arithmetic and continuous fractions, from the quantum part, which uses the principle of superposition and quantum Fourier transform to extract the period of a periodic function, from which one can deduce the factors of the number to be factorized.
TEXT BOOKS	
Quantum computation and quantum information - Nielsen, M.A.; Chuang, I.L, Cambridge University Press, 2000. ISBN: 0521635039	
Philip M. Parker, The 2020-2025 World Outlook for Quantum Cryptography	

REFERENCE BOOKS
1. Naya Nagy, Selim Akl, Marius Nagy, Applications of Quantum Cryptography
2. Walton Frazer, Quantum Information Theory, The Future of Quantum Cryptography and Computing

CLOUD SECURITY LAB	
Course Code: 25CCS4007	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

1. Compare modern security concepts as they are applied to cloud computing
2. Assess the security of virtual systems

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand core cloud computing concepts and fundamental principles, including standard delivery models.
2. Understand the foundational security practices that are required to secure modern cloud computing infrastructures.
3. Understand the complexity of cloud threat actors and techniques used to attack a cloud computing infrastructure.

COURSE LEARNING OUTCOMES (CLO)-COURSE OBJECTIVES (CO) MAPPING

	CLO1	CLO2	CLO3
CO1	✔		
CO2		✔	✔

Mapped SDGs: SDG-4, SDG-9

LIST OF PROGRAMS

1. Install Virtualbox/VMware Workstation with different flavours 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.

Learning Resources	Laboratory Manual

QUANTUM CRYPTOGRAPHY LAB	
Course Code: 25CCS4009	Continuous Evaluation (Internal): 40 Marks
Credits: 1	End Semester Examination: 60 Marks
L T P : 0 0 2	
Prerequisites: Cryptography Fundamentals	

COURSE OBJECTIVE
1. The student should be able to list the postulates of quantum physics and apply them in specific cases in real world
2. The student should be able to work with quantum bits in lab.
3. The student should be able to distinguish between separable states and entangled states in Lab.
4. Students must be able to apply entangled states in teleporting and dense coding in practical.
5. Students must be able to describe the logic of quantum algorithms of academic interest: Deutsch, Deutsch-Jozsa generalizations and Vazirani.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:
1. The basic principles of quantum computing.
2. The fundamental differences between conventional computing and quantum computing.
3. Several basic quantum computing algorithms.
4. The classes of problems that can be expected to be solved well by quantum computers.
5. Understand the Quantum security techniques on real applications.

COURSE LEARNING OUTCOME (CLO)-COURSE OBJECTIVE (CO) MAPPING

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	
CO5					✔

Mapped SDGs: SDG-4, SDG-9

LIST OF EXPERIMENTS

1. Implementing Qubits.

2. Implement Shor's Algorithm for Quantum Cryptography.

3. Implement Grover's Algorithm for Quantum Cryptography.

4. Apply AES algorithm for Post Quantum Cryptography (PQC).

5. Implement RSA Algorithm using HTML and JavaScript for PQC.

6. Implement the Diffie-Hellman Key Exchange algorithm for a given problem for PQC.

7. Calculate the message digest of a text using the SHA-1 algorithm for PQC.

8. Implement the SIGNATURE SCHEME - Digital Signature Standard for PQC.

9. Demonstrate intrusion detection system (ids) using any tool eg. Snort or any other s/w.

10. Automated Attack and Penetration Tools Exploring N-Stalker, a Vulnerability Assessment Tool.

11. Defeating Malware - Building Trojans, Rootkit Hunter.

TEXT BOOKS
1. Quantum computation and quantum information - Nielsen, M.A.; Chuang, I.L, Cambridge University Press, 2000. ISBN: 0521635039
2. Philip M. Parker, The 2020-2025 World Outlook for Quantum Cryptography

REFERENCE BOOKS
1. Naya Nagy, Selim Akl, Marius Nagy, Applications of Quantum Cryptography
2. Walton Frazer, Quantum Information Theory, The Future of Quantum Cryptography and Computing

LIVE PROJECT-IV & INDUSTRIAL VISIT	
Course Code: 25CS4115	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE

To provide hands-on experience at site where Computer Science and engineering projects are executed and help them to improve their skills.

COURSE LEARNING OUTCOMES:

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Gather a first-hand experience on sites.
2. Apply the concepts learnt to design and create an application which help them to enhance their resume.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2
CO1	✔	✔

LIVE PROJECT-IV

Students have to undergo six weeks practical training at the end of sixth semester in Computer Science and Engineering related project sites or with the faculty members of parent or any other institute of repute. At the end of the training they have to submit a report together with a certificate in the format prescribed and make a power point presentation which shall be evaluated.

MINOR PROJECT	
Course Code: 25CS4117	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 8	
Credits: 4	

COURSE OBJECTIVE

To simulate real life situations related to Computer Science and engineering and impact adequate training so that confidence to face and tackle any problem in the field is developed.

COURSE LEARNING OUTCOMES:

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Identify, formulate and analyse existing problem in the (non-automated) work flow for performing a specific task.
2. Design and implement automated solutions for the assigned/identified real world problems.
3. Write technical reports.
4. Practice and develop skills in time management and reporting within an industrial or research laboratory setting.
5. Contribute to an ethical and professional work culture and also to learn to work in diverse teams.

MAPPING BETWEEN COURSE OBJECTIVES (CO) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔	✔	✔	✔	✔

PROJECT

Each student is given an exercise which will cover all the aspects (to the extent possible) like investigation, planning, designing, detailing and estimating of a Computer Science and engineering structure in which the aspects like analysis, application of relevant codes, etc., will find a place. Alternately, a few research problems also may be identified for investigation and the use of laboratory facilities to the fullest extent may be taken as a project work. Alternately, a student is encouraged to take an industrial project with any Computer Science and engineering organization or firm. A project report is to be submitted on the topic which will be evaluated.

SEMESTER – VIII

MAJOR PROJECT	
Course Code: 25CS4114	Continuous Evaluation: 60 Marks
Pre-Requisite: NIL	End Semester Examination: 40 Marks
L T P: 0 0 24	
Credits: 12	

COURSE OBJECTIVE

The objective of the project semester is to make the students solve real world problems using automated solutions, while developing management and writing skills amongst them.

COURSE LEARNING OUTCOMES:

1. Identify, formulate and analyse existing problem in the (non-automated) work flow for performing a specific task.
2. Design and implement automated solutions for the assigned/identified real world problems.
3. Write technical reports.
4. Practice and develop skills in time management and reporting within an industrial or research laboratory setting.
5. Contribute to an ethical and professional work culture and also to learn to work in diverse teams.

MAPPING BETWEEN COURSE OBJECTIVE (CO) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔	✔	✔	✔	✔

MAJOR PROJECT

Each student is given an exercise which will cover all the aspects (to the extent possible) like investigation, planning, designing, detailing and estimating of a Computer Science and engineering structure in which the aspects like analysis, application of relevant codes, etc., will find a place. Alternately, a few research problems also may be identified for investigation and the use of laboratory facilities to the fullest extent may be taken as a project work. Alternately, a student is encouraged to take an industrial project with any Computer Science and engineering organization or firm. A project report is to be submitted on the topic which will be evaluated.

SYLLABUS OF PROFESSIONAL ELECTIVE COURSES

DISTRIBUTED OPERATING SYSTEM	
Course Code: 25CSPE3020	Continuous Evaluation: 40 Marks
Pre-Requisite: NIL	End Semester Examination: 60 Marks
L T P: 3 1 0	
Credits: 4	

COURSE OBJECTIVES
1. To know about basic concepts of Distributed operating system.
2. To provide hardware and software issues in modern distributed systems.
3. To get knowledge in distributed architecture and accessibility of resources in distributed file systems.
4. To learn how to store data in Distributed File System and Distributed Share memory.
5. To understand naming, synchronization, consistency and replication, fault tolerance, security in DFS.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Gain knowledge of distributed operating system architecture. 2. Implement distributed client server applications using remote method invocation. 3. Have knowledge of Synchronization and Deadlock. 4. Have sufficient knowledge about file access. 5. Understand Shared Memory Technique, security, and distributed file systems.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	
CO5					✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	**COURSE CONTENT**

UNIT-I	**INTRODUCTION TO DISTRIBUTED SYSTEM** Definition, Characteristics of Distributed system, Design issues, Resource sharing and the Web Challenges, System models - Architectural and fundamental models -Networking and internetworking Communication in distributed system: Layered protocols, ATM networks, Client –Server model, Remote Procedure Calls and Group Communication.

UNIT-II	**CONCURRENCY CONTROL** Clock synchronization, Mutual Exclusion, Election algorithm, the Bully algorithm, a Ring algorithm, Transactions - Nested transactions - Locks - Optimistic concurrency control - Timestamp ordering - Comparison - Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions
UNIT-III	**DEADLOCK** Deadlock in Distributed Systems, Distributed Deadlock Prevention, Distributed Deadlock Detection, Threads, System models, Processors Allocation, Scheduling in Distributed System, Real Time Distributed Systems.
UNIT-IV	**DISTRIBUTED FILE SYSTEM** Distributed file systems: Distributed file system Design, Distributed file system Implementation, Trends in Distributed file systems. Distributed Shared Memory: What is shared memory, Consistency models, Page based distributed shared memory, shared variables distributed shared memory. Replication in DFS
UNIT-V	**SECURITY** Overview of security techniques, Cryptographic algorithms, Digital signatures, Cryptography pragmatics, Replication, System model and group communications, Fault tolerant services, Highly available services, Transactions with replicated data

TEXT BOOKS
1. Andrew S. Tanenbaum, Maartenvan Steen, Distibuted Systems, —Principles and Pardigms, Pearson Education, 2002.
2. George Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems Concepts and Design, 3rd Edition, Pearson Education, 2002.
REFERENCE BOOKS
1. Tanenbaum and Steen, Distributed Systems PHI, 2002.
2. Sape Mullender, Distributed Systems 2nd Edition.
3. Albert Fleishman, Distributed Systems: Software Design and Implementation, Springer Verlag, 1994.

SOFTWARE PROJECT MANAGEMENT	
Course Code: 25CSPE3024	Continuous Evaluation: 40 Marks
Pre-Requisite: NIL	End Semester Examination: 60 Marks
L T P: 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. To provide an in-depth understanding of various concepts of Software project phases.
2. To understood the basics of the project management techniques.
3. To learn the feasible solution and optimum solution for the resource management. Learnt the time estimation and critical path for project.
4. To learn the various quality models and risk management in the resource planning.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Gain knowledge and understanding of basic concepts related to software project phases, estimation and scheduling.
2. Apply basic concepts related to software project planning, scope and feasibility.
3. Analyse of various project management activities such as tracking, project procurement, configuration management, monitoring.
4. Acquire knowledge about quality assurance, quality control, and risk management.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4
CO1	✔	✔		
CO2		✔	✔	
CO3			✔	
CO4				✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT-I	**Introduction and Software Project Planning:** Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework,

	Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process.
UNIT-II	**Project Organization and Scheduling Project Elements:** Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts. (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.
UNIT-III	**Project Monitoring and Control:** Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.
UNIT-IV	**Software Quality Assurance and Testing Objectives:** Testing Principles, Test Plans, Test Cases, Types of Testing, Levels of Testing, Test Strategies, Program Correctness, Program Verification & validation, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, The SEI Capability Maturity Model CMM), SQA Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Cleanroom process.
UNIT-V	**Project Management and Project Management Tools Software Configuration Management:** Software Configuration Items and tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version Control, Risk Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit Analysis, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools, MS-Project.

TEXT BOOKS

1. Bob Hughes, Mikecotterell, "Software Project Management", Third Edition, Tata McGraw Hill, 2004.

REFERENCE BOOKS

1. M. Cotterell, Software Project Management, Tata McGraw-Hill Publication.
2. Royce, Software Project Management, Pearson Education
3. Kieron Conway, Software Project Management, Dreamtech Press
4. S. A. Kelkar, Software Project Management, PHI Publication

GRID COMPUTING	
Course Code: 25CSPE3026	Continuous Evaluation: 40 Marks
Pre-Requisite: NIL	End Semester Examination: 60 Marks
L T P: 3 1 0	
Credits: 4	

COURSE OBJECTIVES
1. To understand how Grid computing helps in solving large scale scientific problems. 2. To gain knowledge on the concept of virtualization that is fundamental to cloud computing. 3. To learn how to program the grid environment. 4. To understand the security issues in the grid environment.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Understand the genesis & know the applications of grid computing. 2. Understand the technology and tool kits for facilitating grid computing. 3. Evaluate enabling technologies such as high-speed links and storage area networks for building computer grids. 4. Design a grid computing application in one of the key application areas e.g. Computer Animation, E-Research. 5. Implement a grid computing environment; develop communications skills and accept the code of professional conduct and security practice through short presentations and group work.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔	✔		
CO3				✔	
CO4					✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION AND OVERVIEW OF GRID COMPUTING** Early Grid Activities, Current Grid Activities, An Overview of Grid Business Areas, Grid Applications, Grid Infrastructure

UNIT-II	**WEB SERVICES AND RELATED TECHNOLOGIES** Oriented Architecture, Web Service Architecture, XML, Related Technologies and Their Relevance to Web services, XML Messages and Enveloping, Service Message Web Service Interoperability and the Role of the WS-I Organization
UNIT-III	**OGSA** Introduction to Open Grid Services Architecture (OGSA), Commercial Data Center- National Fusion Collaboratory, OGSA Platform Components

UNIT-IV	**OGSI** Introduction-Grid Services, A High-Level Introduction to OGSI, Introduction to Service Data Concepts, Grid Service: Naming and Change Management Recommendations.
UNIT-V	**SECURITY** Trust models for Grid security environment, Authentication and Authorization methods, Grid security infrastructure, and Identity and access management architecture.

TEXT BOOKS

1. Bart Jacob (Editor), "Introduction to Grid Computing", IBM Red Books, Vervante, 2005.
2. Ian Foster, Carl Kesselman, "The Grid: Blueprint for a New Computing Infrastructure", 2nd Edition, Morgan Kaufmann.
3. Frederic Magoules and Jie Pan, "Introduction to Grid Computing" CRC Press, 2009.

REFERENCE BOOKS

1. Barry Wilkinson, "Grid Computing: Techniques and Applications", Chapman and Hall, CRC, Taylor and Francis Group, 2010.
2. Daniel Minoli, "A Networking Approach to Grid Computing", John Wiley Publication, 2005.

OBJECT ORIENTED ANALYSIS & DESIGN	
Course Code: 25CSPE3028	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES
1. To introduce the concepts of OOP and behavioural modelling.
2. To understand the architectural design methods.
3. To learn the application, methodology in a software design.
4. To understand and learn design patterns.
5. To familiarize with the knowledge of design testing in DPIM.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Demonstrate knowledge of structural and behavioral modeling techniques.
2. Demonstrate knowledge of a model-based software development methodology.
3. Create application of the methodology and the modeling techniques in a significant software design project.
4. Demonstrate knowledge of design patterns and their application in a software design project.
5. Demonstrate knowledge of Design and Testing Process Improvement Models.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	
CO5					✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** Introduction to OOP concepts, OO model, analysis, design and implementation. Types of models: Unified Modeling Language (UML) views and basic features, Object-oriented design methodologies, the rational unified process, Object-oriented CASE tools. Introduction to six-level improvement process of design process improvement model (DPIM).
UNIT-II	**STRUCTURAL & BEHAVIOURAL MODELLING** Structural Modeling Techniques Basic Building Blocks -- objects and classes, Structural Composition Techniques, Design Scaling Issues, **Behavioural Modelling:** Use Case Diagrams, Interaction Diagrams, Event State Diagrams, Action Matrices, Business Lifecycle Diagrams, Activity Diagrams, Collaboration Diagrams, Rule Specification Techniques, Behavioral Model-Based Reference Architecture for Component Specification.
UNIT-III	**ARCHITECTURAL MODELLING** Deployment: Common Modelling technique; Modelling processors and devices, modelling distribution of artifacts. Collaboration: Modeling roles, modelling the realization of a Use Case, modelling the realization of an operation, modelling a mechanism
UNIT-IV	**Design Standards Architectural Patterns**: Design Patterns, Program Patterns, Behavioral Design Units Component-Based Specification Techniques **DPIM - Level One**: Requirements Analysis Techniques, Ad Hoc Approach to Design **DPIM - Levels Two, Three and Four**: Design Methodology, Deployment Design Quality Control Properties and Analysis Techniques, Automatic Convertability, Traceability, Standardizability (Design Units/Reusable Patterns), Modularity Changeability (Change Management), Scalability of Design Reliability
UNIT-V	**DPIM - Levels Five and Six**: Design Process Management and Optimization Design Metric Models Testing Maturity Model Extended V-Model Testing Techniques **OO Testing:** Introduction, Object Oriented testing process, testing of analysis and design model, testing of classes.

TEXT BOOKS
1. S. R Schach, Introduction to Object Oriented analysis and Design, Mc Graw Hill, 2003
2. Ali Bahrami , "Object Oriented System Development", McGraw Hill International Edition, 1999.
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data" by EMC Education Services
REFERENCE BOOKS
1. Booch G., "Object Oriented Analysis and Design", Addison Wesley Publishing Company, 2nd Edition, 2000.
2. Rambaugh.J, Blaha. M. Premerlani.W, Eddy F and Loresen W, "Object Oriented Modeling andDesign",Prentice Hall of India, 1997.
3. Coad P, Yourdon E., "Object oriented analysis", Yourdon Press, 1991.
4. Bennett, S., "Schuam's Outline of UML". New York: McGraw-Hill 2004
5. S. Perdita. "Using UML: Software Engineering with Objects and Components." Addison-Wesley 2000
6. R. Miles, "Learning UML 2.0", O'REILLY 2006
7. E. Gamma., "Design Patterns: Elements of Reusable Object-Oriented Software", Addison-Wesley

NEURAL NETWORKS & FUZZY LOGIC	
Course Code: 25CSPE3030	Continuous Evaluation: 40 Marks
Pre-Requisite : Soft Computing Course	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. To provide in depth detail for perceptron.
2. To get familiar with the principles of RBF, RNN, unsupervised learning.
3. To learn fuzzy set theory, fuzzy logic and understand the role of uncertainty in real-time applications.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. To introduce methodologies and modelling concept of ANN. To provide in depth detail of the perceptron.
2. To get familiar with the principles of MLP, RBF, Unsupervised learning.
3. To understand different types of associative memories, and RNN.
4. To learn fuzzy set theory, fuzzy logic and understand the role of uncertainty in realtime applications

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔	✔			
CO2			✔		
CO3				✔	✔

Mapped SDGs: SDG-4,SDG-3, SDG-4, SDG-9 , SDG-11, SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT-I	**INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS (ANN) & SINGLE LAYER PERCEPTRON (SLP)** ANN, Modelling of Human Brain and ANN, Types of ANN, activation function, learning tasks and rules. SLP: Basics of Perceptron, McCulloch Pitt NN, Perceptron Convergence Theorem in both Discrete and Continuous Domain, Linearity and Non-Linearity Problem.
UNIT-II	**MULTI- LAYER FEED FORWARD NETWORKS** Basics of MLP, Generalized Delta Rule, Training Algorithm for MLP, Batch learning,
	Online Learning, Cross-validation in Back Propagation, Detail Study on Convolution Neural Networks. Basics and need of RBF, Interpolation Problem, RBF networks,
UNIT-III	**RECURRENT NETWORKS & ASSOCIATIVE MEMORIES** Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, Architecture of Hopfield Network: Discrete and Continuous Neural network applications, Boltzmann Machine, R-CNN, LSTM, Unsupervised Learning of clusters.
UNIT-IV	**FUZZY SETS, RELATIONS & LOGIC** Classical & Fuzzy Set Theory, Fuzzy Relation, Fuzzy Inference System, Fuzzy Logic and approximate reasoning. Fuzzy control System Design Problem, Industrial Applications.
UNIT-V	**FUZZY ARITHMETIC & OPTIMIZATION** Functions of fuzzy sets, extension principle, fuzzy mapping, interval analysis, vertex method and DSW algorithm. One dimensional fuzzy optimization, fuzzy concept variables and casual relations, fuzzy cognitive maps, agent-based models, Crisp logic, Predicate logic.

TEXT BOOKS
1. J.M. Zurada, “Introduction to artificial neural systems”, Jaico Pub.
2. Simon Haykin, “Neural Networks”, PHI
3. S. N. Sivanandam and S.N. Deepa, “*Principles of Soft Computing,*” 2nd Ed., Wiley India.

REFERENCE BOOKS
1. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2004
2. Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2003

3. S. Rajasekharan and G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy logic,
Genetic algorithms: synthesis and applications", PHI Publication, 2004.
4. Timothy J. Ross, " Fuzzy Logic With Engineering Applications", Tata McGraw-
Hill Inc. 2000

CYBER SECURITY	
Course Code: 25CSPE3032	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. To aware the students about the cyber security and its implications.
2. To provide students with a practical and theoretical knowledge of cryptography and network security.
3. To provide the students' knowledge of different types of attacks on the Network.
4. To aware the student about data privacy.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Define the concept of ethical hacking and its associated applications in Information Communication Technology (ICT) world.
2. Underline the need of digital forensic and role of digital evidences.
3. Explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection.
4. Recognize the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications /devices like Windows/Unix system.
5. Apply the knowledge of IDS to secure network and performing router and network analysis.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔	✔			
CO2		✔	✔		
CO3			✔	✔	
CO4				✔	✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT-I	**INTRODUCTION** Cyber-attacks, types of attacks, Introduction to cyber security, objectives of security, elements of cyber security, Introduction to Information Security, Introduction to Data and Network Security, Finding vulnerabilities and exploits.

UNIT-II	**INTRUSION DETECTION SYSTEMS** Overview of intrusions, system intrusion process, dangers of system intrusions, anomaly detection, misuse detection, types of IDS, the limitations and open problems of intrusion detection systems, Statistical and machine approaches to detection of attacks on computers, Techniques for studying the Internet attacks, network based attacks, host based attacks.
UNIT-III	**SECURITY IN CLOUD COMPUTING** What is Cloud Computing, Essential Characteristics, Cloud security challenges, Software as a service security, secure software development life cycle, data usage, data privacy, identity access management, physical security.
UNIT-IV	**DATA PRIVACY** Fundamental Concepts, Definitions, Data Privacy Attacks, Data linking and profiling, access control models, role based access control, privacy in different domains- medical, financial, etc.
UNIT-V	**CRYPTOGRAPHY** Services, mechanisms and attacks, the OSI security architecture, Network security Model, classical Encryption techniques, Private and Public Key Cryptography.

TEXT BOOKS

1. Michael T. Goodrich and Roberto Tamassia, "Introduction to Computer Security", Addison Wesley, 2011.
2. B. Raghunathan, "The Complete Book of Data Anonymization: From Planning to Implementation", Auerbach Pub, 2013.
3. John W. Rittinghouse, "Cloud Computing: Implementation Management & Security", CRC Press.
4. Roberto Di Pietro, Luigi V. Mancini, "Intrusion Detection System", Springer ,2008
5. William Stallings-"Cryptography and Network Security", Pearson education, 6th edition, SBN 10**:** 0133354695, 2013

REFRENCE BOOKS

1. Russell Dean Vines and Ronald L. Krutz, "Cloud Security: A Comprehensive Guide To Secure Cloud Computing", Wiley India Pvt Ltd, 2010.
2. Anderson, James P., "Computer Security Threat Monitoring and Surveillance," Washing, PA, James P. Anderson Co., 1980.
3. L. Sweeney, "Computational Disclosure Control: A Primer on Data Privacy Protection", MIT Computer Science, 2002.

DESIGN THINKING	
Course Code: 25CSPE3034	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. To provide an overview of an exciting field of design thinking and business processes.
2. To introduce the tools required for design thinking like IBM Blueworks live, IBM Mural
3. To immerse students into the world of innovation as a systematic process of tackling relevant business and/or social problems.
4. To provide a social and thinking space for the recognition of innovation challenges and the design of creative solutions.
5. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students will be able to:

1. Understand and critically apply the concepts and methods of business processes.
2. Understand and apply IBM Blueworks live and process designer tool concepts.
3. Understand and analyzing design thinking history and its various concepts.
4. Understand, analyzing and create models with users collaboration to apply design thinking concepts.
5. Build the process model that is used to implement process application and use different mural template to apply design thinking concepts for solving real world problem.

COURSE LEARNING OUTCOMES (CLO) - COURSE OBJECTIVES (CO) MAPPING

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	
CO5					✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**INTRODUCTION TO BUSINESS PROCESS MANAGEMENT &AS-IS BUSINESS PROCESS** Define business process management (BPM), List and describe the phases in the BPM lifecycle procedure, Define process modeling., Describe how to use IBM Business Process Manager to accomplish process modeling goals, Explain how to create and modify process applications in the Process Center, Create a process application, Explain case management, Describe the purpose and function of Blue works Live, List and describe the core notation elements that are used in IBM Process Designer, Create a business process definition (BPD) from the process and nested process tasks and responsible, Explain how to create and modify process models with the Designer view of the IBM Process Designer.
UNIT-II	**PLAYBACK 0: MODELING PROCESS** List and describe gateways as they are used in IBM Process Designer, List and describe intermediate event types that are used in IBM Process Designer, Model a business process escalation path with an attached timer intermediate event, Describe the Playback 0 validation goals and requirements, Validate that a process model meets Playback 0 goals and Requirements, Describe IBM Business Process Manager product components, Identify the integrations with other IBM products.
UNIT-III	**ENTERPRISE DESIGN THINKING – HISTORY, OVERVIEW** Understand what came before Design Thinking, Identify who did what to bring it about, Learn how it built upon previous approaches, Get an overview of the whole approach to design thinking, Understand the principles, loop, and keys, Determine what is most important.
UNIT-IV	**ENTERPRISE DESIGN THINKING –7 KEY HABITS, THE LOOP, USER RESEARCH** Learn 7 key habits of effective thinkers design, Avoid common anti-patterns, Optimize for success with these habits, Understand the importance of iteration, Learn how to observe, reflect, & make, Get ready to drill down & do tomorrow, Understand the importance of user research, Appreciate empathy through listening, Learn key methods of user research.
UNIT-V	**ENTERPRISE DESIGN THINKING – MAKE, USER FEEDBACK:-** Understand how Make fits into the Loop, Learn how to leverage Observe information, Learn Ideation, Storyboarding, & Prototyping, Understand user feedback and the Loop, Learn the different types of user feedback, Learn how to carry out getting feedback.

UNIT-VI	**PROJECT** Creating Discovery Map, Process Model In Blueworks Live. Adding And Viewing Process Details In Blueworks Live Enterprise Design Thinking - User Research, Reflect, Ideation, Storyboarding, Crafting Hills, Prototyping In Mural.

TEXT/REFERENCE BOOKS
1. IBM SKILLS ACADEMY

BUSINESS INTELLIGENCE	
Course Code: 25CSPE3038	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

CO1: To introduce students to the foundational concepts, components, and significance of Business Intelligence (BI) in decision-making.
CO2: To equip students with practical skills in data integration and transformation using open-source ETL tools.
CO3: To provide hands-on understanding of data warehousing and OLAP operations using open-source platforms.
CO4: To train students in designing dynamic dashboards and reports using modern open-source BI visualization tools.
CO5: To develop critical thinking by exploring real-world BI case studies using both legacy and modern tools across industries.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

CLO1: Describe the architecture, functions, and scope of Business Intelligence systems.
CLO2: Apply ETL processes using open-source tools for real-world data preparation tasks.
CLO3: Design and implement data warehouse schemas and perform OLAP operations.
CLO4: Develop interactive dashboards and schedule reports using visualization platforms.
CLO5: Analyze and compare legacy and modern BI solutions in various industry contexts.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	√				
CO2		√			
CO3			√		
CO4				√	
CO5	√			√	√

Mapped SDGs: SDG-4, SDG-8, SDG-9, SDG-11, SDG-16

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**Introduction to Business Intelligence** Definition and significance of Business Intelligence (BI) Key components of BI: Data Sources: structured and unstructured Data Integration (Extract-Transform-Load (ETL)/ ELT) processes Data Storage:

	Data Warehousing, Data Lakes,and Data Lakehouses Reporting, Dashboards and Visualization Comparison with related fields:BI vs Data Analytics,BI vs Data Mining Role of BI in informed decision-making Applications across industries: retail, banking, healthcare, and logistics,Career pathways and future trends in BI
UNIT-II	**Data Acquisition, Preparation and Cloud Integration** **Tools Used:** Python with Pandas (for data manipulation, cleaning, basic ETL scripting), SQL (for data extraction and transformation within databases), or KNIME or Talend Open Studio (For visual ETL workflow) **Primary Topics:** Introduction to open-source ETL tools Cloud Data Integration concepts Practical data preparation pipelines Combining multiple data sources Data type handling and formatting **Tutorial Exercises**: Build an ETL pipeline to extract, clean, transform, and load employee data from a CSV/JSON file. Merge product and sales data from different sources (e.g., a database and an API endpoint), handle data inconsistencies, and export in a unified, clean format. Implement data validation rules within an ETL process to ensure data quality.
UNIT-III	**Data Warehousing and Online Analytical Processing** **Tool Used:** Apache Kylin or Pentaho Community Edition **Primary Topics:** Fundamentals of Data Warehousing Designing a warehouse schema Introduction to Online Analytical Processing (OLAP) Cube building and multidimensional queries Introduction to Cloud Data Warehouses Data Lake vs. Data Warehouse vs. Data Lakehouse Data Governance in Data Warehousing **Tutorial Exercises**: Design a star schema for a university admissions dataset and implement in Pentaho. Load transformed data into the designed data warehouse. Create an OLAP cube and perform slice-and-dice and drill-down operations on student data.
UNIT-IV	I**nteractive Data Visualization and Reporting** **Tools Used:** Microsoft Power BI (for comprehensive dashboarding, AI features, integration), Tableau (for advanced visualization), Metabase or Apache Superset **Primary Topics:** Concepts of effective data visualization Data Storytelling Using open-source BI reporting tools Creating user-interactive dashboards Key Performance Indicators (KPIs) and Metrics Design Scheduling and automating reports

	Introduction to AI-Powered Visualization **Tutorial Exercises**: Design and build an interactive sales performance dashboard in Microsoft Power BI, incorporating multiple data sources, filters, and drill-down capabilities. Create a compelling data story and a series of linked visualizations in Tableau to analyze customer behavior or market trends. Connect a database and schedule an automated weekly report with performance KPIs.
UNIT-V	**Case Studies in Real-World BI Systems** **Healthcare BI**: Legacy System: **SAP BusinessObjects** – used for hospital operations, static patient data reporting Modern System: **Tableau** – widely used for real-time clinical dashboards and public health analytics **Retail BI**: Legacy System*:* **IBM Cognos Analytics** – traditionally used for structured reporting and sales KPIs Modern System*:* **Microsoft Power BI** – leading tool for dynamic dashboards, product analytics, and customer behavior insights **Government BI**: Legacy System: **SAS Business Intelligence** – used in public administration for population data analysis and program evaluation Modern System: **Qlik Sense** – popular in government agencies for fraud detection, service optimization, and real-time insights Discussion: Architectural shift from monolithic reporting systems to cloud-enabled interactive platforms Benefits of modern systems: scalability, user accessibility, real-time integration Key concerns: data privacy, transparency, interoperability, ethical use in automated decision-making

TEXT BOOKS

1. "Business Intelligence: A Managerial Perspective on Analytics" by Ramesh Sharda, Dursun Delen, Efraim Turban in Pearson Education .
2. "Data Warehousing for Business Intelligence" by Paul Raj Ponniah in Wiley

REFERENCE BOOKS

1. "Successful Business Intelligence: Unlock the Value of BI & Big Data" by Cindi Howson in McGraw-Hill.
2. "Learning Pentaho BI Suite" by María Carina Roldán in Packt Publishing

INTERNET OF THINGS	
Course Code: 25CSPE3040	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES
1. To understand and learn about various protocols of IoT, sensors and their types.
2. To develop schemes for the applications of IoT in real time scenarios.
3. To design business Intelligence and Information Security for IoT

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Understand the vision of IoT and communication protocols from a global context.
2. Understand and apply IoT protocols.
3. Apply and analyze sensor networks and their components to IoT domain.
4. Design portable IoT using appropriate boards.
5. Evaluate the applications of IoT in agriculture, healthcare, smart grid, factory.
6. Build and create state of the art architecture in IoT.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	✔	✔				
CO2			✔	✔		
CO3					✔	✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**Introduction to IoT:** Definition, Characteristics, Applications, Connectivity Layers, Addressing, Networking, Sensing: Sensors and Transducers, Sensor Classes, Sensor Types, Actuation: Actuator Basics, Actuator Types **Basics of IoT Networking:** IoT Components, Inter-dependencies, SoA, Wireless Networks, Protocol Classification, MQTT, Secure MQTT, CoAP, XMPP,AMQP (Advanced Message Queuing Protocol).
UNIT-II	**IoT Protocols:** Protocol Standardization for IoT-M2M and WSN Protocols. **Connectivity Technologies:** IEEE 802.15.4, ZigBee, 6LoWPAN, RFID, HART, NFC, Bluetooth, Zwave, ISA100.11a

UNIT-III	**Sensor Networks:** Basic Concepts, Wireless Sensor Networks, Sensor Nodes,

	Node Behaviour, Social Sensing, Application Examples, Target Tracking, Wireless Multimedia Sensor Networks, Coverage, Mobile Wireless Sensor Networks and their Applications, UAV (Unmanned Aerial Vehicle) Networks, Machine to Machine Communication, Interoperability in Internet of Things
UNIT-IV	**Introduction to Arduino**: Basic Concepts of Arduino Platform, Examples of Arduino Programming, Integration of Sensors and Actuators with Arduino, **Introduction to Raspberry Pi**, Implementation of IoT with Raspberry, Software Defined Networking, Software Defined IoT Networking
UNIT-V	**Cloud Computing:** Fundamentals, Service Models, Service Management and Security, Case Studies, Open Source Platform, Sensor Cloud, Fog Computing, **Application Domains of IoT :** Smart Cities: Need for Smart Cities, Challenges in Building Smart Cities, Some Technical Issues behind Enabling Smart Cities, Smart Homes: Home Area Networks (HANs), Connected Vehicles, Smart Grid, Industrial IoT, Data Handling and Analytics, Case Study: Agriculture, Healthcare, Activity Monitoring,
UNIT-VI	**PROJECT** Research Activities on IoT with projects and research letters.

TEXT BOOKS
1. Honbo Zhou, "The Internet of Things in the Cloud:A Middleware Perspective" –– CRC Press-2012
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.
3. Dieter Uckelmann, Mark Harrison, "Architecting the Internet of Things", Springer- 2011.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
5. The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

REFERENCE BOOKS
1. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

NETWORK SECURITY & CRYPTOGRAPHY	
Course Code: 25CSPE4019	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. To know the various art of the security exploitation
2. To learn secure programming techniques
3. To understand the mathematics behind cryptography
4. To know the standard algorithms used to provide confidentiality, integrity and authenticity
5. To learn the public key infrastructure that will be used for security practices

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Present the exploitation present in the security.
2. Discuss various types of attacks and their characteristics.
3. Illustrate the basic concept of encryption and decryption for secure data transmission.
4. Analyze various cryptography techniques and its applications.
5. Develop solutions for security problems.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔	✔			
CO2		✔	✔		
CO3			✔		
CO4				✔	✔
CO5					✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT-I	**FUNDAMENTALS** **Security trends** - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.

UNIT-II	**SYMMETRIC KEY CRYPTOGRAPHY** MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures - Modular arithmetic-Euclid‟s algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution.
UNIT-III	**PUBLIC KEY CRYPTOGRAPHY** **MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY**: Primes – Primality Testing – Factorization – Euler‟s totient function, Fermat‟s and Euler‟s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.
UNIT-IV	**MESSAGE AUTHENTICATION AND INTEGRITY** Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509
UNIT-V	**SECURITY PRACTICE AND SYSTEM SECURITY** Electronic Mail security – PGP, S/MIME – IP security – Web Security - SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.

TEXT BOOKS

1. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, Starch Press, 2008.
2. William Stallings, “Cryptography and Network Security: Principles and Practices”, Sixth Edition, Pearson Education, 2014.

REFERENCE BOOKS

1. “The Shellcoder's Handbook: Discovering and Exploiting Security Holes”, 2nd Edition by Chris Anley et al.
2. N. Ferguson, B. Schneier, and T. Kohno. “Cryptography Engineering: Design Principles and Practical Applications”. Wiley, 2010.
3. Neil Daswani, Christoph Kern, and Anita Kesavan, “Foundations of Security: What Every Programmer Needs to Know”, Frist Edition, Apress, 2007.
4. SNMP: A Guide to Network Management (MGH).
5. Telecom Network Management by H.H. Wang (MGH).
6. Network Management by U. Dlack (MGH).

SOFTWARE TESTING	
Course Code: 25CSPE4033	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

CO1: To understand the fundamentals and significance of software testing.
CO2: To apply various white-box and black-box testing techniques in practice.
CO3: To analyze software testing levels and debugging strategies.
CO4: To explore the process and tools for software test automation.
CO5: To evaluate software quality through testing strategies and tools in real-world applications.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

CLO1: Demonstrate understanding of software testing principles with real-world examples.
CLO2: Apply appropriate testing techniques including white-box and black-box methods.
CLO3: Analyze software at various levels of testing and perform debugging.
CLO4: Identify, classify, and resolve software bugs through systematic testing approaches.
CLO5: Perform and document test strategies while managing trade-offs between testing methods.
CLO6: Implement and experiment with software test automation tools and frameworks.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	√				√	
CO2		√			√	
CO3			√	√		
CO4						√
CO5				√		√

Mapped SDGs: SDG-4, SDG-8, SDG-9,SDG-12

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** Introduction to software testing and its challenges, Basic Definitions: Error, Fault, Failure, Incident, Test Cases, Overview of the Software Testing Process and limitations of testing.
UNIT-II	**TESTING TECHNIQUES** White–Box and Black–Box Testing, Boundary Value Analysis, Equivalence Class Testing, Decision Table-Based Testing, Cause-Effect Graph Technique, Cyclomatic Complexity Analysis, Data Flow Testing, Control flow Testing.
UNIT-III	**REDUCING THE NUMBER OF TEST CASES** Prioritization guidelines, Priority category, Scheme, Risk Analysis, Regression Testing, Slice based testing, Regression Testing **Testing Activities:** Unit Testing, Levels of Testing, Integration Testing, Debugging, Domain Testing.
UNIT-IV	**UNIT-IV: SYSTEM AND NON-FUNCTIONAL TESTING** Verification and Validation Testing, Alpha Testing, Beta Testing, Stress Testing, Load Testing, Volume Testing, Usability testing, Bug, Bug life cycle, Introduction to Performance and Security Testing
UNIT-V	**UNIT-V: AUTOMATED TESTING TOOLS AND AGILE TESTING** Test Automation: Scope of Automation, Process Model for Automation, Challenges in Automation, Static Testing Tools, Dynamic Testing Tools, Tools for Functional and Non-Functional Testing (e.g., Selenium) Basics of Agile and DevOps Testing

TEXT BOOKS

1. Software Testing: Principles and Practices, Srinivasan Desikan, Gopalaswamy Ramesh, Pearson Education, 2008.
2. Software Testing: Principle, Techniques and Tools, M. G. Limaye, Tata McGraw Hill, 2009.
3. Effective Methods for Software Testing, William E. Perry, John Wiley and Sons,

REFERENCE BOOKS

1. An Integrated Approach to Software Engineering, Pankej Jalote, Narosa Publishing House, New Delhi 1997.
2. The Art of Software Testing, Glenford J.Myers, John Wiley & Sons, 1979.
3. Software Testing: A Craftman's Approach, P. C. Jorgensen, CRC Press, 1995.
4. Software Testing Techniques, Boris Beizer, Dreamtech, 2006.
5. Effective Software Testing: 50 Specific Ways to Improve Your Testing, Dustin, Pearson Education, 2002.

WIRELESS ADHOC AND SENSOR NETWORK	
Course Code: 25CSPE4023	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES
1. To cover major aspects of ad hoc and sensor networking, from design through performance issues to application requirements.
2. To start with the design issues and challenges associated with implementations of ad hoc and sensor network applications. This includes mobility, disconnections, and battery power consumption.
3. To provide a detailed treatment of proactive, reactive, and hybrid routing protocols in mobile wireless networks. It also covers the IEEE 802.11 Wireless LAN and Bluetooth standards and discusses their characteristics and operations.
4. To cover wireless sensor networks (architecture, design, protocols, and applications).
5. To give students hands-on experience in designing a mobile ad hoc network using the NS2 network simulator.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Understand the principles of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks. To specify and identify deficiencies in existing wireless protocols for MAC layer and Network layer, and then go onto formulate new and better protocols.
2. Familiarize with the mechanisms for implementing security and trust mechanisms in MANETs and WSNs.
3. Enhance the basic knowledge about the principles and characteristics of wireless sensor networks (WSNs).
4. Understand how proactive and reactive protocols function and their implications on data transmission delay and bandwidth consumption along with design issues in wireless communication.
5. Understand the congestion control mechanism at transport layer and to acquire skills to design and implement a basic mobile ad hoc or wireless sensor network via simulations or programming of PDAs.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔	✔		
CO3				✔	
CO4				✔	✔
CO5					✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**AD HOC Wireless** Introduction, Mobile Ad Hoc Networks, Technologies for Ad Hoc Network, Issues in Ad hoc wireless Networks IEEE 802.11 Architecture and protocols. Protocol for AD HOC Wireless Networks. Issues and classification of MAC protocol, Dynamic Source Routing (DBR), Adhoc Distance Vector (AoDV) routing, Routing Protocols, Application of Ad Hoc and sensor networks
UNIT-II	**Transport Layer & Security Protocols** Issues in designing transport layer protocols, classification of transport layer solutions, TCP over Ad Hoc Wireless Networks, Network Security requirements and Attacks
UNIT-III	**Wireless Sensor Networks** Basic Sensor Network Architectural Elements, Applications of Sensor Networks, Comparison with Ad Hoc Wireless Networks, Challenges and Hurdles. Architecture of WSNs Hardware components, Operating systems and execution environments, some examples of sensor nodes, Network Architecture, Sensor networks scenarios, Optimization goals and figures of merit Design principles for WSNs.
UNIT-IV	**Communication Protocols** Physical Layer and Transceiver design considerations in WSNs, Fundamentals of (wireless) MAC protocol, Address and name management in wireless sensor networks, Localization and positioning Routing protocols Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless, Routing Strategies in Wireless Sensor Networks
UNIT-V	**Transport & QoS in WSN** Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control in network processing – Operating systems for wireless sensor networks – Examples
UNIT-VI	**PROJECT** Research Activities and hands-on experience in designing a mobile ad hoc network using the NS2 network simulator

TEXT BOOKS
1. C. S. Ram Murthy, B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall of India , 2007.
2. Andreas Willig and John H. Karl, Protocols & Architectures for Wireless Sensor Networks, Wiley, 2005

REFERENCE BOOKS

1. B. Tavli and W. Heinzelman, Mobile Ad Hoc Networks: Energy-Efficient Real-Time Data Communications, Springer , 1st Edition, 2006
2. Ramin Hekmat, Ad-hoc Networks: Fundamental Properties and Network Topologies, Springer , 1st Edition, 2006

ADVANCED JAVA PROGRAMMING	
Course Code: 25CSPE4035	Continuous Evaluation: 40 Marks
Pre-Requisite : Core Java Programming	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. To develop graphical programs with networking functionality. Using Graphics, Animations and Multithreading for designing Simulation and Game based applications.
2. To design and develop GUI applications using Swing and Event Handling.
3. To design and develop Web applications.
4. To understand designing of distributed applications using Remote Method Invocation (RMI)

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Learn the graphics and animation on the web pages, using Java Applets.
2. Learn and design a full set of Event driven UI widgets and other components, including windows, menus, buttons, checkboxes, text fields, scrollbars and scrolling lists, using Abstract Windowing Toolkit (AWT) & Swings Usage.
3. Learn Java Data Base Connectivity (JDBC) so as to retrieve and manipulate the information on any relational database through Java programs.
4. Learn and design the server side programming using Servlets and JSP
5. Use the invocation of the remote methods in an application using RMI.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔	✔			
CO2			✔		
CO3				✔	
CO4					✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT-I	**INTRODUCTION TO ADVANCED JAVA** Java Streaming – Components and events handling – Threading concepts – Networking features – Byte code interpretation – Media Techniques.

UNIT NUMBER	COURSE CONTENTS
UNIT-II	**SWINGS** Introduction to swings, difference between AWT and Swings, java foundation classes, java swings classes.
UNIT-III	**ADVANCED NETWORKING** Client- Sever computing – Sockets – Content and Protocols handlers – Developing distributed applications – RMI – Remote objects – Object serialization
UNIT-IV	**REMOTE METHOD INVOCATION** Remote Method Invocation (RMI): RMI Architecture, Designing RMI application, Executing RMI application.
UNIT-V	**RELATED JAVA TECHNIQUES** 3D graphics – JAR file format and creation – Internationalization. **SERVLETS** Java Servlets: Servlet Interaction & Advanced Servlets, Life cycle of Servlet,Java Servlet Development Kit, Javax.servlet package, Reading Servlet Parameters, Reading Initialization Parameters, The javax.servlet. http Package, Handling HTTP.

TEXT BOOKS

1. Jame Jaworski, "*Java Unleashed*", SAMS Techmedia Publications, 1999.
2. H.M.Deitel and P.J.Deitel, "Java how to program with an Introduction to Visual J++", Pearson Education, 1998.
3. Java: The Complete Reference, Ninth Edition Paperback by Herbert Schildt
4. Advanced Java Programming, Uttam Kumar, Oxford Publications.

REFERENCE BOOKS

1. Campione, Walrath and Huml, "*The Java Tutorial*", Addison Wesley, 1999.
2. Duane A.Bailey, "*Java Structures*", McGraw-Hill Publications, 1999.
3. Jeff Frentzen and Sobotka, '*Java Script*", Tata McGraw-Hill, 1999.
4. Jamie Jaworski, "*Java Unleashed*", SAMS Techmedia Publication, 1999.
5. Jason Blooberg. Jeff Kawski, and Paul Treffers, "*Web Page Scripting Techniques",*Hayden books, 1996.

NASSCOM ASSOCIATE ANALYTICS - II	
Course Code: 25CSPE4037	Continuous Evaluation: 40 Marks
Pre-Requisite: NIL	End Semester Examination: 60 Marks
L T P: 3 1 0	
Credits: 4	

COURSE OBJECTIVES
1. To provide knowledge of the tools, technologies & programming languages which is used in day to day business analytics cycle.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Understand the tools, technologies & programming languages which is used in day to day analytics cycle.
2. Analyze and use the best tools to make sense from available raw data.

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Data Management & Introduction to Big Data Tools (NOS 2101)** Design Data Architecture and manage the data for analysis, understand various sources of Data like Sensors/signal/GPS etc. Export all the data onto Cloud ex. AWS/Rackspace etc. Introduction to Big Data tools like Hadoop, Spark, Impala etc., Data ETL process, Identify gaps in the data and follow-up for decision making.
UNIT-II	**Big Data Analytics & Machine Learning Algorithms (NOS 2101)** Run descriptive' s to understand the nature of the available data, collate all the data sources to suffice business requirement, Run descriptive statistics for all the variables and observe the data ranges, Outlier detection and elimination. Hypothesis testing and determining the multiple analytical methodologies, Train Model on 2/3 sample data using various Statistical/Machine learning algorithms, Test model on 1/3 sample for prediction etc.

UNIT-III	**Data Visualization (NOS 2101)** Prepare the data for Visualization, Use tools like Tableau, QlikView and D3, Draw insights out of Visualization tool.

UNIT-IV	**Maintain Healthy, Safe & Secure Working Environment (NOS 9003)** Introduction, workplace safety, Report Accidents & Emergencies, Protect health & safety as your work, course conclusion, assessment
UNIT-V	**Provide Data/Information in Standard Formats (NOS 9004)** Introduction, Knowledge Management, Standardized reporting & compliances, Decision Models, course conclusion. Assessment

TEXT/REFERENCE BOOKS
1. NASSCOMM

DATA WAREHOUSING & DATA MINING	
Course Code: 25CSPE4025	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVE

CO1: To introduce the concepts, architecture, and applications of data warehousing and data mining.
CO2: To develop the ability to preprocess data and apply OLAP operations and dimensional modeling for business analysis.
CO3: To explore and implement core data mining techniques such as classification, prediction, clustering, and association rule mining.
CO4: To apply mining methods to complex data types including spatial, multimedia, text, and web data.
CO5: To evaluate and deploy data mining models effectively in real-world and decision-support applications.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

C**LO1:** Understand the architecture and components of data warehousing and data mining systems, including OLAP operations.
CLO2: Apply data preprocessing techniques such as cleaning, integration, transformation, and reduction to prepare analytical datasets.
CLO3: Analyze and implement classification and prediction models such as decision trees, Bayesian classifiers, and support vector machines.
CLO4: Discover patterns and associations using frequent itemset mining and constraint-based association rule techniques.
CLO5: Perform cluster analysis using partitioning, hierarchical, density-based, and model-based clustering methods.
CLO6: Describe complex data types and apply mining techniques to spatial, multimedia, text, and web data.
CLO7: Evaluate and apply data mining models in real-time applications for decision support and knowledge extraction.

COURSE LEARNING OUTCOME (CLO) - COURSE OBJECTIVE (CO) MAPPING

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
CO1	✓						
CO2		✓					
CO3			✓	✓	✓		✓
CO4						✓	
CO5			✓	✓	✓	✓	✓

Mapped SDGs: SDG-4, SDG-8, SDG-9,SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**DATA WAREHOUSING AND BUSINESS ANALYSIS:** Introduction to Data Warehousing, Data warehousing Components, Building a Data warehouse, Data Warehouse Architecture, DBMS Schemas for Decision Support, Data Extraction, Cleanup, and Transformation Tools, Metadata in DW, reporting, Query tools and Applications, Online Analytical Processing (OLAP), OLAP and Multidimensional Data Analysis.
UNIT-II	**DATA MINING:** Data Mining Functionalities, Data Preprocessing, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation, Architecture Of a Typical Data Mining Systems, Classification Of Data Mining Systems.Association Rule Mining: Efficient and Scalable Frequent Item set Mining Methods, Mining Various Kinds of Association Rules, Association Mining to Correlation Analysis, Constraint-Based Association Mining.
UNIT-III	**CLASSIFICATION AND PREDICTION:**Introduction Classification and Prediction, Classification by Decision Tree, Introduction to Bayesian Classification, Rule Based Classification, Classification by Back propagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error Measures, Evaluating the Accuracy of a Classifier or Predictor, Ensemble Methods, Model Section.
UNIT-IV	**CLUSTER ANALYSIS:** Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis.
UNIT-V	**MINING OBJECT, SPATIAL, MULTIMEDIA, TEXT AND WEB DATA:** Multidimensional Analysis and Descriptive Mining of Complex Data Objects, mining of structured and semi-structured data, Spatial Data Mining, Multimedia Data Mining: image, audio, and video data, Text Mining: from unstructured textual content, Mining the World Wide Web: analysing web structure, usage, and conten**t.**

TEXT BOOKS

1. Data Warehousing In the Real World; Sam Anahory & Dennis Murray; 1997, Pearson.
2. Data Mining- Concepts & Techniques; Jiawei Han & Micheline Kamber- 2001, Morgan Kaufmann.
3. Data Mining Techniques; Arun Pujari; 2001, University Press; Hyderbad.

REFERENCE BOOKS

1. Data Mining; Pieter Adriaans & Dolf Zantinge; 1997, Pearson,
2. Data Warehousing, Data Miniing and OLTP; Alex Berson, 1997, Mc Graw Hill.
3. Data warehousing System; Mallach; 2000, Mc Graw Hill.
4. Building the Data Warehouse; W.H. Inman, 1996, John Wiley & Sons.
5. Developing the Data Warehouses; W.H Ionhman,C.Klelly, John Wiley & Sons.
6. Managing the Data Warehouses; W.H.Inman, C.L.Gassey, John Wiley & Sons.

MOBILE COMPUTING	
Course Code: 25CSPE4027	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. To provide knowledge of concepts, models, condition of the mobile user and architecture of Mobile networks.
2. To learn about various mobile computing Models and to study about various routing protocols that are suitable for mobile networks.
3. To understand the concept of mobile agents and their applications.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:

1. Grasp the concepts and features of mobile computing technologies and applications.
2. Understand the underlying wireless and mobile communication networks work, their technical features, and what kinds of applications they can support
3. Develop mobile computing applications by analyzing their characteristics and requirements, selecting the appropriate computing models and software architectures, and applying standard programming languages and tools

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3
CO1	✔		
CO2		✔	
CO3			✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT-I	**Overview of Ad Hoc Networks:** Introduction to Mobile Computing – Challenges and Applications of Mobile Computing- Frequencies for radio transmission- Antennas -Multiplexing — Spread spectrum -MAC Protocols: SDMA- TDMA- FDMA- CDMA. Introduction to Cellular Systems — GSM: Architecture, Services & Protocols-GPRS-Radio frequency identification(Rfid)-Wireless Broadband- Introduction to 1G, 2G, 3G and 4G: features and challenges, Applications of 4G.
UNIT-II	Wireless and Mobile Computing Models LAN Protocols: IEEE 802.11/a /g/n & Bluetooth, Data Management Issues. Sensor Networks- Challenges, Architecture, and Applications.

UNIT-III	**Routing in Mobile Networks** Routing Taxonomy, Applications, Challenges in Mobile Environments, Hidden and exposed terminal problems, Routing Protocols- Proactive, Reactive, and Hybrid protocols, Dynamic State Routing (DSR), Ad hoc On-Demand Distance Vector (AODV), Destination Sequenced Distance – Vector Routing (DSDV), and Cluster Based Routing Protocol (CBRP), and Temporally Ordered Routing algorithm (TORA), Directed-diffusion, Low Energy Adaptive Clustered Hierarchical (LEACH) routing protocol.
UNIT-IV	**Mobile TCP/IP** Distributed location and data management: Mobile IP- Problem with Mobility, Terminology, Operation, Tunneling, Data transfer to the mobile system, Transport Control Protocol (TCP) Over wireless- Indirect TCP (I-TCP), Snoop TCP, Mobile TCP (M-TCP), Data management issues, Data delivery models, Broadcast disks, data replication, Data caching and design issues, Air indexing, Transaction processing in mobile computing environment.
UNIT-V	**MOBILE AGENTS** Introduction to Mobile Agents, Mobile agents vs. Client server, Agent migration and design issues, Mobile agent communication, Mobile Agent Security – Security Requirements and Cryptographic Techniques, Taxonomy of Possible Attacks – Malicious Agents, Malicious Agencies, Protecting Mobile Agents - Preventing Attacks on Mobile Agents, Detecting Attacks on Mobile Agents, Protecting Agencies - Agent Authentication and Authorization.

TEXT BOOKS
1. Charles E. Perkins, Ad hoc Networks, Addison Wesley, 2008. 2. Mazliza Othman, Principles of mobile computing and communications, Auerbach Publications, 2007.
REFERENCE BOOK

1. Mobile Computing Technology, Applications and service creation, Asoke K Telukder, Roopa R Yavagal by TMH.
2. Wireless Communications & Networks, Second Edition,William Stallings by Pearson
3. TCP/IP Protocol Suite by Behrouz A Forouzan, Third Edition,TMH

OPEN SOURCE SOFTWARE	
Course Code: 25CSPE4031	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. To introduces concepts, principles and applications of open source software.
2. To discuss about open source software development process.
3. To understand the difference between open source software and commercial software.
4. To familiarize with Linux operating system.
5. To understand and development of web applications using open source web technologies like Apache, MySql and PHP (LAMP/XAMP).

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Understand the difference between open source software and commercial software.
2. Identify, install and run Linux operating system.
3. Install and manage applications.
4. Identify, install open source web technologies Apache, MySql, PHP.
5. Develop web applications using LAMP.
6. Write session control PHP code for a website.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	✔	✔				
CO2		✔	✔			
CO3			✔	✔		
CO4				✔	✔	
CO5					✔	✔

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT-I	**OPEN SOURCE**: Introduction to Open Source – Open Source vs. Commercial Software – What is Linux? - Free Software – Where I can use Linux? Linux Kernel – Linux Distributions.
UNIT-II	**LINUX**: Introduction to Linux Essential Commands - Filesystem Concept - Standard Files 1. The Linux Security Model - Vi Editor - Partitions creation - Shell

UNIT-III	**APACHE**: Apache Explained - Starting, Stopping, and Restarting Apache - Modifying the Default Configuration - Securing Apache - Set User and Group - Consider Allowing Access to Local Documentation - Don't Allow public html Web sites - Apache control with .htaccess.
UNIT-IV	**MYSQL**: Introduction to MYSQL - The Show Databases and Table - The USE command - Create Database and Tables - Describe Table - Select, Insert, Update, and Delete statement - Some Administrative detail - Table Joins - Loading and Dumping a Database.
UNIT-V	**PHP**: Introduction- General Syntactic Characteristics - PHP Scripting - Commenting your code - Primitives, Operations and Expressions - PHP Variables - Operations and Expressions Control Statement - Array - Functions - Basic Form Processing - File and Folder Access - Cookies - Sessions - Database Access with PHP - MySQL - MySQL Functions - Inserting Records - Selecting Records - Deleting Records - Update Records.

TEXT BOOK

1. James Lee and Brent Ware, "Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP", Dorling Kindersley (India) Pvt. Ltd, 2008.

REFERENCE BOOK

1. Eric Rosebrock, Eric Filson,"Setting Up LAMP: Getting Linux, Apache, MySQL, and PHP and working Together", Published by John Wiley and Sons, 2004.
2. Philosophy of GNU URL: http://www.gnu.org/philosophy/.
3. Version control system, URL: http://git-scm.com/
4. SVN version control, URL: http://svnbook.red-bean.com

NASSCOM ASSOCIATE ANALYTICS - III	
Course Code: 25CSPE4039	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVE
1. This course provides knowledge of the advanced concepts of tools, technologies & programming languages which is used in day to day business analytics cycle.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Understand the tools, technologies & programming languages which is used in day to day analytics cycle.
2. Analyze and use the best tools to make sense from available raw data.

Mapped SDGs: SDG-4

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**Introduction to Predictive Analytics & Linear Regression (NOS 2101)** What and Why Analytics, Introduction to Tools and Environment, Application of Modelling in Business, Databases & Types of data and variables, Data Modelling Techniques, Missing imputations etc. Need for Business Modelling, Regression – Concepts, Blue property-assumptions-Least Square Estimation, Variable Rationalization, and Model Building etc.
UNIT-II	**Logistic Regression Objective Segmentation (NOS 2101)** Model Theory, Model fit Statistics, Model Conclusion, Analytics applications to various Business Domains etc. Regression Vs Segmentation – Supervised and Unsupervised Learning, Tree Building – Regression, Classification, Overfitting, Pruning and complexity, Multiple Decision Trees etc.
UNIT-III	**Time Series Methods/Forecasting, Feature Extraction (NOS 2101)** Arima, Measures of Forecast Accuracy, STL approach, Extract features from generated model as Height, Average, Energy etc and Analyze for prediction.

UNIT-IV	**Working with Documents (NOS 0703)** Standard Operating Procedures for documentation and knowledge sharing, Defining purpose and scope documents, Understanding

	structure of documents – case studies, articles, white papers, technical reports, minutes of meeting etc., Style and format, Intectual Property and Copyright, Document preparation tools – Visio, PowerPoint, Word, Excel etc., Version Control, Accessing and updating corporate knowledge base, Peer review and feedback.
UNIT-V	**Develop Knowledge, Skill and Competences (NOS 9005)** Introduction to Knowledge skills & competences, Training & Development, Learning & Development, Policies and Record keeping, etc.

TEXT/REFERENCE BOOKS
1. NASSCOMM

SYLLABUS OF ABILITY ENHANCEMENT COURSES

COMMUNICATIVE ENGLISH

(COMMON TO ALL BRANCHES OF B.TECH.)

Communicative English (Common To All branches of B.Tech)	
Course Code:25AEC101	Continuous Evaluation:40 Marks
L T P: 2 0 0	End Semester Examination:60 Marks
Credits: 2	Prerequisite: Nil

COURSE OBJECTIVES (CO)

1. To prepare the students for their career which will require them to listen to, read, speak, and write in English both for their professional as well as interpersonal communication
2. To empower the students to improve both abilities to communicate and their linguistic competence and boost their confidence.
3. To enable the students to properly communicate and express themselves in writing.
4. To enable students to identify the common mistakes made by most learners of English and not make those errors both in their writing and speaking.
5. To study, understand and implement each unit according to National Education Policy 2020 and Bloom's Taxonomy.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Recall and identify English vocabulary words and grammatical structures.
2. Analyse the structure and organization of written texts, identifying the introduction, body, and conclusion.
3. Examine how the use of specific language techniques impacts the effectiveness of communication.
4. Assess and critique public speeches and presentations based on clarity, coherence, and persuasiveness.
5. Evaluate one's own language skills and identify areas for improvement.

MAPPING MATRIX OF COURSE OBJECTIVES (CO) & COURSE LEARNING

Course Objective	**Course Learning Outcomes**				
	CLO 1	**CLO 2**	**CLO 3**	**CLO 4**	**CLO 5**
CO 1					
CO 2					
CO 3					
CO 4					
CO 5					

COURSE CONTENTS

Unit-I: Introduction to Communication

The importance of communication through English at the present time; the process of communication and factors that influence communication: sender, receiver, channel, code, topic, message, context, feedback, 'noise', filters and barriers; Verbal and non-verbal communication

Listening Skills: Importance and types of Listening
Identifying and rectifying common errors: Subject-verb agreement, Concord, Types of Sentences (Statements, interrogative, exclamatory and imperative, wh- questions, question-tags) Use of modals
Vocabulary Building, word collocation

Unit-II: Workplace Communication
Communication challenges in culturally diverse workforce; Ethics in Communication
Bias-free communication
Effective Business Presentations: Importance in workplace communication; Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Handling Questions; Power Point Presenta

Unit-III: Writing at Work
Business letters
Writing notices, circulars, emails.
Writing reports and precis writing
Writing CVs (for Technical Positions and Internships)

Unit-IV: Soft Skills/Life Skills
Body Language
Connected Speech (Intonation in Everyday Speaking and Conversation)
Types of interviews, Planning and preparing for a Job Interview; Stages of an Interview; Mastering the art of giving interviews.

TEXT BOOKS

1. English Grammar in Use. Raymond Murphy. Cambridge UP.4th Edition.
2. Business Communication by Carol M Lehman, Debbie D Dufrene and Mala Sinha. Cengage Learning. 2nd Edition.
3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian [MACMILLAN]
4. Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman and Shalini Upadhyay. Cengage Learning. 2018 Edition.

REFERENCE BOOKS

1. Technical Communication, Principle and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford University Press.
2. Communication skill by Sanjay Kumar & Puspa Lata, Oxford University Press. 2nd Edition.
3. Business Communication Today by Courtland L Bovee and Thill, Pearson

Communicative English Lab (Common To All branches of B. Tech)	
Credits: 1	Continuous Evaluation:60 Marks
L T P: 0 0 2	End Semester Examination:40 Marks
Prerequisite: Nil	Course Code:25AEC151

COURSE OBJECTIVES (CO)

1. To prepare the students for their career which will require them to listen to, read, speak, and write in English both for their professional as well as interpersonal communication
2. To empower the students to improve both abilities to communicate and their linguistic competence and boost their confidence.
3. To enable the students to properly communicate and express themselves in writing.
4. To enable students to identify the common mistakes made by most learners of English and not make those errors both in their writing and speaking.
5. To study, understand and implement each unit according to National Education Policy 2020 and Bloom's Taxonomy.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Summarize conversations, demonstrating understanding of the content.
2. Apply communication strategies to maintain conversations and express ideas clearly.
3. Critique and assess various spoken interactions to identify strengths and areas for improvement in communication.
4. Create engaging dialogues or role-plays that demonstrate real-life communicative scenarios.
5. Develop and present persuasive arguments or opinions on various topics in English.

MAPPING MATRIX OF COURSE OBJECTIVES (CO) & COURSE LEARNING

Course Objective	Course Learning outcomes				
	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 1					
CO 2					
CO 3					
CO 4					
CO 5					

LIST OF Activities

Unit-I

Listening and Speaking
Accent in speech
Longer Discourse (dialogues, songs, contextual speech etc.)
Role-play
Practicing sounds of English

Extempore Presentations

Unit-II
Reading comprehension practice: Technical text
General text

Unit-III
Guided composition
Free-writing

TEXT BOOKS

1. English Grammar in Use. Raymond Murphy. Cambridge UP.4th Edition.
2. Business Communication by Carol M Lehman, Debbie D Dufrene and Mala Sinha. Cengage Learning. 2nd Edition.
3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian [MACMILLAN]
4. Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman and Shalini Upadhyay. Cengage Learning. 2018 Edition.

REFERENCE BOOKS

1. Technical Communication, Principle and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford University Press.
2. Communication skill by Sanjay Kumar & Puspa Lata, Oxford University Press. 2nd Edition.
3. Business Communication Today by Courtland L Bovee and Thill, Pearson

GERMAN LANGUAGE PHASE I	
Course Code: 21FLGR301	Continuous Evaluation: 40 Marks
Credits: 2	End Semester Examination: 60 Marks
L T P: 2 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (COs)

1. To develop oral and written skills of understanding, expressing and exchanging Information/ interacting.
2. To develops the ability to construct sentences and frame questions.
3. To provide German language as a competitive edge in career choices.
4. To know the culture of the countries where the German language is spoken.
5. To provide employment opportunities as well as helping them to develop projects on browsing German websites

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Read and write short, simple texts.
2. Have Fluency in reading and writing.
3. Understand a dialogue between two native speakers and to take part in short, simple conversations using the skills acquired.
4. Know the culture of the countries where the German language is spoken.
5. Learn pronunciation so that they can read the text and e-mail during their employment, instructing them to write their own CV and developing a fundamental conversation with any German national.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE LEARNING OUTCOMES / COURSE OBJECTIVES	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

COURSE CONTENTS

UNIT-I : INTRODUCTION

Grüße, Wortschatz

UNIT-II : THEMEN

Das Alphabet, die Aussprache, die Zahlen, Land und Stadt beschreibung, Berufe, rede über Dinge, die Zeit, Mahlzeiten und Getränke

UNIT-III : GRAMMATIK

Plural, Artikel, Possessive Artikel, Adjektive, Sich vorstellen, Verben (regulär, unregelmäßig, Pronomen), Nominativ Pronomen, Präpositionen,

UNIT-IV : WORTSCHATZ

emanden vorstellen, Nationalitäten, Länder, Zahlen, Über die Wochentage sprechen, Die Monate des Jahres, Die Berufe, Die Farben, Die Gegensätze, Die Sätze mit der Zeit

UNIT-V : MÜNDLICHER AUSDRUCK

Mündliche und Höraktivitäten

TEXT BOOK

1. Tangram aktuell 1 (Lektion 1-4 Kursbuch + Arbeitsbuch, Lektion 5-8 Kursbuch + Arbeitsbuch, Übungsheft)

REFERENCE BOOKS

1. Wolfgang Hieber: Lernziel Deutsch, Teil 1. Max Hueber Verlag

2. Korbinian Braun, u.a.: Deutsch als Fremdsprache IA, Grundkurs. Ernst Klett Stuttgart

3. Rolf Brüseke: Starten Wir! A1. München: Hueber Verlag

GERMAN LANGUAGE PHASE II	
Course Code: 21FLGR401	Continuous Evaluation: 40 Marks
Credits: 2	End Semester Examination: 60 Marks
L T P: 2 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (COs)

To demonstrate their ability to recognize, identify, extract and/or differentiate key information conveyed in spoken announcements, instructions, and in interactions between native speakers on familiar topics.

1. To demonstrate effective speaking and listening skills in German on informal and some formal topics related to personal, professional, academic, and leisure activities.
2. To develop awareness of the nature of language and language learning.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Read and write short, simple texts.
2. Have Fluency in reading and writing.
3. Use language creatively and spontaneously.
4. Get awareness about cross-cultural and intercultural difference.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE LEARNING OUTCOMES / COURSE OBJECTIVES	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✔			
CO02		✔		
CO 03			✔	
CO 04				✔

COURSE CONTENTS

UNIT-I : THEMEN

Einkaufen, Tagesablauf, Lebenslauf , Nach dem Weg fragen, Wegbeschreibungen, Der Körper, Ereignisse der Vergangenheit erzählen

UNIT-II : GRAMMATIK

Trennbare und untrennbare Verben, Dativ , Modalverben, Präteritum von sein, haben, Perfekt

UNIT-III : WORTSCHATZ

Kleidung, Haushaltswaren, Sachen zum Essen und Trinken, Verkehrsmittel, Namen von Orten und Sehenswürdigkeiten, Information über Deutschland, Ordinalzahlen

UNIT-IV : KOMPOSITION

Themen zum schreiben wie Deutschland und Delhi, was haben Sie am wochenende gemacht, Traummann/Traumfrau

UNIT-V: Mündlicher Ausdruck

Sprechen uber die Stadt, Das Haus, Meine Famile

TEXT BOOK

1. Tangram aktuell 1 (Lektion 1-4 Kursbuch + Arbeitsbuch, Lektion 5-8 Kursbuch + Arbeitsbuch, Übungsheft)

REFERENCE BOOKS

1. Wolfgang Hieber: Lernziel Deutsch, Teil 1. Max Hueber Verlag

2. Korbinian Braun, u.a.: Deutsch als Fremdsprache IA, Grundkurs. Ernst Klett Stuttgart

3. Rolf Brüseke: Starten Wir! A1. München: Hueber Verlag

Website pages:

1. https://www.nthuleen.com/teach.html

FRENCH LANGUAGE PHASE I	
Course Code: 21FLFR301	Continuous Evaluation: 40 Marks
Credits: 2	End Semester Examination: 60 Marks
L T P : 2 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (COs)

1. To develop oral and written skills of understanding, expressing and exchanging Information/ interacting.
2. To develops the ability to construct sentences and frame questions.
3. To provide French language as a competitive edge in career choices.
4. To know the culture of the countries where the French language is spoken.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Read and write short, simple texts.
2. Have Fluency in reading and writing.
3. Use language creatively and spontaneously.
4. Know the culture of the countries where the French language is spoken.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE LEARNING OUTCOMES / COURSE OBJECTIVES	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✔			
CO02		✔	✔	
CO 03			✔	
CO 04				✔

COURSE CONTENTS

UNIT-I : INTRODUCTION

Les Salutations, Vocabulaire

UNIT-II : SUJETS

L'Alphabet, Le Prounciation, Les Nombres, Décrire votre pays, ville, Les Professions, Parler de choses,L'Heure, Les Repas et les boissons

UNIT-III : GRAMMAIRE

Le Nom et le pluriel des noms, Les Articles, Les Adjectifs Possessifs, Les Adjectifs Qualificatifs, Se présenter, Les Verbes (Regular, irregular, pronominaux), Les Pronoms Sujet, Les Prépositions, L'interrogation

UNIT-IV : LEXIQUE

Présenter quelq'un, Les nationalités, Les Pays, Les Nombres, Parler des jours de la semaine, Les mois de l'année, Les Professions, Les Couleurs, Les Contraires, Les phrase avec l'heure

UNIT-V : L'EXPRESSION D'ORALE

Les activites d'orale et ecouter

TEXT BOOK

1. Version Originale – 1 Livre de l'élève: Monique Denyer, Agustin Garmendia, Marie-Laure Lions Olivieri, Editions Maisons des Langues, Paris

REFERENCE BOOKS

1. Nathan verbs conjugasion , Le Robert Nathan, Paperback
2. Larrouse French to English Dictionary, Larrouse, Paperback
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al, Cle International, Paris.

FRENCH LANGUAGE PHASE II	
Course Code: 21FLFR401	Continuous Evaluation: 40 Marks
Credits: 2	End Semester Examination: 60 Marks
L T P: 2 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (COs)

1. To Demonstrate an elementary knowledge of French sentence structure through speaking and writing.
2. To develop the language proficiency required to communicate effectively in French.
3. To form a sound base of the skills, language and attitudes required for progression to work or further study, either in French or another subject area.
4. To develop awareness of the nature of language and language learning.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:

1. Read and write short, simple texts.
2. Have Fluency in reading and writing.
3. Use language creatively and spontaneously.
4. Know the culture of the countries where the French language is spoken.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE LEARNING OUTCOMES / COURSE OBJECTIVES	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✔			
CO02		✔		
CO 03			✔	
CO 04				✔

COURSE CONTENTS UNIT-I :

SUJETS

La France, Le Fromage, le vin, Les saisons, Les recettes, Indiquer un chemin,Demander la direction, Donner des indications, Le corps, Les elements du passé, Raconteur une journée

UNIT-II : GRAMMAIRE

La negation, L'imperatif ,Le passé recent,Le future, Le passé compose, L'imparfait, Les nombres ordinaux

UNIT-III : LEXIQUE

Les vêtements, Les animaux, Parler de prix, Le corps, Vocabulaire de la gare et du train, Le voyage, Les achats Les Prepositions, L'interrogation

UNIT-IV : Composition

les sujets pour l'ecriture comme la maison, l'ecole

UNIT-V : L'expression d'orale

Les etudiants ecrivent le petit paragraphess sur les sujets en utillisant les expression et le temps comme ma maison , ma famille.

TEXT BOOK

1. Version Originale – 1 Livre de l'élève: Monique Denyer, Agustin Garmendia, Marie-Laure Lions Olivieri, Editions Maisons des Langues, Paris

REFERENCE BOOKS

1. Nathan verbs conjugasion , Le Robert Nathan, Paperback
2. Larrouse French to English Dictionary, Larrouse, Paperback
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al, Cle International, Paris.
4. Alter Ego Part 1
5. Echo Part 1

SYLLABUS OF SKILL ENHANCMENT COURSES
SEMESTER – III

Department Of Training & Placement			
Training Cell			
Programme	**Faculty of Engineering & Technology**		
Year / Semester	**2 / 3**	**Course Category**	**SEC**
Course Code	**25SS351**	**Course Title**	**Effective Communication Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO): -

TO1. To define and understand communication and its process.
TO2. To make student practice on communication skills via LSRW approach via instructing, engaging, assessing and re engaging.
TO3. To enhance the confidence and motivation of a student by honing his communication skills.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

TLO1. To communicate effectively and interact with people with confidence.
TLO2. To demonstrate and differentiate between various forms of communication.
TLO3. To apply effective communication skills confidently which a student need to get ahead in job and life.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
TRAINING LEARNING OUTCOMES (TLO) TRAINING OBJECTIVES (TO)	TLO1	TLO2	TLO3
TO1			
TO2			
TO3			

Unit	**Course Contents**	**Student Engagement Activity**
Unit-I	**Verbal Communication Skills** Communication Process & its importance 7 C's of Communication Formal & Informal Conversation Requirements of effective verbal communication	Conversation Cards Activity

Unit-II	**Nonverbal Communication Skills** Importance of nonverbal skills in effective communication Types of nonverbal (body language) skills Barriers to nonverbal communication	Power of Body Language Activity

Unit-III	**Listening Skills** Role of listening skills in effective communication Barriers to listening Overcoming listening barriers Empathetic listening & avoiding selective listening	Chinese Whisper Activity
Unit-IV	**Reading & Writing Skills** Types of reading strategies to enhance improve reading skills Types of written communication	The What IF Activity
Unit- V	**Visual Communication** Types of visual communication Importance of visual communication Picture narration/description technique	Interpret The Picture Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.

Pedagogy

The training will be based on the concept of learning by practice.

The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.

The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Effective Communication Skills Course

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Verbal Communication Skills	Speech Activity	15	Written Test	10
II	Non Verbal Communication Skills	Role Play	15		
III	Listening Skills	Oral	10		

IV	Reading & Writing Skills	Assessment / Written Assessment	20	Viva	20
V	Visual Communication		10		

SEMESTER –IV

Department Of Training & Placement			
Training Cell			
Programme	**Faculty of Engineering & Technology**		
Year / Semester	**2 / 4**	**Course Category**	**SEC**
Course Code	**25SS452**	**Course Title**	**Teamwork & Interpersonal Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO): -

TO1. To make the students learn & demonstrate effective teamwork, leadership & interpersonal skills.
TO2. To equip the students with capability of handling stress and utilization of work time effectively.
TO3. To make the students understand the importance and application of Emotional Quotient, Critical Thinking & Problem Solving Skills.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

TLO1. To be confident working in a team and leading it as well.
TLO2. To categorize the work and achieve expected performance within the time frame & will be able to adapt himself to work under various kinds of stress and re-energies himself to bounce back from such situations.
TLO3. To get benefitted from Emotional Quotient in building stronger professional relationships and achieving career and personal goals.
TLO4. To face complex problems and effectively deal with it in the job due to Critical Thinking & Problem Solving Skills.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)				
Training Learning Outcomes (TLO) Training Objectives (TO)	TLO1	TLO2	TLO3	TLO4
TO1				
TO2				

TO3				

Unit	Course Contents	Student Engagement Activity
Unit - I	**Team Management** Team communication & team conflict resolution Role of a team leader Team goal setting & understanding team development Team dynamics & multicultural team activity Johari Window Model	Collaborative Working Game Activity
Unit-II	**Time Management** Time management matrix Pareto Principle (80/20 rule) Development process of plan of action	What You Did Yesterday Activity
Unit-III	**Leadership** Difference between leadership & management Types of leadership style Core leadership skills	Lead The Blindfolded Activity
Unit-IV	**Stress Management** Sign of stress & its impact Types of stress Techniques of handling stress	Keeping Cool Activity
Unit - V	**Emotional Intelligence** Emotional intelligence & emotional competence Components & behavioral skills of emotional intelligence	Guess The Emotion Game Activity
Unit - VI	**Critical Thinking** Types of thinking & Characteristics Critical thinking standards Barriers to critical thinking	Think Pair Share Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

The training will be based on the concept of learning by practice.
The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Teamwork & Interpersonal Skills

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Team Management	Role Play / Group Activity	10	Written Test	10
II	Time Management		10		
III	Leadership		10		
IV	Stress Management	Assignment	10	Viva	20
V	Emotional Intelligence	Written Test	10		
VI	Critical Thinking		20		

SEMESTER – V

Department Of Training & Placement			
Training Cell			
Programme	**Faculty of Engineering & Technology**		
Year / Semester	**3 / 5**	**Course Category**	**SEC**
Course Code	**25SS553**	**Course Title**	**Presentation Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO):-

TO1. To develop the public speaking skills in the student.
TO2. To make the students learn and adapt to the necessary etiquettes required working and growing in corporate culture.
TO3. To make the students learn to speak in a debate session by putting his arguments and making others accept his viewpoint convincingly.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

TLO1. To be confident in presenting himself in front of audience.
TLO2. To become professional in his approach towards work culture.
TLO3. To enhance the level communication skills while interacting with others.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
Training Learning Outcomes (TLO) **Training Objectives (TO)**	TLO1	TLO2	TLO3
TO1			
TO2			
TO3			

Unit	Course Contents	Student Engagement Activity
Unit-I	**Importance of Presentation Skills** 4 P's of presentation skills – plan, prepare, practice & present Guidelines for effective presentation	PPT Presentation Activity

Unit-II	**Storytelling Skills** 4 P's of storytelling skills – people, place, plot & purpose Types of storytelling techniques Importance of storytelling skills	Start From Where I Stopped Activity

Unit-III	**Corporate Culture Etiquettes** Importance of professional behavior at work place Understand & implementation of etiquettes at work place Importance of values & ethics Types of professional / corporate etiquettes	Etiquettes Role Play Activity
Unit-IV	**Debate / Extempore** Difference between debate, extempore & group discussion Learning argument /counter argument in debate	Current Affair Topic Speech Activity
Unit-V	**Art of Creating Impression** Importance of creating first impression 6 ways to master the art of creating impression	Speech Activity
Unit-VI	**Problem Solving** Types of problems & its solutions Problem solving process & tools	Think Pair Share Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

The training will be based on the concept of learning by practice.
The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Presentation Skills

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Importance of Presentation Skills	Presentation Activity	20	Written Test	10
II	Storytelling Skills	Speech Activity	15		
III	Corporate Culture	Assignment	10		

	Etiquettes				
IV	Debate/Extempore	Speech Activity / Written Activity	15	Viva	20
V	Art of Creating Impression		10		
VI	Problem Solving				

SEMESTER – VI

Department Of Training & Placement			
Training Cell			
Programme	**Faculty of Engineering & Technology**		
Year / Semester	**3 / 6**	**Course Category**	**SEC**
Course Code	**25SS654**	**Course Title**	**Professional Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO): -

TO1. To encourage students to learn and apply the effective writing skills.
TO2. To make the students learn various types of business correspondence letters, cover letters & resume.
TO3. To encourage students to learn as to how to talk and convince people in GD & interview.
TO4. To make the students learn to build rapport for building positive relationships professionally at workplace.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

TLO1. To understand the importance of professional writing required in workplace.
TLO2. To explore different formats in resume, cover letters & other business related letters.
TLO3. To develop knowledge, skills and understanding people in-group and individually.
TLO4. To apply communication strategies either in-group or one on one basis and will be confident to lead the discussion among them.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)				
Training Learning Outcomes (TLO) Training Objectives (TO)	TLO1	TLO2	TLO3	TLO4
TO1				
TO2				
TO3				

TO4	-	-	-	

Unit	Course Contents	Student Engagement Activity
Unit-I	**Email Writing** Importance of email communication skills Basic rules of effective email writing Structure of email – address, subject, message text, attachments, signature	Email Practice Activity
Unit-II	**Resume Writing** Difference between Resume, CV & Bio data Guidelines of resume writing Resume preparation of the student	Resume Making Activity
Unit-III	**Letter Writing** Types of Letter Writing – Application, Leave, etc. Cover letter	Letter Writing Activity
Unit--IV	**Group Discussion (GD)** Characteristics of GD & subject knowledge Do's & Don'ts in GD Strategies of GD Types of GD	Group Discussion Practice Activity
Unit-V	**Interview Skills** Preparation of the interview & company details information Do's & Don'ts in interview Types of Interviews Strategies of interview	Mock Interview Practice Activity
Unit-VI	**Negotiation Skills** Importance of negotiation skills Four phases of negotiation skills Barriers to negotiation & overcoming it Win-win negotiation	Win-Win Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

The training will be based on the concept of learning by practice.

The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.

The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Professional Skills

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Email Writing	Written Assignment	10	Written Test	10
II	Resume Writing		10		
III	Letter Writing		10		
IV	Group Discussion	Group Discussion Activity	15	Viva	20
V	Interview Skills	Mock Interview Activity	15		
VI	Negotiation Skills	Role Play	10		

SEMESTER – VII

Department Of Training & Placement			
Training Cell			
Programme	**Faculty of Engineering & Technology**		
Year / Semester	**4 / 7**	**Course Category**	**SEC**
Course Code	**25AR755**	**Course Title**	**Aptitude & Reasoning**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO): -

TO1. To understand the basic concepts of quantitative ability and logical reasoning.
TO2. To make students practice on the concepts of quantitative ability and logical reasoning.
TO3. To prepare the students for aptitude and reasoning round in placement selection process & other competitive exams.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

TLO1. To understand the basic concepts of quantitative ability.
TLO2. To solve campus placements aptitude papers covering Quantitative Ability.
TLO3. To Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
TRAINING LEARNING OUTCOMES (TLO) TRAINING OBJECTIVES (TO)	TLO1	TLO2	TLO3
TO1			
TO2			
TO3			

A-Quantitative Ability

UNIT - I

Number System
Percentage
Profit, Loss and Discount
Simple Interest and Compound Interest

UNIT – II

Allegation and Mixture
Average

Ratio, Proportion and Variation, Problem on Ages and Numbers
Time and Work
Time, Speed and Distance

UNIT – III

Permutation and Combination
Probability
Data Interpretation
Geometry and Menstruations
Sequence, Series & Progression and Logarithmic

UNIT - IV

B- Logical Reasoning

Number Series and Alphabet Series
Direction Sense Test
Coding -Decoding
Blood Relation

UNIT – V

Syllogism
Dice, Cube and Cuboids
Seating Arrangement

UNIT – VI

Clock and Calendar
Critical Reasoning
Order and Ranking, Ven diagram, Analogy

Learning Resources	
Text Books	**Quantitative Aptitude for Competitive Examinations** by R S Aggarwal: S Chand Publishing, 2022.
	A Modern Approach to Logical Reasoning by R S Aggarwal: S Chand Publishing, 2022.

Pedagogy-

The training will be based on the concept of learning by doing and practice.

The training will involve 50% of the training time on teaching the concepts and the remaining 50% will be focusing on practice.

The training will follow a circular approach where students are taught, evaluated and given the feedback.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Aptitude & Reasoning

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Quantitative Ability	Written Assignment	10	Written Test	30
II			10		
III			10		
IV	Logical Reasoning		15		
V			15		
VI			10		

SYLLABUS OF MULTIDISCIPLINARY COURSES

Department of Mathematics			
Multi-Disciplinary Course (MDC)			
Year/Semester	**1st Year/1st Semester**	**Course Category**	**Multidisciplinary Course**
Course Code	**25MDC101**	**Course Title**	**Statistical Methods**
Continuous Evaluation: 40		**End Semester Examination: 60**	
Prerequisite: Basic Mathematics		**L T P : 2 0 2**	**Credits: 3**

Course Objectives (CO) - The Course is designed with the following objectives:

1. To introduce the basics of statistics and graphical representation of data
2. To equip the students with measures of central tendency and dispersion
3. To learn about correlation and regression analysis
4. To know about the probability in daily life

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

1. Understand the basics of statistics and explain data for graphical representation
2. Understand the concept of measures of central tendency and measures of dispersion
3. Understand the basics of correlation and regression
4. Understand the concept of probability in real life scenario

Mapping Matrix between Course Objectives and Course Learning Outcomes:

CLO / CO	CL 1	CL 2	CL 3	CL 4
CO 1	✔			
CO 2		✔		
CO 3			✔	
CO4				✔

COURSE CONTENTS:

Unit-I: Data Visualization

Data types and measurement scales, Graphical representation of data, Measures of Central Tendency-mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Skewness and Kurtosis.

Application domain problems: Analyze, interpretation and significance of data

Unit -II: Bivariate Data Analysis

Bivariate Data, Scatter plot, Correlation, Karl Pearson's correlation coefficient, Rank correlation Spearman's, Concept of errors, Principle of least squares, fitting of polynomial and exponential curves. Simple linear regression and its properties. Fitting of linear regression line and coefficient of determination.Application domain problems: Machine learning and data analysis

Unit-III: Probability

Probability: Introduction, random experiments, sample space, events, and algebra of events. Definitions of Probability –classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem, and its applications.
Application domain problems: Decision making, forecasting, Naives Bayes analysis

Unit -IV: Testing of Hypothesis

Type I error and Type II error and power of test. Hypothesis testing for- population means, difference of two population means, population proportions, difference between two population proportions, population variance, ratio of two population variances. Chi square test: test of goodness of fit.
Application domain problems: Decision making for the available data

Practical/Lab Work to be performed in Computer Lab

The practical will be taught using Excel software and/or using some statistical software like R /SPSS. Students are encouraged to use resources available on open sources.

1. Graphical representation of data.
2. Practical based on measures of central tendency
3. Practical based on measures of dispersion.
4. Practical based on combined mean and variance and coefficient of variation.
5. Practical based on moments, skewness, and kurtosis.
6. Fitting of polynomials, exponential curves.
7. Karl Pearson correlation coefficient.
8. Correlation coefficient for a bivariate frequency distribution.
9. Lines of regression, angle between lines and estimated values of variables.
10. Problems based on conditional probability and Baye's theorem

Reference Books

1. Agresti, A. (2010): Analysis of Ordinal Categorical Data, 2nd Edition, Wiley
2. Goon A.M., Gupta M.K. and Dasgupta B. Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata, 2002
3. Fundamental of Mathematical Statistics by S.C. Gupta and V.K Kapoor, Saurabh Jain 2017
4. Hogg, R. V. McKean J. W. and Craig, A. T. (2012), Introduction to Mathematical Statistics, Pearson 7th Edition R for beginners by Emmanuel Paradis (Freely available) at https://cran.rproject.org/doc/contrib/Paradisrdebuts_en.pdf)

Department of Environmental Sciences			
Program: UG program			
Year/Semester	1st Year/I or II	**Course Category**	**MDC**
Course Code	25MDC101	**Course Title**	Environmental Geoscience & Disaster Management
Continuous Evaluation: 40		**End Semester Examination:** 60	
Prerequisite: Nil		**L T P** : 3 0 0	**Credits: 3**

COURSE OBJECTIVES (COs): The Course is designed with the following objectives:

1. To provide fundamental knowledge of earth origin and earth Processes.
2. Educate the students about the types of rocks & geological resources.
3. To understand the Disaster and Disaster management.
4. Role of Geospatial technology in geological resources and Disaster management.

COURSE LEARNING OUTCOMES (CLOs)

The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

1. Able to explain the origin and Internal structure of earth.
2. Analyse the Geological resources and geochemistry of minerals.
3. Collect a comprehensive understanding of disaster management.
4. Evaluate the role of technology in disaster management.

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

	COURSE LEARNING OUTCOMES (CLOs)			
COURSE OBJECTIVES (COs)	**CLO1**	**CLO2**	**CLO3**	**CLO4**
CO1	√			
CO2		√		
CO3			√	
CO4				√

COURSE CONTENTS

Unit-1

Origin of the Earth:

Theories and hypothesis of the origin of earth- Oparin-Haldane hypothesis, Big bang theory, the material basis of life, geological time scale, evolution of earth's atmosphere and life through the geological time scale.

Unit-2

Internal Structure of the Earth:

Internal Structure of Earth, differentiation of the earth into core, mantle, crust. Formation of core, mantle, crust, atmosphere, hydrosphere, and biosphere. Convection

in Earth's core and production of its magnetic field. Geothermal gradient and internal heat of the Earth. Earthquake and earthquake belts: seismic waves and internal constitution of the Earth. Volcanoes and volcanism, distribution of volcanoes.

Unit-3

Fundamentals of Earth process

Concepts Rocks, Formation of rocks, types of rock (Igneous rock, Metamorphic Rocks, and Sedimentary rocks), Continental drift theory, Plate tectonic, sea floor spreading. Basic concepts of weathering, erosion, and deposition of earth materials by water wind and glaciers.

Unit-4

Geological Resources and Exploration:

Fundamentals of geological resources, their formation, reserves in minerals, coal, oil, gas geological constraints in their availability and use; environmental consequences of their exploitation to air, water, soil, climate, and life. Distribution of minerals in India.

Unit-5

Disaster Management:

Disaster introduction- disaster management, capability vulnerability, risk, preparedness and mitigation. Disaster management cycle. Hazard zonation and mapping- risk reduction measures. Landslide, Earthquake, Tsunami, Flood, Minamata Disaster, Bhopal Gas Disaster, 1984, Chernobyl Disaster, 1986, Fukushima Daiichi nuclear disaster, 2011. Role of geo-spatial technology in surveillance, monitoring, risk assessment, and disaster management Sendai Framework for Disaster Risk Reduction.

RECOMMENDED TEXTBOOKS:

1. Mukherjee, S. (2004). Text Book of Environmental remote Sensing. Published by Macmillan India Limited New Delhi ISBN: 1403922357.
2. Keller, E.A. (1996). Introduction to Environmental Geology. Prentice Hall, Upper Saddle River, New Jersey.
3. Disaster management by R. Subramanian, Vikash Publishing house, ISBN 9352718704

REFERENCE BOOKS

1. Keller, E.A. (1996). Introduction to Environmental Geology. Prentice Hall, Upper Saddle River, New Jersey.
2. J.R Jensen, Remote Sensing of the Environment: An Earth Resource Perspective, 2012

Principals of Management & Organizational Behaviour	
Course Code: 25MDC 401	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
Prerequisite: NIL	Course Category: Multidisciplinary

COURSE OBJECTIVES

1. To understand the functions and responsibilities of managers.
2. To acquaint the students with the fundamentals of managing business.
3. To understand individual and group behaviour at work place so as to improve the effectiveness of an organization.
4. To analyse human behaviour in the organization setting in order to manage it in accordance to the intentions.

COURSE LEARNING OUTCOMES

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Demonstrate the roles, skills and functions of management.
2. Analyse the causes and consequences of applying different business strategies.
3. Analyse and compare individual behaviour related to motivation and rewards.
4. Identify group behaviour, leadership styles and the role of leaders in a decision making process.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

Course Objectives (COs)	Course Learning Outcomes (CLOs)			
	CLO 1	CLO 2	CLO 3	CLO 4
CO 1				
CO 2				
CO 3				
CO 4				

COURSE CONTENTS

Unit 1: Introduction to the management

Management Concept, Nature, Process and significance, levels of management, managerial skills, functions of management, management and administration, evolution of management, Role of management and insights from Indian practices and ethos.

Unit 2: Functions of the management

Planning: Types of Plans & The planning process; Organizing: Common organisational structures; Staffing: features and necessity; Leading: types of leaders; Controlling: functions and types

Unit 3: Introduction to Organizational Behaviour

Meaning, importance and scope of OB; abilities: meaning and forms, attitudes: framework, work related attitudes, personality: types, assessment, perception: process, factors influencing perception, perceptual errors

Unit 4: Foundation of Group Behaviour

Defining and classifying groups; need to join groups, stages of group development; group dynamics: group properties as roles, norms and size; group decision making techniques, conflict management

TEXT BOOKS

1. Stephen Robbins, Organizational Behavior, 16th edition (2012), Pearson Education.
2. K. Aswathappa, Organizational Behaviour, 13th edition (2016), Himalaya Publishing House.
3. Fred Luthans, Organizational Behavior, 14th edition (2017), McGraw-Hill.

SUGGESTED READINGS

1. Gregory Moorhead & Ricky W. Griffin, Organizational Behaviour, 11th edition (2009), Jaico Publication.
2. Tripathy PC and Reddy PN, Principles of Management, 6th edition (2011), McGraw-Hill.

Year/Semester	**3rd / 4th**	**Course Category**	**MDC**
Course Code	**25MDC501**	**Course Title**	**Library Information Science & Media Literacy**
Continuous Evaluation: 40		**End Semester Examination:60**	
Prerequisite: Nil		**L T P : 3 0 0**	**Credits: 3**

Course Objectives (CO) - The Course is designed with the following objectives:

CO-1: To know the library collection and their classifications.
CO-2: To discuss the library information services.
CO-3: To understand the importance of media
CO-4: To grasp the significance of motive of media

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

CLO-1: Explain the library collection and their classifications.
CLO-2: Analyse the library information services.
CLO-3: Analyse the media roles.
CLO-4: Analyze the motive of the media.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

	CO-1	**CO-2**	**CO-3**	**CO-4**
CLO-1	√			
CLO-2		√		
CLO-3			√	
CLO-4				√

COURSE CONTENTS:

UNIT-1: Library Collection

1. Type of Information Sources : Primary, Secondary and Tertiary
2. Reference Collection: Type of reference sources
3. Indexing and Abstracting Journals
4. Multimedia Collection
5. Arrangement of Information Sources : Classification

UNIT-2: Information Services

1. Bibliography: Type of Bibliography
2. Reviews Literature
3. Citation Style
4. Citation Analysis: Web of Science and Scopus
5. Online Databases : Structure and Retrieval

UNIT-3: Media Literacy

Introduction to Media Literacy Type of media: Traditional versus social media Bias in media

UNIT-4: Motive of Media

Media tycoons and conditions in which media work

Research and Publication ethics

Recommended Books:

1. Richard E. Rubin & Rachel G. Rubin, Foundations of Library and Information Science, 5th Edition. ISBN-9781783304776, Facet Publication, UK
2. https://en.unesco.org/themes/media-and-information-literacy/resources

Year/Semester	3rd /5th	Course Category	Multidisciplinary Course (MDC)
Course Code	25MDC502	Course Title	IPR for Business
Continuous Evaluation: 40		End Semester Examination: 60	
Prerequisite: Nil		L T P: 3 0 0	Credits: 3

COURSE OBJECTIVES:

The objective of this Multidisciplinary Course (MDC) is to familiarize the students with various types of IPR and its relevance to the businesses and their respective streams.

CO 1: To provide students with a basic understanding of various types of IPR and its relevance for business.

CO 2: To acquaint students with the strategies and management techniques associated with intellectual property assets, and the legal considerations and challenges involved.

CO 3: To familiarize the students with the challenges and legal considerations related to intellectual property disputes.

CO 4: To develop skills related to management of intellectual property in business.

COURSE LEARNING OUTCOMES

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

CLO1: Define and discuss about the various types of IPR and its relevance for business

CLO2: Discuss the adjudicating bodies and mechanisms under each of these IPRs

CLO3: Analyze and resolve business disputes relating to IPR

CLO4: Apply the learning to the real-life situations in business

MAPPING COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

	COURSE LEARNING OUTCOMES (CLOs)			
COURSE OBJECTIVES (COs)	CLO1	CLO2	CLO3	CLO4
CO1	√			
CO2		√		
CO3			√	
CO4				√

COURSE CONTENT

UNIT 1

INTRODUCTION TO INTELLECTUAL PROPERTY AND BUSINESS

Concept of IPR in business and its types

International Context - Introduction to the leading International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, TRIPS, The World Intellectual Property Organization (WIPO), World Trade Organization (WTO) and the UNESCO

Innovation as a Business Strategy and relevance of protecting the ideas legally

National IPR Policy

UNIT-2

COPYRIGHT

Concept of Copyright and importance for businesses Media business – protecting performer's rights

Performers' and Broadcasters' Rights Law Assignment, Transmission, Licensing of Copyrights Infringement of Copyrights and remedies

UNIT 3

TRADEMARKS

Trademark – value of and relevance for business Protecting brand value- acquiring trademark nationally and internationally Trade mark disputes – case studies

UNIT 4

PATENTS

Protecting innovation – acquiring patents nationally and internationally

Product and process patent Assigning patents and its commercialization Patent Disputes

UNIT 5

INDUSTRIAL PROPERTIES

Industrial designs – protection - Procedure for Registration of Designs • Copyright under Design Semiconductor Integrated Circuits Layout-Designs Plant varieties – commercialization Monsanto cases Geographical Indications Biotechnology and IPR

UNIT 6

REGISTRATION AND ENFORCEMENT MECHANISMS

Registration authorities of various IPRs IP Management and assertion of rights through declarations use of copyright, trademark signs IP Litigation – Approach of courts – landmark cases

TEXT BOOKS:

1. WIPO DL-101 General Course on Intellectual Property (online)
2. Elizabeth Verkey and Jithin Saji Issac, *Intellectual Property*, Eastern Book Company 2021
3. Anurag K. Agarwal, *Business and Intellectual Property: Protect your Ideas*, IIM Ahmedabad. Random House India (2016)
4. Handbook on IP Commercialisation - Strategies for Managing IPRs and Maximising Value Jakarta: ASEAN Secretariat, November 2019

REFERENCES BOOKS:

1. ICSI Study Material, Intellectual Property Rights: Law and Practice, A. Ramaiya, Guide the Companies Act, LexisNexis, 19th Ed. 2020 (in 6 volumes)
2. WIPO, *Enterprising Ideas A Guide to Intellectual Property for Startups*, 2023
3. Manuals published by Office of the Controller General of Patents, Designs & Trade(CGPDTM), available at https://ipindia.gov.in/ Guide Books by WIPO –Intellectual Property for Business, available at https://www.wipo.int/publications/en/series/index.jsp?id=181

Year/Semester	3rd / 6th	Course Category	Multidisciplinary Course
Course Code	23MDC602	Course Title	Indian Economy
Continuous Evaluation: 40		End Semester Examination:60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

COURSE OBJECTIVES

1. To introduce about different demography terms and trends.
2. To make students familiar with growth and its distribution.
3. To discuss the major changes in agriculture sector over-time.

COURSE LEARNING OUTCOMES

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Review major demographic indicators
2. Comprehend the concept of inequality
3. Analyse agriculture sector

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

Course Objectives (COs)	Course Learning Outcomes (CLOs)		
	CLO 1	CLO 2	CLO 3
CO 1			
CO 2			
CO 3			

COURE CONTENTS

Unit-I

Population and Human Development

Demographic trends and issues; education; health and malnutrition. Demographic features of India's population.

Unit-II

Growth and Distribution

Trends and policies in poverty; inequality and unemployment.

Unit-III

Agriculture

Importance of Agriculture; Causes of backwardness and low productivity; Land Reforms: Need, Implementation and Critical Evaluation

TEXT BOOKS

1. Jean Dreze and Amartya Sen, 2013. *An Uncertain Glory: India and its Contradictions*, Princeton University Press.
2. Pulapre Balakrishnan, 2007, The Recovery of India: Economic Growth in the Nehru Era, *Economic and Political Weekly*, November.
3. Rakesh Mohan, 2008,—Growth Record of Indian Economy: 1950-2008.AStory of

Sustained Savings and Investment, *Economic and Political Weekly*, May.
4. S.L. Shetty, 2007,—India's Savings Performances in the Advent of Planning
   K.L. Krishna and A. Vaidyanathan, editors, *Institutions and Markets in India's Development.*
5. Himanshu, 2010,—TowardsNew Poverty Lines for India, *Economic and Political Weekly*,January.

Year/Semester	3rd / 6th	Course Category	MDC
Course Code	23MDC305	Course Title	Electoral Literacy in India
Continuous Evaluation : 40		End Semester Examination : 60	
Prerequisite: Nil		L T P : 3 0 0	Credits: 3

Course Objectives (CO) - The Course is designed with the following objectives:

1. To know the meaning and nature of the electoral democracy in India
2. To discuss electoral institutions in India
3. To understand the procedural aspect of elections in India
4. To grasp the significance of elections and electoral aspects of democracy, the electoral model code of conduct, issues, and challenges in India's democracy.

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

1. The student shall be able to understand the meaning, definition, and significance of elections in India.
2. The course will help the students to analyse and understand electoral institutions, and their role and functions in the conduct of free and fair elections.
3. The student shall be able to know the party system of India.
4. The course will help the student understand issues and challenges in conducting free and fair elections in India.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

Course Learning Objectives (Cos)	Course Learning Outcome (CLOs)				
	CLO1	CLO2	CLO3	CLO4	CLO5
CO1					
CO2					
CO3					
CO4					

COURSE CONTENTS:

UNIT-1: Elections in India

Suffrage, Types, and Methods of Elections
Parliamentary elections: Lok Sabha & Rajya Sabha
Presidential Elections
State Legislative Assembly Elections
Local Body Elections

UNIT-2: Electoral Institutions

Election Commission (EC)
State Election Commission
Constitution: Part-15

UNIT-3: Political Parties in India

One-party, Two Party, Multi-party system
Model Code of Conduct, Party Funding, and Campaign

UNIT-4: Elections: Issues and Challenges

Issues and Challenges

RECOMMENDED TEXTBOOKS:

1. Subhash C. Kashyap, Our Political System, 2nd, National Book Trust, India, 2008, ISBN: 8123752520
2. D. D. Basu, Introduction to The Constitution Of India, 26th Edition, Lexis Nexis, ISBN: 978-9388548861
3. Bidyut Chakrabarty, Rajendra Kumar Pandey, Indian Government and Politics, Sage Text, ISBN: 8132100581

REFERENCE BOOKS:

1. Sanjay Kumar, Elections in India: An Overview, 1st, Routledge, ISBN: 9781032033136
2. https://eci.gov.in/
3. https://www.lokniti.org/
4. Websites of State Election Commission
5. NCERT, Chapter-3 Indian Constitution at Work

Creating Entrepreneurial Mind Set	
Course Code: 23MDC402	**Continuous Evaluation:** 40 Marks
Credits: 3	**End Semester Examination:** 60 Marks
L T P : 3-0-0	**Course Type:** MDC

COURSE OBJECTIVES

1. To disseminate knowledge about basics of entrepreneurship and forms of ownership.
2. To enlighten students regarding the relevance of creativity and innovation from an entrepreneurship point of view.
3. To give clarity to students regarding formulation of business plan.
4. To familiarize students with the upcoming trends in the entrepreneurship field.

COURSE LEARNING OUTCOMES

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand basics of entrepreneurship and different types of ownerships.
2. Grasp relevance of creativity and innovation and its application in a business.
3. Acknowledge components of a business plan and ways to launch it.
4. Utilize conceptual building skills in interpreting trends for the entrepreneurs.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

Course Objectives (COs)	Course Learning Outcomes (CLOs)			
	CLO 1	CLO 2	CLO 3	CLO 4
CO 1				
CO 2				
CO 3				
CO4				

COURSE CONTENTS

UNIT	CONTENTS
UNIT-I	**Basics of Entrepreneurship** Entrepreneur: Definition, characteristics, functions, types of an entrepreneur; Concept of Entrepreneurship, types, role of entrepreneurship in economic development, Factors affecting Entrepreneurship.
UNIT-II	**Entrepreneurial Development Programme** Entrepreneurial Development Programme (EDP): meaning & concept; The Role and Relevance of Entrepreneurial Development Program in India; Role of Government in Organizing EDP's Critical Evaluation; Women Entrepreneurship- Meaning, Reasons for Slow Growth, Problems faced by Women Entrepreneurs, Development of women Entrepreneurship.

UNIT-III	**Business Planning** Opportunity Identification and selection, Formulation of business plan, External Environmental Analysis - Economic, Social, financial,

	technological, competitive, and legal. Financing: Sources, venture capital, export finance.
UNIT-IV	**Entrepreneurial Trends in the Digital Age** Definition and significance of digital entrepreneurship; Brief overview of key digital trends impacting businesses; Disruptive Technologies; Promoting innovation and adaptability in a digital ecosystem

TEXT BOOKS

1. Burns, Entrepreneurship and small business, 4th edition (2016), Palgrave.
2. Norman M. Scarborough, Essentials of entrepreneurship and small business management, 9th edition (2018), Pearson.
3. Hisrich, R., & Peters, M., Entrepreneurship, 11th edition (2020), Tata McGraw Hill.
4. Prahalad, C. K. (2006). Fortune at the bottom of the pyramid, eradicating poverty through profits. Wharton school Publishing.
5. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries

SUGGESTED READINGS

1. Khandwalla, P., Corporate creativity, 7th edition (2017), Tata Mc. Graw Hill.
2. Mullins, J., New business road test, 4th edition (2013), Prentice Hall.
3. Drucker, P. F. (2006). Innovation and entrepreneurship: Practice and principles. USA: Elsevier.
4. Gersick, K. E., Davis, J. A., Hampton, M. M., & Lansberg, I. (1997). Generation to generation: Life cycles of the family business. Boston: Harvard Business School Press.
5. Holt, D. H. (2004). Entrepreneurship new venture creation. New Delhi: Prentice Hall of India.

Year/Semester	**3rd / 5th**	**Course Category**	**MDC**
Course Code	**23MDC503**	**Course Title**	**Psychology and Emotional Intelligence**
Continuous Evaluation : 40		**End Semester Examination : 60**	
Prerequisite: Nil		**L T P : 3 0 0**	**Credits: 3**

COURSE OBJECTIVES (COs):

CO1: To know the concepts in sociology relevant to the study of society.

CO2: To discuss classical sociological thoughts by sociologists.

CO3: To understand modern and post modern sociological thoughts.

CO4: To grasp the significance of sociological theories in understanding society

CO5: To construct the relation between individual and social structure in the society.

COURSE LEARNING OUTCOMES (CLOs):

After the successful completion of the course, the students will have the ability to:

CLO1: Explain various sociological concepts important in the understanding of society.

CLO2: Application of critical conceptual understanding that is central to sociological investigations.

CLO3: Analyzing the social phenomena with respect to theoretical understanding of society.

CLO4: Recommend analytical as well as methodological understanding to generate authentic knowledge.

CLO5: Integrate the knowledge of social issues in society according to advanced, contemporary, interdisciplinary knowledge.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 1	✔				
CO 2		✔			
CO 3			✔		
CO4				✔	
CO5					✔

COURSE CONTENTS

UNIT–I: INTRODUCTION

Definition, Scope, Nature and Importance of Sociology

SOME BASIC CONCEPTS: Status & Role, Power & Authority, Social Structure & Function

UNIT-II : SOCIETY AND SOCIAL BEHAVIOUR SOCIETY AND SOCIAL BEHAVIOUR: Society: Meaning & Characteristics, Culture, Socialization: Definition & Agencies, Social Mobility: Meaning & Types, Social Group: Meaning and Types

UNIT-III : SOCIAL CONTROLS & SOCIAL BEHAVIOUR

MEANING AND NATURE OF SOCIAL CONTROL: Social Controls & Social Behaviour : Types: Folkways, Mores, Norms, Values, Law

SOCIAL CONFORMITY AND DEVIANCE : Meaning of Conformity & Deviance

UNIT-IV: THEORETICAL PERSPECTIVES

MACRO PERSPECTIVE: Theoretical perspectives: Functionalism, Conflict, Structuralism

MICRO PERSPECTIVE: Theoretical perspectives: Symbolic Interactionism, Exchange Theory, Labelling Theory

UNIT-V: CLASSICAL THEORISTS

EMILE DURKHEIM: Division of Labour in Society, Suicide

KARL MARX: Historical Materialism, Class and Class Conflict, Alienation

MAX WEBER: Authority, Social Action, Ideal Types

UNIT-VI : THEORIES OF MODERNITY

Juggernaut of Modernity, McDonaldization, Risk Society

GLOBALIZATION AND INEQUALITY: Global justice, Need for Global governance

TEXT BOOKS

1. Anthony Giddens, Sociology, Polity Press (2019)
2. Harlambos, M. Sociology: Themes and Perspectives, Oxford University Press
3. C.N. Shankar Rao, Sociology: Principles Of Sociology With An Introduction To Social Thoughts, S. Chand Publications, (2019)

REFERENCE BOOKS

1. Transformation: Theory and Society in India, Oxford University Press (2010)
2. Andre Beteille. Six Essays in Comparative Sociology, Oxford University Press
3. M. Francis, Abraham. Contemporary Sociology: An Introduction to Concepts and Theories, Oxford University Press (2014)
4. J.P.S. Uberoi. Mind and Society: From Indian Studies to General Sociology, Edited by Khalid Tyabji, Oxford University Press (2019)

PERSONAL FINANCIAL PLANNING	
Course Code: 23MDC403	**Continuous Evaluation**: 40
Credits: 03	**End Semester Examination**: 60
L T P : 3-0-0	**Course Type**: MDC
Prerequisite: Student should be aware about various saving schemes and their future benefits.	

COURSE OBJECTIVES

1. Build an understanding to familiarize different aspect of personal financial planning.
2. Analyze and compare different sources of savings and investment.
3. Develop a perspective to understand necessary knowledge and skills for effective Tax planning.
4. Develop skills to assess need for the insurance and retirement planning.

COURSE LEARNING OUTCOMES

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Analyze the meaning and appreciate the relevance of financial planning
2. Analyze the Integration of various avenues of investment for future benefit.
3. Examine the scope and ways of personal tax planning.
4. Analyze the insurance and retirement planning with relevance.

MAPPING MATRIX COURSE OBJECTIVES & COURSE LEARNING OUTCOMES

CO \ CLO	01	02	03	04
01				
02				
03				

04				

UNIT	Course contents
UNIT-I	**Introduction to Financial Planning** Financial goals, steps in financial planning, budgeting incomes and payments, time value of money. Introduction to savings, benefits of savings, management of spending & financial discipline, Setting alerts and maintaining sufficient funds for fixed commitments.
UNIT- II	**Investment Planning** Process and objectives of investment, concept and measurement of return & risk for various asset classes, measurement of portfolio risk and return, diversification & portfolio formation, Various Investment avenues
UNIT- III	**Personal Tax Planning** Tax structure in India for personal taxation, Scope of personal tax planning, exemptions and deductions available to individuals under different heads of income and gross total income.
UNIT- IV	**Insurance and Retirement Benefits Planning** Need for insurance. Life insurance, health insurance, property insurance, credit life insurance and professional liability insurance, Pension plans available in India

BOOKS

1. Halan, M. —Let's Talk Money: You've Worked Hard for It, Now Make It Work for You‖ Harper Collins Publishers, 2020 New York.
2. Madura, J. —Personal Finance, 2021,Pearson Publication
3. Indian Institute of Banking & Finance. —Introduction to Financial Planning, Taxmann Publication, 2021, New Delhi.
4. Keown A.J. —Personal Finance, Pearson Publication, 2021, New York.

REFERENCE BOOKS

1. Pandit, A. —The Only Financial Planning Book that You Will Ever Need, Network 18 Publications Ltd., Mumbai.
2. Sinha, M. —Financial Planning: A Ready Reckoner, McGraw Hill Education, New York.
3. Tripathi, V. —Fundamentals of Investment, Taxmann Publication, New Delhi.

SYLLABUS OF VALUE ADDED COURSES

Year/Semester	2nd Year/ 3rd Semester	**Course Category**	**VAC**
Course Code	23 VAC 301	**Course Title**	Sports , Yoga & Fitness
Continuous Evaluation : 80		**End Semester Examination : 20**	
Prerequisite: Nil		**L T P :1 0 2**	**Credits: 2**

Course Objectives (CO) - The Course is designed with the following objectives:

1. To know about the physical body
2. To discuss about improve range of motion, mobility and coordination in body
3. To understand the ways to improve strength, balance and flexibility.
4. To grasp the significance of yoga and sports in fitness
5. To construct environment for individual and community health.

Course Learning Outcomes (CLO)–The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

1. Explain the role of yoga and fitness in life.
2. Apply the rules of healthy and fit life
3. Analyse the ways and methods of yoga and sports
4. Recommend the practices of Asanas and different sports
5. Integrate the concept of yoga and sports in all round development of students and beings.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	✔				
CO2		✔			
CO3			✔		
CO4				✔	
CO5					✔

COURSE CONTENTS:

UNIT-I: Health and Wellness

Meaning Definition and Importance of Health and Wellness
Dimensions of Health and Wellness
Role of Exercise in maintaining Health and Wellness
Stress and Its management through Exercise
Nutrition for Health and Wellness
Practical-Exercise for Health and Wellness

Warming –Up
Stretching Exercises
Strengthening Exercises
Cardiovascular Exercises
Flexibility and Agility Exercises
Limbering Down
Relaxation Techniques (IRT, QRT, DRT etc.)

UNIT-II Yoga and Fitness

Importance of Yoga and Fitness
Types and Principles of Asanas
Fitness Components
Specific Exercises for Strength, Flexibility, Speed, Agility & Coordinative Abilities
Yoga, Fitness and Personality
General Specific Warm up
Aerobics / Zumba Dance
Asanas
Recreation for Fitness
Report preparation, Records and PPT

UNIT-III Sports and Psychology

Definition of Sports Psychology -Problems related with Adolescence i.e.physical problems, Peer group Relationship, Career Selection, Drug Abuse, Psychological and motion problems.
Importance of Sports Psychology

UNIT-IV Sports and Recreation

Meaning Definition and Concept of Sports Fitness and Recreation
Objectives, Characteristics and principles of Sports Fitness and Recreation
Importance, Purpose, Benefits of Fitness and Recreation
Types of Recreation
Recreation through Sports and Games
Use of Leisure Time Activities and their educational values
Traditional, Folk and Indigenous Games
Three Days outdoor camp and Hiking
Cycling, tie up with District/State Associations
Visits to Recreational Clubs

RECOMMENDED TEXT BOOKS:

1. Foundations of Physical Education, Chales A. Bucher
2. Foundations of Physical Eduction, M.L.Kamlesh
3. History and Principles in Physical Education, Dr. Karan Singh
4. Essentials of Physical Education, Dr. Ajmer Singh
5. Foundations of Physical Education, Dr. A.K.Uppal
6. Physical Education, Manu Sood, New SP Books
7. Health the basis of life: Dr. John Maclay
8. Natural Health & Yoga, Brij Bhushan
9. Health Education, S.K.Mangal
10. Essential of Physical Education, Dr. Ajmer Singh & Dr. Bains

INDIAN CONSTITUTION & POLITY (COMMON TO ALL BRANCHES EXCEPT BIO MEDICAL ENGINEERING)	
Course Code: 21HS102/202	Continuous Evaluation: 40 Marks
Credits: 2	End Semester Examination: 60 Marks
L T P : 2 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

To acquaint the students with legacies of constitutional development in India and help them to understand the most diversified legal document of India and philosophy behind it.
To make students understand the detailed analysis and importance of Fundamental Rights, their relationship with Directive Principles and the significance of Fundamental Duties.
To acquaint the students with the way social, political and economic justice could be realized.
To acquaint the students with the basic postulates of constitutional framework regarding the organization, powers and functions of the various organs of the State.
To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.
To acquaint students with latest intellectual property rights, relating to patent & copyright and innovation environment with related regulatory framework.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

Identify and explore basic concepts in the Constitution and understand their applicability & scope and the importance of the role of judiciary in ensuring checks an balances.
Differentiate different aspects of Indian Legal System and its related bodies
To appreciate the critical Interface between fundamental Rights and directive principles of state policy and apply the rationale to emerging issues and challenges.
Know about the enforcement remedies available under the Constitution of India
To apply Intellectual Property Law principles to real problems and analyse the social impact of Intellectual Property Law and Policy
To apply the very dynamics of IP Law to the individuals, MNC's and other possible stakeholders.

COURSE CONTENTS

Unit-I

Meaning of the Constitution, Constitutional Law and Constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the Constitution
Indian Constitution and its Salient Features
The Preamble of the Constitution
Federal Nature of the Constitution
Parliamentary System

Unit-II

Fundamental Rights:
Right to Equality (Articles 14 to 18)
Right to Freedom (Articles 19 to 22)
Right against Exploitation (Articles 23 to 24)
Right to Freedom of Religion (Articles 25 to 28)
Cultural and Educational Rights (Articles 29 to 30)
Directive Principles of State Policy (Article 36-51)
Fundamental Duties (Article 51 A)

Unit-III

Powers and Functions of the President and the Prime Minister (Articles 52-62, 74-78)
Powers of Indian Parliament: Functions of Rajya Sabha, Functions of Lok Sabha
Centre-State Relations (Article 245-293) (Briefly refer Disaster Management Act 2005)
Judiciary – Supreme Court: Appointment of Judges, Judicial Review, Writ jurisdiction (Article 32, 124,126) Functions of High Court and Subordinate Courts (Article 217, 224, 226, 233)
Amendment of the Constitution: Powers and Procedure (Article 368)

Unit-IV

Regulation to Information- Introduction, Right to Information Act, 2005
Information Technology Act, 2000
Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement.

TEXT/REFERENCE BOOKS

1. Brij Kishore Sharma: Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
2. Granville Austin: The Indian Constitution: Cornerstone of a Nation. 1966, Oxford Clarendon Press.
3. Subhash C. Kashyap: Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT,2018.
4. P. M. Bakshi: The Constitution of India, Latest Edition, Universal Law publishing.
5. H.M. Seervai, Constitutional Law of India (4th Ed., Universal Law Publishing Co. Pvt. Ltd. 2008)
6. M.P. Jain, Indian Constitutional Law (6th Ed. Lexisnexis Butter worths Wadhwa, 2010)
7. J.N. Pandey, Constitutional Law of India (Latest Edition)
8. V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)
9. Suresh T. Viswanathan: The Indian Cyber Laws, Bharat Law House, NewDelhi-88
10. P. Narayan: Intellectual Property Law, Eastern Law House, New Delhi
11. Prabudh Ganguli: Gearing up for Patents: The Indian Scenario, OrientL ongman.
12. BL Wadehra: Patents, Trademarks, Designs and Geological Indications. Universal Law Publishing -LexisNexis.
13. Intellectual Property Rights: Law and Practice, Module III by ICSI (only relevant sections)

Environmental Bioengineering			
Year/Semester	**1ST/I or II**	**Course Category**	
Course Code	**23ESEB101**	**Course Title**	**Environmental Bioengineering**
Continuous Evaluation: 40		**End Semester Examination: 60**	
Prerequisite: Nil		**L T P : 2 0 0**	**Credits: 2**

Course Objectives (CO) - The Course is designed with the following objectives:

1. To provide a comprehensive understanding of the relationship between humans and the environment.
2. Aims to introduce students to the different components of the environment.
3. To develop the understanding of pollution, its causes, and their effects
4. To familiarize the students with the different biological concepts.

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020 and based on the UGC curriculum framework. Upon completion of this course, learners will be able to:

1. Analyse the environmental pollution and sensitize themselves to adverse health impacts of pollution.
2. Demonstrate to safeguard the Earth's environment and its resources.
3. Explain sustainable development, its goals, challenges, and global strategies.
4. Improve biological concepts using an engineering approach.

MAPPING COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

COURSE OBJECTIVES (COs)	COURSE LEARNING OUTCOMES (CLOs)			
	CLO1	CLO2	CLO3	CLO4
CO1	√			
CO2		√		
CO3			√	
CO4				√

COURSE CONTENTS

Unit-1

Human and Environment

Introduction to earth environment, Scope and importance. Components of the environment: Lithosphere, Hydrosphere, Biosphere, Atmosphere. The man- environment interaction, Population growth and natural resource exploitation, Industrial revolution, and its impact on the environment. Understanding of pollutant and pollution; Types of Pollution, Air pollution: Water pollution, Soil pollution and solid waste, Noise pollution, Thermal pollution and their impact on human health

Unit-2

Natural Resources, Sustainable Development & Sustainable living

Overview of natural resources, Classification of natural resources, Resources: Forests, wetlands, Status and challenges. Water resources: Types of water resources, issues and challenges; Soil and mineral resources, Energy resources: renewable and non-renewable sources of energy. Biodiversity

and its distribution, Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges, and strategies for SDGs. Ways to live in sustainable manner- Conservation of energy, water at home, plantation, waste segregation, kitchen gardening.

Unit-3

Introduction of Bioengineering:

Significance of biology, fundamental similarities, and differences between science and engineering-humans as the best machines, brain as a computer, comparison between eye camera, **Biomolecules**: molecules of the life –monomeric unit and polymeric structure, carbohydrates, proteins; nucleotides and lipids. bioengineering introduction and current status in Agriculture, Medicine (vaccine and biosensors) enzyme technology, and environment, and the role of artificial intelligence and robotics in human health monitoring.

Unit 4

Bioengineering in Environment Protection:

What is environmental bioengineering? applications of bioengineering in the environment protection. global environmental problems and bioengineering approaches for their management. sewage treatment, biofertilizers, biofuels, bioreactors, bioremediation, and bioengineering for biomedical waste management. role of artificial intelligence in handling biomedical waste.

RECOMMENDED TEXT BOOKS:

1. Masters, G. M., & Ela, W. P. (2008). Introduction to environmental engineering and science Englewood Cliffs, NJ: Prentice Hall.
2. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
3. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press
4. Environmental Studies for Undergraduate Courses by Erach Bharucha, UGC New Delhi
5. Biology: a Gopal approach Campbell, N.A Reece, J.B Urry, Lisa; Cain M.L Wasserman, S.A Minorsky, P. V Jackson, R. B Person Education ltd.

REFERENCE BOOKS:

1. A.K De Environmental Chemistry New age Publisher, 2016.
2. "Ecology & Environment" P D Sharma, Rastogi Publications, 2009.
3. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/.
4. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/ standards.
5. Principles of Biochemistry (V Edition) by Nelson, D.L; and Cox, M. M. W. H Freeman and company.