CURRICULUM & SYLLABUS

SRM
UNIVERSITY
DELHI-NCR, SONEPAT

CHOICE BASED CREDIT SYSTEM (CBCS)

FOR

BACHELOR OF TECHNOLOGY (B.Tech.)

(4 Year Undergraduate Degree Programme)

IN

COMPUTER SCIENCE AND ENGINEERING

In Data Science and Artificial Intelligence

(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 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 FACULTY 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	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
Work as successful professionals in diverse engineering disciplines	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;

Increasing responsibilities of technical and managerial leadership in their work organizations;	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;
Professional development through a commitment to career-long learning.	7. An ability to acquire and apply new knowledge using appropriate learning strategies with an inner quest to learn, unlearn and relearn.

TABLE 1: MAPPING MATRIX OF FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES AND FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES
(TABULAR FORMAT)

MAPPING	FEPELO1	FEEPLO2	FEEPLO3	FEEPLO4	FEEPLO5	FEEPLO6	FEEPLO7
FEEPEO1	✔	✔					
FEEPEO2		✔	✔				
FEEPEO3			✔	✔			
FEEPEO4				✔	✔	✔	
FEEPEO5						✔	✔

B.TECH - COMPUTER SCIENCE AND ENGINEERING GRADUATES EMPLOYABILITY ATTRIBUTES

EA 1: Sound Knowledge & Skill of Domain Area: Demonstrated competence in university level 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.

1. **Interpersonal skills to work in diverse groups:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.

2. **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.

3. **Positive attitude and thinking:** An ability to have a positive attitude and thinking in challenging situations.

4. **Adaptability:** Adapts learning strategies to new conditions. Recognizes parallels, analogies or similarities of new situations to more familiar situations.

5. **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.

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.

UNITED NATIONS 17 SUSTAINABLE DEVELOPMENT GOALS (SDGs)

The United Nations Sustainable Development Summit for the adoption of 2030 Agenda and the sustainable development goals was held during three historic days in New York, 25-27 September 2015.

Born out of the Rio+20 Conference through paragraph 283 of the Future We Want outcome document, the platform has been revitalized in preparation for the 2030 Agenda, with the 17 sustainable development goals* at its core.

SDG 1 – No Poverty : End poverty in all its forms everywhere.
SDG 2 – Zero Hunger : End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
SDG 3 – Good Health and Well-being : Ensure healthy lives and promote well-being for all at all ages.
SDG 4 – Quality Education : Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
SDG 5 – Gender Equality : Achieve gender equality and empower all women and girls.
SDG 6 – Clean Water and Sanitation : Ensure availability and sustainable management of water and sanitation for all.
SDG 7 – Affordable and Clean Energy : Ensure access to affordable, reliable, sustainable, and modern energy for all.

SDG 8 – Decent Work and Economic Growth : Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.
SDG 9 – Industry, Innovation and Infrastructure : Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
SDG 10 – Reduced Inequality : Reduce inequality within and among countries.
SDG 11 – Sustainable Cities and Communities : Make cities and human settlements inclusive, safe, resilient, and sustainable.
SDG 12 – Responsible Consumption and Production : Ensure sustainable consumption and production patterns.
SDG 13 – Climate Action : Take urgent action to combat climate change and its impacts.
SDG 14 – Life Below Water : Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.
SDG 15 – Life on Land : Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt biodiversity loss.
SDG 16 – Peace, Justice and Strong Institutions : Promote peaceful and inclusive societies, provide access to justice for all, and build effective, accountable institutions.
SDG 17 – Partnerships for the Goals : Strengthen the means of implementation and revitalize the global partnership for sustainable development.

* https://sdgs.un.org/publications/17-sustainable-development-goals-17-partnerships-17979

B.TECH - COMPUTER SCIENCE AND ENGINEERING
PROGRAMME LEARNING OUTCOMES

PLO1. An ability to apply knowledge &skill of mathematics, science and engineering.

PLO2. An ability to identify, analyze, design, develop, implement and integrate software and hardware based computer systems.

PLO3. An ability to understand emerging technologies and related security issues in the computing paradigm.

PLO4. An ability to acquire and apply the skill in modern techniques, methodologies and tools to be innovative and creative.

PLO5. An ability to formulate ,design & demonstrate strong logical, analytical and reasoning skills to adeptly solve problems

PLO6. An ability to apply algorithmic principles and programming prowess in the development of software systems.

PLO7. An awareness of social, health, ethical, legal, financial, and professional responsibilities.

PLO8. An ability to analyze the local and global impact of computing discipline on environmental issues and sustainable development

PLO9. Recognition of the need for self-motivation and ability to engage in lifelong learning and professional development

PLO10. An ability to effectively manage projects involving multidisciplinary teams with ethnic diversity.

PLO11. An ability to communicate effectively, both in written and verbal forms.

PLO12. An ability to demonstrate leadership and entrepreneurship qualities.

TABLE 2: MAPPING MATRIX OF PROGRAM EDUCATIONAL OBJECTIVES (PEO) AND PROGRAM LEARNING OUTCOMES (PLO)

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
PEO1	✔	✔										
PEO2			✔	✔								
PEO3					✔	✔						
PEO4							✔	✔				
PEO5									✔			
PEO6										✔	✔	✔

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 secure a minimum of 180 credits in the course of their study. The credit requirements for their program of study are 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 and Chemistry in the mind of the learners so that they proceed to 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 the 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 teamwork.

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.

Practicals (P):

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

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.

Ability Enhancement Courses (AEC)

Students are required to achieve competency in a Modern Indian Language (MIL) along with English language with special emphasis on language and communication skills. The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and academic writing skills. The focus is on imparting students with necessary skills to articulate their arguments and present their thoughts clearly and coherently and recognize the importance of language as a mediator of knowledge and identity.

Value Added Courses (VAC):

Course components relating to skills, attitudes, and values required to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wildlife conservation, and sustainable development and living health and wellness seek to promote an optimal state of physical, emotional, intellectual, social, spiritual, and environmental well-being of a person, the constitutional obligations with special emphasis on constitutional values and fundamental rights and duties .

Skill Enhancement Courses (SEC)-Technical & Soft Skills:

Technical Skills: Under Technical Skills Broad categories of training to be imparted to Engineering Graduates of various disciplines with common nomenclature .The training is categorized into three categories :Elementary, Intermediate & Advanced keeping in view of 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 are introduced to inculcate Group Dynamics, Teamwork & Leadership Traits by engaging students in interactive sessions through Role Play, Group Discussions, and improve presentation &communication skills of engineering graduates. (One Credit Course from 3rd Semester to 7th semester).

Live Projects (LP) and Summer Internship (SI):

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).

1. 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.
2. 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.

Summer Internship (SI):

1. Students will be monitored on a periodic basis, both by the Faculty Mentor from the Industry and the Faculty in-charge from the department. The Faculty Mentor from the Industry will submit the Mid-Term and End-Term Evaluation report. However, the faculty in-charge from the department will monitor and take periodic review to keep a check on the progress of the students.
2. Students are provided with the internship-related document which helps them to prepare a report. In addition to this, it provides details to students about internship /project evaluation parameters.

Multidisciplinary Courses (Humanities & Social Sciences Courses) (MDC)

The open elective subject courses provide the student with wide latitude to pursue their interests, be it in humanities, management, arts, or their own chosen field of study to have a multidisciplinary approach.

B.TECH COMPUTER SCIENCE AND ENGINEERING

IN

DATASCIENCE & ARTIFICIAL INTELLIGENCE

PROGRAMME STRUCTURE

Category of Courses	Category	No. of Courses	
Basic Applied Sciences	BAS	7	
Engineering Sciences	ES	10	
Professional Core	PC	13	
Professional Electives -Program Specific Specialized Elective Courses	PE	12	
Ability Enhancement Courses	AEC	4	
Skill Enhancement courses (Technical and Soft skills)	SEC	Technical Skills	4
		Soft Skills	5
Value Added Courses	VAC	3	
Practical / Workshop	P/W	17	
Live Project & Industrial Visit and Summer Internship	LP/SI	Live Project and Industrial Visit	4^{th} -7^{th} Semester 4
		Minor Project	7^{th} Semester 1
		Major Project	8^{th} Semester 1
Multidisciplinary Courses (Humanities & Social Sciences Courses) (MDC)	MDC	3	
TOTAL		**83**	

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE 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	0	0	0	0	0	21	11.67
Engineering Sciences	ES	9	9	-	0	0	0	0	0	18	10.00
Professional Core	PC	-	-	9	7	5	6	12	0	39	21.67
Professional Electives -Program Specific Specialized Elective Courses	PE	-	-	4	8	10	8	4	0	34	18.89
Ability Enhancement Courses	AEC	5	2	-	0	0	0	0	0	7	3.89
Skill Enhancement courses (Technical and Soft skills)	SEC	-	-	2	2	2	2	1	0	9	5.00
Value Added Courses	VAC	2	2	2	0	0	0	0	0	6	3.33
Practical / Workshop (Major)	P/W	1	1	4	3	2	3	3	0	17	9.44
Live Project & Industrial Visit & Summer Internship	LP / SI	-	-	-	1	1	1	5	12	20	11.11
Multidisciplinary Courses (Humanities & Social Sciences Courses) (MDC)	MDC	-	-	-	3	3	3	0	0	9	5.00
TOTAL		**26**	**23**	**24**	**24**	**23**	**23**	**25**	**12**	**180**	**100.0**

COURSE CURRICULUM

PROGRAMME COURSES CREDIT STRUCTURE SEMESTER WISE

SEMESTER-I

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
THEORY								
1	25AS101	(BAS)	Engineering Mathematics-I	3	1	0	4	4
OR								
1 (a)	25AS104	(BAS)	Mathematics-I (For BME students)	2	0	0	2	2
1 (b)	25AS109	(BAS)	Biology (For BME students)	1	1	0	2	2
2	25AS103/ 25AS105	(BAS)	Quantum Computation and Communication / Applied Chemistry	3	1	0	4	4
3	25EE101/ 25EC101	(ES)	Basic Electrical Engineering / Basic Electronics Engineering	3	0	0	3	3
4	25ME101	(ES)	Fundamentals of Robotics and AI	3	0	0	3	3
	OR							
	25CS101	(ES)	Fundamentals of Computer & C Programming	3	0	0	3	3
5	25HS101	(AEC)	Communicative English	2	0	0	2	2
6	25HIN101 / 25FLGR101 / 25FLFR101	(AEC)	Hindi-I/German-I/French-I	2	0	0	2	2
7	25ESEB101/ 25VAC101	(VAC)	Environmental Bioengineering / Indian Constitution and Polity	2	0	0	2	2
Total Credits (Theory)				**18/16**	**2**	**0**	**20/18**	**20/18**
PRACTICAL								
8	25AS153/ 25AS155	(BAS)	Quantum Physics Lab / Applied Chemistry Lab	0	0	2	2	1
9	23EE151/25EC151	(ES)	Basic Electrical Engineering Lab / Basic Electronics Engineering Lab	0	0	2	2	1
10	25ME151/25CS151	(ES)	Design thinking and Engineering practices Lab / C Programming Lab	0	0	2	2	1
11	25ME153/25HS151	(ES)/ (AEC)	Engineering Graphics & Design Lab/ Communicative English Lab	0	0	2	2	1`
Total Credits (Practical)				**0**	**0**	**8**	**8**	**4**
TOTAL CREDITS (THEORY + PRACTICAL)				**18/16**	**2**	**8**	**28/26**	**24/22**

L= Lecture, T = Tutorials, P = Practical's & C = Credits]

SEMESTER II

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
THEORY								
1	25AS201	(BAS)	Engineering Mathematics-II	3	1	0	4	4
OR								
1 (a)	25AS204	(BAS)	Mathematics-II(For BME students)	2	0	0	2	2
1 (b)	25AS109	(BAS)	Biology (For BME students)	1	1	0	2	2
2	25AS206/ 25AS208	(BAS)	Quantum Computation and Communication / Applied Chemistry	3	1	0	4	4
3	25EE202/ 25EC202	(ES)	Basic Electrical Engineering / Basic Electronics Engineering	3	0	0	3	3
4	25ME202	(ES)	Fundamentals of Robotics and AI	3	0	0	3	3
	OR							
	25CS202	(ES)	Fundamentals of Computer & C Programming	3	0	0	3	3
5	25HS202	(AEC)	Communicative English	2	0	0	2	2
6	25HIN202 / 25FLGR202 / 25FLFR202	(AEC)	Hindi-I/German-I/French-I	2	0	0	2	2
7	25ESEB202/ 25VAC202	(VAC)	Environmental Bioengineering / Indian Constitution and Polity	2	0	0	2	2
Total Credits (Theory)				**18/16**	**2**	**0**	**20/18**	**20/18**
PRACTICAL								
8	25AS256/ 25AS258	(BAS)	Quantum Physics Lab / Applied Chemistry Lab	0	0	2	2	1
9	23EE252/25EC252	(ES)	Basic Electrical Engineering Lab / Basic Electronics Engineering Lab	0	0	2	2	1
10	25ME252/25CS252	(ES)	Design thinking and Engineering practices Lab / C Programming Lab	0	0	2	2	1
11	25ME254/25HS252	(ES)/ (AEC)	Engineering Graphics & Design Lab/ Communicative English Lab	0	0	2	2	1`
Total Credits (Practical)				**0**	**0**	**8**	**8**	**4**
TOTAL CREDITS (THEORY + PRACTICAL)				**18/16**	**2**	**8**	**28/26**	**24/22**

[L= Lecture, T = Tutorials, P = Practical's & C = Credits

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – III

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
24AS301	Engineering Mathematics-III	BAS	3	0	0	3	3
25CS2007	Programming in Python	PC	3	0	0	3	3
25CS2001	Data Structures Using C	PC	3	0	0	3	3
25CS2005	Database Management Systems	PC	3	0	0	3	3
25CSPEXXX	Professional Elective-I	PE	3	1	0	4	4
Total (Theory)			**15**	**1**	**0**	**16**	**16**
Practical							
25CS2015	Python Programming Lab	P	0	0	2	2	1
25CS2113	Data Structures lab	P	0	0	2	2	1
25CS2111	Database Management Systems Lab	P	0	0	2	2	1
23VAC103	Sports, Yoga & Fitness	VAC	1	0	2	3	2
25CAM2117	Industry Session : Data Science	P	0	0	2	2*	1
Total (Practical)			**1**	**0**	**10**	**11**	**6**
Skill Enhancement Course							
250201C	Digital Marketing	SEC	0	0	2	2	1
23SS351	Effective Communication Skills	SEC	0	0	2	2	1
Total (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total (Theory + Practical+ Skill Enhancement)			**15**	**1**	**14**	**30**	**23**

NOTE: At the end of the semester, students will undergo 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: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – IV

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
24MDC401	Multidisciplinary Elective-I	MDC	3	0	0	3	3
25DI4002	Data Science	PC	2	0	0	2	2
25DI4004	Artificial Intelligence	PC	2	0	0	2	2
25CSPEXXX	Professional Elective-II	PE	3	1	0	4	4
25CS2006	Operating Systems	PC	3	0	0	3	3
25CSPEXXX	Professional Elective-III	PE	3	0	0	3	3
Total (Theory)			**16**	**1**	**0**	**17**	**17**
Practical							
25DI4102	Data Science Lab	P	0	0	2	2	1
25DI4104	Artificial Intelligence Lab	P	0	0	2	2	1
25CS2114	Operating Systems Lab	P	0	0	2	2	1
25CSPEXXX	Professional Elective-III Lab	PE	0	0	2	2	1
Total (Practical)			**0**	**0**	**8**	**8**	**4**
Skill Enhancement Course							
23SS305	Introduction to SPSS	SEC	0	0	2	2	1
23SS452	Teamwork & Interpersonal Skills	SEC	0	0	2	2	1
25CS0204	Live Project-I and Industrial Visit	LP**	0	0	2	2*	1
Total (Skill Enhancement)			**0**	**0**	**6**	**5**	**3**
Total (Theory + Practical+ Skill Enhancement)			**16**	**1**	**14**	**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 SCIENCES AND ENGINEERING

SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – V

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
23MDC501	Multidisciplinary Elective-II	MDC	3	0	0	3	3
25DI5001	Machine Learning	PC	3	0	0	3	3
23CAF3005	Essentials of Hadoop	PC	2	0	0	2	2
25CSPEXXX	Professional Elective-IV	PE	3	1	0	4	4
25CSPEXXX	Professional Elective-V	PE	3	1	0	4	4
Total (Theory)			**14**	**2**	**0**	**16**	**16**
Practical							
25DI5101	Machine Learning Lab	P	0	0	2	2	1
23CAF3113	Hadoop 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 (Practical)			**0**	**0**	**10**	**10**	**5**
Skill Enhancement Course							
25CS0301A	Wearable Technologies	SEC	0	0	2	2	1
23SS553	Presentation Skills	SEC	0	0	2	2	1
Total (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total (Theory + Practical+ Skill Enhancement)			**14**	**2**	**14**	**30**	**23**

Note: At the end of the 4th semester, students will undergo a summer training and create a project which will be evaluated in the current semester (Live Project-I)

Students may opt one course in 6th semester apart from the elective list (as elective) from NPTEL on recommendation of the departmental committee.The subject should not have been previously studied.

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

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – VI

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
25DI6002	Deep and Reinforcement Learning	PC	3	0	0	3	3
25DI6004	Computer Vision	PC	3	0	0	3	3
25CSPEXXX	Professional Elective-VI	PE	3	0	0	3	3
25CSPEXXX	Professional Elective-VII	PE	3	1	0	4	4
24MDCXX	Multidisciplinary Elective-III	MDC	3	0	0	3	3
Total (Theory)			**15**	**1**	**0**	**16**	**16**
Practical							
25DI6102	Deep and Reinforcement Learning Lab	P	0	0	2	2	1
25DI6104	Computer Vision Lab	P	0	0	2	2	1
25CSPEXXX	Professional Elective-VI lab	PE	0	0	2	2	1
25DI6106	Industry Session : DS & AI	P	0	0	2	2	1
25CS0304	Live Project-III & Industrial Visit	LP**	0	0	2	2	1
Total (Practical)			**0**	**0**	**10**	**10**	**5**
Skill Enhancement Course							
25CS0302D	Data Analytics Tools	SEC	0	0	2	2	1
23SS654	Professional Skills	SEC	0	0	2	2	1
Total (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total (Theory + Practical+ Skill Enhancement)			**15**	**1**	**14**	**30**	**23**

Note: Students may opt one course in 6th semester apart from the elective list (as elective) from NPTEL on recommendation of the departmental committee.The subject should not have been previously studied.

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

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SPECIALIZATION: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – VII

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
25CS4003	Quantum Computing	PC	3	1	0	4	4
25DI7001	Distributed Systems and Data Analytics	PC	3	1	0	4	4
25DI7003	Natural Language Processing	PC	3	1	0	4	4
23CSPEXXX	Professional Elective-VIII	PE	3	1	0	4	4
Total (Theory)			**12**	**4**	**0**	**16**	**16**
Practical							
25CS4007	Quantum computing Lab	P	0	0	2	2	1
25DI7101	Distributed Systems and Data Analytics Lab	P	0	0	2	2	1
25DI7105	Industry Session : NLP	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)*	4
Total (Practical)			**0**	**0**	**16**	**12**	**8**
Skill Enhancement Course							
23SS756	Interpersonal Skills : Strategies	SEC	0	0	2	2	1
Total (Skill Enhancement)			**0**	**0**	**2**	**2**	**1**
Total (Theory + Practical+ Skill Enhancement)			**9**	**4**	**18**	**30**	**25**

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-IV)

*** 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: DATASCIENCE & ARTIFICIAL INTELLIGENCE DEGREE COURSE

PROGRAMME COURSES STRUCTURE SEMESTER WISE

SEMESTER – VIII

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Practical							
25CS4114	Major Project*	LP/ SI	0	0	24	24	12
Total (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
23AEC101/23AEC 151	Professional English/Communicative English Lab	AEC	2	0	2	3
23AEC102/ 23AEC103/ 23AEC104	Hindi-I/FRENCH-I/GERMAN-I	AEC	2	0	0	2
23AEC202/ 23AEC203/ 23AEC204	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						
24CS0201A / 24CS0201B/ 24CS0201C/ 24CS0201D	Data Structure and Algorithms using C or C++/ Industry Automation Level-I/ Digital Marketing/ Fundamentals of CAD for Engineers	SEC	0	0	2	1
24CS0202A / 24CS0202B/ 24CS0202C	Introduction to SPSS Tool/ Design Thinking and Augmented Virtual Reality/ Programming Using Python for Engineers	SEC	0	0	2	1
24CS0301A/ 24CS0301B/ 24CS0301C/ 24CS0301D/ 24CS0301E	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
24CS0302A / 24CS0302B/ 24CS0302C/ 24CS0302D	Artificial Intelligence and Machine Learning/ MATLAB for Engineers/ Structural Analysis using FEM-based Tools/ Data Analytics Tools	SEC	0	0	2	1
SOFT SKILL						
23SS351	Effective Communication Skills	SEC	0	0	2	1
23SS452	Teamwork & Interpersonal Skills	SEC	0	0	2	1
23SS553	Presentation Skills	SEC	0	0	2	1
23SS654	Professional Skills	SEC	0	0	2	1
23AR755	Aptitude and Reasoning	SEC	0	0	2	1

LIST OF VALUE ADDED COURSES

Course Code	Course	Category	L	T	P	C
23VACXX	Environment Bioengineering	VAC	2	0	0	2
23VACXX	Indian Constitution and Polity	VAC	2	0	0	2
23VACXX	Sports, Yoga and Fitness	VAC	2	0	0	2

LIST OF

MULTIDISCIPLINARY COURSES (HUMANITIES & SOCIAL SCIENCES COURSES) (HSS)

Code	Category	Course	L	T	P	C
25MDC101/ 23MDCXXX/ 23MDCXXX/ 23MDCXXX/ 23MDCXXX	**MDC-I**	Statistical Methods Environment Geoscience & Disaster Management IPR in Business Library Information Science & Media Literacy Management Process & Organizational Behaviour	**3**	**0**	**0**	**3**
23MDCXXX/ 23MDCXXX/ 23MDCXXX/ 23MDCXXX/ 23MDCXXX	**MDC-II**	Photonics Chemistry & Society Psychology and Emotional Intelligence Indian Economy Creating an Entrepreneurial Mind	**3**	**0**	**0**	**3**
23MDCXXX/ 23MDCXXX/ 23MDCXXX/ 23MDCXXX	**MDC-III**	Life Sciences & Public Health Electoral Literacy in India Personal Financial Planning Interior Design	**3**	**0**	**0**	**3**

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 /ADA Lab	PE	3	0	1	4
IV	25CSPE3001/ 25CSPE3117	Compiler Design/CD Lab	PE	3	1	1	5
V	25CSPE3003/ 25CSPE3113	Computer Networks/CN Lab	PE	3	1	1	5
VI	25CSPE3004/ 25CSPE3118	Software Engineering/SE 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
	25CSPE3032	Cyber Security	PE	3	1	0	4
	25CSPE4037	NASSCOM Associate Analytics – II	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	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 /ADA Lab	PE	3	0	1	4
IV	25CSPE3001/25CSPE3117	Compiler Design/CD Lab	PE	3	1	1	5
V	25CSPE3003/25CSPE3113	Computer Networks/CN Lab	PE	3	1	1	5
VI	25CSPE3004/ 25CSPE3118	Software Engineering/SE Lab	PE	3	0	1	4
VII	25CSPE3024	Software Project Management	PE	3	1	0	4

	25CSPE3028	Object Oriented Analysis & Design	PE	3	1	0	4
	25CSPE3034	Design Thinking	PE	3	1	0	4
VIII	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	1	0	4
II	25CSPE2004	Theory of Computation	PE	3	1	0	4
III	25CSPE2008/25CSPE2118	Analysis and Design of Algorithms /ADA Lab	PE	3	0	2	4
IV	25CSPE3001/25CSPE3117	Compiler Design/CD Lab	PE	3	1	2	5
V	25CSPE3003/25CSPE3113	Computer Networks/CN Lab	PE	3	1	2	5
VI	23CSPE3004/ 23CSPE3118	Software Engineering/SE Lab	PE	3	0	2	4
VII	25CSPE3020	Distributed Operating System	PE	3	1	0	4
	25CSPE3026	Grid Computing	PE	3	1	0	4
	25CSPE3040	Internet of Things	PE	3	1	0	4
VIII	25CSPE4023	Wireless Adhoc and Sensor Network	PE	3	1	0	4
	25CSPE4035	Advanced Java Programming	PE	3	1	0	4
	25CSPE4027	Mobile Computing	PE	3	1	0	4

SEMESTER - I & SEMESTER – II

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 analysis.	12
UNIT-II	Functions of several variables, Partial Derivatives, Homogenous function, Euler's theorem for homogenous functions, Deductions from Euler's theorem, Total	12

	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	
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, 45th 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.

Mathematics-I (For BME only)	
Course Code: 25AS104	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To introduce the concept of Matrices and Determinants.
2. To demonstrate the concept of Differentiation.
3. To introduce the concept of Integration.
4. To create the knowledge of Differential Equations.

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. Develop the essential tool of matrices and determinants.
2. Apply the knowledge of differentiation in Bio-engineering.
3. Solve problems related to integration.
4. Illustrate the concepts of differential equations.

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

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction of matrices, Types of Matrices, Operations on Matrices, Transpose of a Matrix, Symmetric and Skew- Symmetric Matrices, Elementary Operation of a Matrix, Invertible Matrices. Introduction of Determinant, Properties of Determinants, Area of a triangle, Minor and Cofactors, Adjoint and Inverse of a Matrix. Application domain problems: Image and Image Processing, data storage and analysis, Gene sequencing, RNA, DNA analysis.	7
UNIT-II	Introduction, Continuity, Differentiability-Chain Rule, Derivatives of implicit functions, Derivatives of Trigonometric functions and Inverse trigonometric functions, Derivatives of Exponential and Logarithmic functions. Application domain problems: Enabling the modeling and analysis of dynamic biological systems.	7
UNIT-III	Introduction, Elementary Properties, Integration by method of Substitution, Integration using trigonometric identities, Integration by Partial fractions, Integration by parts. Application domain problems: Analyzing medical data	7

UNIT-IV	Introduction, Order and Degree of Differentiation equation, Solution of first order differential equations by method of variable separable, Homogeneous, Linear differential equation, Reducible to linear differential equation, Exact differential equation. Application domain problems: Various biological components interact and change over time, Epidemiology	7

TEXT 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. Jain R. K., Iyengar S. R. K., Advanced Engineering Mathematics, 6th Edition, Narosa Publishing House, 2019.
4. Kreyszig. E, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons. Singapore, 2015.

REFERENCE BOOKS

1. Dass H. K., Advanced Engineering Mathematics, Sultan Chand Publication, Delhi, 2018.

BIOLOGY (For BME only)	
Course Code: 25AS109	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 1 1 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To study the basic living structure and their functions.
2. To focus on different physiological processes and introduce the concept of cell signaling and their role in diseases.
3. To understand the fundamental concepts of genetics in prokaryotes and eukaryotes.
4. To learn about the various levels of organization that plants and animals have, as well as the various activities that they do.
5. To investigate biological topics using a scientific method and get well-informed findings.
6. To integrate biological and engineering knowledge.

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. Explain the complicated relationship between different cellular structures and their roles.
2. Employ experimental ways to solve genetic problems.
3. Explain how animals respond to changes in their environment.
4. When dealing with biological impediments and challenges, problem-solving abilities should be applied.
5. Analyze and interpret the data using appropriate biological methods.
6. Make connections between the various portions of the topics covered in the course.

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

COs/CLOs	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	x					
CO2	x	x				
CO3		x	x			
CO4				x	x	
CO5				x	x	
CO6					x	x

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**NATURE OF LIVING THINGS** Definition of life, Miller's experiment, theories and evidence of origin of life, levels of biological organization, classification of living world, difference between prokaryotes and eukaryotes, Evolutionary processes: Lamarckism, Darwinism, role of mutations and isolating mechanisms, adaptive radiation.	8
UNIT-II	**MOLECULAR ORGANIZATION OF CELL** Difference between animal and plant cell, salient features of intracellular organelles, cell division and cell cycle. Basic idea for Cell division, Mitosis, Meiosis. Basic idea how Central Dogma of life, Introduction to major biomolecules Carbohydrates, fats and proteins.	8

UNIT-III	**FUNDAMENTALS OF GENETICS** Mendelian principles, pleiotropy, epistasis, linkage and crossing over, Mendel's laws - monohybrid - dihybrid inheritance- multiple alleles- structure and organization of chromosome in prokaryote and Eukaryotes. Linkage - types of linkage -crossing over and their types.	7
UNIT-IV	**UNIT IV: PHYSIOLOGY** Animal Physiology: Hormones and their mode of action, types of asexual and sexual reproduction, stages of embryogenesis.	7

TEXT BOOKS

1. Purves et al, Life: The Science of Biology.
2. R. Dulbecco, The Design of Life.
3. Samantha Fowler, Concepts of Biology, Publisher: OpenStax.
4. J. M. Mwaniki, Fundamentals of Biology, Longhorn Publishers and Worldreader

REFERENCE BOOKS

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press.
2. Thyaga Rajan S, Selvamurugan N, Rajesh M.P, Nazeer, Richard Thilagaraj R.A. Barathi. W.S and. Jaganathan, M.K "Biology for Engineers", W.H. Hill, New Delhi.
3. Robert Weaver, "Molecular Biology", MCGraw-Hill.
4. The Biomedical Engineering –Handbook, Joseph D. Bronzino, CRC press.
5. Fundamentals Of Biology -Haupt Arthur W Books Publisher: Read Books Genre: Science, ISBN: 9781406707397, 97814067073
6. Basic Concepts In Biology 6/E by Starr Cengage Learning Inc

QUANTUM COMPUTATION AND COMMUNICATION	
Course Code: 25AS103/25AS206	**Continuous Evaluation:** 30 Marks
Credits: 4	**End Semester Examination:** 70 Marks
L T P : 3 1 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To reinforce the classical foundations relevant to modern physics and quantum theory.
2. To introduce key experiments and principles that led to the development of quantum mechanics.
3. To develop a conceptual and mathematical understanding of quantum mechanics and its postulates.
4. To introduce the Dirac notation and operator formalism central to quantum computation.
5. To familiarize students with classical and quantum logic gates and their role in quantum algorithms.

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. Analyse and solve problems related to classical systems including SHM, resonance, and LCR circuits.
2. Interpret foundational experiments like black body radiation, photoelectric effect, and Compton scattering within the quantum framework.
3. Apply the uncertainty principle, Schrödinger equation, and quantum postulates to idealized systems such as the particle in a 1D box.
4. Represent quantum states and operators using Dirac notation and apply linear algebra tools such as eigenvalues and commutators.
5. Differentiate between classical and quantum logic gates and construct basic quantum circuits using standard gate sets.

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

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**CLASSICAL PHYSICS:** Review of Newtonian Mechanics, Simple Harmonic Motion (SHM), Differential Equation of SHM and its Solutions, Conservation of Energy. Mass-string System, Simple pendulum, LC circuit, Qualitative discussion of damped harmonic and forced harmonic motion, resonance and its applications.	**10**
UNIT-II	**BASICS OF QUANTUM MECHANICS:** Black body problem, Photoelectric effect and Compton scattering (conceptual), stability of atom, dual nature of light and matter, de-Broglie Hypothesis of matter waves, Phase & Group velocities, Davison-Germer experiment.	**10**

UNIT-III	**APPLICATIONSOFQUANTUMMECHANICS:** Uncertainty principle, application of uncertainty principle, significance of wave functions, postulates of quantum mechanics**,** Schrodinger time dependent and time independent equations, particle in a box (1-D infinite potential well).	**10**
UNIT-IV	**MATHEMATICAL TOOLS OF QUANTUM COMPUTATION:** Dirac notation: properties of kets and bras, bra-ket algebra and their matrix representation, Operators and its matrix representation: Hermitian adjoint, Hermitian conjugate rules, Hermitian and skew-Hermitian, projection operators, commutators algebra, inverse and unitary operators, Eigenvalues and Eigenvectors of an operator.	**15**
UNIT-V	**QUANTUM COMMUNICATION:** Classical gates (AND, OR, NOT, NAND, XOR), Qubit and its physical realization, Bloch sphere, Quantum logic gates and matrix forms, Pauli Gates: X, Y, Z gates, Hadamard Gate, S and T gates, identity gate, CNOT gate, controlled-Z gate. Application of quantum gates in quantum computation.	**15**

TEXT BOOKS

1. David J. Griffiths, *Introduction to Quantum Mechanics*, 2nd Edition, 2004, Pearson Education.
2. Michael A. Nielsen and Isaac L. Chuang, *Quantum Computation and Quantum Information*, 10th Anniversary Edition, 2010, Cambridge University Press.
3. H.C. Verma, *Concepts of Physics*, Volume 1, 2008, Bharati Bhawan Publishers.

REFERENCE BOOKS

1. Nouredine Zettili, *Quantum Mechanics: Concepts and Applications*, 2nd Edition, 2009, Wiley.
2. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, 2011, MIT Press.
3. J.J. Sakurai and Jim Napolitano, *Modern Quantum Mechanics*, 2nd Edition, 2011, Cambridge University Press.
4. Albert Paul Malvino, Donald P Leach, Goutam Saha, Digital principles and applications, 7th Edition, 2011, Tata McGraw-Hill Pvt. Ltd.

Quantum Physics Lab	
Course Code: 25AS153/25AS256	**Continuous Evaluation:** 40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

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. To apply the analytical techniques and graphical analysis to the experimental data.

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. 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) AND COURSE LEARNING OUTCOMES (CLOS)

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

LIST OF EXPERIMENTS

(Students are required to complete/perform any 10 experiments from the list below)
Experiment 1: To study the characteristic of LDR and finding the dark resistance.
Experiment 2: To determine the wavelength of sodium light by Newton's ring experiment.
Experiment 3: To determine the wavelength of the given laser source using standard grating.
Experiment 4: To determine Planck's constant.
Experiment 5: To study the I-V characteristics of a PN junction diode.
Experiment 6: To determine the energy band gap by four-probe method.
Experiment 7: To study the solar cell characteristic.
Experiment 8: To determine the dispersive power of a given prism.
Experiment 9: To determine the moment of inertia of the disc and rigidity modulus of the wire by torsional pendulum.
Experiment 10: e/m by J.J. Thomson
Experiment 11: Stern - Gerlach experiment
Experiment 12: Logic gates.

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).

Applied Chemistry	
Course Code: 25AS105 /25AS208	**Continuous Evaluation:** 30 Marks
Credits: 4	**End Semester Examination:** 70 Marks
L T P : 3 1 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. The knowledge of fundamentals of water quality parameters and the treatment of water.
2. To understand the fundamental concepts of electrochemistry and corrosion.
3. To explain states of matter, phase diagram and related applications.
4. To learn various types of polymers, and to understand the basics of spectroscopy.
5. To learn an introductory idea about nanomaterials.

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. Identify and analyze the quality of water.
2. Demonstrate the working of electrochemical cells and batteries.
3. Explain states of matter, phase diagram, related applications.
4. Analyze the application aspects of polymers and spectroscopy.
5. Describe the properties of nanomaterials and its synthesis.

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

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-0	**Introduction:** Atomic and molecular masses, mole concept and molar mass, percentage composition, redox reactions, Chemical and ionic equilibrium; Acid & bases.	**6**
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- Ion Exchange process -Water for drinking purposes-Purification-Sterilization and disinfection: Chlorination, Reverse Osmosis and Electro Dialysis.	**10**
UNIT-II	**Electrochemistry:** Nernst Law and its applications, Electrode Potential, Electrochemical cell, Concentration Cell, Electrochemical Series, Batteries and Cells; Primary Batteries and Secondary Batteries. **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	**16**

	boilers), Factors affecting, metal coatings- Galvanizing and Timing, Corrosion inhibitors, protection.	
UNIT-III	**The Phase rule:** Statement of Gibb's phase rule and explanation of the terms involved, Phase diagram of one component system-water system, Condensed phase rule, Phase diagram of two components System-Eutectic, Pb-Ag system.	**8**
UNIT-IV	**Polymer:** Terminologies, Classification of polymer, Preparation of special polymer-Nylon6,6, Polyethylene, Polystyrene, Teflon, Polymethyl-methacrylate, Bakelite. **UV Spectroscopy:** Lambert Beer's Law, Principles and applications of UV-Visible Molecular Absorption Spectroscopy; Chromophores, effect of conjugation on chromophores.	**12**
UNIT-V	**Nano Materials:** Introduction and 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.	**8**

TEXT BOOKS

1. Engineering Chemistry (NPTEL web-book) by B. L. Tembe, Kamaludddin, and M.M. S. Krishan.
2. Fundamentals of Molecular Spectroscopy by Banwell, Tata McGraw-Hill Education.
3. Textbook of Nanoscience and Nanotechnology, McGraw Hillw Hill Education (India) Pvt. Ltd., 2012.) Pvt. Ltd., 2012.
4. Engineering Chemistry by Jain and Jain, Dhanpat Rai Publication.
5. Engineering Chemistry by Prasanta Rath, Cenage Learning India Private Ltd., 2015.td., 2015.
6. A Textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co., 2020 & Co., 2020.
7. Inorganic Chemistry by Donald A. Tarr and Gary Miessler, Pearson India, Third Edition.
8. Molecular Spectroscopy, Ira N. Levine, John Wiley and Sons.

REFERENCE BOOKS

1. Inorganic Chemistry by W. Overton, Rounk, and Armstrong, Oxford University 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, 10th Edition, S. Chand & Company Ltd., New Delhi, 2003.
4. J.D. Concise Inorganic Chemistry.
5. Inorganic Chemistry, Catherine E. Housecroft and Alan G. Sharpe, 2nd Edition
6. Huheey, J. E., Keiter, E. A., Keiter, R. L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India.

Applied Chemistry Lab	
Course Code: 25AS155/25AS258	**Continuous Evaluation:** 40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

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 principle involved in the synthesis of chemical compounds, and quantitative analysis.

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. Explain the basic concepts of measurement techniques.
2. Execute synthesis of compounds and determination quantitative analysis.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

COs/CLOs	CLO1	CLO2
CO1	x	
CO2		x

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform minimum 8-10 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 $KMnO_4$ 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 alkalinity of given sample.
7. Estimation of calcium in limestone.
8. Acid-Base Titration by Potentiometry.
9. Preparation of Silver/Iron nano particles.
10. Preparation of Bakelite.
11. Preparation of Urea formaldehyde resin.
12. To record UV-Spectrum of $KMnO_4$ and $K_2Cr_2O_7$.
13. Estimation of nickel in given sample solution
14. Estimation of nitrite in given sample solution.

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 (ninth edition); S. Chand,2003.
2. Rani, S.; Laboratory Manual on Engineering Chemistry; DhanpatRai,1998.
3. Department Laboratory Manual.

BASIC ELECTRICAL ENGINEERING	
Course Code:25EE202/25EE202	**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 CONTENT S

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 and power factor, Resonance in series R-L-C circuit, Quality factor and Bandwidth, Introduction to earthing.	**9**
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	**9**

	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.	
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 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 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.

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	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	9

	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.	
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 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,	9

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

FUNDAMENTALS OF ROBOTICS & AI	
Course Code: 25ME101/25ME202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

The objectives of this course are to:

1. Understand and discuss the fundamental elementary concepts of Robotics.
2. Provide insight into different types of robots.
3. Explain intelligent module for robotic motion control.
4. Educate on various path planning techniques.
5. Illustrate the working of innovative robotic devices

COURSE LEARNING OUTCOMES (CLOs)

By the end of this course, students will be able to:

1. Describe the fundamental concepts, history, and components of robotics.
2. Classify various types of robots and analyze their configurations and kinematics.
3. Explain different drive systems, end effectors, and control methods used in robotic systems.
4. Evaluate applications of robotics in industrial, medical, agricultural, and autonomous systems.
5. Demonstrate a basic understanding of Artificial Intelligence concepts relevant to robotics.

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	**Introduction To Robotics:** Introduction to Robotics and Automation, laws of robot, brief history of robotics, basic components of robot, robot specifications, classification of robots, human system and robotics, safety measures in robotics, social impact, Robotics market and the future prospects, advantages and disadvantages of robots.	9
UNIT -II	**Robot Anatomy And Motion Analysis:** Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics, transformations and rotation matrix.	9
UNIT -III	**Robot Drives and End Effectors:** Robot drive systems: Hydraulic, Pneumatic and Electric drive systems, classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper	9

	design, 1 DoF, 2 DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control.	
UNIT -IV	**Robotics Applications: Material Handling:** Pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, Ariel and underwater applications, robotic for computer integrated manufacturing. Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Robots, Autonomous robots, and Swarm robots	9
UNIT -V	**Fundamentals of Artificial Intelligence:** Introduction to Artificial Intelligence: definition, goals, and brief history; basic concepts of AI: learning, reasoning, and problem-solving; knowledge representation and simple rule-based systems; overview of machine learning: supervised and unsupervised learning; role of AI in enabling intelligent behavior in robots.	9

TEXT BOOKS

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009.
2. Mikell P. Grooveret. al., "Industrial Robots - Technology, Programming and Applications",McGraw Hill, Special Edition, (2012).
3. Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rdedition, 2017.
4. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
5. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence",McGraw Hill,1987. https://www.robots.com/applications.

DESIGN THINKING AND ENGINEERING PRACTICES LAB	
Course Code: 25ME151/25ME252	**Continuous Evaluation:**40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To introduce students to the fundamentals of design thinking and its application in engineering problem-solving.
2. To understandworkshop tools used in carpentry, welding, sheet metal, and machining
3. To provide hands-on experience in basic engineering practices such as welding, carpentry, machining, and sheet metal work.
4. To foster creativity, teamwork, and practical skills through physical prototyping.
5. To understand safety, tools, and standard practices involved in common engineering operations.

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course the students will be able to

1. Apply design thinking principles to simple engineering problems
2. Operate basic workshop tools used in carpentry, welding, sheet metal, and machining
3. Demonstrate hands-on skills through the fabrication of simple mechanical components
4. Work effectively as a team member in engineering practice sessions
5. Apply workshop safety protocols and proper tool handling procedures

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. Introduction to Design Thinking: Empathize, Define, Ideate, Prototype, Test – with engineering case examples
2. Safety and Workshop Orientation: Personal Protective Equipment (PPE), safety signs, hazard zones, and tool use policies
3. Carpentry Practice: Sawing, chiselling, planning, drilling – make a dovetail or T-joint
4. Welding Practice: Arc welding (butt & lap joints), electrode selection, safety protocols
5. Sheet Metal Work: Cutting, bending, rivet joining, tray/box making
6. Machining Practice: Lathe operation (facing, turning), drilling, tapping
7. Mini Project (Design + Fabrication): Students form teams to design and fabricate a small product using at least 2 workshop processes
8. Presentation & Evaluation: Final demonstration of project, reflection on design thinking, peer review

TEXT BOOKS

1. **K.C. John**"Mechanical Workshop Practice", PHI Learning Pvt. Ltd., Latest Edition.

Covers carpentry, welding, fitting, machining, and safety practices.
2. **Sanjay Moizuddi**"Introduction to Design Thinking", Pearson Education, 1st Edition.
   Introduces the design thinking process with real-world applications in engineering.
3. **Raghavendra, K. and Krishnamurthy, L.**"Engineering Workshop Practice", PHI Learning Pvt. Ltd.
   A practical reference for workshop tools and exercises (wood, metal, welding).
4. **P. Kannaiah& K.L. Narayana**"Workshop Manual", Scitech Publications.
   Detailed procedural steps for carpentry, sheet metal, fitting, and machining.
5. **IDEO.org**"The Field Guide to Human-Centered Design", IDEO Press (Free PDF available online)
   A hands-on reference for applying empathy, prototyping, and iteration in design thinking.
6. **Tapan P. Bagchi**"Engineering Design", Wiley India Pvt. Ltd.
   Explores the fundamentals of creative problem-solving and product design.

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 help 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,	9

	Type of programming errors, Assembler, Linker, Loader, Compiler, Interpreter, debuggers, Algorithms, flowcharts and their symbols.	
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, TMH.

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/

COMMUNICATIVE ENGLISH	
Course Code: 25HS101/25HS202	**Continuous Evaluation:**40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Basic Knowledge of English	

COURSE OBJECTIVES (COs)

1. To prepare the students for their career which will require them to listen, read, speak, and write in English both for their professional as well as interpersonal communication
2. To write clear, coherent, and well-organized texts, such as emails, essays, reports, and other forms of written communication.
3. 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.
4. To enhance student's ability to understand spoken English in various contexts, including conversations, lectures, and media.
5. To enhance student's vocabulary and master key grammatical structures, enabling them to communicate more effectively and accurately.

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. 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 (COS) AND COURSE LEARNING OUTCOMES (CLOS)

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT -I	**Introduction to Communication** Elements and Process of Communication, Types and Barriers to Communications, Grice Conversational Maxims and Cooperative Principles, Verbal and non-verbal communication, Body Language: Proxemics, Chronemics, and Haptics, Identifying and rectifying common errors: Types of Sentences (Statements, interrogative,	**6**

	exclamatory, Optative, and imperative, Wh/How-questions, question-tags), Basic Grammar: - Articles, Prepositions, Cliches, Collocations, and Punctuations, Case studies based on Communication Skills https://pressbooks.bccampus.ca/technicalwriting/chapter/casestudy-costpoorcommunication/	
UNIT -II	**Workplace Communication** Communication Challenges in a Culturally Diverse Workplace; Ethics in Communication, Bias-free communication, Effective Business Presentations: Importance in workplace communication; Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Handling Questions; and PowerPoint Presentation, Case Studies based on communication challenges in the workplace	**6**
UNIT -III	**Effective Writing** Paragraph Writing: Topic Sentence, Guided composition, Free-writing, Reading comprehension practice: Technical and General text, use of different techniques (skimming and scanning), Selection of Words; Coherence and Cohesion, Use of discourse markers concerning technical writing, Case Studies based on technical writing skills	**6**
UNIT -IV	**Business Writing at Work** Cover Letters and Applications, Writing notices and circulars, Email Writing and Memorandum, Writing reports	**6**

TEXTBOOKS

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.

COMMUNICATIVE ENGLISH LAB	
Course Code: 25HS151/25HS252	**Continuous Evaluation:**60 Marks
Credits: 1	**End Semester Examination:** 40 Marks
L T P : 0 0 2	
Prerequisite: Basic Knowledge of English	

COURSE OBJECTIVES (COs)

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
3. To increase their competence and boost their confidence.
4. To enable the students to properly communicate and express themselves in writing.
5. 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.

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. 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 (COs) & COURSE LEARNING OBJECTIVES (CLOs)

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

LIST OF ACTIVITIES

UNIT	COURSE CONTENTS	HOURS
UNIT -I	• Listening and Speaking • Accent in speech (British and American) • Practicing Sounds of English: Stress and Intonation Patterns	4
UNIT -II	• Role-play • Extempore • JAM (Just a minute)	4
UNIT -III	• Presentations • Interview Simulations • Telephone Etiquettes	4
UNIT	• Formal speech- Welcome Speech and Vote of thanks	4

-IV	• Public Speaking and Rhetoric • Group Discussions and Debates	

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 &PuspaLata, Oxford University Press. 2nd Edition.
3. Business Communication Today by Courtland L Bovee and Thill, Pearson

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 view in to 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	3

	the HP only) by change of position method. .	
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

HINDI -I	
Course Code:25HIN101/25HIN202	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

हिन्दी विषय के प्रश्नपत्र की सामग्री में ज्ञान तथा शिक्षा के बदलते परिदृश्य को ध्यान में रखा गया है।हिन्दी के भक्तिकाल, रीतिकाल और आधुनिककाल के कवियों की कविताओं को पाठ्यक्रम में शामिल किया है | व्याकरण की विभिन्न कोटियों तथा भाषा के सम्प्रेषण से हिन्दी का प्रचार-प्रसार होगा।संचार कौशल के द्वारा छात्रों का ज्ञान परिमार्जित होगा।साहित्येतर छात्रों के ज्ञानवर्धन, भाषायीक्षमता एवम् अभिवृद्धि भी इस पाठ्यक्रम का लक्ष्य है।

COURSE LEARNING OUTCOMES (CLOs)

पाठ्यक्रमपरिणाम

1.Knowledge Outcome

ज्ञानकापरिणाम

At the end of the course, the student should be able to

पाठ्यक्रम केअंत में छात्र सक्षम होना चाहिए

1. -हिन्दी क़े प्रमुख कवि जो पाठ्यक्रम में शामिल है, उनकी कविताओं की व्याख्या और काव्यगत विशेषताओं को छात्र समझेंगे।
2. छात्रों को काव्य में रस, अलंकार और छन्द का ज्ञान प्राप्त होगा|
3. -व्याकरण के अध्ययन से छात्रों को भाषा बोलने, लिखने और पढने में सहायता प्राप्त होगी।

2.Skill Outcome

कौशल का परिणाम

At the end of the course, the student should be able to

पाठ्यक्रम केअंत में छात्रसक्षम होना चाहिए

1. -हिंदी कवियों व उनकी कविताओं से परिचित हो जाएंगे।
2. छात्र दोहे और कविता समझने में सक्षम होंगे।
3. -व्याकरण के ज्ञान के साथ –साथ शब्दों के उच्चारण के बोध से अवगत होंगे।

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	इस इकाई में हिंदी भक्तिकाल के प्रमुख कविकबीरदास हैं। कबीरदास- कबीरदास के दोहे 5 दोहे	8
UNIT-II	इस इकाई में हिंदी रीतिकाल के प्रमुख कवि बिहारीलाल हैं। बिहारीलाल- बिहारीलाल के दोहे 5दोहे	7
UNIT-III	इस इकाई में हिंदी आधुनिककाल के प्रमुख कवि माखनलाल चतुर्वेदीहैं। माखनलाल चत्र्वेदी (पुष्पकीअभिलाषा (कविता	7
UNIT-IV	यह इकाई संचार कौशल से सम्बन्धित है. इसमें **(i)**हिंदी के प्रमुख मुहावरे और लोकोक्तियाँ **(ii)** आत्मपरिचय (self-introduction), साक्षात्कारकौशल (interview skills), कार्यक्रमसंचालन/मंचप्रबंधन (event management)	8

METHODOLOGY पद्धति

- कक्षाव्याख्यान

-व्याकरण के माध्यम से हिंदी शब्दों का उच्चारण व लेखन काअभ्यास किया जाएगा |

-समय-समय पर छात्रों को प्रदत्तकार्य दिया जाएगा |

- साप्ताहिकप्रश्नावली |

REFERENCE BOOKS/ TEXT BOOKS

आवश्यक पुस्तकें और सामग्री

1. -कबीरग्रन्थावली, संपादक-श्यामसुन्दरदास, काशीनागरी प्रचारिणी सभा |
2. बिहारीसतसई, साहित्यसंस्थान प्रयाग|
3. -भाषाविज्ञान, डॉ. भोलानाथ तिवारी ,किताब महल इलाहाबाद |
4. -हिंदीव्याकरण, कामताप्रसादगुरु, प्रभातप्रकाशनदिल्ली

GERMAN-I	
Course Code:25FLGR101	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Basics of English Language	

COURSE OBJECTIVES (COs)

The objective of this course is to impart basic knowledge of German language to the students. The course intends to grow the ability of verbal and written communication. Overall, the objective is to facilitate comprehension of daily life contexts in German, both oral as well as written.

1. To develop oral and written skills of understanding, expressing and exchanging information in German language.
2. To develop awareness of the nature of language and language learning.
3. To develop the ability to construct sentences and frame questions.
4. To provide German language as a competitive edge in career choices.
5. To know some of the aspects of the culture of the countries where German language is spoken.

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course the students will have the ability to:

1. Read and write short, simple texts.
2. Understand and take part in short, simple conversations using the skills acquired.
3. Know some aspects of the culture of the countries where the German language is spoken.
4. Read a text and/or e-mail during any employment.

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

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	- Informationen über Deutschland - Buchstaben, die Aussprache, Wochentage, Monate - Begrüßung, Wie geht's? , sich vorstellen, Zahlen, W-Familie	8
UNIT-II	- Über Personen sprechen (Name, Herkunft, Adresse, Telefonnummer, Alter, Beruf, Familie), - Länder und Sprachen, Berufe, Satzstruktur, Familienmitglieder, Farben, Wetter - Personalpronomen, Konjugation von Verben (sein, haben, heißen, wohnen, kommen, machen, lernen, arbeiten, studieren)	8
UNIT-III	- Nomen (Genus, Singular-Plural), Bestimmter Artikel, Unbestimmter Artikel,Negation, W-Frage, Ja-Nein-	

	Frage - Über Sachen sprechen - Sachen des Alltagslebens(Obst und Gemüse, Schulsachen), Haushaltswaren, Adjektive	7
UNIT-IV	- Akkusativ, Artikel und Personalpronomen im Akkusativ - Unregelmäßige Verben - Kleidung, Lebensmittel Leseverstehen.	8

TEXT BOOKS

1. Netzwerk Neu A1 (Kursbuch+Arbeitsbuch)by StefanieDengler, et al.Ernst Klett Sprachen., 2019.

OPEN EDUCATIONAL RESOURCES

2. **Website for additional materials:**https://www.nthuleen.com/teach.html

REFERENCE BOOKS

1. Studio D A1, Hermann Funk, Christina Kuhn, Silke Demme, 2010, Cornlesen.
2. Einfach Grammatik: Übungsgrammatik Deutsch A1 bis B1, Paul Rusch, Helen Schmitz, 2012, Langenscheidt.
3. Berliner Platz - neu: Lehr- und Arbeitsbuch, Christiane Lemcke, Lutz Rohrmann, Theo Scherling, 2009, Klett Sprachen.
4. Tangram aktuell 1: A1, Rosa-MariaDallapiaza, Eduard von Jan, Sabine Dinsel, 1998, Hueber Verlag.
5. Lernziel Deutsch: Deutsch als Fremdsprache, Teil 1, Wolfgang Hieber, 1984, Max Hueber Verlag

FRENCH-1	
Course Code: 25FLFR101	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Basics of English Language	

COURSE OBJECTIVES (COs)

1. To develop the skills to construct short and simple sentences.
2. To prepare the students to identify themselves with the culture of the Francophone world.
3. To develop in students a good degree of understanding of syntactic, lexical, grammatical and stylistic features of the French language.
4. To demonstrate differences and diversity of the French speaking world with their own

COURSE LEARNING OUTCOMES (CLOs)

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

1. Speak themselves in French used in daily conversations.
2. Explain cultural artefacts, practices and perspectives of the French speaking world.
3. Apply linguistic knowledge to analyse a simple text, identifying its salient features, and thus express themselves effectively in French.
4. Contrast culture of the French speaking world with their own, and hence demonstrate an increased awareness towards its key practices and perspectives.

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

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

COURSE CONTENTS

UNIT	Unités	Objectifs de Communication	Grammaire	Lexique	Heures
UNIT-I	**La Salutation et l'Introduction**	Saluer. Entrer en Contact. S'Excuser. Remercier. Se Présenter/Présenter Quelqu'un.	Pronoms Personnels Sujets. L'Alphabet. Les Articles Indéfinis. Les Verbes en -ER au Présent.	Salutations, Les Nombres. Les Objets de la Classe. La Nationalité.	8

UNIT-II	**On Partage des Renseignements**	Demander de Se Présenter. Donner des Renseignements Personnels.	Etre et Avoir au Présent. Les Verbes en -ER au Présent. Adjectifs de Nationalités. L'Interrogation.	Adjectifs de Nationalité, Métiers et Secteurs Professionnels, Goûts et Intérêts	8
UNIT-III	**Ma Ville et Mon Quartier**	Décrire et Qualifier Ville ou Quartier. Localiser. Demander et Donner Directions.	Verbe Vivre. Articles Définis (Le, la, les). Il y a/ Il n'y a pas. Prépositions. Adjectifs Qualificatifs. Impératif.	Prépositions de lieux. Vocabulaire des Sites. Etablissements et Service de Ville.	7
UNIT-IV	**Mes Intérêts et Goûts**	Parler de Ses Goûts et de Ses Loisirs. Donner Son Impression sur le Caractère de Quelqu'un.	Présent des Verbes en -ER, et du Verbe Faire. Négation, Adjectifs Possessifs.	Avoir l'air. Loisirs. L'Expression des Goûts. Faire du/ de la. Ma Famille.	7

TEXT BOOKS

1. Version Originale 1, Livre de l'élève: Denyer M. & Agustin GarmendiaA. & Olivieri M L L., éd. Maisons des Langues, Paris. 2013.

REFERENCE BOOKS

1. Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. &Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.
2. Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al,CLE International, Paris, 2013.

Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan

ENVIRONMENTAL BIOENGINEERING	
Course Code:25ESEB101/25ESEB202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

Course Objectives (COs) - 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. Including artificial intelligence and its applications.

Course Learning Outcomes (CLOs) –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 MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**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.	**8**
UNIT-II	**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,	**8**

	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-III	**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. Bio-engineering 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.	**7**
UNIT-IV	**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, bio fertilizers, biofuels, bioreactors, bioremediation, and bioengineering for biomedical waste management. Role of artificial intelligence in handling biomedical waste	**7**

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 ErachBharucha, 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.

INDIAN CONSTITUTION & POLITY	
Course Code: 25VAC101/25VAC202	**Continuous Evaluation:**30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To acquaint the students with the fundamental concepts of democracy, diversity and the Constitution.
2. To make students understand the functioning of the three wings of the State
3. To make the students appreciate the purpose of decentralised administration under the Constitution and its functioning
4. To make students analyse and discuss various rights and duties under the Constitution of India

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. Explain the concept of democracy, diversity and the Constitutional Values
2. Describe the functioning of the three wings of the State
3. Sketch the functioning of decentralised administration under the Constitution of India and appreciate the political dimensions.
4. Examine the scope of various rights and duties under the Constitution of India.

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

COs/CLOs	CLO 1	CLO 2	CLO 3	CLO 4
CO1	x	x	x	
CO2		x		x
CO3			x	x
CO4				x

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**DEMOCRACY, DIVERSITY AND THE CONSTITUTION:** ● Concept of democracy and importance of right to vote ● Electoral Politics ● Concepts of diversity and discrimination on the grounds of gender, religion and caste ● Concept of democratic government ● Constitution design and salient features ● Preamble to the Constitution of India	**8**
UNIT-II	**THE THREE WINGS OF THE STATE :** ● The definition of State in Constitution of India ● Parliament, the State legislature and the making of laws	**8**

	● Concept of cooperative federalism ● The Executive and Administration ● Role of Governor and the President of India ● The Judiciary	
UNIT-III	**LOCAL GOVERNMENT AND ADMINISTRATION:** ● Panchayati Raj System ● Rural and Urban administration ● Social and Economic Justice for the marginalized ● Directive Principles of State Policy	**7**
UNIT-IV	**RIGHTS AND DUTIES:** ● Fundamental Rights (Part III of the Constitution) ● Protection of Fundamental Rights – Writ petitions in High Court and Supreme Court of India ● Fundamental Duties ● The concept of Fraternity and secularism ● Public utilities and privatization	**7**

RECOMMENDED TEXT BOOKS:

1. D.D. Basu, Introduction to the Constitution of India, (LexisNexis, 26th Ed., 2022).
2. M. Laxmikant, Indian Polity(McGraw Hill, 7th Ed., 2023)
3. Subhash C. Kashyap, Constitution of India (Vitasta Publishing Pvt. Ltd, 1st Ed., 2019)

REFERENCE BOOKS:

1. M.P. Jain, Indian Constitutional Law (Lexis Nexis, 8th Ed., 2018).
2. H.M. Seervai, Constitutional Law of India (Law & Justice 4th Ed., 2023)
3. P.M. Bakshi, The Constitution of India, (Universal Law Publishing Co.,18th Ed., 2022)
4. J.N.Pandey, Constitutional Law of India(Central Law Agency, 59th Ed.,2022, Allahabad

SEMESTER II

ENGINEERING MATHEMATICS-II (COMMON TO ALL BRANCHES EXCEPT BIO MEDICAL ENGINEERING)	
Course Code:25AS202	**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 of 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 the concept of Complex Integration, Tayler's and Laurent's Expansions, Residues and Singularities.

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. Interpret various physical models through higher order differential equations and solve such linear ordinary differential equations.
2. Describe the basics of vector spaces and linear transformations.
3. Apply Laplace transforms to find the solution of initial value problems.
4. Demonstrate the concept of Analytic functions & its constructions.
5. 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. Application domain problems: Electric field, rate of growth and decay of population dynamic, Antenna Design	12

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.

Mathematics-II (For BME only)	
Course Code: 25AS204	**Continuous Evaluation:** 30 Marks
Credits: 4	**End Semester Examination:** 70Marks

L T P : 3 1 0	
Prerequisite: Mathematics-I	

COURSE OBJECTIVES (COs):

1. To familiarize with the concept of complex variables.
2. To introduce the concept of successive differentiation and nth derivatives.
3. To introduce the concept of Differentiation of several variables.
4. To familiarize with concepts of vector and vector differentiation.
5. To introduce the concept of differential equations and their applications

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 knowledge to construct analytic functions.
2. Execute the higher order differentiation.
3. Develop the essential tool of differentiation of several variables.
4. Illustrate the concept of vector differentiation.
5. Apply the knowledge of differential equations in solving problems

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	Complex numbers and their properties, Complex plane, Polar form of complex numbers, Powers and Roots, Sets of Points in the Complex plane, De-Moivre's theorem and its simple applications. **Application domain problems:** Signal processing of bio-signals	12
UNIT-II	Successive differentiation, nth order derivatives of standard functions, Leibnitz theorem (without proof) **Application domain problems:** Population dynamics	12
UNIT-III	Introduction, Limit & Continuity, Partial derivatives, Homogeneous functions and Euler's theorem, Total derivatives, Jacobians, Properties of Jacobians. **Application domain problems**: Analysis of blood flow, stability analysis	12
UNIT-IV	Introduction, Scalar and vector point functions, differentiation formulae, Level surface, Gradient, Divergence, Curl, Directional	12

	derivatives, Simple Applications. **Application domain problems:** Analysis of bio fluids in biomechanics	
UNIT-V	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. **Application domain problems:** Mathematical modelling in biology	12

TEXTBOOKS/REFERENCE BOOKS

1. Grewal B.S,Higher Engineering Mathematics, KhannaPublications,45thEdition,2020.
2. Jain R. K., Iyengar S. R. K., Advanced Engineering Mathematics, 7th Edition, Narosa Publishing House, 2021.
3. BaliN.P.,Goyal M,Advanced Engineering Mathematics, Laxmi Publications, NewDelhi,2018.
4. Dass H.K.,Advanced Engineering Mathematics, Sultan Chand Publication, Delhi,2018.

HINDI -II	
Course Code: 25HIN202	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

हिंदी विषय के प्रश्नपत्र की सामग्री निर्धारण में ज्ञान तथा शिक्षा के बदलते परिप्रेक्ष्य को ध्यान में रखा गया है|इस सत्र में हिंदी लघु कथाओं को सम्मिलित किया गया है| छात्रों की मौखिक अभिव्यक्ति की क्षमता का विकास करने में निहित मूल्यों का महत्वपूर्ण योगदान होताहै , इससे विद्यार्थियों की कल्पनाशक्ति के विकास के साथ-साथ मनोरंजन भी होताहै| संचार कौशल में मुहावरे, लोकोक्तियां, पत्रलेखनऔरअपठितगद्यांश की समझ के द्वारा हिंदीकाप्रचार-प्रसार होगा| इस प्रकार साहित्य के ज्ञान की अभिवृद्धि वैश्वीकरण के संदर्भ में प्रासंगिकता और उपयोगिकता सिध्द करती है

COURSE LEARNING OUTCOMES (CLOs)

पाठ्यक्रमपरिणाम

1. Knowledge Outcome

ज्ञान का परिणाम

At the end of the course, the student should be able to

1. पाठ्यक्रम के अंत में छात्र सक्षम होना चाहिए
2. हिंदी लघुकथाओं के मूल उद्देश्य को समझने में विद्यार्थी निपुण हो जाएंगे| लघुकथाओं से क्या शिक्षा मिलती है? इसका ज्ञान छात्रों को होगा| व्याकरण के अध्ययन से विद्यार्थियों को भाषा बोलने, लिखने और पढ़ने में सहायता प्राप्त होगी

2. Skill Outcome

कौशल का परिणाम

At the end of the course, the student should be able to

(At the end of the course, the student should be able to)

1. -पाठ्यक्रम केअंत में छात्र सक्षम होना चाहिए
2. -हिंदी लघुकथाओं से मनोरंजन भी होगा |
3. -विद्यार्थी लघुकथाओं के मूलकथ्य को समझेंगे|
4. -विचार तत्व के बोध से अवगत होंगे|
5. -हिंदी में पत्र लेखन और अपठित गद्यांश को समझने में सक्षम होंगे |

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	इस इकाई में हिंदी लघुकथाओं का संक्षिप्त परिचय दिया गया है – 1.हिंदी लघुकथा का सामान्य परिचय |2,हिंदीलघुकथाकेप्रमुखप्रकार		8
UNIT-II	इस इकाई में हिंदी की दो लघुकथाएं सम्मिलित की गई हैं- 1. अंगूरकीबेल 2. किसानऔरठग	8
UNIT-III	इस इकाई में हिंदी की दो लघुकथाएं सम्मिलित की गई हैं- 1 बुराईकाफल 2. चारविद्वानब्राह्मण	7
UNIT-IV	यह इकाई संचार कौशल से सम्बंधित है,इसमें	7

	(i) प्रेसरिपोर्ट, विज्ञापन, अनुवाद (ii)हिंदी पत्र लेखनऔरअपठित गद्यांश को समझना व तर्क संगत उत्तर देना अपेक्षित है|	

METHODOLOG पद्धति
- कक्षाव्याख्यान
-व्याकरण के माध्यम से हिंदी शब्दों का उच्चारण व लेखन काअभ्यास किया जाएगा |
-समय-समय पर छात्रों को प्रदत्तकार्य दिया जाएगा |
- साप्ताहिकप्रश्नावली |
-दैनिकप्रश्नावली

REFERENCE BOOKS/ TEXT BOOKS
आवश्यक पुस्तकें और सामग्री
1. पाठ्यक्रममेंनिर्धारितलघुकथाओंकासंकलन |
2. -भाषाविज्ञान, डॉ. भोलानाथतिवारी ,किताबमहलइलाहाबाद |
3. -हिंदीव्याकरण, कामताप्रसादगुरु, प्रभातप्रकाशन

GERMAN-II	
Course Code:25FLGR202	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: GERMAN-I	

COURSE OBJECTIVES (COs)

The objective of this course is to impart basic knowledge of German language to the students. The course intends to grow the ability of verbal and written communication. Overall, the objective is to facilitate comprehension of daily life contexts in German, both oral as well as written.

1. To develop oral and written skills of understanding, expressing and exchanging information in German language.
2. To develop awareness of the nature of language and language learning.
3. To develop the ability to construct sentences and frame questions.
4. To provide German language as a competitive edge in career choices.
5. To know some of the aspects of the culture of the countries where German language is spoken.

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course the students will have the ability to:

1. Read and write short, simple texts.
2. Understand and take part in short, simple conversations using the skills acquired.
3. Know some aspects of the culture of the countries where the German language is spoken.
4. Read a text and/or e-mail during any employment.

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

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	- Zeitangabe, Tageszeit, Uhrzeit, der Tagesablauf - Präpositionen mit Akkusativ, Ordinalzahlen - Wegbeschreibung, die Himmelsrichtungen - Die Gebäude, Verkehrsmittel	8
UNIT-II	- Das Haus - Modalverben - Essen und Trinken, Messeinheiten, Einkaufen - Körperteile und Krankheiten - Futur	8
UNIT-III	- Dativ, Artikel und Personalpronomen im Dativ - Präpositionen mit Dativ, die Wechselpräpositionen - Possessiv-Artikel, die Konnektoren - Schreiben Teil 1	7

	- Trennbare Verben	
UNIT-IV	- Schreiben Teil 2 (E- Mail Schreiben) - Perfekt - Vergangenheit erzählen, Das Wochenende, Lebenslauf	7

TEXT BOOKS

1.Netzwerk Neu A1 (Kursbuch+Arbeitsbuch)by StefanieDengler, et al.Ernst Klett Sprachen., 2019.

OPEN EDUCATIONAL RESOURCES

1. Website for additional materials: https://www.nthuleen.com/teach.html

REFERENCE BOOKS

1. Studio D A1, Hermann Funk, Christina Kuhn, Silke Demme, 2010, Cornlesen.
2. Einfach Grammatik: Übungsgrammatik Deutsch A1 bis B1, Paul Rusch, Helen Schmitz, 2012, Langenscheidt.
3. Berliner Platz - neu: Lehr- und Arbeitsbuch, Christiane Lemcke, Lutz Rohrmann, Theo Scherling, 2009, Klett Sprachen.
4. Tangram aktuell 1: A1, Rosa-MariaDallapiaza, Eduard von Jan, Sabine Dinsel, 1998, Hueber Verlag.
5. Lernziel Deutsch: Deutsch als Fremdsprache, Teil 1, Wolfgang Hieber, 1984, Max Hueber Verlag.

FRENCH-II	
Course Code: 25FLFR202	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: French-I	

COURSE OBJECTIVES (COs)

1. To develop the skills to construct short and simple sentences.
2. To prepare the students to identify themselves with the culture of the Francophone world.
3. To develop in students a good degree of understanding of syntactic, lexical, grammatical and stylistic features of the French language.
4. To demonstrate differences and diversity of the French speaking world with their own

COURSE LEARNING OUTCOMES (CLOs)

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

1. Express themselves in French used in daily conversations.
2. Recognise and explain cultural artefacts, practices and perspectives of the French speaking world.
3. Apply linguistic knowledge to analyse a simple text, identifying its salient features, and thus express themselves effectively in French.
4. Contrast culture of the French speaking world with their own, andhence demonstrate an increased awareness towards its key practices and perspectives.

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

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

COURSE CONTENTS

UNIT	Unités	Objectifs de Communication	Grammaire	Lexique	Heures
UNIT-I	**Journée Typique**	Parler d'habitudes, Exprimer l'Heure, S'Informer sur l'Heure, Moment et Fréquence.	Verbes Pronominaux au Présent. Verbes Aller et Sortir	Heure, Moments de la Journée. Activités Quotidiennes. Adverb. Météo.	8
UNIT-II	**Achats**	S'informer sur un Produit. Acheter et Vendre un Produit. Donner Son Avis. Parler du temps.	Adjectifs Interrogatifs. Adjectifs Démonstratifs(Ce, cette, ces). Genre et Nombre. Verbe Prendre.	Vêtements. Couleurs. Fruits et Légumes.	8

UNIT-III	**Alimentation**	Parler des Plats et des Aliments. Commander un Menu dans un Restaurant. Situer une Action dans le Futur	Future Proche: Aller +Infinitif. Articles Partitifs(du/de la/des/d'). Pronoms COD. Future.	Aliments. Vocabulaire des Quantités.	7
UNIT-IV	**expérience vécue**	Parler du passé. Parler d'expériences. Parler de ce que nous savons faire.	Passé Composé. Imparfait	Verbes Savoir, Pouvoir et Connaître. Adjectifs Qualificatifs. Vocabulaire des Savoirs et Compétences. Récit de Vie.	7

TEXT BOOKS

1. Version Originale 1, Livre de l'élève: Denyer M. & Agustin GarmendiaA. & Olivieri M L L., éd. Maisons des Langues, Paris. 2013.

REFERENCE BOOKS

1. Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. &Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.
2. Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al,CLE International, Paris, 2013.
4. Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan.

SEMESTER – III

ENGINEERING MATHEMATICS – III	
Course Code: 24AS301	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES (CEO)

1. To familiarize the students with partial differential equations and their solution, Boundary value problem, Fourier transforms, z- transforms and basic concepts of Linear algebra.
2. To solve boundary value problems, Heat and Wave equations.
3. To gain good knowledge in the application of Fourier transform.
4. To demonstrate understanding Z-transform and analyzing Discrete signals by using Z-transform.
5. To understand Vector spaces, and Linear Transformation with its properties.

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. Solve different types of partial differential equations.
2. Find solutions of boundary value problems including heat and wave equations.
3. Apply and analyze Fourier transforms with different applications.
4. Evaluate the problems using z-transforms.
5. Understand linear algebra and its application to Engineering.

MAPPING COURSE EDUCATIONAL OBJECTIVES & COURSE LEARNING OUTCOMES

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
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 π), 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 ofEquation by Direct Integration, Lagrange & Linear Equation of first order. Solution of Linear Partial Differential Equations with Constant Coefficients. **Application domain problems:** Scientific computing of modelling problems in real world scenarios.	-
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 systems.	-

TEXT 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.

REFERENCE BOOKS

1. Churchill R.V. and Brown J., Fourier series and Boundary Value Problems,McGraw-Hill Book Education, 8th Edition, 2017.
2. Kreyszig, E., Advanced Engineering Mathematics, Wiley-India, 10th Edition, 2017.

PROGRAMMING IN PYTHON	
Course Code: 25CS2007	Continuous Evaluation: 40 Marks
Pre-Requisite : Basic Programming Fundamentals	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

1. Understand the fundamental concepts of Python programming including data types, control structures, and structured data types.
2. Apply functional programming constructs, input/output operations, and various Python operators to solve computational problems.
3. Develop object-oriented Python programs using modules, classes, inheritance, and exception handling for modular and robust design.
4. Utilize file handling techniques, regular expressions, and package management for effective data storage and processing.
5. Perform data analysis and visualization using Python libraries such as NumPy, Pandas, Matplotlib, and Seaborn to solve real-world data science problems.

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 understanding of Python syntax, data types, structured data types, and control structures to write basic programs.
2. Implement functional programming paradigms using user-defined and anonymous functions, recursion, generators, and decorators.
3. Develop and apply object-oriented programming principles including class creation, inheritance, and error handling in Python.
4. Construct file I/O operations and apply regular expressions and standard libraries to manipulate and process various file formats**.**
5. Analyze, manipulate, and visualize datasets using popular Python libraries such as NumPy, Pandas, Matplotlib, and Seaborn.

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	CONTENTS
UNIT-I	**Fundamentals of Python Programming** **Introduction of Python:** History and Need for Python, Python Installation and IDLE, Python Syntax, Identifiers, and Keywords. **Data Types and Objects**: Basic Data Types: Integral and Floating Point, Numerical Types and Expressions, Variables and Constants, Comments and Documentation Strings, Type Conversion. **Branching and Iteration:** Conditional Statements (if, elif, else), Looping Constructs (for, while), Control Flow Statements (break, continue, pass), Iteration Techniques. **Structured Data Types**: List, Working with Lists, Tuples and Tuple Methods, Unpacking sequences, Ranges, Mutable Sequences, List Comprehensions, Sets, Set Methods, Frozen sets, Dictionaries, Dictionary Methods, Default Dictionaries, Ordered Dictionaries, and Traversal.
UNIT-II	**Functions, Input/Output, and Operators** **Basic Input/Output**: Reading from and Writing to the Console, Working with Strings and String Methods, String Slicing. **Functions:** Built-in and User-Defined Functions, Function Arguments: Positional, Keyword, Default, Variable Length, Returning Values from Functions, Scope of Variables: Local and Global, The Global Keyword and Passing Groups of Elements, Recursive Functions, Anonymous Functions(Lambda) with 'filter()', 'map()', 'reduce(). **Operators and Expressions:** Expressions, Assignment, Arithmetic, Comparison, Logical, Bitwise Operators, Membership and Identity Operators, Complex Expressions and Precedence Rules, Boolean Expression.
UNIT-III	**Object-Oriented Programming and Exception Handling** **Modules:** Creating and Using Modules, The Special Variable '__name__', Structured Programming Principles. **Classes in Python:** New Style Classes, Creating Classes, Instance Methods, Inheritance, Polymorphism, Method overriding. **Exception Handling**: Types of Errors (Compile- Time, Runtime, Logical), Exception Handling Using try-except Blocks, The assert Statement, User-Defined Exceptions, Exception Classes & Custom Exceptions.
UNIT-IV	**File Handling, Regular Expressions, and Iterators** **File Handling:** Files – Types of Files, Creating and Reading Text Data, File Write Data, Reading and Writing Files (Binary,Text), The Pickle Module, Working with CSV and JSON files, File and Directory Management. **Regular Expressions:** RE Operations, Using Special Characters, RE Methods, Named Groups. **Iterators and Generators:** Iterator Protocol, Generators and Yield Statement. Packages: Importing Modules, Creating and Using Packages.
UNIT-V	**Data Analysis and Visualization with Python** **Introduction to Data Science:** Overview of Data Science Workflow, Python Libraries for Data Science (NumPy, Pandas, SyS, SciPy, Scikit-learn), Working with Arrays Using Libraries like NumPy. **Data Analysis and Visualization**: Analyzing Numerical Data with NumPy, Data Manipulation with Pandas, Data Visualization Techniques, Plotting with Matplotlib and Seaborn.

TEXT/REFERENCE BOOKS

1. Boschetti, A., & Massaron, L. (2018). *Python Data Science Essentials: A Practitioner's Guide Covering Essential Data Science Principles, Tools, and Techniques* (3rd ed.). Packt Publishing

   Gowrishankar S., & Veena A. (2018).
2. *Introduction to Python Programming* (1st ed.). Chapman and Hall/CRC.

REFERENCE BOOKS

1. Downey, A. B. Think Python: How to Think Like a Computer Scientist, 2nd Edition (Green Tea Press/O'Reilly, 2015). Free eBook under CC BY-NC 3.0.
2. Lutz, M. (2025). Learning Python: Powerful object-oriented programming (6th ed.). O'Reilly Media. ISBN 978-1-09817-1308.

OPEN EDUCATIONAL RESOURCES

1. Runestone Interactive Python Books by Runestone Academy. https://runestone.academy/
2. The Joy of Computing Using Python by Prof. Sudarshan Iyengar, NPTEL, IIT Ropar. https://nptel.ac.in/courses/106106182

DATA STRUCTURE	
Course Code: 25CS2001	Continuous Evaluation: 40 Marks
Pre-Requisite: NIL	End Semester Examination: 60 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

- https://www.youtube.com/c/takeUforward
- https://www.youtube.com/c/CodeWithHarry
- https://www.youtube.com/c/GeeksforGeeksVideos
- https://www.youtube.com/c/ApnaCollegeOfficial

Other Sources

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

DATABASE MANAGEMENT SYSTEMS

Course Code: 25CS2005	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 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).
   a. Link: https://nptel.ac.in/courses/106105175.
2. MIT OpenCourseWare – Database Systems (6.830)
   a. Link:🔗 https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/
3. Introduction to Database Systems – IIT Madras (NPTEL, 2025),
   a. Link: https://onlinecourses.nptel.ac.in/noc25_cs40/preview

COMPUTER ARCHITECTURE & ORGANIZATION	
Course Code: 25CSPE2007	Continuous Evaluation: 40 Marks

Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE
CO1: To impart knowledge of computer architecture and system organization. **CO2**: To explain instruction sets, addressing modes, and instruction cycles. **CO3**: To develop understanding of ALU design and arithmetic operations. **CO4**: To introduce control unit design: hardwired and microprogrammed**.** **CO5**: 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:
CLO1: Identify the components and architecture of a computer system. **CLO2:** Differentiate and evaluate RISC and CISC architectures. **CLO3:** Perform binary arithmetic operations using algorithms. **CLO4:** Analyze control unit design using hardwired and microprogramming. **CLO5:** Evaluate memory systems and caching techniques. **CLO6:** 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.

PYTHON PROGRAMMING LAB	
Course Code: 25CS2015	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE

1. To provide hands-on practice in Python basics including data types, control structures, and I/O operations.
2. To develop skills in implementing functions, recursion, and object-oriented programming using Python.
3. To train students in advanced features such as file handling, exception handling, and use of modules and packages.
4. To enable students to manipulate and analyze data using libraries such as NumPy and Pandas.
5. To build the ability to visualize, interpret, and present data insights using Python-based visualization tools.

COURSE LEARNING OUTCOMES (CLO's)

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

1. Implement Python programs using basic syntax, data types, control statements, and built-in data structures.
2. Apply modular and object-oriented programming concepts to solve real-world problems in Python.
3. Perform robust data input/output operations, exception handling, and file manipulations.
4. Analyze and transform structured and unstructured data using NumPy and Pandas.
5. Create visualizations using Matplotlib and Seaborn to support data-driven decision-making.

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

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

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

LIST OF PROGRAMS

1. List, Dictionary, and Tuple Operations
Implement a program to:
1. Perform basic operations on a list: insert(), remove(), append(), len(), pop(), clear()
2. Work with a dictionary: create, access, update, delete, use get()
3. Perform tuple operations: access, count, check for item, convert to list and modify

2. Conditional Statements and User Interaction
Implement a program to:
1. Write a program to add two numbers
2. Check if a number is positive, negative, or zero using if-else
3. Find the largest among three numbers
4. Display weekday name for a given number using if-elif-else

3. Looping Constructs
Implement a program to:
1. Print multiplication table of a number
2. Sum N natural numbers using while loop
3. Check whether a number is prime using loop

4. Functions and Lambda Expressions
Implement a program to:
1. Define a function to calculate factorial of a number
2. Generate Fibonacci sequence using recursion
3. Use lambda, map(), filter(), and reduce() on a list of integers utilize functions with different argument passing mechanisms

5. Object-Oriented Programming
Implement a program to:
1. Create a Student class to accept and display student details
2. Implement single and multilevel inheritance (e.g., Person → Student)
3. Demonstrate polymorphism using method overriding

6. Exception Handling
Implement a program to:
1. Write a calculator with try-except blocks to handle division by zero
2. Raise a custom exception when a user enters invalid marks
3. Use finally block to display a message or clean up

7. File Handling with Encryption
Implement a program to:
1. Read and write a text file using with block
2. Encrypt file content using a simple cipher and write to another file
3. Decrypt the file and display original content

8. CSV and JSON File Processing
Implement a program to:
1. Read and write structured student data using CSV
2. Read and write expense data in JSON format
3. Summarize CSV data (total students, average marks)

9. Regular Expressions in Practice
Implement a program to:
1. Validate email, mobile number, and date format using regex
2. Extract all email IDs from a text file

10. Modules, Packages, and Iterators
Implement a program to:

1. Create a module with common functions and import it
2. Build a package with submodules and use it
3. Create an iterator and generator to produce even numbers

11. NumPy for Numerical Computing
Implement a program to:

1. Create arrays and perform operations: add, subtract, reshape
2. Perform matrix multiplication and slicing

12. Pandas for Data Analysis
Implement a program to:

1. Create a DataFrame from a CSV and display first/last 5 rows
2. Handle missing data and filter rows based on conditions

13. Data Visualization with Matplotlib and Seaborn
Implement a program to:

1. Generate bar, line, and pie charts using Matplotlib
2. Create heatmap and histogram using Seaborn

14. Exploratory Data Analysis (EDA)
Implement a program to:

1. Analyze a dataset (e.g., student performance, COVID data) using Pandas
2. Visualize distribution, relationships using Seaborn

15. Mini Project

- **Movie Ratings Analyzer**: Load IMDb/Netflix dataset, clean using Pandas, visualize top-rated movies by genre/year
  (Personal Expense Tracker, Weather App, YouTube Downloader, etc.)

TEXT BOOKS
● **"Head First Python: A Brain-Friendly Guide"**, Second Edition (Greyscale Indian Edition) by **Paul Barry**, O'Reilly / Shroff Publishers, December 2016 ● **"Automate the Boring Stuff with Python: Practical Programming for Total Beginners"** by Al Sweigart, *1st Edition, No Starch Press, May 1, 2015*
REFERENCE BOOKS
● **"Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython"** by Wes McKinney, *3rd Edition, O'Reilly, 2022* ● **"Python All-in-One For Dummies"** by John C. Shovic and Alan Simpson, *1st Edition, For Dummies, 2019*
OPEN EDUCATIONAL RESOURCES
● **"The Joy of Computing Using Python"** by Prof. Sudarshan Iyengar, NPTEL, IIT Ropar. https://nptel.ac.in/courses/106106182 ● **"Python for Everybody"** by Dr. Charles Severance, University of Michigan. https://www.py4e.com/

DATABASE MANAGEMENT SYSTEMS LAB	
Course Code: 25CS2111	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 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) 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
3. NPTEL: **Database Management System** – IIT Kharagpur Link: https://onlinecourses.nptel.ac.in/noc22_cs91/preview

DATA STRUCTURES LAB	
Course Code: 25CS2113	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 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)

CO \ CLO	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 heap 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 6. https://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.

INDUSTRY SESSION: DATA SCIENCE LAB	
Course Code: 25CS2117	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES
1. To provide an overview of Data Science using Python. 2. To introduce the students with the importance of Machine Learning using and importance of their improvement. 3. To introduce the students to the importance of Data Visualization in Machine Learning using Python programming. 4. To teach the students different tools and libraries of Python Programming so that they can cope up with industry standards and requirements. 5. To enable students to have skills that will help them to solve complex real-world problems and introduce them to a new world of problem-solving techniques.

Mapped SDGs: SDG-4, SDG-8, SDG-9, SDG-10, SDG-16, SDG-17

List of Programs

1. Write a python program to check given no. is positive, negative or zero.
2. Write a python program to get the statistical summary and nature of the data of a given data frame.
3. Draw a bar chart of a given data set.
4. Write a program to implement Linear Regression algorithm.
5. Write a program to implement a Logistic Regression algorithm. Compute the accuracy of the classifier.
6. Write a program to implement k-Nearest Neighbour algorithm to classify data sets.
7. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
8. Write a program to implement the naïve Bayesian classifier for a sample training data set. Compute the accuracy of the classifier.
9. Write a program for clustering using k-Means algorithm.
10. Write a program for clustering using a hierarchical clustering algorithm.

Project Statement

Project Title – Text Message Classification Spam or Ham

How often have we come across messages saying we have won a trip to Hawaii or won a million dollars or won a cash prize. This form of scam through text messages which are generally spam messages is called smishing. A lot of times they ask us to fill in forms and ask for our personal information or SSN number which is really fishy or bound to be a fraud. The goal of this project is to use Data Science to accurately classify whether a message is spam or not.
Since not all online reviews are truthful and trustworthy, it is important to develop techniques for detecting review spam. By extracting meaningful features from the text using Natural Language Processing (NLP), it is possible to conduct review spam detection using various machine learning

techniques. Additionally, reviewer information, apart from the text itself, can be used to aid in this process. In this project, we survey the prominent machine learning techniques that have been proposed to solve the problem of review spam detection and the performance of different approaches for classification and detection of review spam.

TEXT/REFERENCE BOOKS
● **IBM Content/Books**
● **Python Data Science Handbook**: Essential Tools for Working with Data by Jake VanderPlas

ESSENTIALS OF BLOCKCHAIN & IOT –LEVEL-I	
Course Code: 25CS0201	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			✔	✔

Mapped SDGs: SDG-4, SDG-8, SDG-9, SDG-11, SDG-13, SDG-17

TRAINING CONTENTS

MODULE	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

MODULE	TRAINING CONTENT	STUDENTS ENGAGEMENT ACTIVITY
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.
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

DATA SCIENCE	
Course Code: 25DI4002	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 2 0 0	
Credits: 2	

COURSE OBJECTIVES (COs)

1. Introduce the basic principles of data science and key programming skills for data manipulation.
2. Provide knowledge of basic statistical concepts and data visualization techniques.
3. Equip students with the foundational understanding of machine learning algorithms.
4. Enable students to apply data science methods to real-world datasets.
5. Facilitate hands-on experience through a capstone project involving data analysis and machine learning models.

COURSE LEARNING OUTCOMES (CLOs)

1. Understand and apply Python programming to solve data science problems.
2. Perform data cleaning, exploration, and visualization to derive meaningful insights.
3. Apply fundamental probability and statistical methods in analyzing datasets.
4. Implement basic machine learning algorithms for classification and regression tasks.
5. Complete a data science project that involves data collection, cleaning, model building, and result interpretation.

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

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

Mapped SDGs: SDG-4, SDG-8, SDG-9, SDG-10, SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Data Science and Python for Data Science** **Overview of Data Science:** Introduction to data science: Definition, scope, and applications, The data science process: Data collection, cleaning, analysis, and interpretation, Introduction to roles: Data Scientist, Data Analyst, and Data Engineer **Python Programming for Data Science:** Introduction to Python syntax: Variables, data types, conditionals, loops, Libraries for data science: NumPy, pandas, Matplotlib, Seaborn, t-SNE for high-dimensional data visualization, Data structures: Lists, dictionaries, arrays, and data frames, Data manipulation using pandas: Filtering, grouping, aggregating data, Basic data visualization using Matplotlib and Seaborn
UNIT-II	**Data Exploration and Visualization** **Exploratory Data Analysis (EDA):** Descriptive statistics: Mean, median, mode, variance, standard deviation, Data summarization techniques: Box plots, histograms, scatter plots, Correlation and covariance, Identifying missing values and data imputation **Data Visualization:** Visualization principles: Choosing the right plot for the right data, Visualizing data distributions (box plots, histograms), Plotting relationships between variables (scatter plots, pair plots), Visualizing categorical data (bar plots, pie charts), Advanced visualization techniques: Heatmaps, pairplots (using Seaborn)
UNIT-III	**Probability and Statistics for Data Science** **Basic Probability Concepts:** Probability theory: Random variables, probability distributions, Key distributions: Uniform, Normal, Bernoulli, Joint, marginal, and conditional probability, Bayes' Theorem and its application in data science **Introduction to Statistics:** Descriptive vs. inferential statistics, Hypothesis testing and confidence intervals, Correlation vs. causation, Linear regression: Basics, assumptions, and interpretation, Understanding the connection between probability and statistics: using probability models to make statistical inferences and predictions from data.
UNIT-IV	**Supervised Learning:** Overview of machine learning types: Supervised, unsupervised, Linear regression: Model building, training, and evaluation, Classification: Logistic regression, k-Nearest Neighbors (k-NN), Model evaluation: Accuracy, precision, recall, F1 score. **Unsupervised Learning:** Introduction to clustering: k-Means clustering, Dimensionality reduction: Principal Component Analysis (PCA) **Model Evaluation and Validation:** Train-test split, cross-validation, Overfitting vs. underfitting, Performance metrics for regression and classification models, Handling class imbalance: precision-recall curves, ROC curves, and area-under-curve (AUC) metrics for imbalanced datasets**,** Introduction to ranking problems and their evaluation metrics such as Mean Reciprocal Rank (MRR), NDCG, and MAP in applications like recommendation and search.
UNIT-V	**Project :** Choose a dataset from an open-source data repository (e.g., Kaggle), Define the problem statement: Data exploration, model building, and evaluation, End-to-end application: Data preprocessing, feature selection, model training, and visualization of results **Project Presentation:** Create a report or presentation explaining the approach, methodology, results, and insights, Demonstration of the final working model. Students are encouraged to prepare the final report using LaTeX to enhance

	technical writing skills and produce professionally formatted documentation.

TEXT BOOKS / REFERENCE BOOKS

1. W. McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2017. ISBN: 978-1491957660
2. J. Grus, Data Science from Scratch: First Principles with Python, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019. ISBN: 978-1492041139
3. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019. ISBN: 978-1492032649

Further Suggested Readings

1. G. James, D. Witten, T. Hastie, and R. Tibshirani, An Introduction to Statistical Learning with Applications in R, 2nd ed. New York, NY, USA: Springer, 2021. ISBN: 978-1071614174
2. S. Raschka and V. Mirjalili, Python Machine Learning, 3rd ed. Birmingham, UK: Packt Publishing, 2019. ISBN: 978-1789955750
3. C. Bishop, Pattern Recognition and Machine Learning, 1st ed. New York, NY, USA: Springer, 2006. ISBN: 978-0387310732
4. T. Hastie, R. Tibshirani, and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd ed. New York, NY, USA: Springer, 2009. ISBN: 978-0387848570

Artificial Intelligence	
Course Code: 25DI4004	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 2 0 0	
Credits: 2	

COURSE OBJECTIVES

1. Introduce foundational AI concepts and search methods.
2. Explain knowledge representation techniques and inference mechanisms.
3. Explore key machine learning algorithms and their applications.
4. Discuss advanced AI applications in NLP and Computer Vision, including ethical considerations.
5. Provide hands-on project experience to develop practical AI skills.

COURSE LEARNING OUTCOMES (CLO)

1. Define AI principles, agent structures, and classical search strategies.
2. Implement knowledge representation techniques and apply reasoning under uncertainty.
3. Apply machine learning algorithms and evaluate model performance.
4. Analyze and solve real-world problems using NLP and Computer Vision.
5. Complete an AI project demonstrating the application of learned concepts.

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

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

Mapped SDGs: SDG-4, SDG-8, SDG-9, SDG-10, SDG-16, SDG-17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Foundations of Artificial Intelligence** Definitions and types of AI (Narrow AI, General AI, Superintelligent AI), scope and history, intelligent agents, structures of agents, state-space search, classical search algorithms (Breadth-First Search, Depth-First Search, Greedy Best-First Search, A* search), heuristic functions, principles of problem-solving in AI.
UNIT-II	**Knowledge Representation and Reasoning** Knowledge representation techniques (logic-based, rule-based, semantic networks, frames, ontologies), propositional and predicate logic, inference rules, proof strategies, resolution, unification, reasoning under uncertainty (Bayesian networks, probabilistic reasoning, Dempster-Shafer theory), knowledge-based systems (expert systems, case-based reasoning).
UNIT-III	**Machine Learning in AI** Fundamentals of machine learning, categories of ML (supervised, unsupervised, reinforcement learning), key supervised algorithms (linear and logistic regression, decision trees, k-nearest neighbors, Naive Bayes), unsupervised learning (clustering techniques, k-means, hierarchical clustering), dimensionality reduction (Principal Component Analysis), basics of reinforcement learning, Markov Decision Processes, Q-learning, model evaluation techniques (cross-validation, confusion matrices, metrics). Understanding machine learning as function approximation. Introduction to Support Vector Machines (SVM) and the kernel trick for handling non-linear classification. Concept of VC-Dimension and its role in evaluating model capacity and generalization in statistical learning theory.
UNIT-IV	**Advanced Topics in AI** Natural Language Processing (NLP): text preprocessing, tokenization, stemming, lemmatization, language modeling, sentiment analysis, transformer models. Computer Vision: image processing fundamentals, edge detection, object detection, Convolutional Neural Networks. Ethical implications of AI: privacy, bias, transparency, accountability. Emerging AI trends (AI in IoT, social good, AI governance).
UNIT-V	**Project** Project proposal drafting, data collection and preparation, modeling techniques, model development and training, model evaluation and iteration, final project presentation and report demonstrating skills in problem formulation, data handling, and model deployment. Students are encouraged to read and incorporate insights from at least one recent research paper from leading AI/ML conferences such as ICML, NeurIPS, AAAI, or CVPR to support their project design or methodology.

TEXT/REFERENCE BOOKS

S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. New York, NY, USA: Pearson, 2020, ISBN: 978-0134610993.

I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*, Cambridge, MA, USA: MIT Press, 2016, ISBN: 978-0262035613.

K. P. Murphy, *Machine Learning: A Probabilistic Perspective*, Cambridge, MA, USA: MIT Press, 2012, ISBN: 978-0262018029.

Further Suggested Readings
1. C. M. Bishop, *Pattern Recognition and Machine Learning*, 1st ed. New York, NY, USA: Springer, 2006, ISBN: 978-0387310732. 2. R. S. Sutton and A. G. Barto, *Reinforcement Learning: An Introduction*, 2nd ed. Cambridge, MA, USA: MIT Press, 2018, ISBN: 978-0262039246. 3. T. Hastie, R. Tibshirani, and J. H. Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, 2nd ed. New York, NY, USA: Springer, 2009, ISBN: 978-0387848570.

THEORY OF COMPUTATION	
Course Code: 25CSPE2004	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks

L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. **CO1:** Understand the foundations of formal languages and finite automata to model computational systems.
2. **CO2:** Develop the ability to construct and analyze regular expressions and grammars for language representation.
3. **CO3:** Gain proficiency in designing and simplifying context-free grammars, and identifying ambiguity.
4. **CO4:** Learn to model context-free languages using pushdown automata and simulate language recognition.
5. **CO5:** 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. **CLO1:** Explain the foundational concepts of formal languages, grammars, and automata.
2. **CLO2:** Design and analyze finite automata, regular expressions, and context-free grammars for language recognition.
3. **CLO3:** Construct and simulate pushdown automata and Turing machines for appropriate language classes.
4. **CLO4:** Apply theoretical tools like pumping lemmas and closure properties to classify languages.
5. **CLO5:** 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-1COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Formal Languages and Finite Automata** Concept of basic Machine, Properties and limitations of FSM, Moore and Mealy Machines, Equivalence of Moore and Mealy machines, pumping lemma,Alphabets,

UNIT NUMBER	COURSE CONTENTS
	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	**Regular Languages and Grammars**Regular expression conversion and vice versa. Conversion of NFA to DFA by Arden's Method, 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: 40 Marks

Pre-Requisite : NIL	End Semester Examination: 60 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 McIver 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: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 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 Method, 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

ANALYSIS AND DESIGN OF ALGORITHM LAB	
Course Code: 25CS**2118**	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 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

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

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

LIST OF EXPERIMENT:

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 BOOK:

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

Data Science Lab	
Course Code: 25DI4102	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES
1. CO1: Develop practical data analysis skills.
2. CO2: Foster statistical and machine learning competency.
3. CO3: Enhance data visualization and interpretation abilities.
4. CO4: Build foundational knowledge in dimensionality reduction.
5. CO5: Encourage exploratory data analysis (EDA) proficiency.

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. **CLO1**: Proficiency in data manipulation using Python libraries.
2. **CLO2**: Application of basic machine learning models.
3. **CLO3**: Effective use of visualization tools for data interpretation.
4. **CLO4**: Understanding and applying dimensionality reduction techniques.
5. **CLO5**: Execution of an end-to-end data science project.

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

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

Mapped SDGs: SDG-4, SDG-8, SDG-9, SDG-12, SDG-17

LIST OF EXPERIMENTS

Experiment 1: Data Collection and Cleaning

1. **Objective**: Collect a sample dataset from a public data repository and perform initial data cleaning.
2. **Instructions**:

   Download a dataset (e.g., from Kaggle or UCI Machine Learning Repository).
   Load the dataset using pandas.
   Identify and handle missing values (e.g., by imputing, removing rows/columns).
   Detecting and handling duplicate entries.
   Create a summary report of cleaned data (e.g., mean, median, null values per column).

Experiment 2: Data Visualization Basics

1. **Objective**: Visualize data using basic plotting functions.
2. **Instructions**:

   Choose a cleaned dataset and use matplotlib and seaborn for visualization.
   Create histograms for continuous variables.
   Plot a scatter plot for two variables to study relationships.
   Generate a box plot to visualize the spread and identify outliers.
   Customize plots with titles, labels, and legends.

Experiment 3: Descriptive Statistics Calculation

1. **Objective**: Calculate and interpret key descriptive statistics.
2. **Instructions**:

   Load a dataset and calculate the mean, median, mode, standard deviation, and variance.
   Implement functions to calculate the range and interquartile range.
   Interpret the results by discussing what each statistic reveals about the data distribution.

Experiment 4: Probability Distributions and Sampling

1. **Objective**: Generate and visualize probability distributions.
2. **Instructions**:

   Use numpy to generate random samples for normal, binomial, and Poisson distributions.
   Plot histograms for each distribution using matplotlib.
   Use scipy.stats to calculate probabilities and cumulative probabilities.
   Draw samples from each distribution and discuss sampling's role in data analysis.

Experiment 5: Linear Regression

1. **Objective**: Build a simple linear regression model.
2. **Instructions**:

   Select a dataset with two continuous variables.

Use scikit-learn to split the dataset into training and test sets.
Implement linear regression using LinearRegression from scikit-learn.
Plot the regression line on a scatter plot.
Calculate the model's performance metrics (e.g., mean squared error, R-squared).

Experiment 6: Logistic Regression for Classification

1. **Objective**: Implement logistic regression on a binary classification dataset.
2. **Instructions**:

   Choose a binary classification dataset (e.g., Titanic survival dataset).
   Preprocess the data, including encoding categorical variables.
   Train a logistic regression model using scikit-learn.
   Evaluate model accuracy and visualize the confusion matrix.
   Plot the ROC curve and calculate the AUC score.

Experiment 7: Clustering with K-Means

1. **Objective**: Implement K-Means clustering on a dataset.
2. **Instructions**:

   Choose a dataset with multiple continuous variables (e.g., Iris dataset).
   Use KMeans from scikit-learn to cluster the data into k clusters.
   Plot the clusters and centroids on a scatter plot.
   Experiment with different values of k and observe changes in the cluster formation.
   Calculate and discuss the inertia score to evaluate clustering performance.

Experiment 8: Decision Trees for Classification

1. **Objective**: Train a decision tree for classification.
2. **Instructions**:

   Use a multi-class classification dataset (e.g., Iris dataset).
   Preprocess the data and train a decision tree classifier.
   Visualize the decision tree using plot_tree from scikit-learn.
   Discuss how the tree structure represents decision rules.
   Evaluate the model's accuracy and explain feature importance.

Experiment 9: Principal Component Analysis (PCA)

1. **Objective**: Reduce dimensionality of a dataset using PCA.
2. **Instructions**:

   Choose a dataset with several continuous variables (e.g., Wine dataset).
   Standardize the dataset and apply PCA using scikit-learn.
   Plot the variance explained by each principal component.
   Visualize the dataset in the first two principal components' space.
   Discuss how dimensionality reduction simplifies data analysis.

Experiment 10: Mini Project on Exploratory Data Analysis (EDA)

1. **Objective**: Apply EDA techniques to gain insights from a chosen dataset.
2. **Instructions**:

   1. Choose a publicly available dataset related to a real-world problem.

2. Perform data cleaning, transformation, and preprocessing.
3. Use visualizations to identify patterns, correlations, and outliers.

4. Summarize findings and insights gained from the dataset.
5. Document the steps, plots, and findings in a structured report.

TEXT BOOKS

- W. McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2017. ISBN: 978-1491957660
- J. Grus, Data Science from Scratch: First Principles with Python, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019. ISBN: 978-1492041139
- A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019. ISBN: 978-1492032649

Reference BOOKS

- G. James, D. Witten, T. Hastie, and R. Tibshirani, An Introduction to Statistical Learning with Applications in R, 2nd ed. New York, NY, USA: Springer, 2021. ISBN: 978-1071614174
- S. Raschka and V. Mirjalili, Python Machine Learning, 3rd ed. Birmingham, UK: Packt Publishing, 2019. ISBN: 978-1789955750
- C. Bishop, Pattern Recognition and Machine Learning, 1st ed. New York, NY, USA: Springer, 2006. ISBN: 978-0387310732
- T. Hastie, R. Tibshirani, and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd ed. New York, NY, USA: Springer, 2009. ISBN: 978-0387848570

Artificial Intelligence Lab	
Course Code: 25DI4104	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

1. Introduce the fundamental concepts and historical foundations of Artificial Intelligence (AI).
2. Explore problem-solving strategies, classical search algorithms, and heuristic methods in AI.
3. Explain knowledge representation techniques, reasoning methods, and uncertainty handling in AI.
4. Develop skills in applying machine learning (ML) algorithms and evaluation techniques.
5. Investigate advanced AI topics such as Natural Language Processing (NLP), Computer Vision, and ethical considerations.

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 definitions, types, and history of AI, and describe the role of intelligent agents.
2. Apply classical search algorithms and heuristic functions to solve structured problems.
3. Represent knowledge using logic and implement reasoning techniques for AI applications.
4. Implement and evaluate machine learning models for supervised and unsupervised learning tasks.
5. Analyze advanced AI applications in NLP, Computer Vision, and ethical considerations in real-world scenarios.

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

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

Mapped SDGs: SDG-4, SDG-8, SDG-9, SDG-10, SDG-12, SDG-17

LIST OF EXPERIMENTS

1. **State-Space Search Implementation**
   Implement Breadth-First Search (BFS) and Depth-First Search (DFS) algorithms to solve a maze problem. Students will write a program that visualizes the paths explored by each search technique, allowing them to understand the differences in exploration strategies.
2. **Heuristic Search with A***
   Use the A* algorithm to solve a shortest-path problem on a graph. Students will implement the algorithm and compare its efficiency with BFS and DFS, gaining insights into the role of heuristic functions in optimizing search processes.
3. **Knowledge Representation with Propositional Logic**
   Represent knowledge for a given scenario using propositional logic. Students will create truth tables and evaluate logical expressions, enabling them to structure information logically and systematically.
4. **Reasoning Under Uncertainty**
   Design a Bayesian Network for a medical diagnosis problem. Students will model conditional dependencies between variables and calculate posterior probabilities, enhancing their understanding of probabilistic reasoning techniques.
5. **Linear and Logistic Regression**
   Train linear and logistic regression models on a dataset using Python. Students will build and evaluate these models, observing their effectiveness in making predictions for different types of data relationships.
6. **Clustering Techniques**
   Apply k-means and hierarchical clustering methods on a dataset. Students will group data points into clusters and visualize the results, comparing the strengths and weaknesses of each clustering technique.
7. **Reinforcement Learning with Q-Learning**
   Implement a Q-learning algorithm for decision-making in a grid-world environment. Students will train an agent to navigate the grid and reach a goal, learning how reinforcement learning adapts to dynamic environments.
8. **NLP Text Preprocessing**
   Perform text preprocessing tasks such as tokenization, stemming, and lemmatization on a given text corpus. Students will analyze the processed text and extract useful features for NLP applications.
9. **Image Classification with CNNs**
   Build and train a Convolutional Neural Network (CNN) to classify images from a dataset like MNIST or CIFAR-10. Students will learn the basics of feature extraction and model evaluation in computer vision tasks.
10. **AI Project Development**
    Develop a complete AI project from problem identification to deployment. Students will collect and preprocess data, create models, evaluate them, and present their findings in a comprehensive report, demonstrating their understanding of AI concepts and tools.

TEXT BOOKS

- W. McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2017. ISBN: 978-1491957660
- J. Grus, Data Science from Scratch: First Principles with Python, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019. ISBN: 978-1492041139
- A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019. ISBN: 978-1492032649

Reference BOOKS

- G. James, D. Witten, T. Hastie, and R. Tibshirani, An Introduction to Statistical Learning with Applications in R, 2nd ed. New York, NY, USA: Springer, 2021. ISBN: 978-1071614174
- S. Raschka and V. Mirjalili, Python Machine Learning, 3rd ed. Birmingham, UK: Packt Publishing, 2019. ISBN: 978-1789955750
- C. Bishop, Pattern Recognition and Machine Learning, 1st ed. New York, NY, USA: Springer, 2006. ISBN: 978-0387310732
- T. Hastie, R. Tibshirani, and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd ed. New York, NY, USA: Springer, 2009. ISBN: 978-0387848570

OPERATING SYSTEMS LAB	
Course Code: 25CS2114	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 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.
5. To Implement Scheduling Algorithms

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 problems 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

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING-LEVEL-II	
Course Code: 25CS0202	Continuous Evaluation: 70 Marks
Pre-Requisite : NIL	End Semester Examination:30 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 SDG Goals: SDG -4,SDG–8,SDG-9,SDG-17

TRAINING CONTENTS

MODULE	TRAINING CONTENTS	STUDENTS ENGAGEMENT ACTIVITY
UNIT-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
UNIT-II	**PROBLEM SOLVING:** Depth-first, breadth-first search, Problem Reduction, Constraint Satisfaction , Means-End Analysis.	Solving manually constraint satisfaction problem
UNIT- III	**INTRODUCTION TO MACHINE LEARNING** Machine Learning Basics, Need of Machine Learning, Application Domains, Basic Learning Techniques.	Identification of ML Model based on Application

MODULE	TRAINING CONTENTS	STUDENTS ENGAGEMENT ACTIVITY
UNIT- IV	**CLASSIFICATION PROBLEM** Machine learning Algorithms for classification problem	Design decision trees
UNIT- 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.

Text Books

1. Introduction to Machine Learning, E. Alpaydin. MIT Press
2. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill.

Reference Books

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron.
2. Artificial Intelligence and Machine Learning, Vinod Chandra S. S., Anand Hareendran
3. Machine Learning, T.M. Mitchell, Mc-Graw Hill
4. Stuart Russell, Peter Norvig, Artificial intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020

Open Educational Resources (OERs)

1. Journal of Machine Learning Research (JMLR).
2. AI Communications (IOS Press - Hybrid OA).

LIVE PROJECT-I & INDUSTRIAL VISIT	
Course Code: 25CS0204	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 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)

	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

Machine Learning	
Course Code: 25DI5001	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 2 0 0	
Credits: 2	

COURSE OBJECTIVES

1. Provide foundational understanding of machine learning and its applications.
2. Develop proficiency in implementing and evaluating supervised learning algorithms.
3. Explore clustering, dimensionality reduction, and unsupervised learning techniques.
4. Understand the basics of neural networks and apply deep learning for image and sequential data tasks.
5. Enable practical implementation of machine learning concepts through a comprehensive project.

COURSE LEARNING OUTCOMES (CLO)

1. Explain fundamental machine learning concepts and types of learning.
2. Implement supervised learning techniques for classification and regression.
3. Apply unsupervised learning methods for clustering and dimensionality reduction.
4. Build and train neural network models for image and sequence data.
5. Demonstrate the ability to solve real-world problems using machine learning techniques.

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

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

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

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Machine Learning** Overview of machine learning, types of learning: supervised, unsupervised, and reinforcement learning. Applications of machine learning in industries, healthcare, and finance. Linear regression for predicting continuous values. Logistic regression for binary classification. Understanding loss functions and optimization techniques such as gradient descent.
UNIT-II	**Supervised Learning Techniques** Decision Trees and Random Forests for classification and regression tasks. Support Vector Machines (SVM) for linear and non-linear classification. Naive Bayes algorithm for probabilistic classification. Introduction to the ranking problem as a supervised learning task. Overview of learning-to-rank approaches: pointwise, pairwise, and listwise methods. Examples of ranking models such as RankNet and LambdaMART. Applications in search and recommendation systems. Evaluation metrics for supervised learning: accuracy, precision, recall, F1-score, and ROC curves. Cross-validation techniques for model evaluation.
UNIT-III	**Unsupervised Learning Techniques** Clustering techniques: k-means, hierarchical clustering, and DBSCAN. Dimensionality reduction methods: Principal Component Analysis (PCA) and Singular Value Decomposition (SVD). Association rule learning for market basket analysis. Hands-on applications in clustering and reducing data dimensions.
UNIT-IV	**Neural Networks and Deep Learning** Introduction to neural networks, perceptron, activation functions, and backpropagation. Basics of deep learning, convolutional neural networks (CNN) for image processing tasks, and recurrent neural networks (RNN) for sequential data. Introduction to optimization techniques like Adam optimizer. Overview of TensorFlow and PyTorch for implementing neural networks.
UNIT-V	**Project** Students work in groups or individually to identify a real-world problem and apply machine learning techniques to solve it. Activities include data collection and preprocessing, model selection, training, evaluation, and deployment. Emphasis on presenting results through visualizations and preparing a comprehensive project report. Students are encouraged to participate in data science competitions or open challenges hosted by reputed conferences such as KDD Cup, CIKM AnalytiCup, or WSDM Cup. Projects can be aligned with datasets from these platforms to simulate real-world complexity and evaluation.

TEXT/REFERENCE BOOKS

1. T. M. Mitchell, Machine Learning, McGraw-Hill, 1997, ISBN: 978-0070428072.
2. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006, ISBN: 978-0387310732.
3. S. Raschka and V. Mirjalili, Python Machine Learning, 3rd ed., Packt Publishing, 2019, ISBN: 978-1789955750.

Further suggested Readings

I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, MIT Press, 2016, ISBN: 978-0262035613.

K. P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012, ISBN: 978-0262018029.

S. Haykin, Neural Networks and Learning Machines, 3rd ed., Pearson, 2008, ISBN: 978-0131471399.

ESSENTIALS OF HADOOP	
Course Code: 25CAF3005	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 2 0 0	
Credits: 2	

COURSE OBJECTIVES

1. To provide an overview of an exciting field of big data analytics
2. To develop an understanding of the complete open-source Hadoop ecosystem and its near term future direction
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSQL MapReduce
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
5. To enable students to have skills that will help them to solve complex real-world problems in decision support.

COURSE LEARNING OUTCOMES (CLO)

After completion of course, students would 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. Applying and analyzing architecture and APIs with use of Devices, Gateways and Data Management in Big data.
4. Evaluate the application of Big Data in Industrial and Commercial Building Automation, evaluating Big Data performance using MapReduce and Real-World Design Constraints.
5. Build and create state of the art architecture in Big Data. Creating projects and research activities based on Pig, Hive, Pig Latin.

Mapped SDGs: SDG-4, SDG-8, SDG-9, SDG-11, SDG-12

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**BIG DATA** Introduction to Big Data, Enabling Technologies for Big Data, Big Data Analytics, Classification of Analytics, Big Data Platforms, Storage Platforms for Large Scale Data Storage, Future of BigData.
UNIT-II	**HADOOP** Introduction to Hadoop Hadoop vs RDBMS, Hadoop vs BigData, Types of data, Brief history of Hadoop, Problems with traditional large-scale systems, Requirements for a new approach, Anatomy of a Hadoop cluster.

UNIT-III	**HDFS** Concepts & Architecture, Data Flow (File Read , File Write), Fault Tolerance, Shell Commands, Java Base API, Data Flow Archives, Coherency, Data Integrity, Role of Secondary NameNode, Zookeeper
UNIT-IV	**MAPREDUCE** Theory, Data Flow (Map – Shuffle - Reduce), MapRed vs MapReduce APIs, Programming Mapper, Reducer, Combiner, Partitioner, Implementation of Mahout, R, Sqoop, Yarn, what is flume Flume, architecture of flume , Flume Modes , the overall architecture of Ambari and Ambari' relation to other services and components of a Hadoop cluster, the functions of the main components of Ambari, initiating start and stop services from Ambari Web Console
UNIT-V	**HIVE AND PIG** List the characteristics of representative data file formats including flat/text files CSV XML JSON and YAML ,Architecture, Installation, Configuration, Hive vs RDBMS, Tables, DDL & DML, Partitioning & Bucketing, Hive Web Interface, Why Pig, Use case of Pig, Pig Components, Data Model, Pig Latin.
UNIT-VI	**PROJECT** Research Activities on Big Data with projects and research letters. (POC on dataset)

TEXT/REFERENCE BOOKS
● Gelman, Andrew, and Jennifer Hill. Data Analysis Using Regression and Multilevel/Hierarchical Models. 1st ed. Cambridge, UK: Cambridge University Press, 2006. ISBN:9780521867061.
● 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
● Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data" by EMC Education Services

Further suggested Readings
● Analytics: Data Science, Data Analysis and Predictive Analytics for Business" by Daniel Covington.
● Machine Learning for Big Data: Hands-On for Developers and Technical Professionals" by Jason Bell.

COMPILER DESIGN	
Course Code: 25CS3001	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 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.

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

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

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

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. MITOpenCourseWareCompilers(6.035), https://ocw.mit.edu/courses/6-001-structure-and-interpretation-of-computer-programs-spring-2005/pages/lecture-notes/
2. StanfordCS143: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: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVE

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 (CLO)

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

1. Describe the functions of each layer in OSI and TCP/IP model.
2. Describe the functions of the data link layer and explain the protocols.
3. Classify the routing protocols and analyze how to assign the IP addresses for the given network.
4. Describe the Session layer design issues and Transport layer services.
5. Explain the functions of Application layer and Presentation layer paradigms and Protocols.

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/

COMPUTER NETWORKS LAB	
Course Code: 25CSPE3113	Continuous Evaluation: 60 Marks

Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE

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 (CLO)

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
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
Andrew S. Tanenbaum, "Computer Networks", Pearson Fourth Edition, 2005 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.

Machine Learning Lab	
Course Code: 25DI5101	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks

L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES
1. Familiarize students with the foundational concepts and types of machine learning. 2. Equip students with practical skills in supervised learning techniques. 3. Develop an understanding of unsupervised learning methods and their applications. 4. Introduce neural networks and deep learning for solving complex tasks. 5. Enable students to apply machine learning techniques to solve real-world problems.

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. Describe key concepts and types of machine learning. 2. Implement supervised learning algorithms for classification and regression tasks. 3. Analyze data using clustering and dimensionality reduction methods. 4. Construct neural networks and deep learning models for various applications. 5. Demonstrate the application of machine learning techniques in a real-world project.

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

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

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

LIST OF EXPERIMENTS

Experiment 1: Linear Regression Model Implementation
Implement a linear regression model using Python. Use a dataset of house prices to predict the price based on features like area, number of bedrooms, and location. Train, test, and evaluate the model using metrics such as Mean Squared Error (MSE).

Experiment 2: Logistic Regression for Classification

Develop a logistic regression model to classify email as spam or not spam. Use a labeled dataset, split it into training and testing sets, and evaluate the model using confusion matrix and accuracy score.

Experiment 3: Decision Tree for Classification
Build a decision tree classifier to predict loan approval based on customer features such as income, credit score, and employment history. Visualize the tree structure and compute performance metrics like precision and recall.

Experiment 4: K-Nearest Neighbors for Classification
Implement the K-Nearest Neighbors (KNN) algorithm to classify Iris flower species based on petal and sepal dimensions. Test the model on unseen data and visualize the decision boundaries.

Experiment 5: K-Means Clustering
Apply K-Means clustering on a dataset of customer purchasing behavior to identify different customer segments. Visualize the clusters and analyze their characteristics.

Experiment 6: Principal Component Analysis (PCA)
Use PCA for dimensionality reduction on a high-dimensional dataset, such as MNIST digit dataset. Visualize the reduced dimensions and explain the variance retained in the components.

Experiment 7: Building a Neural Network
Design and train a simple neural network for handwritten digit classification using the MNIST dataset. Implement using TensorFlow or PyTorch, and analyze training loss and accuracy over epochs.

Experiment 8: Convolutional Neural Network (CNN)
Develop a Convolutional Neural Network to classify images from the CIFAR-10 dataset. Implement layers for convolution, pooling, and fully connected classification.

Experiment 9: Market Basket Analysis
Perform association rule mining on transactional data to extract frequent itemsets and generate association rules. Use metrics like support, confidence, and lift to evaluate the rules.

Experiment 10: Real-World Machine Learning Project
Choose a real-world dataset (e.g., healthcare, finance, or e-commerce). Preprocess the data, apply machine learning algorithms, evaluate the model, and present insights through visualizations and a report.

TEXT/REFERENCE BOOKS

1. T. M. Mitchell, Machine Learning, McGraw-Hill, 1997, ISBN: 978-0070428072.
2. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006, ISBN: 978-0387310732.
3. S. Raschka and V. Mirjalili, Python Machine Learning, 3rd ed., Packt Publishing, 2019, ISBN: 978-1789955750.

Further Suggested Readings

1. I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, MIT Press, 2016, ISBN: 978-0262035613.
2. K. P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012, ISBN: 978-0262018029.
3. S. Haykin, Neural Networks and Learning Machines, 3rd ed., Pearson, 2008, ISBN: 978-0131471399.

HADOOP LAB	
Course Code: 25CAF3113	Continuous Evaluation: 60 Marks

Pre-Requisite : Linux and SQL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES
● To provide an overview of an exciting field of big data analytics
● Develop an understanding of the complete open-source Hadoop ecosystem and its near term future direction
● To introduce the tools required to manage and analyze big data like Hadoop, NoSQL MapReduce
● To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
● To enable students to have skills that will help them to solve complex real-world problems in decision support.

Mapped SDGs: SDG-4, SDG-8, SDG-9, SDG-11, SDG-12

LIST OF PROGRAMS:

1. Implement the following file management tasks in Hadoop: Adding files and directories
   - Retrieving files
   - Deleting files
   - Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.
2. Install and Run Hive then use Hive to create,load, alter, and drop databases, tables.
3. Implement Hive Partitioning with a data set.
4. Implement Hive bucketing with a data set.
5. Implement scoop commands
6. Run a basic Word Count Map Reduce program to understand Map Reduce paradigm with data set.
7. Implement Hbase commands with a data set.
8. Install and Run Pig then write Pig Latin scripts to sort, group, join and filter your data.
9. Explore Zookeeper
10. Explore Ambari

Project Statement : Working on Proof of Concept For example we want to analyze You tube data then problem statement will be :

1. Find out the top 5 categories in which the most number of videos are uploaded.
2.Find top 10 rated videos,
3.Find top 10 most viewed videos
4.Find the number of videos with rating less than 1

Text/Reference Books:

White, T. (2015). *Hadoop: The definitive guide* (4th ed.). O'Reilly Media.

LIVE PROJECT-II & INDUSTRIAL VISIT	
Course Code: 25CS0303	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 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: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 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)

	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

Engineering a Compiler, Second Edition, Keith D. Cooper & Linda Torczon., Morgan Kaufmann, Elsevier.
Compiler Design, Sandeep Saxena, Rajkumar Singh Rathore, S.Chand Publications
T. Parr, The Definitive ANTLR 4 Reference. Raleigh, NC, USA: Pragmatic Bookshelf, 2013.
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/

WEARABLE Technology	
Course Code: 25CS0301A	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P :0 0 2	
Credits: 1	

COURSE OBJECTIVES (CO's)

1. To know the hardware requirement of wearable systems
2. To understand the communication and security aspects in the wearable devices
3. To know the applications of wearable devices in the field of medicine.

COURSE LEARNING OUTCOMES (CLO's)

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

1. Describe the concepts of wearable systems.
2. Explain the energy harvestings in wearable devices.
3. Use the concepts of BAN in health care.
4. Compare the various wearable devices in healthcare system

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

CLO / CO	CLO1	CLO2	CLO3	CLO4
CO1	√	√		
CO2		√	√	
CO3			√	√

COURSE CONTENTS

UNIT NUMBER	TRAINING CONTENTS
UNIT-I	**INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS** Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.
UNIT-II	**SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES** Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT-III	**WIRELESS HEALTH SYSTEMS** Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.
UNIT-IV	**APPLICATIONS OF WEARABLE SYSTEMS** Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TEXT BOOKS

- Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
- Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
- Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
- Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCE BOOKS / RESOURCES

- Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
- Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

DESIGN THINKING AND AUGMENTED VIRTUAL REALITY-LEVEL- II & III	
Course Code: 23CS0301	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)

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 analyse design thinking history and its various concepts.
3. Understand, analyse and create models with users collaboration to apply design thinking concepts.
4. Understands 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 OUTCOMES (TLO)-TRAINING OBJECTIVES (TO) MAPPING

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

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

TRAINING CONTENTS

MODULE	TRAINING CONTENT	STUDENTS ENGAGEMENT ACTIVITY
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.
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
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.
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.
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 for how AR and VR can be used in Education.	Designing of Solution to the Problem.

LEARNING RESOURCES

1. Hooked by Nir Eyal
2. The Art of Creative Thinking by Rod Judkins
3. Start Up nation by Dan Senor and Saul singer
4. Start with Why by Simon Sinek
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

Deep and Reinforcement Learning	
Course Code: 25DI6002	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 2 0 0	
Credits: 2	

COURSE OBJECTIVES
1. Build a strong foundation in neural network principles and techniques.
2. Explore advanced deep learning architectures for solving real-world problems.
3. Understand the principles and methods of reinforcement learning.
4. Investigate advanced topics in deep reinforcement learning.
5. Apply theoretical knowledge to solve real-world problems through projects.

COURSE LEARNING OUTCOMES (CLO)
1. Understand the concepts and mechanisms of neural networks.
2. Analyze deep learning architectures and their applications.
3. Demonstrate the principles and methods of reinforcement learning.
4. Implement and experiment with deep reinforcement learning techniques.
5. Solve a real-world problem using deep and reinforcement learning techniques.

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

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

Mapped SDGs:
SDG-4, SDG-8, SDG-9, SDG-10

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Neural Networks** Overview of neural networks, perceptron and multilayer perceptron (MLP), activation functions, feedforward and backpropagation algorithms, gradient descent optimization, overfitting and regularization techniques such as dropout and weight decay, evaluation metrics for deep learning models.
UNIT-II	**Deep Learning Architectures** Convolutional Neural Networks (CNNs): convolution operations, pooling, and fully connected layers, applications in image classification. Recurrent Neural Networks (RNNs): sequence modeling, vanishing gradient issue, Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU). Autoencoders for feature extraction and dimensionality reduction. Introduction to attention mechanisms for sequence learning. Overview of Transformer architecture and its advantages over recurrent models in handling long-range dependencies.
UNIT-III	**Fundamentals of Reinforcement Learning** Key concepts of reinforcement learning: agents, states, actions, rewards, and environments. Markov Decision Processes (MDPs), Bellman equations, value functions, exploration vs exploitation trade-off, policy and value iteration methods, Monte Carlo and Temporal Difference (TD) learning.
UNIT-IV	**Deep Reinforcement Learning** Combining deep learning with reinforcement learning, Deep Q-Learning, experience replay, policy gradient methods, actor-critic models, applications in robotics and games. Advanced topics like Proximal Policy Optimization (PPO) and Trust Region Policy Optimization (TRPO).
UNIT-V	**Project** Students work on a real-world project applying deep learning or reinforcement learning techniques. Select a suitable problem, preprocess the dataset or simulate the environment, train and test the model, evaluate the results, and present findings in a report.

TEXT/REFERENCE BOOKS

1. I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, MIT Press, 2016. ISBN: 978-0262035613.
2. R. S. Sutton and A. G. Barto, Reinforcement Learning: An Introduction, 2nd ed., MIT Press, 2018. ISBN: 978-0262039246.
3. F. Chollet, Deep Learning with Python, 2nd ed., Manning Publications, 2021. ISBN: 978-1617296864.

Further Suggested Readings

1. K. D. Waghmare, Deep Learning: Applications and Techniques, BPB Publications, 2019. ISBN: 978-9389423466.
2. P. Warden, TinyML: Machine Learning with TensorFlow Lite, O'Reilly Media, 2019. ISBN: 978-1492052043.
3. V. Minh et al., "Playing Atari with Deep Reinforcement Learning," arXiv preprint arXiv:1312.5602, 2013.

Computer Vision	
Course Code: 25DI6004	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 2 0 0	
Credits: 2	

COURSE OBJECTIVES
1. Understand the principles of image formation and image processing techniques. 2. Demonstrate the ability to extract and analyze key features from images for representation and detection. 3. Evaluate various segmentation and recognition techniques in supervised and unsupervised contexts. 4. Apply advanced deep learning techniques for real-world computer vision tasks. 5. Design and implement a comprehensive computer vision project to solve practical problems.

COURSE LEARNING OUTCOMES (CLO)
1. Explain fundamental principles of computer vision, including image formation and processing. 2. Analyze and implement algorithms for feature extraction and keypoint detection. 3. Differentiate between various image segmentation and recognition methods, understanding their applications. 4. Experiment with advanced models such as CNNs for tasks like object detection and 3D vision. 5. Create a complete computer vision pipeline for a selected application, integrating learned methods.

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

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

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

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Fundamentals of Computer Vision** Introduction to computer vision, overview of imaging geometry, image formation models, camera models, and calibration. Discuss image processing basics: sampling and quantization, color models, and histograms. Introduction to spatial filtering, convolution, edge detection, and noise removal techniques. Study morphological operations and region properties of images.
UNIT-II	**Feature Extraction and Representation** Principles of feature extraction: corners, edges, and blobs. Techniques such as Harris Corner Detector, Scale-Invariant Feature Transform (SIFT), and Speeded-Up Robust Features (SURF). Histogram of Oriented Gradients (HOG) for object detection and shape representation. Keypoint matching and descriptor techniques. Introduction to feature-based object detection and matching, fundamentals of Hough Transform, and application of feature extraction in pattern recognition.
UNIT-III	**Image Segmentation and Object Recognition** Image segmentation techniques including thresholding, region-based segmentation, clustering-based methods, and active contours. Supervised and unsupervised techniques in image classification. Introduction to object recognition using Bag of Features (BoF) and Support Vector Machines (SVMs). Exploring pre-trained models in image classification such as VGGNet and ResNet.
UNIT-IV	**Advanced Topics in Computer Vision** Foundations of deep learning in computer vision: convolutional neural networks (CNNs), architectures like AlexNet and YOLO. Applications in object detection, image captioning, and video analysis. Overview of 3D computer vision: depth estimation, stereo vision, and 3D reconstruction. Explore diffusion-based methods for image enhancement, denoising, and semantic segmentation. Explore generative adversarial networks (GANs) for image synthesis and style transfer.
UNIT-V	**Project** Practical implementation of computer vision concepts in a project. Emphasis on datasets, training, testing, and evaluation of computer vision models. Project topics can include object detection, image segmentation, or real-time video

	analysis. Students are required to document their findings and present a detailed report with code and outcomes.

TEXT/REFERENCE BOOKS

1. Gonzalez, R. C., & Woods, R. E., Digital Image Processing, 4th ed., Pearson, 2018. ISBN: 978-0-13-335672-4.
2. Bishop, C. M., Pattern Recognition and Machine Learning, Springer, 2006. ISBN: 978-0-387-31073-2.
3. King, R., Feature Extraction for Computer Vision: A Machine Learning Perspective, Springer, 2021. ISBN: 978-3-030-69355-4.

Further Suggested Readings

1. Forsyth, D. A., & Ponce, J., Computer Vision: A Modern Approach, 2nd ed., Pearson, 2012. ISBN: 978-0-13-608592-8.
2. Szeliski, R., Computer Vision: Algorithms and Applications, 2nd ed., Springer, 2022. ISBN: 978-3-030-34491-3.
3. Goodfellow, I., Bengio, Y., & Courville, A., Deep Learning, MIT Press, 2016. ISBN: 978-0-262-03561-3.

SOFTWARE ENGINEERING	
Course Code: 25CS**3004**	Continuous Evaluation: 40 Marks
Pre-Requisite : Concept of OOP and Methodology	End Semester Examination: 60 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

Computer Vision Lab

Course Code: 25DI6104	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

1. CO1: Understand the principles of image formation, processing, and feature extraction.
2. CO2: Develop skills to apply and analyze image segmentation and recognition techniques.
3. CO3: Explore and implement machine learning models for object recognition tasks.
4. CO4: Experiment with advanced deep learning methods for real-world computer vision applications.
5. CO5: Gain hands-on experience in designing and evaluating comprehensive computer vision 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. CLO1: Demonstrate basic image processing operations such as filtering and edge detection.
2. CLO2: Implement feature extraction techniques to detect and describe keypoints in images.
3. CLO3: Analyze and apply segmentation methods for object separation in images.
4. CLO4: Build and evaluate machine learning and deep learning models for vision tasks.
5. CLO5: Design and document a full-fledged computer vision pipeline as a practical project.

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

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

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

LIST OF EXPERIMENTS

Experiment 1: Image Enhancement and Filtering
Perform basic image enhancement techniques such as brightness adjustment, contrast enhancement, and gamma correction. Implement spatial filtering operations like smoothing and sharpening using convolution kernels.

Experiment 2: Edge Detection
Implement edge detection algorithms such as Sobel, Prewitt, and Canny edge detectors. Visualize and analyze the effectiveness of different detectors on a set of images.

Experiment 3: Image Thresholding
Apply global and adaptive thresholding techniques to segment objects in images. Experiment with Otsu's method and study its application in binary segmentation.

Experiment 4: Morphological Operations
Perform operations like erosion, dilation, opening, and closing on binary images. Analyze their effect in removing noise or enhancing object boundaries.

Experiment 5: Feature Detection and Matching
Implement feature detection methods such as Harris Corner, SIFT, and SURF. Perform keypoint matching between two images and visualize the matches.

Experiment 6: Object Detection Using Hough Transform
Detects lines and circles in an image using the Hough Transform. Apply this technique to real-world scenarios such as road lane detection or object contour identification.

Experiment 7: Image Segmentation
Apply clustering-based segmentation methods like k-means and region-growing techniques. Evaluate the segmentation accuracy on standard datasets.

Experiment 8: Image Classification with Machine Learning
Train a machine learning model (e.g., SVM) to classify images into predefined categories. Use feature extraction techniques to preprocess the input images.

Experiment 9: Object Detection with CNNs
Build and train a Convolutional Neural Network (CNN) for object detection. Experiment with transfer learning using pre-trained models like YOLO or SSD.

Experiment 10: Project Implementation
Integrate the techniques learned in previous experiments to build a complete computer vision pipeline. The project should involve dataset preparation, model training, evaluation, and application to a real-world problem.

TEXT/REFERENCE BOOKS

1. Gonzalez, R. C., & Woods, R. E., Digital Image Processing, 4th ed., Pearson, 2018. ISBN: 978-0-13-335672-4.
2. Bishop, C. M., Pattern Recognition and Machine Learning, Springer, 2006. ISBN: 978-0-387-31073-2.
3. King, R., Feature Extraction for Computer Vision: A Machine Learning Perspective, Springer, 2021. ISBN: 978-3-030-69355-4.

Further suggested Readings

1. Forsyth, D. A., & Ponce, J., Computer Vision: A Modern Approach, 2nd ed., Pearson, 2012. ISBN: 978-0-13-608592-8.
2. Szeliski, R., Computer Vision: Algorithms and Applications, 2nd ed., Springer, 2022. ISBN: 978-3-030-34491-3.
3. Goodfellow, I., Bengio, Y., & Courville, A., Deep Learning, MIT Press, 2016. ISBN: 978-0-262-03561-3.

Deep and Reinforcement Learning Lab	
Course Code: 25DI6102	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

1. Understand and implement fundamental concepts of deep learning, including neural networks, CNNs, and RNNs.
2. Develop proficiency in reinforcement learning methods, including Q-learning, deep Q-networks, and policy gradient methods.
3. Implement and train deep learning models to solve real-world tasks such as image classification, time series forecasting, and sequence prediction.
4. Apply reinforcement learning algorithms to solve problems involving decision-making in dynamic environments.
5. Develop and complete a project that demonstrates the practical application of deep and reinforcement learning techniques.

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 the ability to implement basic deep learning models like perceptrons, CNNs, and RNNs.
2. Apply reinforcement learning algorithms like Q-learning and deep Q-networks to solve simple decision-making tasks.
3. Evaluate and optimize deep learning models for a variety of tasks, including classification and regression.
4. Implement and test reinforcement learning algorithms in environments like grid worlds and OpenAI Gym tasks.
5. Build and deploy a reinforcement learning agent for a complex problem, showcasing knowledge from the entire course.

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

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

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

LIST OF EXPERIMENTS

Experiment 1: Implementing a Perceptron
In this experiment, students will implement a simple perceptron from scratch to classify linearly separable data. They will use a basic dataset (e.g., AND or OR logic gate) and apply the perceptron learning rule to train the model and evaluate its accuracy.

Experiment 2: Training a Multilayer Perceptron (MLP) on a Classification Task
Students will use a deep neural network architecture (MLP) to perform classification on a simple dataset such as the Iris dataset. They will configure hidden layers, select activation functions, and apply backpropagation to train the model and evaluate its performance.

Experiment 3: Implementing Convolutional Neural Networks (CNNs) for Image Classification
In this experiment, students will implement a CNN to classify images from a dataset such as MNIST or CIFAR-10. They will configure convolutional layers, pooling layers, and fully connected layers, followed by training the network to classify images.

Experiment 4: Implementing Recurrent Neural Networks (RNNs) for Sequence Prediction
Students will build and train an RNN for sequence prediction tasks, such as time series forecasting or simple text generation. They will explore different architectures like vanilla RNNs and compare their performance with LSTMs or GRUs.

Experiment 5: Training a Simple Autoencoder for Dimensionality Reduction
In this experiment, students will implement an autoencoder network to reduce the dimensionality of data. They will use datasets like MNIST or a custom dataset and compare the compressed and reconstructed data to evaluate the performance of the model.

Experiment 6: Implementing Q-Learning for Simple Gridworld Environment
Students will implement a Q-learning algorithm to solve a basic reinforcement learning task in a grid world environment. They will explore the concepts of state-action values and update the Q-table to find the optimal policy for the agent.

Experiment 7: Implementing Deep Q-Network (DQN) for CartPole
Students will apply deep reinforcement learning by implementing a Deep Q-Network (DQN) to solve the CartPole problem using the OpenAI Gym. They will use a neural network to approximate the Q-function and apply experience replay and target networks for stable learning.

Experiment 8: Implementing Policy Gradient Methods for Reinforcement Learning
In this experiment, students will implement a policy gradient algorithm for reinforcement learning. They will train a policy network using the REINFORCE algorithm to optimize the agent's actions in an environment such as CartPole or MountainCar.

Experiment 9: Implementing Actor-Critic Methods for Reinforcement Learning
Students will implement an Actor-Critic method to solve a reinforcement learning problem, exploring the difference between the actor and critic components. They will apply this method to a standard reinforcement learning environment and compare the results with traditional Q-learning.

Experiment 10: Project: Building a Reinforcement Learning Agent for a Complex Task
In this final experiment, students will apply the knowledge gained from the course to develop a reinforcement learning agent for a more complex task (e.g., self-driving car simulation or video game agent). Students will preprocess data, train models, and evaluate the performance of the agent.

TEXT/REFERENCE BOOKS
1. T. M. Mitchell, Machine Learning, McGraw-Hill, 1997, ISBN: 978-0070428072.
2. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006, ISBN: 978-0387310732.
3. S. Raschka and V. Mirjalili, Python Machine Learning, 3rd ed., Packt Publishing, 2019, ISBN: 978-1789955750.

Further suggested Readings
1. I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, MIT Press, 2016, ISBN: 978-0262035613.
2. K. P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012, ISBN: 978-0262018029.
3. S. Haykin, Neural Networks and Learning Machines, 3rd ed., Pearson, 2008, ISBN: 978-0131471399.

SOFTWARE ENGINEERING LAB	
Course Code: **25CS3118**	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 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-16

LIST OF EXPERIMENTS

- **Structure Diagram:**
  a. To display a relationship among the various structures using a Class diagram.
  b. Manifestation concept of Component Diagram.
  c. Network architect process using the Deployment Diagram.
- **Behavior Diagram:**
  a. Use-Case Diagram–To display the relationship among actors & Use-cases.
  b. Activity Diagram–To display the action states & source transition states.
  c. State Machine Diagram– sequence of state response & action on the interaction.
- **Interaction Diagram:**
  a. Sequence Diagram – To display the time sequence of object interactions.
  b. Communication Diagram – To display the elements of frame, lifeline, messages.
- **Case Study:**
  a. UML interaction overview diagram for online shopping.
  b. Bank ATM behavioral using state machine diagram.
  c. 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/

Industry Session : DS & AI	
Course Code: 25DI6106	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

1. Understand the industrial applications of Data Science and AI in real-world problem-solving.
2. Gain hands-on experience with data pre-processing, analysis, and visualization techniques.
3. Implement machine learning and deep learning algorithms for predictive modeling and decision-making.
4. Explore and apply AI methods for tasks such as recommendation systems, fraud detection, and automation.
5. Develop an end-to-end project leveraging DS and AI techniques to address an industry-relevant problem.

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. Perform data cleaning, preprocessing, and visualization to understand real-world datasets.
2. Build predictive models using supervised and unsupervised machine learning techniques.
3. Implement advanced AI methods for specialized tasks such as image and text analytics.
4. Analyze the impact of AI-based systems in industrial domains like healthcare, retail, and finance.
5. Deliver a comprehensive DS & AI project showcasing problem-solving, teamwork, and presentation skills.

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

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

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

LIST OF EXPERIMENTS

Experiment 1: Data Cleaning and Preprocessing
Explore datasets from domains such as healthcare or retail. Perform data cleaning operations like handling missing values, outlier detection, and normalization.

Experiment 2: Exploratory Data Analysis (EDA)
Perform statistical analysis and visualization using libraries like Matplotlib and Seaborn. Generate insights from a dataset by plotting trends, correlations, and distributions.

Experiment 3: Predictive Modeling for Customer Churn
Develop a machine learning model to predict customer churn in a telecom dataset. Use logistic regression and evaluate model performance using metrics like accuracy and ROC-AUC.

Experiment 4: Recommendation System for E-commerce
Build a collaborative filtering-based recommendation system to suggest products to users. Experiment with datasets like MovieLens or an e-commerce dataset.

Experiment 5: Fraud Detection in Banking
Train and evaluate classification models (e.g., Random Forest, XGBoost) on a dataset to detect fraudulent transactions. Emphasize precision and recall metrics.

Experiment 6: Sentiment Analysis in Text Data
Perform sentiment analysis on a dataset of product reviews using natural language processing (NLP) techniques. Utilize TF-IDF and machine learning classifiers.

Experiment 7: Image Classification for Manufacturing Defects
Use Convolutional Neural Networks (CNNs) to classify defective vs. non-defective products. Employ datasets from the manufacturing industry or Kaggle.

Experiment 8: Demand Forecasting in Retail
Implement time series analysis using ARIMA or LSTM models to forecast product demand. Evaluate forecasting accuracy using Mean Absolute Error (MAE).

Experiment 9: Healthcare Analytics with AI
Apply AI methods to classify diseases or predict patient outcomes using medical datasets. Explore models such as decision trees or deep learning for prediction.

Experiment 10: Industry-focused DS & AI Project
Integrate the techniques learned in previous experiments to solve an industry-specific problem. Examples include predictive maintenance, personalized marketing, or smart city traffic optimization.

TEXT/REFERENCE BOOKS

1. E. Alpaydin, Introduction to Machine Learning, 4th ed. Cambridge, MA: MIT Press, 2020. ISBN: 9780262043793.
2. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd ed. Sebastopol, CA: O'Reilly Media, 2019. ISBN: 9781492032649.
3. S. Sharda, D. Delen, and E. Turban, Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th ed. Harlow, UK: Pearson Education, 2017. ISBN: 9781292220565.

Further suggested Readings

1. I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning. Cambridge, MA: MIT Press, 2016. ISBN: 9780262035613.
2. T. Hastie, R. Tibshirani, and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd ed. New York: Springer, 2009. ISBN: 9780387848570.
3. J. Han, M. Kamber, and J. Pei, Data Mining: Concepts and Techniques, 3rd ed. Amsterdam: Morgan Kaufmann, 2011. ISBN: 9780123814791.

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

- Gelman, Andrew, and Jennifer Hill. Data Analysis Using Regression and Multilevel/Hierarchical Models. 1st ed. Cambridge, UK: Cambridge University Press, 2006. ISBN: 9780521867061.
- 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
- Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data" by EMC Education Services
- Analytics: Data Science, Data Analysis and Predictive Analytics for Business" by Daniel Covington.
- Machine Learning for Big Data: Hands-On for Developers and Technical Professionals" by Jason Bell.

OPEN EDUCATIONAL RESOURCES (OER's)
• NPTEL Course by Prof. Rajiv Misra, Big Data Computing, IIT Patna, 2022. https://nptel.ac.in/courses/106105254 • IBM SkillsBuild, Data Analysis and Visualization with Python, 2023. https://skillsbuild.org/ • MIT OpenCourseWare, Statistics for Applications (18.650), Fall 2020 https://ocw.mit.edu/courses/18-650-statistics-for-applications-fall-2020/ • EdX Course by UC San Diego, Big Data Analytics Using Spark, 2023. https://www.edx.org/course/big-data-analytics-using-spark • Analytics: Data Science, Data Analysis and Predictive Analytics for Business" by Daniel Covington. • Machine Learning for Big Data: Hands-On for Developers and Technical Professionals" by Jason Bell.

LIVE PROJECT-III & INDUSTRIAL VISIT	
Course Code: 25CS0304	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 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:

- Gather first-hand experience on sites.
- 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

Distributed Systems and Data Analytics	
Course Code: 25DI7001	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 2 0 0	
Credits: 2	

COURSE OBJECTIVES

1. Understand the fundamental principles of distributed systems and their applications.
2. Explore the design and implementation of distributed data storage and management techniques.
3. Develop skills to analyze and implement distributed data analytics workflows.
4. Apply distributed systems knowledge to scale machine learning and real-time analytics tasks.
5. Build and evaluate a practical project based on distributed systems and data analytics.

COURSE LEARNING OUTCOMES (CLO)

1. Explain the architecture and communication mechanisms of distributed systems.
2. Implement data storage and consistency techniques in distributed environments.
3. Develop and optimize distributed analytics pipelines using modern frameworks.
4. Demonstrate distributed machine learning workflows and real-time data processing.
5. Design and present a comprehensive project solving a distributed systems problem.

COURSE LEARNING OUTCOMES (CLO)-COURSE OBJECTIVES (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	**Fundamentals of Distributed Systems** Introduction to distributed systems architecture, types, and challenges. Concepts of processes, threads, and synchronization. Communication in distributed systems: message passing, Remote Procedure Calls (RPC), and Remote Method Invocation (RMI). Hands-on examples using Java or equivalent programming language to demonstrate RPC and RMI concepts, including basic client-server interaction and remote object invocation. Distributed coordination with leader election and consensus algorithms (Paxos, Raft).
UNIT-II	**Distributed Data Storage and Management** Overview of distributed file systems and databases. Case studies on HDFS and Google File System (GFS). Basics of NoSQL databases and their consistency models (CAP theorem). Data partitioning, replication, and fault tolerance. An introduction to distributed transactions and eventual consistency.
UNIT-III	**Distributed Data Analytics Frameworks** Overview of distributed data analytics with tools like Hadoop and Spark. MapReduce programming paradigm and its implementation. In-memory computing with Apache Spark, RDDs, and Spark SQL. Data pipeline orchestration with tools like Apache Airflow. Use of distributed graph processing systems like Pregel and GraphX.
UNIT-IV	**Machine Learning in Distributed Environments** Scaling machine learning workflows with distributed computing. Distributed training of ML models using frameworks like TensorFlow, PyTorch, and Horovod. Federated learning and its applications. Real-time analytics with distributed stream processing platforms like Apache Kafka and Apache Flink.
UNIT-V	**Project** Design and implement a distributed system or data analytics pipeline addressing a real-world use case. Examples include distributed web crawling, log analytics, machine learning model training, or fault-tolerant distributed services. Present project documentation and performance evaluation.

TEXT/REFERENCE BOOKS

1. T. White, Hadoop: The Definitive Guide, 4th ed. Sebastopol, CA: O'Reilly Media, 2015. ISBN: 9781491901632.
2. M. Zaharia, B. Chambers, and S. Ryza, Learning Spark: Lightning-Fast Big Data Analysis, 2nd ed. Sebastopol, CA: O'Reilly Media, 2020. ISBN: 9781492050049.
3. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd ed. Sebastopol, CA: O'Reilly Media, 2019. ISBN: 9781492032649.

Further Suggested Readings

1. G. Coulouris, J. Dollimore, T. Kindberg, and G. Blair, Distributed Systems: Concepts and Design, 5th ed. Boston: Pearson, 2011. ISBN: 9780132143011.
2. I. Foster, Designing and Building Parallel Programs: Concepts and Tools for Parallel Software Engineering. Reading, MA: Addison-Wesley, 1995. ISBN: 9780201575941.
3. M. Stonebraker and P. Brown, SQL: A Systems Approach to Data Processing. San Francisco: Morgan Kaufmann, 1999. ISBN: 9781558605327.

Natural Language Processing	
Course Code: 25DI7003	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 2 0 0	
Credits: 2	

COURSE OBJECTIVES

1. Understand the theoretical foundations of Natural Language Processing.
2. Gain proficiency in text preprocessing and linguistic feature extraction.
3. Explore machine learning and deep learning techniques for language modeling and text analysis.
4. Develop and evaluate NLP-based applications for real-world use cases.
5. Design, implement, and present a complete NLP solution through a hands-on project.

COURSE LEARNING OUTCOMES (CLO)

1. Demonstrate an understanding of key linguistic and computational concepts in NLP.
2. Implement preprocessing and syntactic analysis pipelines.
3. Apply advanced models like Transformers for semantic analysis and text generation.
4. Design NLP systems for tasks such as classification, sentiment analysis, and translation.
5. Build and evaluate a project that addresses a real-world problem using NLP techniques.

COURSE LEARNING OUTCOMES (CLO)-COURSE OBJECTIVES (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 to Natural Language Processing** Overview of NLP and its importance in AI, components of NLP systems, syntactic analysis, and basic concepts in linguistics. Tokenization, stemming, and lemmatization techniques. Regular expressions for text preprocessing. Parts of speech (POS) tagging and parsing methods. Key applications such as chatbots, text summarization, and translation systems. Introduction to language models, including n-gram models, neural language models, and the concept of next-word prediction. Brief discussion on evaluation of language models using perplexity.
UNIT-II	**Semantic Analysis and Word Representations** Semantic analysis techniques including semantic role labeling and word-sense disambiguation. Introduction to distributional semantics. Word embeddings: Word2Vec, GloVe, and FastText. Contextual word representations using Transformers and BERT. Exploring semantic similarity and sentiment analysis.
UNIT-III	**Text Generation and Sequence Modeling** Sequence modeling techniques including Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), and GRUs. Language modeling concepts and their use in text generation. Exploring attention mechanisms and Transformer architectures. Implementing machine translation, summarization, and question-answering systems using encoder-decoder frameworks.
UNIT-IV	**Applications of NLP** Text classification, sentiment analysis, and topic modeling. Introduction to Named Entity Recognition (NER) and information extraction. Algorithms for NER such as Hidden Markov Models (HMM), Conditional Random Fields (CRF), and rule-based approaches. Speech-to-text and text-to-speech systems. Text search and retrieval applications using NLP techniques. Introduction to platforms like Apache Lucene and ElasticSearch. Ethics in NLP, including bias and fairness in language models. Industrial applications in healthcare, finance, and customer service.
UNIT-V	**Project** Design and implement a distributed system or data analytics pipeline addressing a real-world use case. Examples include distributed web crawling, log analytics, machine learning model training, or fault-tolerant distributed services. Present project documentation and performance evaluation.

TEXT/REFERENCE BOOKS

1. C. Manning, H. Schütze, Foundations of Statistical Natural Language Processing, MIT Press, 1999, ISBN: 978-0262133609.
2. T. K. Das, Natural Language Processing and Text Mining, Springer, 2017, ISBN: 978-9811075078.
3. R. Socher, Deep Learning for NLP, Stanford, 2021, ISSN: Not applicable (online publication).

Further Suggested Readings

1. J. Allen, Natural Language Understanding, 2nd ed., Pearson, 1995, ISBN: 978-0805303346.
2. D. Jurafsky and J. H. Martin, Speech and Language Processing, 3rd ed., Pearson, 2023, ISBN: 978-0131873216.
3. S. Bird, E. Klein, and E. Loper, Natural Language Processing with Python, 1st ed., O'Reilly Media, 2009, ISBN: 978-0596516499.

QUANTUM COMPUTING

Course Code: 25CS4003	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES

1. To recall the basics of computer science and algorithms.
2. To explore all the parts of a quantum computer and how this fights interference issues.
3. To explore the specific tasks in which a quantum computer can make a difference.
4. To understand the hardware behind the quantum computer.
5. To understand the importance of IBM Q Network and its strategic partners.

COURSE LEARNING OUTCOMES (CLO)

After completion of course, students would be able to:

1. Understand how quantum computing fits the big picture.
2. Understand quantum computing industry applications.
3. Explain the difference between classical and quantum computing with the importance of IBM Q Network and its strategic partners.
4. Explore which companies are betting on quantum and how.
5. Explain how quantum-enhanced feature spaces can help with feature mapping and Explore Aqua risk analysis for finance modules.

	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	**Quantum Introduction** Basics of computer science, the business case for quantum computing, the path from science to system. **Industry and Business Impacts:** The Road to quantum advantage, problem solving with quantum computing, Industry Applications of quantum computing.
UNIT-II	**Science and Tech of Quantum Computing:** **Quantum vs. Classical**: The power of conventional computing, Pre-quantum computing, Controlling quantum phenomena, **Core concepts:** Superposition, Interference, **Hardware:** Qubits, Refrigeration, Quantum volume, IBM Q System One.
UNIT-III	**IBM Q Programs:** **IBM Q Experience**: Circuit Composer, Qiskit Notebooks, **IBM Q Network:** The IBM QNetwork Focus Areas, The IBM Q Network Member Benefits, The IBM Q Teams. **Quantum Computing Security:** Infrastructure, Applications, Services, **Quantum Computing Companies:** Quantum Computing Landscape , IBM Q, Alibaba, D-Wave Systems, Google, Microsoft, Rigetti Computing, Amazon Web Services.
UNIT-IV	**Quantum Computing in Depth:** **Review of Quantum Computing fundamentals:** Basic computer systems, Quantum computer systems, Qubits, **Inside a quantum computer:** Scalable Quantum Systems, Parts of a quantum computer, **Programming a quantum computer:** IBM Q Experience**.**
UNIT-V	**Machine Learning with Qiskit:** **Classic AI-Support Vector Machine:** Classify data, Improved AI/ML Processes with Quantum, Quantum-enhanced feature spaces to classify data, **Quantum-enhanced Feature Spaces:** A quantum circuit representing the quantum feature map, this is the circuit we just constructed for input vector x, Qiskit Aqua can make feature maps in one line of code, With Aqua, we can solve thefull problem in a few lines of code
UNIT-VI	**Qiskit Aqua Framework:** Algorithms and Applications, Modularity and Extensibility of the Aqua Library, Algorithms and Optimizers, Extensible Libraries and Features, Modularity, Qiskit Chemistry

	Algorithms and Applications, **Solving Problem with Qiskit**: Speeding up calculations in quantitative finance. Industry Scenario, Risk analysis, Quantum risk analysis, Possibilities of new chemical innovation, .

TEXT/REFERENCE BOOKS
● Computing with Quantum Cats: From Colossus to Qubits **by John Gribbin** ● Quantum Computing for Computer Scientists Noson Yanofsky and Mirco Mannucci ● Quantum Computation and Quantum Information Michael Nielsen and Isaac Chuang.

QUANTUM COMPUTING LAB	
Course Code: 25CS4007	Continuous Evaluation: 60 Marks
Pre-Requisite : Basic Quantum Mechanism	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES
1. To access and navigate IBM Q Experience. 2. To identify Superposition, Entanglement, and Noise 3. To swap the gates of qubits 4. To code an Algorithm with Aqua 5. To perform calls to Aqua

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

List of Programs

1. Build a Quantum Random Number Generator.
2. Implement Grover's Search Algorithm.
3. Use Shor's Algorithm to Factor a Number.
4. Find the Ground State Energy of a Lithium Hydride Molecule.
5. Explore Quantum Hardware with Qiskit Pulse.
6. Sort Images Using a Quantum Machine Learning Algorithm.
7. Implement IBM Q Experience
8. Understand the Superposition, Entanglement, & Noise
9. Non-Connected Qubits & Gate Swaps
10. Identify Quantum SVM for Classification

Project Statement

Computational projects on quantum computing suitable for students in a junior-level quantum mechanics course are described. In these projects students write their own programs to simulate quantum computers. Knowledge is assumed of introductory quantum mechanics through the properties of spin 1/2. Initial, more easily programmed projects treat the basics of quantum computation, quantum gates, and Grover's quantum search algorithm. These are followed by more advanced projects to increase the number of qubits and implement Shor's quantum factoring algorithm. The projects can be run on a typical laptop or desktop computer, using most programming languages. Supplementing resources available elsewhere, the projects are presented here in a self-contained format especially suitable for a short computational module for physics students.

TEXT/REFERENCE BOOKS
● Computing with Quantum Cats: From Colossus to Qubits **by John Gribbin.**

- Quantum Computing for Computer Scientists
  Noson Yanofsky and Mirco Mannucci.

- Quantum Computation and Quantum Information
  Michael Nielsen and Isaac Chuang.

Distributed Systems and Data Analytics Lab	
Course Code: 25DI7101	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

1. Understand and implement the basic principles of distributed systems.
2. Demonstrate proficiency in distributed data storage and management techniques.
3. Analyze and optimize distributed data analytics workflows.
4. Apply distributed systems to build scalable machine learning and real-time data processing solutions.
5. Design and evaluate distributed system projects based on real-world problems.

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. Implement communication and coordination mechanisms in distributed systems.
2. Configure distributed storage systems to ensure fault tolerance and consistency.
3. Develop distributed analytics pipelines using frameworks like Hadoop and Spark.
4. Utilize distributed machine learning techniques for large-scale data processing.
5. Design and present a functional distributed system or analytics solution.

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

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

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

LIST OF EXPERIMENTS

Experiment 1: Message Passing in Distributed Systems

Implement a message-passing system using sockets in Python. Ensure communication between multiple processes running on different machines.

Experiment 2: Distributed Mutual Exclusion

Simulate a distributed system where multiple nodes implement a token-based mutual exclusion algorithm to access shared resources.

Experiment 3: Setting Up a Hadoop Distributed File System (HDFS)

Install and configure a multi-node Hadoop cluster. Demonstrate data replication, storage, and fault tolerance in HDFS.

Experiment 4: Analyzing Data with MapReduce

Write and execute a MapReduce program to analyze large datasets, such as word count or sentiment analysis. Test scalability on multiple nodes.

Experiment 5: Working with Apache Spark RDDs

Create and manipulate Resilient Distributed Datasets (RDDs) in Apache Spark. Perform transformations and actions to process datasets.

Experiment 6: Real-Time Stream Processing with Apache Kafka

Set up a Kafka streaming pipeline. Consume and process real-time data from a producer to a consumer using Apache Spark or Flink.

Experiment 7: Distributed Training of ML Models

Implement distributed training for a machine learning model using TensorFlow's distributed strategy or PyTorch’s DDP. Analyze speedup.

Experiment 8: Consistency and Fault Tolerance

Simulate a distributed database and implement a protocol (e.g., Paxos) to ensure consistency during node failures.

Experiment 9: Graph Processing in Distributed Systems

Use Apache Spark GraphX or Pregel to analyze a graph dataset, such as finding the shortest path or connected components.

Experiment 10: Capstone Project

Develop and deploy a distributed system or data analytics pipeline. Suggested examples: distributed file sharing system, real-time fraud detection pipeline, or scalable recommendation system. Present the design and performance evaluation.

TEXT/REFERENCE BOOKS

1. T. White, Hadoop: The Definitive Guide, 4th ed. Sebastopol, CA: O'Reilly Media, 2015. ISBN: 9781491901632.
2. M. Zaharia, B. Chambers, and S. Ryza, Learning Spark: Lightning-Fast Big Data Analysis, 2nd ed. Sebastopol, CA: O'Reilly Media, 2020. ISBN: 9781492050049.
3. A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd ed. Sebastopol, CA: O'Reilly Media, 2019. ISBN: 9781492032649.

Further suggested Readings

1. G. Coulouris, J. Dollimore, T. Kindberg, and G. Blair, Distributed Systems: Concepts and Design, 5th ed. Boston: Pearson, 2011. ISBN: 9780132143011.
2. I. Foster, Designing and Building Parallel Programs: Concepts and Tools for Parallel Software Engineering. Reading, MA: Addison-Wesley, 1995. ISBN: 9780201575941.
3. M. Stonebraker and P. Brown, SQL: A Systems Approach to Data Processing. San Francisco: Morgan Kaufmann, 1999. ISBN: 9781558605327.

Industry Session : NLP	
Course Code: 25DI7105	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

1. Understand the fundamental concepts and techniques of Natural Language Processing (NLP).
2. Implement and analyze preprocessing techniques and linguistic features extraction.
3. Explore deep learning models for language understanding and generation.
4. Design and develop industry-grade NLP applications for real-world problems.
5. Collaborate on a project that integrates various NLP methods to address complex industrial problems.

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. Explain and apply basic NLP concepts and frameworks.
2. Preprocess and tokenize datasets to prepare text data for analysis.
3. Train and evaluate deep learning models for text generation and semantic analysis.
4. Develop end-to-end systems for tasks like chatbots, sentiment analysis, and document summarization.
5. Deliver a comprehensive NLP project, integrating theory and application in an industrial scenario.

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

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

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

LIST OF EXPERIMENTS

Experiment 1: Text Preprocessing and Tokenization

Write a script to clean raw textual data by removing noise, punctuation, and stop words. Perform tokenization and analyze the frequency distribution of tokens.

Experiment 2: Named Entity Recognition (NER)

Using an NLP library like spaCy, extract named entities from a dataset. Classify them into categories such as persons, organizations, and locations.

Experiment 3: Sentiment Analysis with Pre-trained Models

Apply pre-trained language models (e.g., BERT or RoBERTa) to classify the sentiment of text data. Evaluate the model's performance using metrics like accuracy and F1-score.

Experiment 4: Word Embeddings

Generate word embeddings using Word2Vec or GloVe. Visualize relationships between words using dimensionality reduction techniques like t-SNE.

Experiment 5: Text Summarization

Implement an extractive text summarizer using libraries such as Hugging Face Transformers. Compare the generated summaries with ground truth data.

Experiment 6: Topic Modeling

Perform topic modeling on a collection of documents using Latent Dirichlet Allocation (LDA). Identify and interpret the dominant topics.

Experiment 7: Chatbot Design

Build a rule-based chatbot for a specific industry use case, such as customer support or healthcare. Enhance its capabilities using intent recognition techniques.

Experiment 8: Machine Translation

Translate text between two languages using sequence-to-sequence models or pre-trained translation models. Evaluate the performance using BLEU scores.

Experiment 9: Document Similarity

Implement cosine similarity to compare the semantic similarity of two documents. Extend this to retrieve similar documents from a corpus.

Experiment 10: Comprehensive NLP Project

Develop an end-to-end NLP solution, such as a customer sentiment analyzer for social media. Integrate preprocessing, model training, and a user-friendly interface to showcase results.

TEXT/REFERENCE BOOKS

1. C. Manning, H. Schütze, Foundations of Statistical Natural Language Processing, MIT Press, 1999, ISBN: 978-0262133609.
2. T. K. Das, Natural Language Processing and Text Mining, Springer, 2017, ISBN: 978-9811075078.
3. R. Socher, Deep Learning for NLP, Stanford, 2021, ISSN: Not applicable (online publication).

Further suggested Readings

1. J. Allen, Natural Language Understanding, 2nd ed., Pearson, 1995, ISBN: 978-0805303346.
2. D. Jurafsky and J. H. Martin, Speech and Language Processing, 3rd ed., Pearson, 2023, ISBN: 978-0131873216.
3. S. Bird, E. Klein, and E. Loper, Natural Language Processing with Python, 1st ed., O'Reilly Media, 2009, ISBN: 978-0596516499.

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

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	✔	✔

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

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

1. 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 problems 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	√	√	√	√	√

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

MINOR 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. Alternatively, a few research problems also may be identified for investigation and the use of laboratory facilities to the fullest extent may be taken as project work. Alternatively, 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

1. 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 OUTCOME:

1. Identify, formulate and analyse existing problems 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	√	√	√	√	√

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

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. Alternatively, a few research problems also may be identified for investigation and the use of laboratory facilities to the fullest extent may be taken as 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 OBJECTIVE

1. To know about basic concepts of Distributed operating systems.
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 a 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, SDG-9, SDG-16

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 NUMBER	COURSE CONTENT
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 systemImplementation, 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, Maarten van Steen, Distributed Systems, —Principles and Paradigms, 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.

OPEN EDUCATIONAL RESOURCES

1. NPTEL – Distributed Systems by Prof. P.K. Biswas (IIT Kharagpur)
2. MIT OCW – Distributed Systems Concepts
3. “Distributed Systems” by Andrew Tanenbaum Free preview
4. AFS Overview – Carnegie Mellon
5. Distributed File Systems Lecture – Georgia Tech
6. Linux NFS Admin Guide – TLDP

SOFTWARE PROJECT MANAGEMENT	
Course Code: 25CS**PE3024**	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks

L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVE

1. To provide an in-depth understanding of various concepts of Software project phases.
2. To understand the basics of the project management techniques.
3. To learn the feasible solution and optimum solution for resource management. Learn the time estimation and critical path for the project.
4. To learn the various quality models and risk management in 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. Analysis 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, SDG-8, SDG-9

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, Mike Cotterell, "Software Project Management", Third Edition, Tata McGraw Hill, 2004.

2. Agile, Scrum, closer alignment with modern industry practices, new chapter, more MCQs/exercises Cotterell & Mall Hughes, 6th2017–2018.

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

OPEN EDUCATIONAL RESOURCES

1. NPTEL: Software Engineering & Project Management – IIT Kharagpur
2. MIT OpenCourseWare: Software Project Management
3. YouTube – Introduction to SPM (Lectures)
4. GanttProject (Free Tool)
5. PERT/CPM Explained – SlideShare
6. COCOMO Estimation Calculator (Web Tool)

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 OBJECTIVE

1. To understand introduction and application to Grid Computing.
2. To gain knowledge of web services architecture, XML, and related technologies.
3. To learn about the Open Grid Services Architecture (OGSA) and its platform components.
4. To understand the Open Grid Services Infrastructure (OGSI) and grid service management.
5. To comprehend security issues, including trust models, authentication, authorization, and identity management in grid environments.

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, SDG-9, SDG-16

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, Grid Performance Optimization
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.
   Focuses on scheduling/resource management and bio-inspired optimization *Mastering Grid Computing* – Ankit 2023–24
2. Daniel Minoli, "A Networking Approach to Grid Computing", John Wiley Publication, 2005.

Open Educational Resources

- **Link:** https://nptel.ac.in/courses/106105016
  - **Instructor:** Dr. Srinivasan, IIT Madras
  - **Contents:** Introduction to Grid Computing, Globus Toolkit, Middleware, Applications
- **Link:** https://ocw.mit.edu/courses/6-824-distributed-systems-spring-2006/
  - **Instructor:** Prof. Frans Kaashoek
  - **Contents:** Grid and Cluster Computing basics, data sharing, distributed file systems.

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 OBJECTIVE

1. To introduce the concepts of OOP and behavioural modelling.
2. To understand the architectural design methods.
3. To learn the application methodology in 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, SDG-9

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. 3rd 2007
2. Rambaugh.J, Blaha. M. Premerlani.W, Eddy F and Loresen W, “Object Oriented Modeling and Design",Prentice Hall of India, 1997.
   Object-Oriented Modeling and Design with UML by Michael Blaha and James Rumbaugh, 2nd edition (Pearson, 2004 & updated 2011)
3. Bennett, S., "Schaum's Outline of UML”. New York: McGraw-Hill 2004
4. S. Perdita. “Using UML: Software Engineering with Objects and Components.” Addison-Wesley 2000

Open Educational Resources

1. **NPTEL – Object Oriented Systems Development**
   Link: https://nptel.ac.in/courses/106105153
   Instructor: Prof. Partha Pratim Das (IIT Kharagpur)**Contents:** OO Concepts, UML, Use Case, Class Diagrams, Design Patterns
2. **MIT OpenCourseWare – Software Construction (Partial OOAD)Link:** https://ocw.mit.edu/courses/6-005-software-construction-fall-2016/
   Includes: OO principles, specification, design, Java-based examples

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 perceptrons.
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 concepts 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.
5. Utilize fuzzy set theory and fuzzy logic to handle uncertainty in real-time control and decision-making systems.

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. **Introduction to Artificial Neural Systems,– 5th Edition** (Jacek M. Żurada, West Publishing,1992).
2. **Neural Networks and Learning Machines, – 3rd Edition** (Simon S. Haykin, Pearson,2009)
3. **Principles of Soft Computing, – 3rd Edition** (S. N. Sivanandam & S. N. Deepa, Wiley India, 2023)**.**

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

OPEN EDUCATIONAL RESOURCES (OERs)

1. Dive into Deep Learning: Available: https://d2l.ai
2. Artificial Neural Networks for Beginners – Carlos Gershenson: Available: https://arxiv.org/abs/cs/0308031
3. Fuzzy Logic with Engineering Applications – Timothy J. Ross (Preview): Available:https://books.google.com/books/about/Fuzzy_Logic_with_Engineering_Applications.html?id=ZnEoPwAACAAJ
4. IIT Patna – Neural Network Basics: Available:https://www.iitp.ac.in/~ai-nlp-ml/course/dnlp/Neural-Network%28Basics%29.pdf
5. NPTEL-Soft Computing by Dr. Deepak Garg: Available:https://nptel.ac.in/courses/106105173
6. CMU Lecture Notes – MLP: Available:https://www.cs.cmu.edu/~epxing/Class/10715/lectures/MultiLayerPerceptron.pdf

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 OBJECTIVE

1. To inform the students about 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 inform 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 the Information Communication Technology (ICT) world.
2. Underline the need of digital forensic and the role of digital evidence.
3. Explain the methodology of incident response and various security issues in the 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 systems.
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, SDG-9, SDG-16

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION C**yber-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. William Stallings-"Cryptography and Network Security", Pearson education, 6th edition, SBN 10**:** 0133354695, 2013
5. William Stallings – Computer Security: Principles and Practice, 5th Edition, Pearson Education.
6. William Stallings – Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson Education.
7. William Stallings – Network Security Essentials: Applications and Standards, 7th Edition, Pearson Education

REFERENCE 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
4. P.W. Singer – Cybersecurity and Cyberwar: What Everyone Needs to Know, 2nd Edition, Oxford University Press
5. Charles J. Brooks – Cybersecurity Essentials, 2nd Edition, Wiley
6. Kevin Mitnick – The Art of Invisibility, Updated Edition, Back Bay Books
7. Tim Mather – Cloud Security and Privacy, 1st Edition (Reprint 2023), O’Reilly Media
8. Michael Sikorski – Practical Malware Analysis, 1st Edition (Reprint 2023), No Starch Press

Open Educational Resources

1. https://www.youtube.com/c/NetworkChuck
2. https://www.youtube.com/c/TheCyberMentor
3. https://www.youtube.com/c/HackerSploit
4. https://www.youtube.com/c/NullByteWHT
5. https://www.youtube.com/c/JohnHammond010
6. https://www.youtube.com/c/IppSec
7. https://www.youtube.com/c/Cyberspatial

Other Sources

1. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8858
2. https://dl.acm.org/journal/tops
3. https://www.journals.elsevier.com/computers-and-security
4. https://academic.oup.com/cybersecurity
5. https://link.springer.com/journal/10207
6. https://www.journals.elsevier.com/journal-of-information-security-and-applications
7. http://sdiwc.net/journals/ijcsdf/

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 OBJECTIVE

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 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 analyze design thinking history and its various concepts.
4. Understand, analyze and create models with user collaboration to apply design thinking concepts.
5. Build the process model that is used to implement process application and use different mural templates to apply design thinking concepts for solving real world problems.

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 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

1. To introduce students to the foundational concepts, components, and significance of Business Intelligence (BI) in decision-making.
2. To equip students with practical skills in data integration and transformation using open-source ETL tools.
3. To provide hands-on understanding of data warehousing and OLAP operations using open-source platforms.
4. To train students in designing dynamic dashboards and reports using modern open-source BI visualization tools.
5. 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:

1. Describe the architecture, functions, and scope of Business Intelligence systems.
2. Apply ETL processes using open-source tools for real-world data preparation tasks.
3. Design and implement data warehouse schemas and perform OLAP operations.
4. Develop interactive dashboards and schedule reports using visualization platforms.
5. 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	COURSE 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**: **1.** Build an ETL pipeline to extract, clean, transform, and load employee data from a CSV/JSON file. **2.** 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. **3.** 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 1. Introduction to Online Analytical Processing (OLAP) 2. Cube building and multidimensional queries 3. Introduction to Cloud Data Warehouses 4. Data Lake vs. Data Warehouse vs. Data Lakehouse 5. Data Governance in Data Warehousing **Tutorial Exercises**: 1. Design a star schema for a university admissions dataset and implement it in Pentaho. 2. Load transformed data into the designed data warehouse. 3. Create an OLAP cube and perform slice-and-dice and drill-down operations on student data.
UNIT-IV	**Interactive 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**:

	1. Design and build an interactive sales performance dashboard in Microsoft Power BI, incorporating multiple data sources, filters, and drill-down capabilities. 2. Create a compelling data story and a series of linked visualizations in Tableau to analyze customer behavior or market trends. 3. 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.
OPEN EDUCATIONAL RESOURCES(0ER)
1. **Saylor Academy:: https//learn.saylor.org/course/view.php?id=409.** 2. **MIT OpenCourseWare – Data Mining:https://ocw.mit.edu.**

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 OBJECTIVE
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-3, SDG-4, SDG-9, SDG-11

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

Open Educational Resources

1. **NPTEL – Introduction to Internet of Things**

   Link: https://nptel.ac.in/courses/106105166
   Instructor: Prof. Sudip Misra (IIT Kharagpur)
   Topics: IoT architecture, protocols, sensors, cloud integration

2. **OpenLearn – Internet of Everything (IoE)Link:** https://www.open.edu/openlearn/science-maths-technology/internet-everything/content-section-overview
   Topics: IoT, smart cities, connected devices, data ethics

NETWORK SECURITY & CRYPTOGRAPHY	
Course Code: 25CS**PE4019**	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	

Credits: 4	

COURSE OBJECTIVE

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, SDG-9, SDG-16

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”, First 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).

Open Educational Resources

1. NPTEL – Cryptography and Network Security
   Link: https://nptel.ac.in/courses/106105031
   Instructor: Prof. D. Mukhopadhyay (IIT Kharagpur)
   Topics: Classical ciphers, RSA, AES, hash functions, authentication, firewalls
2. NPTEL – Computer Networks and Internet Protocol (with Security Modules)
   Link: https://nptel.ac.in/courses/106105183
   Instructor: Prof. S. Misra (IIT Kharagpur)
   Covers: TCP/IP, Secure Socket Layer (SSL), IPSec, VPN

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

1. To understand the fundamentals and significance of software testing.
2. To apply various white-box and black-box testing techniques in practice.
3. To analyze software testing levels and debugging strategies.
4. To explore the process and tools for software test automation.
5. 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:

1. Demonstrate understanding of software testing principles with real-world examples.
2. Apply appropriate testing techniques including white-box and black-box methods.
3. Analyze software at various levels of testing and perform debugging.
4. Identify, classify, and resolve software bugs through systematic testing approaches.
5. Perform and document test strategies while managing trade-offs between testing methods.
6. 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-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**

UNIT NUMBER	COURSE CONTENTS
	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. **Testing Activities:** Unit Testing, Levels of Testing, Integration Testing, Debugging, Domain Testing.
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 Non-Functional Testing, Challenges in non-functional testing, Introduction to Performance and Security Testing
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.
2. Software Testing: Principle,Techniques and Tools, M. G. Limaye, Tata McGraw Hill, 2017.
3. Effective Methods for Software Testing, William E. Perry, John Wiley and Sons,3rd Edition

REFERENCE BOOKS

1. An Integrated Approach to Software Engineering, Pankej Jalote, Narosa Publishing House, New Delhi 2005.
2. The Art of Software Testing,Glenford J.Myers, John Wiley & Sons, 2012.
3. Software Testing: Software Testing: A Craftsman's Approach (4th ed.)
4. Software Testing Techniques, Boris Beizer, Dreamtech, 2006.
5. Effective Software Testing: 50 Specific Ways to Improve Your Testing, Dustin, Pearson Education, 2002.

OPEN EDUCATIONAL RESOURCES (OERs)

1. Software Testing: Foundations (4th ed.) by Spillner, Linz & Schaefer – Free ISTQB-aligned PDF ICDST E-print Archive
2. Introduction to Software Testing – Public domain PDF from Computer eBooks Google Books+15All Free Stuff Ebooks+15CampusBooks+15
3. MIT OpenCourseWare & VHB – Introductory test methodologies available as open modules
4. "Software Testing Foundations" (Spillner, Linz & Schaefer, 4th ed., ISTQB)

Journals (free access or open access):

1. Journal of Software: Evolution and Process
2. Software Testing, Verification and Reliability (Wiley)

3. Empirical Software Engineering Journal (Springer, OA articles)

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 OBJECTIVE

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 yourself 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 the 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, SDG-9, SDG-11

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

C. S. Ram Murthy, B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall of India , 2007.

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

OPEN EDUCATIONAL RESOURCES(OER)
1. **NPTEL – Wireless Ad Hoc and Sensor Networks** **Link:** https://nptel.ac.in/courses/106105160 **Instructor:** Prof. Sudip Misra (IIT Kharagpur) **Topics:** MANETs, WSN architecture, routing protocols, MAC layer, QoS 2. **NPTEL – Sensor Networks and Internet of Things** **Link:** https://nptel.ac.in/courses/106105173 **Instructor:** Prof. Prabhakar T.V. (IISc Bangalore) **Topics:** WSN node design, communication, energy issues, IoT integration

ADVANCED JAVA PROGRAMMING	
Course Code: 25CS**PE4035**	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, SDG-9

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-II	**SWINGS** Introduction to swings, difference between AWT and Swings, java foundation classes, java swings classes.
UNIT-III	**ADVANCED NETWORKING** Client- Server 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.

OPEN EDUCATIONAL RESOURCES(OER)

1. **NPTEL – Programming in Java (Includes Advanced Topics)**

   Link: https://nptel.ac.in/courses/106105191
   Instructor: Prof. Debasis Samanta (IIT Kharagpur)
   Topics: JDBC, JavaBeans, Multithreading, Networking, GUI (Swing), Servlets

2. **Coursera (Free Audit) – Advanced Java Programming**

   Link: https://www.coursera.org/learn/advanced-java-programming
   Institution: LearnQuest
   Topics: Java Networking, RMI, JDBC, Servlets, JSP
   Type: Videos + Assignments + Certificate (paid option)

NASSCOM ASSOCIATE ANALYTICS - II	
Course Code: 25CS**PE4037**	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVE
1. To provide knowledge of the tools, technologies & programming languages which are used in the 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 are used in the day to day analytics cycle. 2. Analyze and use the best tools to make sense from available raw data.

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

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
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

1. To introduce the concepts, architecture, and applications of data warehousing and data mining.
2. To develop the ability to preprocess data and apply OLAP operations and dimensional modeling for business analysis.
3. To explore and implement core data mining techniques such as classification, prediction, clustering, and association rule mining.
4. To apply mining methods to complex data types including spatial, multimedia, text, and web data.
5. 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:

1. Understand the architecture and components of data warehousing and data mining systems, including OLAP operations.
2. Apply data preprocessing techniques such as cleaning, integration, transformation, and reduction to prepare analytical datasets.
3. Analyze and implement classification and prediction models such as decision trees, Bayesian classifiers, and support vector machines.
4. Discover patterns and associations using frequent itemset mining and constraint-based association rule techniques.
5. Perform cluster analysis using partitioning, hierarchical, density-based, and model-based clustering methods.
6. Describe complex data types and apply mining techniques to spatial, multimedia, text, and web data.
7. 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 to 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. Han, J., Pei, J., & Tong, H. (2022). *Data Mining: Concepts and Techniques* (4th ed.). Morgan Kaufmann.
2. Sam Anahory, Dennis Murray – Data Warehousing in the Real World, Pearson Education.
3. Arun K. Pujari – Data Mining Techniques, Universities Press.

REFERENCE BOOKS

1. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar – Introduction to Data Mining, 2nd Edition, Pearson.
2. Paulraj Ponniah – Data Warehousing Fundamentals for IT Professionals, Wiley India.
3. Margaret H. Dunham, S. Sridhar – Data Mining: Introductory and Advanced Topics, Pearson Education.
4. W.H. Inmon – Building the Data Warehouse, John Wiley & Sons.
5. Alex Berson, Stephen J. Smith – Data Warehousing, Data Mining and OLAP, McGraw Hill.
6. Developing the Data Warehouses- W.H Ionhman,C.Klelly, John Wiley & Sons.

OPEN EDUCATIONAL RESOURCES

1. **MIT OpenCourseWare (OCW) – Data Mining** 🔗 **MIT OCW Machine Learning**
2. **MERLOT Collection** 🔗 **MERLOT – Data Mining**
3. **OER Commons** 🔗 **OER Commons – Data Mining Resources**

MOBILE COMPUTING	
Course Code: 25CS**PE4027**	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVE

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-9, SDG-11, SDG-13

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 -D**istributed 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
Charles E. Perkins, Ad hoc Networks, Addison Wesley, 2008. 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 EDUCATIONAL RESOURCES(OER)

1. **NPTEL – Mobile Computing**

   Link: https://nptel.ac.in/courses/106106147
   Instructor: Prof. Kumaravelu S (IIT Madras)
   Topics: GSM, GPRS, 3G/4G, mobile TCP, MAC protocols, mobile IP

2. **NPTEL – Wireless and Mobile Networks**

   Link: https://nptel.ac.in/courses/106105081
   Instructor: Prof. Bhaskaran Raman (IIT Bombay)
   Topics: Mobility models, wireless TCP, adhoc routing, sensor networks

OPEN SOURCE SOFTWARE	
Course Code: 25CS**PE4031**	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVE

1. To introduce concepts, principles and applications of open source software.
2. To discuss the open source software development process.
3. To understand the difference between open source software and commercial software.
4. To familiarize myself with the Linux operating system.
5. To understand and develop 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 systems.
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, SDG-9, SDG-11

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**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	**UNIT II LINUX**: Introduction to Linux Essential Commands - Filesystem Concept - Standard Files 1. The Linux Security Model - Vi Editor - Partitions creation - Shell Introduction 2. String Processing - Investigating and Managing Processes - Network Clients - Installing Application.
UNIT-III	**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	**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	**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

- 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

- Eric Rosebrock, Eric Filson,"Setting Up LAMP: Getting Linux, Apache, MySQL, and PHP and Working Together", Published by John Wiley and Sons, 2004.
- Philosophy of GNU URL: http://www.gnu.org/philosophy/.
- Version control system, URL: http://git-scm.com/
- SVN version control, URL: http://svnbook.red-bean.com

OPEN EDUCATIONAL RESOURCES(OER)

1. **NPTEL – Data Science for Engineers (with R examples)**

   Link: https://nptel.ac.in/courses/106106179
   Instructor: Prof. Raghunathan Rengaswamy (IIT Madras)
   Topics: Data preprocessing, classification, regression, clustering using R

2. **edX – Data Analysis for Life Sciences (R-based ML Intro)**

Link:
https://www.edx.org/professional-certificate/harvardx-data-analysis-for-life-sciences
Institution: Harvard University
Courses include: Statistical learning, ML using R, case studies

Data Analytics Tools	
Course Code: 25CS0302D	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 an understanding of the fundamental concepts and processes of data analytics.
2. To introduce students to R and R-Studio, and teach basic data types and structures in R.
3. To equip students with skills for importing, exporting, and performing exploratory data analysis (EDA) in R.
4. To familiarize students with report generation tools like Google Data Studio and Tableau, focusing on creating interactive dashboards.
5. To enable students to apply their knowledge through hands-on activities and case studies, enhancing their practical skills in data analytics.

COURSE LEARNING OUTCOMES (CLO's)

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

1. Demonstrate an understanding of the basic principles and processes of data analytics.
2. Utilize R and R-Studio to handle basic data types and structures, and perform fundamental operations.
3. Import, export, and clean data in R, and conduct exploratory data analysis (EDA) using descriptive statistics and data visualization techniques.
4. Create interactive reports and dashboards using Google Data Studio and Tableau, effectively visualizing data insights.
5. Apply data analytics tools and techniques to real-world datasets through hands-on projects, presenting and interpreting their findings accurately.

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-9

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT-I	**Introduction to Data Analytics** Overview of Data Analytics: Definition and importance, Types of data analytics, Applications and examples; Data Analytics Process: Steps in the data analytics process, Key concepts; Introduction to Data Analytics Tools: Overview of tools, Comparison of tools
UNIT-II	**Foundations of R and Data Structures** Introduction to R and RStudio: Installation and setup, RStudio interface; Basic R Syntax and Operations: Writing and executing R commands, Basic arithmetic and logical operations, Understanding variables and assignments; Data Types and Structures in R: Vectors, matrices, and arrays, Data frames and lists, Factors and strings
UNIT-III	**Data Handling and Exploratory Analysis in R** File Import and Export in R: Reading data from CSV, Excel, Writing data to CSV and Excel, Handling different file types; Exploratory Data Analysis (EDA) with R: Descriptive statistics, Data visualization using `ggplot2`, Data manipulation using `dplyr`, Case study
UNIT-IV	**Interactive Data Visualization Tools : Google Data Studio / Tableau / Any other** Introduction, Creating an account/installation, Connecting to data sources, Building basic visualizations, Creating interactive dashboards;
UNIT-V	**Hands-On Activity / Case Study** Mini Project with R: Choose a dataset, Perform data manipulation, visualization, and analysis, Present findings; Mini Project with Google Data Studio / Tableau: Choose a dataset, Create visualizations and dashboard, Present the dashboard and insights

TEXT BOOKS

Grolemund, G., & Wickham, H. (2017). R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. O'Reilly Media.

Matloff, N. (2011). The Art of R Programming: A Tour of Statistical Software Design. No Starch Press.

Murray, D. (2016). Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software. John Wiley & Sons.

Devey, B. (2020). Google Data Studio for Beginners: A Step by Step Guide to Building Better Data Visualizations and Business Intelligence with Google Data Studio. Independently Published

REFERENCE BOOKS / RESOURCES

1. Shmueli, G., Patel, N. R., & Bruce, P. C. (2010). Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner. John Wiley & Sons.
2. Adler, J. (2010). R in a Nutshell: A Desktop Quick Reference. O'Reilly Media.
3. Few, S. (2013). Information Dashboard Design: Displaying Data for At-a-Glance Monitoring. Analytics Press.
4. Google. (n.d.). Google Data Studio Help Center. Retrieved from https://support.google.com/datastudio/answer/6283323?hl=en
5. Google. (n.d.). Introduction to Data Studio. Coursera. Retrieved from https://www.coursera.org/learn/google-data-studio

NASSCOM ASSOCIATE ANALYTICS - III	
Course Code: 25CS**PE4039**	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, SDG-8, SDG-9

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
NASSCOMM

SYLLABUS OF ABILITY ENHANCEMENT COURSES

COMMUNICATIVE ENGLISH
(COMMON TO ALL BRANCHES OF B.TECH.)

COMMUNICATIVE ENGLISH	
Course Code: 25HS101/25HS202	**Continuous Evaluation:**40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Basic Knowledge of English	

COURSE OBJECTIVES (COs)

1. To prepare the students for their career which will require them to listen, read, speak, and write in English both for their professional as well as interpersonal communication
2. To write clear, coherent, and well-organized texts, such as emails, essays, reports, and other forms of written communication.
3. 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.
4. To enhance student's ability to understand spoken English in various contexts, including conversations, lectures, and media.
5. To enhance student's vocabulary and master key grammatical structures, enabling them to communicate more effectively and accurately.

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. 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 (COS) AND COURSE LEARNING OUTCOMES (CLOS)

COs/CLOs	**CLO1**	**CLO2**	**CLO3**	**CLO4**	**CLO 5**
CO1	✓	✓	✓		
CO2		✓		✓	
CO3			✓		
CO4				✓	✓
CO5					✓

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT -I	**Introduction to Communication** Elements and Process of Communication, Types and Barriers to Communications, Grice Conversational Maxims and Cooperative Principles, Verbal and non-verbal communication, Body Language: Proxemics, Chronemics, and Haptics, Identifying and rectifying common errors: Types of Sentences (Statements, interrogative, exclamatory, Optative, and imperative, Wh/How-questions, question-tags), Basic Grammar: - Articles, Prepositions, Cliches, Collocations, and Punctuations, Case studies based on Communication Skills https://pressbooks.bccampus.ca/technicalwriting/chapter/casestudy-costpoorcommunication/	**6**
UNIT -II	**Workplace Communication** Communication Challenges in a Culturally Diverse Workplace; Ethics in Communication, Bias-free communication, Effective Business Presentations: Importance in workplace communication; Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Handling Questions; and PowerPoint Presentation, Case Studies based on communication challenges in the workplace	**6**
UNIT -III	**Effective Writing** Paragraph Writing: Topic Sentence, Guided composition, Free-writing, Reading comprehension practice: Technical and General text, use of different techniques (skimming and scanning), Selection of Words; Coherence and Cohesion, Use of discourse markers concerning technical writing, Case Studies based on technical writing skills	**6**
UNIT -IV	**Business Writing at Work** Cover Letters and Applications, Writing notices and circulars, Email Writing and Memorandum, Writing reports	**6**

TEXTBOOKS

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.

COMMUNICATIVE ENGLISH LAB	
Course Code: 25HS151/25HS252	**Continuous Evaluation:**30 Marks
Credits: 1	**End Semester Examination:** 70 Marks
L T P : 0 0 2	
Prerequisite: Basic Knowledge of English	

COURSE OBJECTIVES (COs)

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
3. To increase their competence and boost their confidence.
4. To enable the students to properly communicate and express themselves in writing.
5. 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.

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. 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 (COs) & COURSE LEARNING OBJECTIVES (CLOs)

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

LIST OF ACTIVITIES

UNIT	COURSE CONTENTS	HOURS
UNIT -I	• Listening and Speaking • Accent in speech (British and American) • Practicing Sounds of English: Stress and Intonation Patterns	4
UNIT -II	• Role-play • Extempore • JAM (Just a minute)	4
UNIT -III	• Presentations • Interview Simulations • Telephone Etiquettes	4
UNIT -IV	• Formal speech- Welcome Speech and Vote of thanks • Public Speaking and Rhetoric • Group Discussions and Debates	4

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 &PuspaLata, Oxford University Press. 2nd Edition.
3. Business Communication Today by Courtland L Bovee and Thill, Pearson

FRENCH-1	
Course Code: 25FLFR101	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Basics of English Language	

COURSE OBJECTIVES (COs)

1. To develop the skills to construct short and simple sentences.
2. To prepare the students to identify themselves with the culture of the Francophone world.
3. To develop in students a good degree of understanding of syntactic, lexical, grammatical and stylistic features of the French language.
4. To demonstrate differences and diversity of the French speaking world with their own

COURSE LEARNING OUTCOMES (CLOs)

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

1. Speak themselves in French used in daily conversations.
2. Explain cultural artefacts, practices and perspectives of the French speaking world.
3. Apply linguistic knowledge to analyse a simple text, identifying its salient features, and thus express themselves effectively in French.
4. Contrast culture of the French speaking world with their own, and hence demonstrate an increased awareness towards its key practices and perspectives.

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

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

COURSE CONTENTS

UNIT	Unités	Objectifs de Communication	Grammaire	Lexique	Heures
UNIT-I	**La Salutation et l'Introduction**	Saluer. Entrer en Contact. S'Excuser. Remercier. Se Présenter/Présenter Quelqu'un.	Pronoms Personnels Sujets. L'Alphabet. Les Articles Indéfinis. Les Verbes en -ER au Présent.	Salutations, Les Nombres. Les Objets de la Classe. La Nationalité.	8

UNIT-II	**On Partage des Renseignements**	Demander de Se Présenter. Donner des Renseignements Personnels.	Etre et Avoir au Présent. Les Verbes en -ER au Présent. Adjectifs de Nationalités. L'Interrogation.	Adjectifs de Nationalité, Métiers et Secteurs Professionnels, Goûts et Intérêts	8
UNIT-III	**Ma Ville et Mon Quartier**	Décrire et Qualifier Ville ou Quartier. Localiser. Demander et Donner Directions.	Verbe Vivre. Articles Définis (Le, la, les). Il y a/ Il n'y a pas. Prépositions. Adjectifs Qualificatifs. Impératif.	Prépositions de lieux. Vocabulaire des Sites. Etablissements et Service de Ville.	7
UNIT-IV	**Mes Intérêts et Goûts**	Parler de Ses Goûts et de Ses Loisirs. Donner Son Impression sur le Caractère de Quelqu'un.	Présent des Verbes en -ER, et du Verbe Faire. Négation, Adjectifs Possessifs.	Avoir l'air. Loisirs. L'Expression des Goûts. Faire du/ de la. Ma Famille.	7

TEXT BOOKS

1. Version Originale 1, Livre de l'élève: Denyer M. & Agustin GarmendiaA. & Olivieri M L L., éd. Maisons des Langues, Paris. 2013.

REFERENCE BOOKS

1. Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. &Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.
2. Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al,CLE International, Paris, 2013.

   Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan

GERMAN-II	
Course Code:25FLGR202	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: GERMAN-I	

COURSE OBJECTIVES (COs)

The objective of this course is to impart basic knowledge of German language to the students. The course intends to grow the ability of verbal and written communication. Overall, the objective is to facilitate comprehension of daily life contexts in German, both oral as well as written.

1. To develop oral and written skills of understanding, expressing and exchanging information in German language.
2. To develop awareness of the nature of language and language learning.
3. To develop the ability to construct sentences and frame questions.
4. To provide the German language as a competitive edge in career choices.
5. To know some of the aspects of the culture of the countries where German language is spoken.

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course the students will have the ability to:

1. Read and write short, simple texts.
2. Understand and take part in short, simple conversations using the skills acquired.
3. Know some aspects of the culture of the countries where the German language is spoken.
4. Read a text and/or e-mail during any employment.

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

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	- Zeitangabe, Tageszeit, Uhrzeit, der Tagesablauf - Präpositionen mit Akkusativ, Ordinalzahlen - Wegbeschreibung, die Himmelsrichtungen - Die Gebäude, Verkehrsmittel	8
UNIT-II	- Das Haus - Modalverben - Essen und Trinken, Messeinheiten, Einkaufen - Körperteile und Krankheiten - Future	8
UNIT-III	- Dativ, Artikel und Personalpronomen im Dativ - Präpositionen mit Dativ, die Wechselpräpositionen - Possessiv-Artikel, die Konnektoren - Schreiben Teil 1 - Trennbare Verben	7
UNIT-IV	- Schreiben Teil 2 (E- Mail Schreiben) - Perfekt - Vergangenheit erzählen, Das Wochenende, Lebenslauf	7

TEXT BOOKS

1.Netzwerk Neu A1 (Kursbuch+Arbeitsbuch)by Stefanie Dengler, et al.Ernst Klett Sprachen, 2019.

OPEN EDUCATIONAL RESOURCES

1. Website for additional materials: https://www.nthuleen.com/teach.html

REFERENCE BOOKS

1. Studio D A1, Hermann Funk, Christina Kuhn, Silke Demme, 2010, Cornlesen.
2. Einfache Grammatik: Übungsgrammatik Deutsch A1 bis B1, Paul Rusch, Helen Schmitz, 2012, Langenscheidt.
3. Berliner Platz - neu: Lehr- und Arbeitsbuch, Christiane Lemcke, Lutz Rohrmann, Theo Scherling, 2009, Klett Sprachen.
4. Tangram aktuell 1: A1, Rosa-MariaDallapiaza, Eduard von Jan, Sabine Dinsel, 1998, Hueber Verlag.
5. Lernziel Deutsch: Deutsch als Fremdsprache, Teil 1, Wolfgang Hieber, 1984, Max Hueber Verlag.

1.

FRENCH-1	
Course Code: 25FLFR101	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Basics of English Language	

COURSE OBJECTIVES (COs)

1. To develop the skills to construct short and simple sentences.
2. To prepare the students to identify themselves with the culture of the Francophone world.
3. To develop in students a good degree of understanding of syntactic, lexical, grammatical and stylistic features of the French language.
4. To demonstrate differences and diversity of the French speaking world with their own

COURSE LEARNING OUTCOMES (CLOs)

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

1. Speak themselves in French used in daily conversations.
2. Explain cultural artefacts, practices and perspectives of the French speaking world.
3. Apply linguistic knowledge to analyse a simple text, identifying its salient features, and thus express themselves effectively in French.
4. Contrast culture of the French speaking world with their own, and hence demonstrate an increased awareness towards its key practices and perspectives.

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

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

COURSE CONTENTS

UNIT	Unités	Objectifs de Communication	Grammaire	Lexique	Heures
UNIT-I	**La Salutation et l'Introduction**	Saluer. Entrer en Contact. S'Excuser. Remercier. Se Présenter/Présenter Quelqu'un.	Pronoms Personnels Sujets. L'Alphabet. Les Articles Indéfinis. Les Verbes en -ER au Présent.	Salutations, Les Nombres. Les Objets de la Classe. La Nationalité.	8
UNIT-II	**On Partage des Renseignements**	Demander de Se Présenter. Donner des Renseignements Personnels.	Etre et Avoir au Présent. Les Verbes en -ER au Présent. Adjectifs de Nationalités. L'Interrogation.	Adjectifs de Nationalité, Métiers et Secteurs Professionnels, Goûts et Intérêts	8

UNIT-III	**Ma Ville et Mon Quartier**	Décrire et Qualifier Ville ou Quartier. Localiser. Demander et Donner Directions.	Verbe Vivre. Articles Définis (Le, la, les). Il y a/ Il n'y a pas. Prépositions. Adjectifs Qualificatifs. Impératif.	Prépositions de lieux. Vocabulaire des Sites. Etablissements et Service de Ville.	7
UNIT-IV	**Mes Intérêts et Goûts**	Parler de Ses Goûts et de Ses Loisirs. Donner Son Impression sur le Caractère de Quelqu'un.	Présent des Verbes en -ER, et du Verbe Faire. Négation, Adjectifs Possessifs.	Avoir l'air. Loisirs. L'Expression des Goûts. Faire du/ de la. Ma Famille.	7

TEXT BOOKS

1. Version Originale 1, Livre de l'élève: Denyer M. & Agustin GarmendiaA. & Olivieri M L L., éd. Maisons des Langues, Paris. 2013.

REFERENCE BOOKS

1. Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. &Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.
2. Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al,CLE International, Paris, 2013.

   Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan

FRENCH-II	
Course Code: 25FLFR202	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: French-I	

COURSE OBJECTIVES (COs)

1. To develop the skills to construct short and simple sentences.
2. To prepare the students to identify themselves with the culture of the Francophone world.
3. To develop in students a good degree of understanding of syntactic, lexical, grammatical and stylistic features of the French language.
4. To demonstrate differences and diversity of the French speaking world with their own

COURSE LEARNING OUTCOMES (CLOs)

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

1. Express themselves in French used in daily conversations.
2. Recognise and explain cultural artefacts, practices and perspectives of the French speaking world.
3. Apply linguistic knowledge to analyse a simple text, identifying its salient features, and thus express themselves effectively in French.
4. Contrast culture of the French speaking world with their own, andhence demonstrate an increased awareness towards its key practices and perspectives.

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

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

COURSE CONTENTS

UNIT	Unités	Objectifs de Communication	Grammaire	Lexique	Heures
UNIT-I	**Journée Typique**	Parler d'habitudes, Exprimer l'Heure, S'Informer sur l'Heure, Moment et Fréquence.	Verbes Pronominaux au Présent. Verbes Aller et Sortir	Heure, Moments de la Journée. Activités Quotidiennes. Adverb. Météo.	8
UNIT-II	**Achats**	S'informer sur un Produit. Acheter et Vendre un Produit. Donner Son Avis. Parler du temps.	Adjectifs Interrogatifs. Adjectifs Démonstratifs(Ce, cette, ces). Genre et Nombre. Verbe Prendre.	Vêtements. Couleurs. Fruits et Légumes.	8
UNIT-III	**Alimentation**	Parler des Plats et des Aliments. Commander un Menu dans un Restaurant. Situer une Action dans le Futur	Future Proche: Aller +Infinitif. Articles Partitifs(du/de la/des/d'). Pronoms COD. Future.	Aliments. Vocabulaire des Quantités.	7
UNIT-IV	**expérience vécue**	Parler du passé. Parler d'expériences. Parler de ce que nous savons faire.	Passé Composé. Imparfait	Verbes Savoir, Pouvoir et Connaître. Adjectifs Qualificatifs. Vocabulaire des Savoirs et Compétences. Récit de Vie.	7

TEXT BOOKS

1. Version Originale 1, Livre de l'élève: Denyer M. & Agustin GarmendiaA. & Olivieri M L L., éd. Maisons des Langues, Paris. 2013.

REFERENCE BOOKS

1. Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. &Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.
2. Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al,CLE International, Paris, 2013.
4. Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan.

DIGITAL MARKETING	
Course Code: 25CS0201C	Continuous Evaluation: 70 Marks
Pre-Requisite : NIL	End Semester Examination: 30 Marks
L T P : 0 0 2	
Credits: 2	

TRAINING OBJECTIVES(TOs)

1. To provide a foundational understanding of digital marketing concepts and strategies.
2. To explain the principles and practices of Search Engine Optimization (SEO).
3. To explore the role and strategies of social media marketing.
4. To examine digital advertising tools and methods for optimizing ad performance.
5. To design marketing strategy.

TRAINING LEARNING OUTCOMES (TLO's)

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

1. Explain the importance and components of digital marketing.
2. Understand how search engines work and apply SEO techniques to improve website visibility.
3. Develop strong social media profiles and create effective social media marketing strategies.
4. Utilize digital advertising tools and measure the performance of digital advertising campaigns.
5. Analyze and design marketing strategy for a given application or domain.

TRAINING LEARNING OUTCOMES (TLOs)-TRAINING OBJECTIVES (TOs) MAPPING

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

COURSE CONTENTS

UNIT NUMBER	TRAINING CONTENTS	ACTIVITY
UNIT-I	**INTRODUCTION TO DIGITAL MARKETING & MARKETING ANALYSIS:** Introduction To Online Digital Marketing, Importance Of Digital Marketing, Traditional Vs. Digital Marketing, Types of Digital Marketing, Market Research, Keyword Research And Analysis	Use keyword planner tools to identify high-potential keywords for their industry.
UNIT-II	**SEARCH ENGINE OPTIMIZATION(SEO):** Introduction to SEO, How Search engine works, SEO Phases, History Of SEO, How SEO Works, , Types Of SEO technique, Keywords, Keyword Planner tools	**Review the SEO history and current status of a real-world website**
UNIT-III	**SOCIAL MEDIA MARKETING:** Introduction to Social Media Networks, Types of Social Media Websites and their Marketing strategies. Creating Strong Social Media Profiles.	**Develop a social media strategy for a startup, focusing on creating strong profiles and engaging content.**
UNIT-IV	**ADVERTISING TOOLS and OPTIMIZATION:** Advertising & its importance, Digital Advertising, Different Digital Advertisement, Performance of Digital Advertising, Display Advertising Media, Digital metrics.	Analyze the digital advertising strategy of a major e-commerce platform
UNIT-V	**CASE STUDY/HANDS-ON:** Googlebot (Google Crawler) /You-tube advertising/ Develop a social media strategy for a startup, focusing on creating strong profiles and engaging content/ Design a digital advertising campaign for a local business and measure its performance using digital metrics.	

TEXT BOOKS

- Digital Marketing –Kamat and Kamat-Himalaya
- Marketing Strategies for Engaging the Digital Generation, D. Ryan

REFERENCE BOOKS

- Digital Marketing, V. Ahuja, Oxford University Press
- Digital Marketing, S.Gupta, McGraw-Hill
- Quick win Digital Marketing, H. Annmarie , A. Joanna, Paperback edition

Department Of Training & Placement			
Training Cell			
Programme	**Faculty of Engineering & Technology**		
Year / Semester	**2 / 3**	**Course Category**	**SEC**
Course Code	**23SS351**	**Course Title**	**Effective Communication Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

TRAINING OBJECTIVES(TOs)

1. TO1. To define and understand communication and its process.
2. TO2. To make student practice on communication skills via LSRW approach via instructing, engaging, assessing and re engaging.
3. TO3. To enhance the confidence and motivation of a student by honing his communication skills.

TRAINING LEARNING OUTCOMES(TLOs)

After the completion of the training, the student will have ability:

1. TLO1. To communicate effectively and interact with people with confidence.
2. TLO2. To demonstrate and differentiate between various forms of communication.
3. TLO3. To apply effective communication skills confidently, to get ahead in job and life.

MAPPING MATRIX OF TRAINING OBJECTIVES AND TRAINING LEARNING OUTCOMES			
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:

1. The training will be based on the concept of learning by practice.
2. The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student engagement in training activities.
3. 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 Assessment / Written Assessment	10		
IV	Reading & Writing Skills		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	**23SS452**	**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): -

1. TO1. To make the students learn & demonstrate effective teamwork, leadership & interpersonal skills.
2. TO2. To equip the students with capability of handling stress and utilization of work time effectively.
3. 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:

1. TLO1. To be confident working in a team and leading it as well.
2. 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.
3. TLO3. To get benefitted from Emotional Quotient in building stronger professional relationships and achieving career and personal goals.
4. TLO4. To face complex problems and effectively deal with it in the job due to Critical Thinking & Problem Solving Skills.

MAPPING MATRIX OF TRAINING LEARNING OUTCOMES AND TRAINING OBJECTIVES

TRAINING LEARNING OUTCOMES (TLO) **TRAINING OBJECTIVES (TO)**	TLO1	TLO2	TLO3	TLO4
TO1				
TO2				
TO3				

UNIT	COURSE CONTENT	STUDENT ENGAGEMENTS
UNIT-I	**TEAM MANAGEMENT** 1. Team communication & team conflict resolution 2. Role of a team leader 3. Team goal setting & understanding team development 4. Team dynamics & multicultural team activity 5. Johari Window Model	Collaborative Working Game Activity
UNIT-II	**TIME MANAGEMENT** 1. Time management matrix 2. Pareto Principle (80/20 rule) 3. Development process of plan of action	What You Did Yesterday Activity
UNIT-III	**LEADERSHIP** 1. Difference between leadership & management 2. Types of leadership style 3. Core leadership skills	Lead The Blindfolded Activity
UNIT-IV	**STRESS MANAGEMENT** 1. Sign of stress & its impact 2. Types of stress 3. Techniques of handling stress	Keeping Cool Activity
UNIT-V	**EMOTIONAL INTELLIGENCE** 1. Emotional intelligence & emotional competence 2. Components & behavioral skills of emotional intelligence	Guess The Emotion Game Activity
UNIT-VI	**CRITICAL THINKING** 1. Types of thinking & Characteristics 2. Critical thinking standards 3. 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 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 AND PLACEMENT			
TRAINING CELL			
PROGRAMME	**FACULTY OF ENGINEERING AND TECHNOLOGY**		
YEAR/ SEMESTER	**3 / 5**	**COURSE CATEGORY**	**SEC**
COURSE CODE	**23SS553**	**COURSE TITLE**	**PRESENTATION SKILLS**
CONTINUOUS EVALUATION: 70		**END TERM EXAMINATION: 30**	
PREREUSITE :NIL		**L T P: 0 0 2**	**CREDITS:1**

TRAINING OBJECTIVES

1. TO1. To develop the public speaking skills of the student.
2. TO2. To make the students learn and adapt to the necessary etiquettes required working and growing in corporate culture.
3. 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:

After the completion of the training, the student will have ability:

1. TLO1. To be confident in presenting himself in front of an audience.
2. TLO2. To become professional in his approach towards work culture.
3. TLO3. To enhance the level of 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** 6. 4 P's of presentation skills – plan, prepare, practice & present 7. Guidelines for effective presentation	PPT Presentation Activity
Unit-II	**Storytelling Skills** 4. 4 P's of storytelling skills – people, place, plot & purpose 5. Types of storytelling techniques 6. Importance of storytelling skills	Start From Where I Stopped Activity
Unit-III	**Corporate Culture Etiquettes** 7. Importance of professional behavior at work place 8. Understand & implementation of etiquettes at work place 9. Importance of values & ethics 10. Types of professional / corporate etiquettes	Etiquettes Role Play Activity
Unit-IV	**Debate / Extempore** 4. Difference between debate, extempore & group discussion 5. Learning argument /counter argument in debate	Current Affair Topic Speech Activity
Unit-V	**Art of Creating Impression** 11. Importance of creating first impression 6. 6 ways to master the art of creating impression	Speech Activity
Unit-VI	**Problem Solving** 12. 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

1. The training will be based on the concept of learning by practice.
2. The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student engagement in training activities.
3. 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

<table>
<tr><th>Unit No.</th><th>Unit Name</th><th>Internal Assessment Parameter</th><th>Internal Marks (70)</th><th>End Term Assessment Parameters</th><th>End Term Marks (30)</th></tr>
<tr><td>I</td><td>Importance of Presentation Skills</td><td>Presentation Activity</td><td>20</td><td rowspan="3">Written Test</td><td rowspan="3">10</td></tr>
<tr><td>II</td><td>Storytelling Skills</td><td>Speech Activity</td><td>15</td></tr>
<tr><td>III</td><td>Corporate Culture Etiquettes</td><td>Assignment</td><td>10</td></tr>
<tr><td>IV</td><td>Debate/Extempore</td><td rowspan="2">Speech Activity / Written Activity</td><td>15</td><td rowspan="2">Viva</td><td rowspan="2">20</td></tr>
<tr><td>V</td><td>Art of Creating Impression</td><td rowspan="2">10</td></tr>
<tr><td>VI</td><td>Problem Solving</td><td></td><td></td><td></td></tr>
</table>

SEMESTER – VI

Department Of Training & Placement			
Training Cell			
Programme	**Faculty of Engineering & Technology**		
Year / Semester	**3 / 6**	**Course Category**	**SEC**
Course Code	**23SS654**	**Course Title**	**Professional Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

TRAINING OBJECTIVES:

1. TO1. To encourage students to learn and apply effective writing skills.
2. TO2. To make the students learn various types of business correspondence letters, cover letters & resume.
3. TO3. To encourage students to learn as to how to talk and convince people in GD & interview.
4. TO4. To make the students learn to build rapport for building positive relationships professionally at the workplace.

Training Learning Outcomes (TLO): -
After the completion of the training, the student will have ability:

1. TLO1. To understand the importance of professional writing required in the workplace.
2. TLO2. To explore different formats in resume, cover letters & other business related letters.
3. TLO3. To develop knowledge, skills and understanding people in-group and individually.
4. 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** 8. Importance of email communication skills 9. Basic rules of effective email writing 10. Structure of email – address, subject, message text, attachments, signature	Email Practice Activity
Unit-II	**Resume Writing** 13. Difference between Resume, CV & Bio data 14. Guidelines of resume writing 15. Resume preparation of the student	Resume Making Activity
Unit-III	**Letter Writing** 16. Types of Letter Writing – Application, Leave, etc. 17. Cover letter	Letter Writing Activity
Unit--IV	**Group Discussion (GD)** 11. Characteristics of GD & subject knowledge 12. Do's & Don'ts in GD 13. Strategies of GD 14. Types of GD	Group Discussion Practice Activity
Unit-V	**Interview Skills** 18. Preparation of the interview & company details information 19. Do's & Don'ts in interview 20. Types of Interviews 21. Strategies of interview	Mock Interview Practice Activity
Unit-VI	**Negotiation Skills** 7. Importance of negotiation skills 8. Four phases of negotiation skills 9. Barriers to negotiation & overcoming it 10. 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

1. The training will be based on the concept of learning by practice.
2. The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student engagement in training activities.
3. 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	**23AR755**	**Course Title**	**Aptitude & Reasoning**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

TRAINING OBJECTIVES:

1. TO1. To understand the basic concepts of quantitative ability and logical reasoning.
2. TO2. To make students practice on the concepts of quantitative ability and logical reasoning.
3. TO3. To prepare the students for aptitude and reasoning round in placement selection process & other competitive exams.

TRAINING LEARNING OUTCOMES:

After the completion of the training, the student will have ability:

1. TLO1. To understand the basic concepts of quantitative ability.
2. TLO2. To solve campus placements aptitude papers covering Quantitative Ability.
3. 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			

QUANTITATIVE APTITUDE:

UNIT	CONTENT
I	Number System ,Percentage, Profit, Loss and Discount Simple Interest and Compound Interest.
II	Allegation and Mixture AverageRatio, Proportion and Variation, Problem on Ages and Numbers ,Time and Work Time, Speed and Distance.
III	Permutation and Combination,Probability Data Interpretation,Geometry and Menstruations,Sequence, Series & Progression and Logarithmic.

LOGICAL REASONING:

UNIT	CONTENT
IV	Number Series and Alphabet Series, Direction Sense Test, Coding -Decoding Blood Relation.
V	Syllogism, Dice, Cube and Cuboids, Seating Arrangement.
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:

1. The training will be based on the concept of learning by doing and practice.
2. The training will involve 50% of the training time on teaching the concepts and the remaining 50% will be focusing on practice.
3. The training will follow a circular approach where students are taught, evaluated and given 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 Logical Reasoning	Written Assignment	10	Written Test	30
II			10		
III			10		
IV			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 (COs)

1. Understand and apply various statistical measures to analyze and interpret data.

2. To analyze bivariate data using correlation and regression techniques, interpret and fit appropriate curves for predictive modeling.

3. Understand fundamental probability concepts.

4. Apply appropriate hypothesis testing methods to analyze population parameters.

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. Compute and interpret different measures of central tendency, dispersion to summarize and analyze datasets.

2. Compute and interpret correlation coefficient and fit a linear regression model.

3. Apply the laws of addition and multiplication, and use Bayes' theorem to solve real-world problems.

4. Elucidate and conduct hypothesis tests for single and two-population parameters in real-world scenarios.

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	CONTENT
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, interpret and significance of data.
UNIT-II	**Bivariate Data Analysis** Bivariate Data, Scatter plot, Correlation, Karl Pearson's correlation coefficient, Rank correlation – Spearman's and Kendall's measures. 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		**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 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	CONTENT
UNIT-I	**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-II	**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-III	**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-IV	**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-V	**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: 23MDC 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	CONTENT
UNIT-I	**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-II	**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-III	**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-IV	**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	**23MDC501**	**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	CONTENTS
UNIT-I	**Library Collection:** Type of Information Sources : Primary, Secondary and Tertiary, Reference Collection: Type of reference sources Indexing and Abstracting Journals Multimedia Collection Arrangement of Information Sources : Classification.
UNIT-II	**Information Services:** Bibliography: Type of Bibliography. Reviews Literature. Citation Style. Citation Analysis: Web of Science and Scopus. Online Databases : Structure and Retrieval.
UNIT-III	**Media Literacy** Introduction to Media Literacy. Type of media: Traditional versus social media. Bias in media.
UNIT-IV	**Motive of Media** Media tycoons and conditions in which media works. 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	23MDC502	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	CONTENT
UNIT-I	**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-II	**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-III	**TRADEMARKS** Trademark – value of and relevance for businesses Protecting brand value- acquiring trademark nationally and internationally Trade mark disputes – case studies
UNIT-IV	**PATENTS** Protecting innovation – acquiring patents nationally and internationally Product and process patents Assigning patents and its commercialization Patent Disputes
UNIT-V	**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-VI	**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 to 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/.
4. 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 different demography terms and trends.
2. To make students familiar with growth and its distribution.
3. To discuss the major changes in the 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			

COURSE CONTENTS

UNIT	CONTENT
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: Indiaand its Contradictions*, Princeton UniversityPress.
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 ofIndian Economy: 1950-2008.AStory of Sustained Savings and Investment, *Economic and Political Weekly*,May.
4. S.L. Shetty, 2007,—India's SavingsPerformancesincethe Advent ofPlanning,in K.L. Krishna and A. Vaidyanathan, editors, *Institutions and Markets in India's Development.*
5. Himanshu, 2010,—TowardsNew Poverty LinesforIndia, *Economicand Political Weekly*,January.

Year/Semester	3rd / 6th	Course Category	MDC
Course Code	23MDC604	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 OBJECTIVE AND COURSE LEARNING OUTCOMES

COURSE OBJECTIVES (CO)	COURSE LEANING OUTCOME(CLO)				
	CLO1	CLO2	CLO3	CLO4	CLO5
CO1					
CO2					
CO3					
CO4					

COURSE CONTENTS:

UNIT	CONTENT
UNIT-I	**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-II	**Electoral Institutions** Election Commission (EC) State Election Commission Constitution: Part-15
UNIT-III	**Political Parties in India** One-party, Two Party, Multi-party system Model Code of Conduct, Party Funding, and Campaign
UNIT-IV	**Elections: 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:	**Continuous Evaluation:** 40 Marks
Credits: 3	E**nd 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 plans.
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(CO)	**COURSE LEARNING OUTCOMES(CLO)**			
	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
CO 1	✓				
CO 2		✓			
CO 3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	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: 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	**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:	**Continuous Evaluation**: 40
Credits: 03	**End Semester Examination**: 60
L T P : 3-0-0	**Course Type**: MDC
Prerequisite: Students should be aware about various saving schemes and their future benefits.	

COURSE OBJECTIVES:

1. Build an understanding to familiarize different aspects 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 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 insurance and retirement planning with relevance

MAPPING MATRIX COURSE OBJECTIVES & COURSE LEARNING OUTCOMES

CLO / CO	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

TEXT 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 an 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 :**(BLOOM'S TEXONOMY)**

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 CONTENT:

UNIT	COURSE CONTENT
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 –UpStretchinGExercises 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. Adolescence-Problems related with Adolescence i.e.physical problems, Peer group Relationship, Career Selection,Drug Abuse, Psychological and Emotion 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 AssociationsVisits to Recreational Clubs

RECOMMENDED TEXT BOOKS:

1. Foundations of Physical Education, Chales A. Bucher
2. Foundations of Physical Education, 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

(COMMON TO ALL BRANCHES EXCEPT BIO MEDICAL ENGINEERING)	
Course Code: 23VAC102/202	Continuous Evaluation: 30 Marks
Credits: 2	End Semester Examination: 70 Marks
L T P : 2 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

1. 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.
2. To make students understand the detailed analysis and importance of Fundamental Rights, their relationship with Directive Principles and the significance of Fundamental Duties.
3. To acquaint the students with the way social, political and economic justice could be realized.
4. To acquaint the students with the basic postulates of constitutional framework regarding the organization, powers and functions of the various organs of the State.
5. To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.
6. 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:

1. 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.
2. Differentiate different aspects of Indian Legal System and its related bodies
3. To appreciate the critical Interface between fundamental Rights and directive principles of state policy and apply the rationale to emerging issues and challenges.
4. Know about the enforcement remedies available under the Constitution of India
5. To apply Intellectual Property Law principles to real problems and analyse the social impact of Intellectual Property Law and Policy
6. 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)

INDIAN CONSTITUTION & POLITY (COMMON TO ALL BRANCHES EXCEPT BIO MEDICAL ENGINEERING)	
Course Code: 23VAC102/202	Continuous Evaluation: 30 Marks

Credits: 2	End Semester Examination: 70 Marks
L T P : 2 0 0	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

1. 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.
2. To make students understand the detailed analysis and importance of Fundamental Rights, their relationship with Directive Principles and the significance of Fundamental Duties.
3. To acquaint the students with the way social, political and economic justice could be realized.
4. To acquaint the students with the basic postulates of constitutional framework regarding the organization, powers and functions of the various organs of the State.
5. To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.
6. 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:

1. 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.
2. Differentiate different aspects of Indian Legal System and its related bodies
3. To appreciate the critical Interface between fundamental Rights and directive principles of state policy and apply the rationale to emerging issues and challenges.
4. Know about the enforcement remedies available under the Constitution of India
5. To apply Intellectual Property Law principles to real problems and analyse the social impact of Intellectual Property Law and Policy
6. 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.

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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	
Course Code:25ESEB101/25ESEB202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

Course Objectives (COs) - 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. Including artificial intelligence and its applications.

Course Learning Outcomes (CLOs) –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 MATRIX OF COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**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.	**8**
UNIT-II	**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 a sustainable manner- Conservation of energy, water at home, plantation, waste segregation, kitchen gardening.	**8**
UNIT-III	**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. Bio-engineering 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.	**7**
UNIT-IV	**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, bio fertilizers, biofuels, bioreactors, bioremediation, and bioengineering for biomedical waste management. Role of artificial intelligence in handling biomedical waste	**7**

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 ErachBharucha, 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.