CURRICULUM & SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

FOR

BACHELOR OF TECHNOLOGY (B.Tech.)

(4 Year Undergraduate Degree Programme)

IN

COMPUTER SCIENCE & ENGINEERING WITH SPECIALIZATION IN CLOUD ENGINEERING & DEVOPS AUTOMATION IN ASSOCIATION WITH XEBIA

(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 the 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.

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

MAPPING OF FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES

AND FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES

MAPPING MATRIX OF FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES AND ENGINEERING PROGRAM LEARNING OUTCOMES

(TABULAR FORMAT)

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

B.TECH - COMPUTER SCIENCE AND ENGINEERING GRADUATES EMPLOYABILITY ATTRIBUTES

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

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

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

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

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

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

- **Communication Skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such abilities include reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

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

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

- **Learn to Learn:**  Unlearn  Relearn: An ability to identify and to address their own educational needs in a changing world, sufficiently to maintain their competence and contribute to the advancement of knowledge.

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

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

B.TECH - COMPUTER SCIENCE AND ENGINEERING PROGRAMME EDUCATIONAL OBJECTIVES

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

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

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

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

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

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

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROGRAMME LEARNING OUTCOMES (PLOs)

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

PLO2-Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

PLO4-Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

PLO6-The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PLO7-Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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

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

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

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

PLO12-Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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: End poverty in all its forms everywhere

SDG-2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

SDG-3: Ensure healthy lives and promote well-being for all at all ages

SDG-4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

SDG-5: Achieve gender equality and empower all women and girls

SDG-6: Ensure availability and sustainable management of water and sanitation for all

SDG-7: Ensure access to affordable, reliable, sustainable and modern energy for all

SDG-8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

SDG-9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG-10: Reduce inequality within and among countries

SDG-11: Make cities and human settlements inclusive, safe, resilient and sustainable

SDG-12: Ensure sustainable consumption and production patterns

SDG-13: Take urgent action to combat climate change and its impacts

SDG-14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

SDG-15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

SDG-16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG-17: 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

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

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO10	PLO11	PLO12
PEO 1	√	√										
PEO 2			√	√								
PEO 3					√	√						
PEO 4							√	√				
PEO 5									√			
PEO 6										√	√	√

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 is comprised of the following Programme Structure:

- **Basic Applied Sciences (BAS) and Engineering Science (ES):** The purpose of Basic Applied Sciences in Engineering study is to lay a strong foundation of basic principles of various disciplines such as Mathematics, Physics, and Chemistry in the mind of the learners so that they proceed to the rest of their years of study with up to date knowledge and training of basic engineering skills. The Engineering Sciences requirements support multiple objectives: first, the courses provide a strong foundation in the basic tools and methodologies common to all engineering disciplines; second, all the students are exposed to basics of each discipline allowing for cross-disciplinary competencies; last, there is a multi-disciplinary project component where students from different engineering disciplines come together on a design project, allowing for practice in collaborative team work.
- **Professional Core Courses (PC):** The Professional core courses are aimed at providing the student with a solid foundation in their chosen field of study as per Industry 4.0 skills and knowledge.
- **Practicals (P):** The labs are fully well equipped with latest software to conduct practical 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 To understand the fundamentals of big data concepts, architectures, and its growing importance in real-world applications.

- To apply statistical and inferential techniques to analyze structured and unstructured datasets.
- To explore modern data visualization tools and techniques for meaningful representation of big data.
- To introduce OLAP, data mining, and knowledge discovery approaches for decision-making support.
- To design and implement big data solutions using Hadoop ecosystem and distributed computing tools.
- 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 in Engineering Graduates of various disciplines with common nomenclature. The training is categorized into three categories: Elementary, Intermediate & Advanced keeping in view of the 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, Team work &Leadership Traits by engaging students in interactive sessions through Role Play, Group Discussions, and improving 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 5th semester - 7th Semester to develop an ability in engineering graduates to apply skills and knowledge attained to solve real life complex problems. (One Credit each semester).

- A student may create a live project as an internship project. In that case, the student will be monitored on a periodic basis, both by the Industry Expert and the Faculty In-charge. The Industry In-charge will submit the Mid-Term and End-Term Evaluation report. However, the faculty in-charge will take periodic presentations to keep a check on the progress of students.
- A student may also create a live project under the supervision of Institutional faculty (in-house or other institutes of repute). Six step comprehensive approach is introduced for Identification of Projects, Allocation & Monitoring of projects through digital platforms.

Summer Internship (SI):

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 take periodic presentations to keep a check on the progress of Students.

- Students are provided with the internship-related document which helps them to prepare a report. In addition to this, it provides a detail to students about internship/project evaluation parameters.

➢ **Multidisciplinary Courses (Humanities and Social Science 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 in order to have a multidisciplinary approach.

B.TECH COMPUTER SCIENCE AND ENGINEERING TABLE 3: PROGRAMME STRUCTURE

Category of Courses	Category	No. of Courses		
Basic Applied Sciences	BAS			7
Engineering Sciences	ES			10
Professional Core	PC			14
Professional Electives -Program Specific Specialized Elective Courses	PE			11
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			9
Live Project & Industrial Visit and Summer Internship	LP /SI	Live Project and Industrial Visit	5^{th} -7^{th} Semester	3
		Minor Project	7^{th} Semester	1
		Major Project	8^{th} Semester	1
Multidisciplinary courses (Humanities and Social Sciences)(HSS)	MDC			3
TOTAL				**75**

BACHELOR OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING) DEGREE COURSE

TABLE 4: PROGRAMME CREDIT STRUCTURE SEMESTER WISE

Semesters → / Courses	CATEGORY	I	II	III	IV	V	VI	VII	VIII	TOTAL	%AGE
Basic Applied Sciences	BAS	9	9	4	0	0	0	0	0	22	12.22
Engineering Sciences	ES	9	9	-	0	0	0	0	0	18	10.00
Professional Core Courses	PC	0	0	9	14	6	9	8	0	46	25.56
Professional Electives- Program Specific Specialization Electives	PE	0	0	3	4	11	8	8	0	34	18.89
Ability Enhancement Courses	AEC	5	2	-	-	-	0	0	0	7	3.89
Skill Enhancement Courses(Technical &Soft Skills)	SEC	0	0	2	2	2	2	1	0	9	5.00
Practicals/Workshops	P/W	0	0	3	2	1	2	1	0	9	5.00
Live Project & Industrial Visit and Summer Internship	LP/SI	0	0	0	0	1	1	6	12	20	11.11
Multidisciplinary courses (Humanities and Social Sciences)(HSS)	MDC	0	0	0	3	3	3	0	0	9	5.00
Value Added Courses	VAC	2	2	2	-	-	-	-	-	6	3.33
TOTAL		**25**	**22**	**23**	**25**	**24**	**25**	**24**	**12**	**180**	100.0

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
	25ME202	(ES)	Fundamentals of Robotics and AI	3	0	0	3	3
	OR							
4	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]

SEMESTER III

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
25CD203	Advanced Linux	PC	2	0	1	3	3
25CS2001	Data Structures	PC	3	0	0	3	3
25CS2005	Database Management Systems	PC	3	0	0	3	3
25CSPExxx	Professional Elective – I	PE	3	0	0	3	3
25CD201	Source Code Management & Development Automation	PC	3	1	0	4	4
Total Credits (Theory)			**14**	**2**	**1**	**16**	**16**
Practical							
25CS2111	Database Management Systems Lab	P	0	0	2	2	1
25CS2113	Data Structures Lab	P	0	0	2	2	1
25CD215	Source Code Management & Development Automation Lab	P	0	0	2	2	1
23VAC301	Sports, Yoga and Fitness	VAC	1	0	2	3	2
Total Credits (Practical)			**1**	**0**	**8**	**9**	**5**
Skill Enhancement Course							
25CS0201C	Digital Marketing	SEC	0	0	2	2	1
25SS351	Effective Communication Skills	SEC	0	0	2	2	1
Total Credits (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total Credits (Theory + Practical+ Skill Enhancement)			**15**	**2**	**13**	**29**	**23**

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)

SEMESTER – IV

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
24MDCxxx	Multidisciplinary Elective-I	MDC	3	0	0	3	3
25CSPExxx	Professional Elective – II	PE	3	1	0	4	4
25CS2006	Operating Systems	PC	3	0	0	3	3
25CSPE2008	Analysis and Design of Algorithms	PC	3	0	0	3	3
25CD204	Build and Release Management	PC	3	0	0	3	3
Total Credits (Theory)			**15**	**1**	**0**	**16**	**16**
Practical							
25CS2114	Operating Systems Lab	P	0	0	2	2	1
25CSPE2118	Algorithms Lab	P	0	0	2	2	1
25CD214	Build and Release Management lab	P	0	0	2	2	1
Total Credits (Practical)			**0**	**0**	**8**	**8**	**4**
Skill Enhancement Course							
25CS0202A	Design thinking and Augmented Virtual Reality	SEC	0	0	2	2	1
23SS452	Teamwork & Interpersonal Skills	SEC	0	0	2	2	1
Total Credits (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total Credits (Theory + Practical+ Skill Enhancement)			**15**	**01**	**12**	**28**	**22**

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

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)

SEMESTER – V

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
24MDCxxx	Multidisciplinary Elective-II	MDC	3	0	0	3	3
25CDPExx	Professional Elective – III	PE	3	0	0	3	3
25CSPE3001	Compiler Design	PC	3	1	0	4	4
25CSPE3003	Computer Networks	PC	3	1	0	4	4
25CD301	Continuous Integration and Continuous Deployment	PC	3	0	0	3	3
25CD303	Agile Practices	PC	3	0	0	3	3
Total Credits (Theory)			**18**	**2**	**0**	**20**	**20**
Practical							
25CSPE3117	Compiler Design Lab	P	0	0	2	2	1
25CD311	Continuous Integration and Continuous Deployment Lab	P	0	0	2	2	1
25CS0303A	Live Project – I &Industrial Training	LP**	0	0	2	2	1
Total Credits (Practical)			**0**	**0**	**6**	**6**	**3**
Skill Enhancement Course							
25CS0301A	Wearable Technology	SEC	0	0	2	2	1
23SS553	Presentation Skills	SEC	0	0	2	2	1
Total Credits (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total Credits (Theory + Practical+ Skill Enhancement)			**18**	**02**	**10**	**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-III),

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

SEMESTER – VI

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
25CD302	Test Automation	PC	3	0	0	3	3
25CD304	Application Containerization	PC	3	0	0	3	3
25CDPExxx	Professional Elective-IV	PE	3	0	0	3	3
25CSPExxx	Professional Elective-V	PE	3	1	0	4	4
25CSPExxx	Professional Elective-VI	PE	3	1	0	4	4
24MDCxxx	Multidisciplinary Elective-III	MDC	3	0	0	3	3
Total Credits (Theory)			**18**	**2**	**0**	**20**	**20**
Practical							
25CD312	Test Automation Lab	P	0	0	2	2	1

25CD314	Application Containerization Lab	P	0	0	2	2	1
25CS0304A	Live Project – II &Industrial Visit	LP**	0	0	2	2	1
Total Credits (Practical)			**0**	**0**	**6**	**6**	**3**
Skill Enhancement Course							
25CS0302D	Data Analytics Tools	SEC	0	0	2	2	1
23SS551A	Professional Skills	SEC	0	0	2	2	1
Total Credits (Skill Enhancement)			**0**	**0**	**4**	**4**	**2**
Total Credits (Theory + Practical + Skill Enhancement)			**18**	**02**	**10**	**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)

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

SEMESTER – VII

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
25CD401	System Provisioning and Configuration Management	PC	3	0	0	3	3
25CS4003	Cloud Computing	PC	3	1	0	4	4
25CDPExxx	Professional Elective – VII	PE	3	0	0	3	3
25CDPExxx	Professional Elective – VIII	PE	3	1	0	4	4
Total Credits (Theory)			**12**	**2**	**0**	**14**	**14**
Practical							
25CS4113	Cloud Computing Lab	P	0	0	2	2	1
25CS4115A	Live Project – III& Industrial Training	LP	0	0	2	2	1
25CD411	System Provisioning and Configuration Management Lab	P	0	0	2	2	1
25CS4117A	Minor Project	LP	0	0	10	10(8)	5
Total Credits (Practical)			**0**	**0**	**14**	**14**	**8**
Skill Enhancement Course							
23AR755	Aptitude and Reasoning	SEC	0	0	2	2	1
Total Credits (Skill Enhancement)			**0**	**0**	**2**	**2**	**1**
Total Credits (Theory + Practical+ Skill Enhancement)			**12**	**02**	**16**	**30**	**23**

SEMESTER – VIII

COURSE CODE	COURSE	CATEGORY	HOURS PER WEEK				CREDITS
			L	T	P	TOTAL HOURS	
Theory							
25CD4002	AI Driven DevOps	PC	3	0	0	3	3
25CD4003	DevSecOps: Integrating security into DevOps practices	PC	3	0	0	3	3
Total Credits (Theory)			**6**	**0**	**0**	**6**	**6**
Practical							
25CS4114	Major Project	LP	0	0	24	24 (12)	12
Total Credits (Practical)			**0**	**0**	**24**	**12**	**12**
Total Credits (Theory + Practical+ Skill Enhancement)			**06**	**00**	**24**	**18**	**18**

** To be monitored at the Institute Level*

*** Teaching Load*

LIST OF PROFESSIONAL ELECTIVES
SPECIALIZATION-I

Subject Code	Course	Category	L	T	P	C
Professional Elective -I						
24CSPE2007	Computer Architecture and Organization	PE	3	0	0	3
Professional Elective -II						
23CSPE2004	Theory of Computation	PE	3	0	0	3
Professional Elective -III						
23CDPE321	Python Programming	PE	3	0	0	3
23CDPE323	Big Data Overview	PE	3	0	0	3
Professional Elective –IV						
23CDPE322	Supervised Learning	PE	3	0	0	3
23CDPE324	Domain-Driven Approach to Design And Implement Microservices	PE	3	0	0	3
Professional Elective –V						
24CSPE3002	AI and Expert Systems	PE	3	0	0	3
Professional Elective –VI						
23CSPE3020	Distributed Operating System	PE	3	1	0	4
23CSPE3032	Cyber Security	PE	3	1	0	4
23CSPE3028	Object Oriented Analysis & Design	PE	3	1	0	4
23CSPE3030	NeuralNetworks & Fuzzy Logic	PE	3	1	0	4
Professional Elective –VII						
23CDPE421	Digital Product Engineering and Design Thinking	PE	3	0	0	3
23CDPE423	Software Craftsmanship Overview	PE	3	0	0	3
Professional Elective –VIII						

23CS4019	Network Security & Cryptography	PE	3	1	0	4
23CS4023	Wireless Adhoc and Sensor Network	PE	3	1	0	4
23CS4035	Advanced Java Programming	PE	3	1	0	4
23CS4025	Data Warehousing& Data Mining	PE	3	1	0	4

SPECIALIZATION-II

Subject Code	Course	Category	L	T	P	C
Professional Elective - I						
23CSPE2007	Computer Architecture and Organization	PE	3	0	0	3
Professional Elective - II						
23CSPE2004	Theory of Computation	PE	3	0	0	3
Professional Elective -III						
23CDPE321	Python Programming	PE	3	0	0	3
23CDPE323	Big Data Overview	PE	3	0	0	3
Professional Elective – IV						
23CDPE322	Supervised Learning	PE	3	0	0	3
23CDPE324	Domain-Driven Approach to Design And Implement Microservices	PE	3	0	0	3
Professional Elective – V						
23CSPE3002	AI and Expert Systems	PE	3	0	0	3
Professional Elective – VI						
23CSPE3026	Grid Computing	PE	3	1	0	4
23CSPE3036	Predictive Analytics	PE	3	1	0	4
23CSPE3038	Business Intelligence	PE	3	1	0	4
23CSPE3040	Internet of Things	PE	3	1	0	4
Professional Elective – VII						
23CDPE421	Digital Product Engineering and Design Thinking	PE	3	0	0	3
23CDPE423	Software Craftsmanship Overview	PE	3	0	0	3
Professional Elective – VIII						

23CSPE4027	Mobile Computing	PE	3	1	0	4
23CSPE4031	Open Source Software	PE	3	1	0	4
24CSPE4041	Advanced Internet of Things	PE	3	1	0	4
23CSPE4047	Advanced Block Chain	PE	3	1	0	4

LIST OF ABILITY ENHANCEMENT COURSES

Course Code	Course	Category	L	T	P	Credits
24HS101/24HS201/ 24HS151/24HS251	Communicative English/ Communicative English Lab	AEC	2	0	2	3
24HIN-101- I /24FLFR101-I /24FLGR101-I	Hindi-I/French-I/ German-I	AEC	2	0	0	2
24HIN-201- II /24FLFR201-II /24FLGR201-II	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						
24CS0201C	Digital Marketing	SEC	0	0	2	1
24CS0202A	Design thinking and Augmented Virtual Reality	SEC	0	0	2	1
24CS0301A	Wearable Technology	SEC	0	0	2	1
24CS0302D	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)

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

23MDC403		Personal Financial Planning	3	0	0	3
23MDC404		Interior Design	3	0	0	3
24MDC107		Probability & Statistics	3	0	0	3

Note

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

*Course shall be based on applications, tools and techniques.

SEMESTER - I

ENGINEERING MATHEMATICS-I	
Course Code: 25AS101	**Continuous Evaluation: 40 Marks**
Credits: 4	**End Semester Examination: 60 Marks**
L T P : 3 1 0	
Prerequisite: 12th Mathematics	

COURSE OBJECTIVES (COs)

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

TEXT BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 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: 25AS107	**Continuous Evaluation: 40 Marks**
Credits: 2	**End Semester Examination: 60 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.	**8**
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.	**8**
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: 40 Marks**
Credits: 2	**End Semester Examination: 60 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 evidences 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: 40 Marks**
Credits: 4	**End Semester Examination: 60 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.

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

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

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:** 60 Marks
Credits: 1	**End Semester Examination:** 40 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: 40 Marks**
Credits: 4	**End Semester Examination: 60 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 boilers), Factors affecting, metal coatings- Galvanizing and Timing, Corrosion inhibitors, protection.	**16**
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:** 60 Marks
Credits: 1	**End Semester Examination:** 40 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.

COs/CLOs	CLO1	CLO2
CO1	x	
CO2		x

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

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:25EE101/25EE202	**Continuous Evaluation:**40 Marks
Credits: 3	**End Semester Examination: 60 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 operation and construction of single-phase transformers (core and shell types). EMF equation, losses, efficiency, and voltage regulation. **B. Three-Phase Induction Motor:** Concept of rotating magnetic field; Principle of operation, types and constructional features, Slip and its significance; Applications of squirrel cage and slip ring motors; Torque-speed characteristics of 3-phase induction motor.	**9**
UNIT-IV	**Poly-Phase System***:* Advantages of 3-phase system, Generation of 3-phase voltages, Voltage, current, and power in a star and delta connected systems, 3-phase balanced and unbalanced circuits, Power measurement in 3-phase circuits using the two-wattmeter method.	**9**
UNIT-V	**Renewable Sources:** Sources of Electrical Power, Introduction to Wind, Solar, Fuel cell, Tidal, Geothermal, Hydroelectric, Thermal-steam, diesel, gas power plants **Electric Vehicles:** What is an EV, Benefits of EVs, EV and its types: BEV, PHEV, HEV, and FCEV, EV scenario in India.	**9**

TEXT BOOKS

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

REFERENCE BOOKS

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

BASIC ELECTRICAL ENGINEERING LAB	
Course Code: 23EE151/23EE252	**Continuous Evaluation:**60 Marks
Credits: 1	**End Semester Examination:** 40 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:**40 Marks
Credits: 3	**End Semester Examination: 60 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 approximation (with cut-in voltage), Third approximation (including forward resistance and reverse leakage current), Structure and working principle of Zener diode, VI characteristics of Zener diode in breakdown region, Zener diode as a voltage regulator, half and Full Wave Rectifier: Circuit diagram, operation, and waveform analysis, Calculation of average and RMS output voltage, Ripple factor and efficiency, Transformer requirements and peak inverse voltage (PIV) analysis. **Wave Shaping Circuits:** Clipping Circuits, Clamping Circuits.	9
UNIT-II	**BIPOLAR JUNCTION TRANSISTORS AND ITS BIASING:** BJT structure and working principle (NPN/PNP),CE, CB, and CC configurations: input/output characteristics and applications, BJT current and voltage relations, Switching operation of BJT: cutoff, active, and saturation regions, DC load line: operating point (Q-point) determination, Biasing methods: base bias, emitter feedback bias, collector feedback bias, voltage divider bias, Thermal runaway and stability factor	9
UNIT-III	**FIELD EFFECT TRANSISTORS (FET) AND ITS BIASING:** Introduction to JFET: structure, operation, and characteristics, Comparison of BJT and FET: input impedance, noise, gain, power usage, JFET transfer and drain characteristics, pinch-off voltage, Biasing methods for JFET: self-bias, voltage-divider bias, current source bias, FET operation in ohmic and active regions, Introduction to MOSFETs: D-type and E-type structures and operation, MOSFET as a switch: operation, input/output characteristics , E-MOSFET biasing technique: self-bias, voltage-divider bias, current source bias	9

UNIT-IV	**OP-AMP: OP-AMP:** Ideal op-amp characteristics and internal block diagram, Op-amp equivalent circuit model, Comparator circuit using op-amp: zero crossing detector, Inverting and non-inverting op-amp configurations: gain expressions and phase relations, summing amplifier using op-amp (inverting and non-inverting), Differential amplifier, integrator and differentiator circuits: design and waveforms.	9
UNIT-V	**DIGITAL ELECTRONICS:** Number systems: Binary, Decimal, Octal, Hexadecimal and their conversions. Basic logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR – symbols, truth tables, logic expressions, Consensus theorem , Boolean algebra: laws, identities, and logic simplification, De Morgan's Theorems and duality principle, Transposition theorem, Consensus 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:**60 Marks
Credits: 1	**End Semester Examination:** 40 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: $V_o = -A \cdot V_i$.
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:**40 Marks
Credits: 3	**End Semester Examination: 60 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 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.	9
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:**60 Marks
Credits: 2	**End Semester Examination:** 40 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:40 Marks**
Credits: 3	**End Semester Examination: 60 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, Type of programming errors, Assembler, Linker, Loader, Compiler, Interpreter, debuggers, Algorithms, flowcharts and their symbols.	9
UNIT -III	**BASICS OF 'C' LANGUAGE** C Fundamentals, Basic data types, variables and scope, storage classes, operators and expressions, formatted input/ output, expressions, selection statements, loops and their applications.	9
UNIT -IV	**ARRAY & FUNCTION** Arrays, functions, recursive functions, pointers and arrays. Strings literals, arrays of strings; applications. Storage Classes and Pre-processor Directives.	9
UNIT -V	**STRUCTURE & FILE SYSTEM** Structures, declaring a Structure, Accessing Structure Elements, Storing Structure elements, Array of Structures, Unions and Enumerations, Dynamic memory allocation. File Input/Output, Data Organization, File Operations, opening a File, reading from a File, Closing the File, Writing to a File, File Opening Modes.	9

TEXT BOOKS

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

OPEN EDUCATIONAL RESOURCES

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

REFERENCE BOOKS

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

C PROGRAMMING LAB	
Course Code: 25CS151/25CS252	**Continuous Evaluation: 60 Marks**
Credits: 1	**End Semester Examination: 40 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					√

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, 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: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 -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

ENGINEERING GRAPHICS & DESIGN LAB	
Course Code: 25ME153/25ME254	**Continuous Evaluation: 60 Marks**
Credits: 1	**End Semester Examination:40 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 the HP only) by change of position method. .	3

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

HINDI -I	
Course Code:25HIN101/25HIN202	**Continuous Evaluation: 40 Marks**
Credits: 2	**End Semester Examination: 60 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 चतुर्वेदी (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: 40 Marks**
Credits: 2	**End Semester Examination: 60 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: 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

ENVIRONMENTAL BIOENGINEERING	
Course Code:25ESEB101/25ESEB202	**Continuous Evaluation:40 Marks**
Credits: 3	**End Semester Examination: 60 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 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.

INDIAN CONSTITUTION & POLITY	
Course Code: 25VAC101/25VAC202	**Continuous Evaluation:40 Marks**
Credits: 2	**End Semester Examination: 60 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 Concept of cooperative federalism The Executive and Administration Role of Governor and the President of India The Judiciary	**8**
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: 40 Marks**
Credits: 4	**End Semester Examination: 60Marks**
L T P : 3 1 0	
Prerequisite: Engineering Mathematics-I	

COURSE OBJECTIVES (COs):

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

COURSE LEARNING OUTCOMES (CLOs):

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 equation and solve such linear ordinary differential equation.
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, modelling 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: 40 Marks**
Credits: 4	**End Semester Examination: 60Marks**
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, n^{th}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 derivatives, Simple Applications. **Application domain problems:** Analysis of bio fluids in biomechanics	12
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: 40 Marks**
Credits: 2	**End Semester Examination: 60 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- . अंगूरकीबेल 2. किसानऔरठग	8

UNIT-III	इस इकाई में हिंदी की दो लघुकथाएं सम्मिलित की गई हैं- बुराईकाफल 2. चारविद्वानब्राह्मण	7
UNIT-IV	यह इकाई संचार कौशल से सम्बंधित है,इसमें (i) प्रेसरिपोर्ट, विज्ञापन, अनुवाद (ii)हिंदी पत्र लेखनऔरअपठित गद्यांश को समझना व तर्क संगत उत्तर देना अपेक्षित है|	7

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: 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 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 - 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 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: 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.

SEMESTER – III

ADVANCED LINUX	
Course Code: 25CD203	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 1 2 0	
Credits: 3	

COURSE OBJECTIVE (COs)

1. To introduce students to the origin, architecture, and distributions of Linux, with focus on Ubuntu.
2. To enable learners to navigate and manage the Ubuntu filesystem and shell environment.
3. To develop proficiency in Ubuntu-based package management and storage configuration.
4. To impart skills related to user, group, permission, and security configuration in Ubuntu.
5. To train students in performance monitoring, job scheduling, and log management using Ubuntu tools.

COURSE LEARNING OUTCOMES (CLOs)

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. Describe the Linux architecture, evolution, and Ubuntu installation methods.
2. Demonstrate navigation, file operations, and permission handling in Ubuntu's filesystem.
3. Install, update, and configure software packages using APT, SNAP, and manage mounts.
4. Manage users, groups, permissions, and configure secure access in Ubuntu.
5. Monitor system performance and automate routine tasks using Ubuntu's built-in tools.

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

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

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

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Role of Administrator** Introduction to Linux, Different Types of Linux, What is GPLv2, Run Levels in Linux, Role of Linux Administrator, Developer vs Administrator, Critical Tasks of Linux Administrator, Requirements for Installing Linux, Installing Linux, Download ISO Image, Install Linux Using Oracle Virtualbox, Installation Completed, Booting in Linux
UNIT-II	**Delving Deep into Filesystem Hierarchy** Linux File System Hierarchy, Structure of Linux File System, Why a Linux File System is Unique?, Everything is a File, An Overview of Top Level Directories, Essential Commands in /bin and /sbin, Permissions in Linux, GRUB, MBR
UNIT-III	**Package Management Systems** Introduction to Package Management, Linux Package Managers, RPM, Yum, Package in Yum, Listing Available, Installed and Group Packages, Installing, Updating and Removing Group Packages, yum shell, APT, Debian Package Management System, Using apt, APT-get and APT-cache, apt-cache
UNIT-IV	**Configuration & Maintenance** Managing Public and Private Groups, Linux Group Management, Group Management Commands, Adding a New User in Linux, Modifying Existing Groups and Users, Adding a User to Groups, Ownership of Linux Files, Private Groups Usage, /etc/groups file, Setting Default Permissions for New Files Using umask, Security in Linux
UNIT-V	**Monitoring in Linux** Introduction to Monitoring in Linux, Linux Monitoring Metrics, Linux In-built Performance Monitoring Tools, Other Monitoring Tools, Linux Monitoring using SNMP, Third Party Monitoring Tools

TEXT BOOKS
● *Linux Bible* by Christopher Negus in Wiley ● *Running Linux* by Matthias Kalle Dalheimer and Matt Welsh in O'Reilly Media ● *Linux Administration: A Beginner's Guide*, 8th Edition, McGraw-Hill Education, 2020.

REFERENCE BOOKS/OER
● *How Linux Works* by Brian Ward in No Starch Press ● *Linux Command Line and Shell Scripting Bible* by Richard Blum and Christine Bresnahan in Wiley ● *Linux Command Line and Shell Scripting Bible*, 4th Edition, Wiley, 2021. ● MIT OpenCourseWare – Operating System Engineering (Hands-on Labs) ● Debian Administration Handbook (Free PDF) – Debian Handbook ● Ubuntu Documentation (Official) –Ubuntu User and Admin Guide ● GNU Project and GPLv2 Info – GNU Licenses - Free Software Foundation

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 OBJECTIVE
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's)
The syllabus adhere 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. 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.

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

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

COURSE CONTENTS

UNIT NUMBER	**COURSE CONTENTS**

UNIT-I	L**inear 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

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

REFERENCE BOOKS

- Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser "Data Structures and Algorithms in Python" 2nd Edition (2024) Publisher: Wiley ISBN: 978-1119860917
- 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
- Mark Allen Weiss "Data Structures and Algorithm Analysis in C++" 4th Edition (2023) Publisher: Pearson ISBN: 978-0132847377
- 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
- Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.
- Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
- Alfred V. Aho, Jeffrey D. Ullman,John E. Hopcroft ,Data Structures and Algorithms, 1st edition, Pearson, 2002.
- Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006.

Open Educational Resources

- 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 the 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 Relational Database Design process with Normalization and Denormalization of data. Also, formulate SQL queries on the respect data into RDBMS and on the data.
5. Understand and apply the concept of transaction, concurrency control and recovery in database.
6. Understand the 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						✓

SDG Goals: 4, 8,9,17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION:** Database System and it's Applications, Purpose of Database Systems, Data 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 data base 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. Introduction to 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 Data bases.
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- Loss less and Lossy Join Decomposition, Functional Dependency Preservation, Irreducible Set of Functional Dependencies, Schema Refinement in Data base 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	**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

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

REFERENCE BOOKS

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

OPEN EDUCATIONAL RESOURCES (OER):

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

SOURCE CODE MANAGEMENT &DEVELOPMENT AUTOMATION	
Course Code: 25CD201	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE
The Objective of this course is to give a strong foundation of the Source Code Management & Development Automation
1. To introduce the various version control systems.
2. To teach the fundamental techniques and principles in GIT.
3. To enable students to have skills that will help them to understand the need of Source Code Management.
4. To teach the basic Linux Environment.
5. To teach rapid application development and the advantage of automation.
6. To enable students to have skills that will help them to understand the need of Development Automation.

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 would be able to:
1. Understand the traditional toolkit for DevOps.
2. Learn the history and overview of source code management.
3. Learn the Control systems of DevOps.
4. Understand Automation.
5. Learn to interact with the Linux Environment.
6. To understand the make and makefiles.
7. To understand the advantage of Automation in database backups.

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

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
CO1	✓						
CO2		✓					
CO3			✓				
CO4				✓	✓		
CO5						✓	
CO6							✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Typical Toolkit of DevOps -** DevOps: An Overview, Achieving DevOps, Continuous Practices, CI Working, Continuous Integration Practices, Commit Code Frequently, maintain a Single Source Repository, Don't commit code, Keep the Build Fast, Every Commit Should Build the Mainline, Fix Broken Builds Immediately, Write Automated Developer Tests, Automated deployment helps, Benefits of Continuous Integration, Continuous Delivery, Continuous Delivery Process, Benefits of continuous delivery practices **Continuous Deployment -** Continuous Deployment, Continuous Deployment Process, Benefits of Continuous Deployment, Version Control System (VCS), Repository and Working Copy, Types of version control systems, Benefits of Version Control Systems
UNIT-II	**Version Control System &Variants -** Brief History of Version Control Systems, Basic Operations in a VCS, Create, Checkout, Commit, Update, Add, Edit, Delete, Rename, Move, Revert, Merge, Resolve, Lock, Branch, Examples of Version Control Systems, Concurrent Versions System (CVS), Subversion (SVN), Features of SVN, Limitations, Mercurial, Features of Mercurial, Git, The Making - History of Linux and Git, Advantages of Git, Local Repository, Centralized Version Control System (CVCS) **Version Control System vs Distributed Version Control System -** Distributed Version Control System (DVCS), Advantages of Distributed Version Control System , Private Workspace, Easier Merging, Easy to Scale Horizontally , Disadvantages of Distributed Version Control System , vs Distributed Version Control Systems, Comparison of CVCS and DVCS, Multiple Repositories Model, Multiple Repositories for Different Services, Resetting the Local Environment, Revert - Cancelling out the Changes
UNIT-III	**Introduction to Automation-** The Software Delivery Pipeline, Overview of the Continuous Delivery Pipeline, Fully Automated Software Delivery Process, The Build Process, Automated build, Automated Test, Automated Deployment, Benefits of Automated Deployment, Automated Deployment and DevOps Adoption, Automated Deployment and DevOps Adoption, Overview of Rapid Application Development (RAD), Phases in RAD, Essential Aspects of RAD, Code generation, Categories of Code Generators
UNIT-IV	**Advantages of Automation -** Advantages of Automation, Automation Scenarios, Archiving Logs, Auto-Discard Old Archives, MySQL (RDBMS) Backups, Email Web Server Summary, Ensure Web Server is Running, User Command Validation, Disk Usage Alarm, Sending Files to Recycle Bin, Restoring Files from Recycle Bin, Logging Delete Actions, File Formatter, Decrypting Files, Bulk File Downloader, System Information, Install LAMP Stack, Get NIC's IP, Scenarios Where Automation Prevents Error **Interacting with Linux Environment -** The Linux System, Linux File System, Partitions, Common System Directories, Shell, User Groups and Permissions, User Accounts, The Password File, Creating User Accounts, File Ownership, File Permissions, Working with Bash, Shell Features

UNIT-V	**Scripting Development Tasks -** Writing Automation Scripts, Task Scheduling Using Cron, Basic Linux Commands, Best Practices for Scripting, Make use of Shell's Built- In Options, Naming Conventions, Annotations Make the Logic Clean, Command Substitution, Always Begin with a Shebang, Variable Substitution, Conditionals, Regular Expressions **Understanding Make and Makefiles -** Why "Make"? Why not Others?, Why not use "Bash Script" instead of "Makefile"?, features of "Make", Various versions and Variants of "Make", Structure of a "Makefile", What is a Rule?, Structure of a "Makefile" Rule, Targets, Some Special Built-in Target Names, Automatic Variables, Suffix Rules, Pattern Rules, The "Make" command, "Make" arguments, rsive makefile, Building Binary from Source Code, Conditionals in "Makefile", Best Practices in writing "Makefiles"

TEXT BOOKS

- Pro Git – Book by Scott Chacon and Ben Straub (available at https://git-scm.com/book/).
- Running Linux – Book by Matthias Kalle Dalheimer, Matt Welsh, O'Reilly Media, Inc, ISBN: 9780596007607, 2005.
- Mastering Linux Shell Scripting – Book by Andrew Mallett Mokhtar Ebrahim, Ingram short title; 2nd edition, 2018.

REFERENCE BOOKS/OER

- Introducing GitHub – Book by Peter Bell and Brent Beer.
- Pragmatic Version Control Using Git.pdf - The Swiss Bay – Book by P de Bie https://theswissbay.ch/pdf/
- Linux Command Line and Shell Scripting Bible – Book by Richard Blum, Christine Bresnahan, Wiley, 3rd edition, 2015
- Advanced Bash-Scripting Guide – Book by M Cooper https://tldp.org/LDP/abs/abs-guide.pdf

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 OBJECTIVES

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 heapify operations to maintain heap properties.
13. Implement Dijkstra's algorithm for computing the shortest path from a source node to all other nodes in a weighted graph using an adjacency matrix or list.
14. Implement Prim's algorithm to generate a minimum spanning tree for a connected, weighted, undirected graph. Explore greedy strategies in graph processing.

TEXT BOOK

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

REFERENCE BOOKS

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

Open Sources for Learning

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

Others Resources

- **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**

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

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 system.

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

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

REFERENCE BOOKS

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

OPEN EDUCATIONAL RESOURCES (OER):

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

SOURCE CODE MANAGEMENT & DEVELOPMENT AUTOMATION LAB	
Course Code: 25CD215	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE
This fundamental course will enable the students to learn the concepts of Source Code Management & Development Automation.
1. To introduce the various version control systems.
2. To teach the fundamental techniques and principles in GIT.
3. To enable students to have skills to work in GIT tool that will help them to understand the need of Source Code Management.
4. To introduce the shell scripting.
5. To teach the data backup and working with makefiles.
6. To enable students to have skills that will help them to understand the need of Development Automation.

COURSE LEARNING OUTCOMES (CLO)
The syllabus adhere 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. Understand and Install the version control systems.
2. Learn the Git operations.
3. Learn on the Git configuration, History, Merge Resolution, and Branching.
4. Apply Git concepts and techniques for implementation in various Operating Systems.
5. Understand the concepts of Automation.
6. Learn to interact with Linux Environment.
7. To understands the make and makefiles.

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

CLO CO	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
CO1	✓	✓					
CO2			✓				

CO3				✓			
CO4					✓		
CO5						✓	
CO6							✓

LIST OF PROGRAMS

Source Code Management:

1. Introducing Version Control System -Installing Git CLI on Linux, Mac & Windows
2. Setting up a Git Repository & Initialization
3. Cloning an Existing Repository
4. Introducing GitHub & Exploring GitHub
5. Fork and Push an Existing Repository
6. Working with Git- File States, Project Section, Workflow
7. Working with Git Operations- git status, git add, git commit, git stage
8. Git Configuration Files -.gitattributes
9. Identifying Binary Files, Diffing Binary Files
10. Working with Git History
11. Merge Resolution in Git
12. Working with Git Branching

Development Automation:

1. Introduction to Bash & Shell Scripting
2. Conditional Statement & Loop
3. Working with Automation Scripts that save Time & Effort
4. Automatically delete archive files that are older than two days.
5. Take MySQL Backups every 12 hours and move them to the backup directory.
6. Continuously monitor and Restart the web server if it is not running
7. Continuously monitor and Restart the web server if it is not running
8. Block executing the forbidden commands.
9. Monitor the disk usage and alert if it is beyond the given threshold.
10. Moves the deleted files/folders to the recycle bin
11. Working with Cron
12. Working with Make and MakeFiles

TEXT BOOKS

- Pro Git – Book by Scott Chacon and Ben Straub (available at https://git-scm.com/book/).
- Running Linux – Book by Matthias Kalle Dalheimer, Matt Welsh, O'Reilly Media, Inc, ISBN: 9780596007607, 2005.
- Mastering Linux Shell Scripting – Book by Andrew Mallett Mokhtar Ebrahim, Ingram short title; 2nd edition, 2018.

REFERENCE BOOKS

- Introducing GitHub – Book by Peter Bell and Brent Beer.
- Pragmatic Version Control Using Git.pdf - The Swiss Bay – Book by P de Bie https://theswissbay.ch/pdf/
- Linux Command Line and Shell Scripting Bible – Book by Richard Blum, Christine Bresnahan, Wiley, 3rd edition, 2015
- Advanced Bash-Scripting Guide – Book by M Cooper https://tldp.org/LDP/abs/abs- guide.pdf

SEMESTER IV

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

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

OPEN EDUCATION RESOURCES

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

ANALYSIS AND DESIGN OF ALGORITHMS	
Course Code: 25CS2008	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES (CO's)

1. To analyze the asymptotic performance of algorithms and to write rigorous correctness proofs for algorithms.
2. To demonstrate a familiarity with major Divide and conquer algorithms and data structures.
3. To apply important Dynamic programming design paradigms and methods of analysis.
4. To demonstrate through examples greedy design paradigm.
5. To Synthesize efficient algorithms in common engineering design situations

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. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.
2. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
3. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
4. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
5. For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.

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

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

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: substitution method - Lower bounds – **searching:** linear search, binary search and Interpolation Search, Pattern search: The naïve string-matching algorithm - Rabin-Karp algorithm - Knuth-Morris-Pratt algorithm. **Sorting:** Insertion sort – heap sort.
UNIT-II	**GRAPH ALGORITHMS** **Graph algorithms:** Representations of graphs - Graph traversal: DFS – BFS - applications - Connectivity, bi-connectivity - Minimum spanning tree: Kruskal's and Prim's algorithm- 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 **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 Trees.
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 – Venn diagram representation -NP-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 quick sort - Finding kth smallest number

TEXT BOOKS

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

3rd edition

REFERENCE BOOKS

- Aho, Ullman & Hopcraft, "*The Design and Analysis of Algorithms*", Pearson Education, 2001
- S.E.Goodman , S.T.Hedetniemi , "*Introduction to the Design and Analysis of Algorithms*", McGraw Hill , 2002
- Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.
- Sara Baase , "*Computer Algorithms - Introduction to design and analysis",* Pearson.
- S. Sridhar, "Design and Analysis of Algorithms", Oxford university press, 2014.

BUILD AND RELEASE MANAGEMENT	
Course Code: 25CD204	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE
1. The main objective of this course is to impart knowledge on Build and Release Management among the participants.
2. To teach the participants about dependency management and associated concepts like dependency identification and scope, using repositories and the associated tools.
3. To describe the detailed note on documentation and reporting and the process of generating unit test and code coverage reports.
4. To demonstrate the Test Framework and a release cycle.

COURSE LEARNING OUTCOMES (CLO)
The syllabus adhere 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. Understand the dependency management.
2. Learn a repository and its associated tools.
3. Understands documentation and reporting.
4. Understands Test Framework and a release cycle

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

CO \ CLO	CLO1	CLO2	CLO3	CLO4
CO1	✓			
CO2		✓		
CO3			✓	
CO4				✓

SDG MAPPED: 4,8,9,17

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT-I	**INTRODUCTION TO BUILD AND RELEASE MANAGEMENT** Build Introduction—Build and Release Management, Build Management, Build Reporting – Sample SonarQube Report, Build Reporting, Build status, Release Planning, Packaging, Authorization, Redeployment, Declarative Dependency Management.
UNIT-II	**DEPENDENCY MANAGEMENT** Build Tools – Ant, Maven, Gradle, Using Repositories; Maven Repository – Local, Central, Remote; Maven Dependency Search Sequence, Dependency Management,Parent POM,Concept of Child POM-a and Child POM-b, Dependency Identification, Dependency Scope, Transitive Dependencies, Features of Transitive Dependencies.
UNIT-III	**DOCUMENTATION AND REPORTING** Documentation Overview, Different types of documentation, Reporting, Maven Site Plugin, Maven Site Lifecycle, Maven site Configuration in pom.xml, Advanced Site Reports, Unit Testing, Unit Testing Techniques.
UNIT-IV	**TEST FRAMEWORK** Unit Testing Framework – Java, Junit, Code Coverage, Code Coverage Calculation, Code Coverage Tools, Comparison of Code Coverage Tools, Sample Code Coverage Report, Code Coverage – Pros and Cons.
UNIT-V	**UNDERSTANDING A RELEASE CYCLE** Project Release Lifecycle, Different Stages of a Release Cycle, Source Code Repository, Different Types of Source Code Repositories, Concept of GitHub, First Time Git Setup, Creation of Organization in GitHub, Creation of Repository, Branch in GitHub, How to Check-in Code to Github, Deploying Build to Production, Maven Prepare Goal, Perform Goal, Clean Goal, Maven Rollback Goal.

TEXT BOOKS

- Joel Kruger, Helen Beal,"Embracing DevOps Release Management: Strategies and tools to accelerate continuous delivery and ensure quality software deployment",ISBN-13, Packt Publishing, April 12, 2024
- Apache Maven Cookbook –Book by Raghuram Bharathan, Ingram Short Title, ISBN: 9781785286124, 2015

REFERENCE BOOKS

- Introducing Maven – Book by Balaji Varnasi, Apress, ISBN: 9781484254103, 2019
- Maven: The Complete Referencehttps://books.sonatype.com/mvnref-book/pdf/mvnref- pdf.pdf

BUILD AND RELEASE MANAGEMENT LAB	
Course Code: 25CD214	Continuous Evaluation: 60 Marks
Pre-Requisite: NIL	End Semester Examination: 40 Marks
Credits: 1	
L T P : 0 0 2	

COURSE OBJECTIVE

1. The main objective of this course is to impart knowledge on Build and Release Management among the participants.
2. To teach the participants about dependency management and associated concepts like dependency identification and scope, using repositories and the associated tools.
3. To describe the detailed note on documentation and reporting and the process of generating unit test and code coverage reports.
4. To demonstrate the Test Framework and a release cycle.

COURSE LEARNING OUTCOMES

The syllabus adhere 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. Understand the dependency management.
2. Learn a release cycle.
3. Understand documentation and reporting.
4. Understand the process of various testing and code coverage report generation.

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

CO / CLO	CLO1	CLO2	CLO3	CLO4
CO1	✓			
CO2		✓		
CO3			✓	
CO4				✓

SDG MAPPED: 4,8,9,17

LIST OF PROGRAMS

1. To Configure Maven and Understand the working of POM Hierarchy.
2. To Create a Maven Project and Explore POM File Structure.
3. To Integrate a Repository Manager within Maven Configuration.
4. To Specify and implement Nexus Repository Requirements in pom.xml.
5. To Implement Password Encryption for Secure Maven Operations.
6. To Deploy Build Artifacts to a Nexus Repository.
7. To Configure Repository Mirrors in Maven Project.
8. To Execute Unit Tests using the Maven Surefire Plugin.
9. To Utilize the Maven Clean Plugin and work with Managing Compilation.
10. To Manage Resources with the Maven Resources Plugin.
11. To Execute Maven Goals through Eclipse with the Maven Assembly Plugin.

TEXT BOOKS

- Joel Kruger, Helen Beal,"Embracing DevOps Release Management: Strategies and tools to accelerate continuous delivery and ensure quality software deployment",ISBN-13, Packt Publishing, April 12, 2024
- Maven: The Definitive Guide – Book by Sonatype Company, O'Reilly Media, Inc, ISBN: 9780596517335, 2008.
- Apache Maven Cookbook –Book by Raghuram Bharathan, Ingram Short Title, ISBN: 9781785286124, 2015.

REFERENCE BOOKS / OER

- Introducing Maven – Book by Balaji Varnasi, Apress, ISBN: 9781484254103, 2019.
- Maven: The Complete Referencehttps://books.sonatype.com/mvnref-book/pdf/mvnref- pdf.pdf

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.

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 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. Write a program to implement CPU scheduling for first come first serve and shortest job first.
2. Write a program to perform priority scheduling and Round Robin.
3. Write a program for page replacement policy using a LRU
4. Write a program for page replacement policy using FIFO.
5. Write a program for page replacement policy using Optimal.
6. Write a program to implement first fit, best fit and worst fit algorithms for Memory management.
7. Implementation of resource allocation graph (RAG)
8. Write a program to implement reader/writer problem using semaphore.
9. Implement the solution for Bounded Buffer (producer-consumer) problem using inter process communication techniques by Semaphores
10. Write a program to implement Banker's algorithm for deadlock avoidance.

TEXT BOOKS

- Abraham Silberschatz Peter B. Galvin and Greg Gagne, Operating System Concepts,Wiley 10th Ed.
- Garry. J. Nutt, Operating Systems: A Modern Perspective, Addison-Wesley
- Andrew S. Tanenbaum and Herbert Bros, Modern Operating Systems (4th Edition), Pearson.

REFERENCE BOOKS

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

OPEN EDUCATIONAL RESOURCES (OER's)

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

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

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

CO4				√	
CO5					√

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

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

TEXT BOOK:

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

REFERENCE BOOKS
● Aho, Ullman & Hopcraft, “The Design and Analysis of Algorithms”, Pearson Education, 2001 ● S.E.Goodman, S.T.Hedetniemi, “Introduction to the Design and Analysis of Algorithms”, McGraw Hill , 2006 ● Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3rd Edition, Pearson Education, 2012.
OPEN EDUCATIONAL RESOURCES
● https://youtu.be/uJUBd_3C12w?list=PL_uaeekrhGzJZz9-D3-J8kJqg8ZEODt4y

SEMESTER – V

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. 1.Describe and analyse the Internet's evolution, network standards, OSI & TCP/IP models, types of networks, topologies, signal properties, and transmission techniques.
2. 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. 3. Differentiate IPv4 and IPv6 addressing schemes, explain packet formats, and analyse routing concepts and protocols such as RIP, OSPF, and BGP.
4. 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. 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 Protocol**: 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 or IP address.
8. Implement and analyze Single-Area and Multi-Area OSPF, focusing on link costs and interface configurations.
9. Configure WEP (Wired Equivalent Privacy) security on a wireless router and test its connectivity.
10. Configure Ethernet and serial interfaces on network devices and verify successful communication.
11. Configure a Cisco router as a DHCP server to dynamically allocate IP addresses.

Note:

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

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

CONTINUOUS INTEGRATION AND CONTINUOUS DEPLOYMENT	
Course Code: 25CDV3007	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

The Objective of this course is to give a strong foundation of the Source Code Management & Development Automation

1. To introduce the Continuous Integration and Continuous Deployment work flow.
2. To teach the fundamental techniques and principles in the stages of continuous integration and continuous delivery, and continuous testing.
3. To enable students to have skills that will help them to understand the need of Development and Operations.
4. To teach the Continuous Testing.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus adhere 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. Understand the Integration and Continuous deployment.
2. Understands static code analysis.
3. Learn anatomy of continuous delivery pipeline.
4. Learn the Continuous Testing.

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

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

CO4				✔
CO5				

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

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Overview** Introduction to CI, Continuous Integration Workflow, Benefits of Continuous Integration, How CI Benefits Distributed Teams, Continuous Delivery, Steps Involved in CICD, Pipelines, Prerequisites, Checklist, Business Drivers for Continuous Deployment, Benefits of Continuous Deployment, CD – The HP Laserjet Case Study
UNIT-II	**Stages of Continuous Integration and Continuous Delivery** Core CI Process, VCS, Merging Local Changes to Integration Branch, Fork & Pull, Code Review, Automated code builds – Key metrics, Static Code Analysis, Snapshot, Sample Bug Report, Automated Unit Testing- JUNIT, Test Frameworks, Automated Unit Testing Process
UNIT-III	**Stages Extended** Code Coverage analysis, Code Coverage Methods, Condition Coverage, Line Coverage, Publishing Code Coverage reports to Jenkins, Uploading build artifact to a repository, Advanced CI process, Automated Functional Testing, Publish Report to the Development Team, Google Canary release Case study
UNIT-IV	**Anatomy of a Continuous Delivery Pipeline** Simple Delivery Pipeline, Continuous Deployment Pipeline, Releasing an application to Production, Zero-Downtime Releases, Rolling back deployments, Blue-Green Deployments, Canary Releasing, Emergency Fixes, Continuous Delivery engineering practices, Continuous Development/Integration
UNIT-V	**Continuous Testing** Deploying and Promoting your Application, Modeling Your Release Process and Promoting Builds, Continuous Deployment to successive environments until before Production, Continuous monitoring for the delivery pipeline, Nagios sampler report, Continuous Feedback rules

TEXT BOOKS

- Continuous Delivery and DevOps A Quickstart Guide - Book by Paul Swartout, Packt Publishing Limited, 2nd edition, ISBN: 9781784399313, 2014.
- Jenkins: The Definitive Guide –Book by John Ferguson Smart, O'Reilly Media, Inc, 1st edition, ISBN: 9781449305352, 2011.
- Continuous Delivery –Book by Jez Humble and David Farley, Addison-Wesley, 1st edition, ISBN: 9780321601919, 2010.
- Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation: Jez Humble, David Farley: Addison–Wesley: 1st Edition 2010
- Accelerate: The Science of Lean Software and DevOps – Building and Scaling High Performing Technology Organizations: Nicole Forsgren, Jez Humble, Gene Kim
- IT Revolution Press: 1st Edition2018 Jenkins: The Definitive Guide: John Ferguson Smart: O'Reilly Media, 1st Edition 2011
- The DevOps Toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices: Viktor Farcic: Leanpub (Online): Online Edition: 2021

REFERENCE BOOKS/OER

- Continuous Delivery – Book by Eberhard Wolff, Addison-Wesley, 1st edition, ISBN: 9780134691473, 2017.
- Jenkins User Handbook : https://www.jenkins.io/user-handbook.pdf
- Jenkins: The Definitive Guide: John Ferguson Smart
- https://www.bogotobogo.com/DevOps/Jenkins/images/Intro_install/jenkins-thedefinitive-guide.pdf
- Continuous Integration: Improving Software Quality and Reducing Risk: Paul M. Duvall, Steve Matyas, Andrew Glover: Addison–Wesley: 1st Edition: 2007
- The DevOps Handbook: Gene Kim, Jez Humble, Patrick Debois, John Willis, IT Revolution Press: 1st Edition: 2016
- Accelerate: The Science of Lean Software and DevOps: Nicole Forsgren, Jez Humble, Gene Kim: IT Revolution Press: 1st Edition: 2018 Jenkins: The Definitive Guide: John Ferguson Smart: O'Reilly Media 1st Edition: 2011
- Martin Fowler on CI https://martinfowler.com/articles/continuousIntegration.html
- Atlassian CI/CD Overview https://www.atlassian.com/continuous-delivery/ci-vs-ci-vs-cd
- GitLab CI/CD Documentation https://docs.gitlab.com/ee/ci/
- ThoughtWorks Technology Radar – CI/CD https://www.thoughtworks.com/radar

AGILE PRACTICES	
Course Code: 25CD303	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

1. To enable students to recognize the need for Agile Practices in modern development.
2. To understand the role of digital transformation and product management in Agile systems.
3. To introduce Agile principles, including values and methodologies.
4. To provide hands-on knowledge of Scrum practices, roles, and planning techniques.
5. To explain Kanban principles and its application in workflow optimization.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus adhere 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. Explain the concepts of Agile in the context of DevOps and Digital Transformation.
2. Understand and apply Agile frameworks including Scrum and Kanban.
3. Describe and implement planning and estimation techniques in Agile projects.
4. apply principles of Product Management and Design Thinking.
5. Use Agile methodologies to improve team collaboration, visibility, and delivery flow.

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

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

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

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION TO DIGITAL TRANSFORMATION** Introduction, Challenges of Traditional Business Model, Why Digital Transformation, Design Thinking, Different Phases of Design Thinking, Divergence, Emergence and Convergence of Design Thinking, Design Thinking vs. Agile vs. Lean, Agile Practices, Design Sprint and its Phases, Design Thinking Vs Design Spirit Case studies of Digital Transformation (e.g., Netflix, Amazon, Government e-Services)
UNIT-II	**INTRODUCTION TO PRODUCT MANAGEMENT** Introduction to Product Management & Service Mindset, Product Manager, Building Products and services, Product lifecycle and phases, product development & Methodology; systems thinking, value chain, Introduction of Capability Optimization and Capability Maturity Model, Business Integration methods, Agile methodology, Product Marketing; User Experience Design, MVP (Minimum Viable Product) and Lean Canvas
UNIT-III	**AGILE PRACTICES** Agile Methodology, Software, History of Software Engineering and Software Development Methodologies, Roles and Responsibilities, DevOps Culture and CI/CD basics, Developers vs IT Operations Conflict, Birth of Agile, Agile Metrics, Four Values of the Agile Manifesto, Agile and Lean
UNIT-IV	**AGILE & SCRUM METHODOLOGY** Scrum, Scrum Theory, Scrum Values, Scrum Roles, Scrum Master Scrum Sprints, Benefits of Scrum, Planning and Estimation, Agile Planning, Levels of Agile Planning, Conditions of Satisfaction, Velocity, Estimating Techniques, Soft Skills in Agile,, Agile Tooling – Jira, Trello, GitHub Projects.
UNIT-V	**KANBAN PRINCIPLES** Kanban Principle, Kanban Board, Kanban Core Practices, Make work visible, Limit work in progress (WiP), Manage flow, Make progress policies explicit, Implement feedback mechanisms, Improve collaboratively (using methods and models), Difference between Scrum and Kanban (Scrum-ban), Real Kanban board tools (Trello/Jira).

TEXT BOOKS
● **"Agile Software Development: Principles, Patterns, and Practices"** by Robert C. Martin and Micah Martin, *Publisher: Pearson Education* ● **"Essential Scrum: A Practical Guide to the Most Popular Agile Process"** by Kenneth S. Rubin, *Publisher: Addison-Wesley* ● **"The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses"** by Eric Ries, *Publisher: Crown Business*
REFERENCE BOOKS/OER
● **"Scrum: The Art of Doing Twice the Work in Half the Time"** by Jeff Sutherland, *Publisher:* Crown Business, 2014 ● **"User Story Mapping: Discover the Whole Story, Build the Right Product"** by Jeff Patton, *Publisher:* O'Reilly Media, 2014 ● Introduction to Agile Project Management – edX, UMGC ● Agile Software Development – Coursera, University of Minnesota ● 3. Agile Essentials – IBM Cognitive Class

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: 40 Marks	
End Semester Examination: 60 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

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

ONLINE EDUCATIONAL RESOURCES

1. Compiler Design (NPTEL - noc21_cs07) S. Chattopadhyay, "Compiler Design," NPTEL, IIT Kharagpur. [Online]. Available: https://onlinecourses.nptel.ac.in/noc21_cs07/preview
2. Compiler Design (NPTEL - 106104123) S. K. Aggarwal, "Compiler Design," NPTEL, IIT Kanpur. [Online]. Available: https://nptel.ac.in/courses/106104123
3. Computation Structures (MIT OpenCourseWare) C. Terman, "6.004 Computation Structures," MIT OpenCourseWare, Electrical Engineering and Computer Science, Spring 2017. [Online]. Available: https://ocw.mit.edu/courses/6-004-computation-structures-spring-2017/pages/c11/
4. 15-411 Compiler Design (Carnegie Mellon University) F. Pfenning, "15-411 Compiler Design," Carnegie Mellon University, Fall 2008. [Online]. Available: https://www.cs.cmu.edu/~fp/courses/15411-f08/

CONTINUOUS INTEGRATION AND CONTINUOUS DEPLOYMENT LAB	
Course Code: 25**CDV3113**	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE

The Objective of this course is to give a strong foundation of the Source Code Management & Development Automation

1. To introduce the Continuous Integration and Continuous Deployment work flow.
2. To teach the fundamental techniques and principles in the stages of continuous integration and continuous delivery, and continuous testing.
3. To enable students to have skills that will help them to understand the need of Development and Operations.
4. To teach the Continuous Testing.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus adhere 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. Understand the Integration and Continuous deployment.
2. Understands static code analysis.
3. Learn anatomy of continuous delivery pipeline.
4. Learn the Continuous Testing.

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

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

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

Experiment Number	**CONTENTS**

1	Introduction to Jenkins and setup/configuration
2	Installation and Configuration of git/Java/maven on Build server (Windows)
3	Jenkins job, parameters, build, post-build actions and Pipeline
4	Jenkins Agent/Slave configuration with Windows/Ubuntu master hosts
5	Configuring Jenkins with git plugin
6	Create a new Jenkins pipeline
7	Merging local changes to the version control system (Git)
8	Use Jenkins as a Continuous Integration server
9	Deploying the application to staging/prod environment
10	Merging feature branch code (V 2.0) to existing application
11	Uploading plugins manually in Jenkins
12	Backup Management in Jenkins Server

TEXT BOOKS

- Continuous Delivery and DevOps A Quickstart Guide - Book by Paul Swartout, Packt Publishing Limited, 2nd edition, ISBN: 9781784399313, 2014.
- Jenkins: The Definitive Guide –Book by John Ferguson Smart, O'Reilly Media, Inc, 1st edition, ISBN: 9781449305352, 2011.
- Continuous Delivery –Book by Jez Humble and David Farley, Addison-Wesley, 1st edition, ISBN: 9780321601919, 2010.
- Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation: Jez Humble, David Farley: Addison–Wesley: 1st Edition 2010
- Accelerate: The Science of Lean Software and DevOps – Building and Scaling High Performing Technology Organizations: Nicole Forsgren, Jez Humble, Gene Kim
- IT Revolution Press: 1st Edition2018 Jenkins: The Definitive Guide: John Ferguson Smart: O'Reilly Media, 1st Edition 2011
- The DevOps Toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices: Viktor Farcic: Leanpub (Online): Online Edition: 2021

REFERENCE BOOKS

- Continuous Delivery – Book by Eberhard Wolff, Addison-Wesley, 1st edition, ISBN: 9780134691473, 2017.
- Jenkins User Handbook : https://www.jenkins.io/user-handbook.pdf
- Jenkins: The Definitive Guide: John Ferguson Smart
- https://www.bogotobogo.com/DevOps/Jenkins/images/Intro_install/jenkins-thedefinitive-guide.pdf
- Continuous Integration: Improving Software Quality and Reducing Risk: Paul M. Duvall, Steve Matyas, Andrew Glover: Addison–Wesley: 1st Edition: 2007
- The DevOps Handbook: Gene Kim, Jez Humble, Patrick Debois, John Willis, IT Revolution Press: 1st Edition: 2016
- Accelerate: The Science of Lean Software and DevOps: Nicole Forsgren, Jez Humble, Gene Kim: IT Revolution Press: 1st Edition: 2018 Jenkins: The Definitive Guide: John Ferguson Smart: O'Reilly Media 1st Edition: 2011
- Martin Fowler on CI https://martinfowler.com/articles/continuousIntegration.html
- Atlassian CI/CD Overview https://www.atlassian.com/continuous-delivery/ci-vs-ci-vs-cd
- GitLab CI/CD Documentation https://docs.gitlab.com/ee/ci/
- ThoughtWorks Technology Radar – CI/CD https://www.thoughtworks.com/radar

TEST AUTOMATION	
Course Code: 25CD3004	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

The Objective of this course is to give a strong foundation of Test Automation.

1. To enable students to have skills that will help them to understand the need of software testing life cycle.
2. To teach the fundamental techniques and principles in selenium test tool.
3. To introduce the concepts of software testing, Manual testing and Automated testing.
4. To Knowledge in the Test Case Design

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 Testing in DevOps.
2. Understand to the Design Test Cases.
3. Learn various approaches to Test the Software.
4. Understand the Test Case Design

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

	CLO1	CLO 2	CLO 3	CLO 4
CO1	✔			
CO2		✔		
CO3			✔	
CO4				✔
CO5				

Mapped SDG: 4,9,11,12,16.

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Software Testing** Seven principles of Software Testing, SDLC vs STLC, Testing Life Cycle, Usability Testing, Why do we need Usability Testing, How to do Usability testing, Advantages & Disadvantages, Functional Testing, End to End Testing,Methods, Advantages & Disadvantages, Compatibility Testing, Types GUI testing, Techniques API testing, Advantages
UNIT-II	**Test Automation: Selenium** Selenium components, Selenium Architecture, TestNGInstalling TestNg in Eclipse,TestNG annotations – Understanding usage, Setting priority of execution for test cases, Hard Assertion, Soft Assertion, TestNG Reports, ANT-Downloading & Configuring, XSLT report generation generation using TestNg and Ant
UNIT-III	**Introduction to Selenium 3.x** Describe Selenium 3.x advantages and implementation, Define drivers for Firefox, IE, chrome, Iphone, Android etc, Analyse first Selenium Code, Differentiate between Close and Quit, Describe Firepath and firebug Add-ons installation in Mozilla, Inspect elements in Mozilla, Chrome and IE, Identifying WebElements using id, name, class, Generate own CssSelectors. Differentiate between performance of CssSelectors as compared to Xpaths, Define class attribute, Handle Dynamic objects/ids on the page, Analyse whether object is present on page or not
UNIT-IV	**Manual Testing** Manual Testing, Manual Testing – How to Approach?, Manual Testing – Myth and fallacy, Defect Life Cycle, Qualities of a good Manual Tester, Manual Testing vs Automation Testing, Types, System Testing, Acceptance Testing, Unit Testing, Techniques, Integration Testing, Smoke- Sanity Testing
UNIT-V	**Introduction to Test Design** Test Scenario, When not to use test scenarios, Test Case Design, Best Practices in Test Case Design, Test Basis, Traceability Matrix

TEXT BOOKS:

- Flexible Test Automation –Book by Vitaliano Inglese, Pasquale Arpaia, Momentum Press, ISBN: 9781606503836, 2014.
- Flexible Test Automation: Vitaliano Inglese, Pasquale Arpaia Publisher: Momentum PressYear: 2014
- Experiences of Test Automation: Case Studies of Software Test Automation: Mark Fewster, Dorothy Graham: Addison Wesley Edition: 1st Year: 2012
- Experiences of Test Automation: Case Studies of Software Test Automation –Book byMark Fewster, Dorothy Graham, Addison Wesley, 1st edition, ISBN: 9780321754066, 2012.

REFERENCE BOOKS / OER:

- Selenium Testing Tools Codebook – Book by Unmesh Gundecha, Packt Publication Limited, ISBN: 9781849515740, 2012.
- A Course on Software Test Automation Designhttp://www.testingeducation.org/course_notes/hoffman_doug/test_automation/ auto8.p df
- Complete Guide to Test Automation Techniques, Practices, and Patterns for Building and Maintaining Effective Software Projects ArnonAxelrodhttp://tisten.ir/wpcontent/uploads/2019/01/Complete-Guide-to-Test-Automation-Tec hniquesPractices-and-Patterns-for-Building-and-Maintaining-Effective-Software-Projects-A press-2018-Arnon-Axelrod.pdfm

TEST AUTOMATION LAB	
Course Code: 25CD312	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE
The Objective of this course is to give a strong foundation of Test Automation.
1. To introduce the concepts of software testing, Manual testing and Automated testing.
2. To teach the fundamental techniques and principles in selenium test tool.
3. To enable students to have skills that will help them to understand the need of software testing life cycle.
4. To demonstrate the build an automation in Ecommerce platform.

COURSE LEARNING OUTCOMES (CLO)
The syllabus adhere 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. Design test scenarios for varied applications
2. Integrate automation Scripts
3. Build & Execute Automation Scripts
4. Understand the Build & Execute Automation Scripts in Ecommerce.

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

CLO **CO**	CLO1	CLO2	CLO3	CLO4
CO1	✔			
CO2		✔		
CO3			✔	
CO4				✔

Mapped SDG: 4,9,11,12,16.

LIST OF PROGRAMS

1. Design and document test scenarios for any ecommerce web application to validate
2. Build an automation script for registration and login for eCommerce platform
3. Proceed to write the script similarly using Java for Registration page
4. Integrate extent report with automation scripts for result reporting
5. Build an automation script for searching the article eCommerce platform
6. Build an automation script for article details page eCommerce platform
7. Build an automation script for searching the article and validate the searching of the article
8. Build an automation script for navigating to the article details page and validate all the details for an article
9. Implement the parameterized data for the automation script build in starting.
10. Build an automation script for data driven test eCommerce platform
11. Refactor your test code for Login, Search Page and Article details page based on the framework created in above step
12. Execute automation script developed on Chrome and Firefox
13. Integrate automation scripts with Jenkins for execution on build deployment

TEXT BOOKS

- Selenium Web Driver Practical Guide – Book by Satya Avasarala, Packt Publishing Limited, ISBN: 781782168850, 2014.

REFERENCE BOOKS/OER

- Flexible Test Automation –Book by Vitaliano Inglese, Pasquale Arpaia, Momentum Press, ISBN: 9781606503836, 2014.
- Experiences of Test Automation: Case Studies of Software Test Automation – Book by Mark Fewster, Dorothy Graham, Addison Wesley, 1st edition, ISBN: 9780321754066, 2012.
- Selenium Testing Tools Codebook – Book by Unmesh Gundecha, Packt Publication Limited, ISBN: 9781849515740, 2012.
- A Course on Software Test Automation Designhttp://www.testingeducation.org/course_notes/hoffman_doug/test_automation/aut o8. pdf
- Complete Guide to Test Automation Techniques, Practices, and Patterns for Building and Maintaining Effective Software Projects — ArnonAxelrodhttp://tisten.ir/wp- content/uploads/2019/01/Complete-Guide-to-Test-Automation-Te chniques-Practices- and-Patterns-for-Building-and-Maintaining-Effective-Software-Projects-Apress-2018- Arnon-Axelrod.pdf

APPLICATION CONTAINERIZATION	
Course Code: 25CDV3006	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

The Objective of this course is to give a strong foundation of Containers for development & Deployments.

1. To introduce the Containerization and its application.
2. To teach the fundamental techniques and principles in virtualization and orchestration tools.
3. To enable students to have skills in Aws Kubernetes that will help them to understand the need of Development and Deployment.
4. To teach the Virtualization and LinuX Containers.

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 Containers in DevOps.
2. Understand Orchestration tools.
3. Understand and implement in AWS and KUBERNETES
4. Understand the LinuX Containers and Virtualization.

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

	CLO 1	**CLO 2**	**CLO 3**	**CLO 4**
CO1	✔			
CO2		✔		
CO3			✔	
CO4				✔

CO5				

Mapped SDG: 4,9,11,12,16.

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Application Containerization** Understanding Containers: Transporting Goods Analogy, Problems in Shipping Industry before Containers, Shipping Industry Challenges, Container: The Saviour, Solution by Containers in the Shipping Industry, Challenges in the Software Industry, Problems in Software Industry Before Containers, Put that in Container! Solution by containers in the Software Industry
UNIT-II	**Virtualization** Introduction, Hypervisor, Scope of Virtualisation, Containers vs Virtual Machines, Understanding Containers, Containerisation Platform, Runtime and Images, Container Platform, Container Runtime, The Chroot System, FreeBSD Jails, LinuX Containers (LXC), Docker
UNIT-III	**Introduction to Containerization** Docker architecture, Docker Daemon (Container Platform), Docker Rest API , CLIDifferent environments: (Dev, QA and Prod), Overcoming issues with different environments, Development Environment , Testing Environment, Staging Environment, Production Environment, Virtual machines for dev/deployments, Containers for dev/deployments, Advantages and drawbacks of containerization.
UNIT-IV	**Orchestration Tools** What is orchestration?, Need of orchestration, Case study: Need of Orchestration , Need of Orchestration: Container and Microservices, Orchestration Tools, Docker Swarm, Docker Swarm Architecture Kubernetes, Kubernetes Architecture
UNIT-V	**AWS Kubernetes** Amazon Web Services, AWS (ECS,EKS), AWS Elastic Container Services Architecture, EKS Architecture, Azure Kubernetes Services, Openshift, Google Kubernetes Engine, KUBERNETES ON CLOUD, Need for Monitoring of container, Elements Monitored, Log Monitoring Infrastructure Monitoring, pplication Performance Monitoring, How to Monitor, Tool to Monitor

TEXT BOOKS:

- Developing with Docker –Book by Jarosław Krochmalski, Packt Publication Limited,
- 1st edition, ISBN: 9781786469908, 2016.
- Orchestrating, Clustering, and Managing Containers –Book by Adrian Mouat, O'Reilly
- Media, ISBN: 9781491966112, 2016

REFERENCE BOOKS / OER:

- The Docker Book: Containerization is the new virtualization – Book by James Turnbull, 2014.
- Cloud Native DevOps with Kubernetes by John Arundel & Justin Domingushttps://get.oreilly.com/rs/107-FMS-070/images/Next-Architecture.pdf?
- The Docker Book: Containerization is the new virtualization – Book by James Turnbull, 2014.
- Cloud Native DevOps with Kubernetes by John Arundel & Justin Domingushttps://get.oreilly.com/rs/107-FMS-070/images/Next-Architecture.pdf?

APPLICATION CONTAINERIZATION LAB	
Course Code: 25CDV3114	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

The Objective of this course is to give a strong foundation of Containers for development & Deployments.

1. To introduce the Containerization and its application.
2. To teach the fundamental techniques and principles in virtualization and orchestration
    a. tools.
3. To enable students to have skills in Aws Kubernetes that will help them to understand the need of Development and Deployment.
4. To teach the Virtualization and LinuX Containers.

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 Containers in DevOps.
2. Understand Orchestration tools.
3. Understand and implement in AWS and KUBERNETES
4. Understand the LinuX Containers and Virtualization.

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

	CLO1	CLO 2	CLO 3	CLO 4
CO1	✔			
CO2		✔		
CO3			✔	
CO4				✔
CO5				

Mapped SDG: 4,9,11,12,16.

Experiment Number	CONTENTS
1	Playing with Vagrant
2	Understanding Vagrant File and Configuration of Sandbox
3	Installation and Configuration of Docker Machine
4	Working with Docker Images and running Docker Containers
5	Dockerfile: Working with Containerization Application
6	Docker Extras – Docker Pot Binding, Docker Volumes, Docker Linking, Monitoring
7	DTR : Working with Docker Hub and Publishing Images
8	Working with Docker Compose
9	Docker-Swarm : spin up 3 virtual machines (vagrant in our case) and setup swarm cluster with one manager and 2 node
10	Working with Kubernetes -Minikube
11	Deploying Pods and Services on Minikube

TEXT BOOKS:

- Developing with Docker –Book by Jarosław Krochmalski, Packt Publication Limited,
- 1st edition, ISBN: 9781786469908, 2016.
- Orchestrating, Clustering, and Managing Containers –Book by Adrian Mouat, O'Reilly
- Media, ISBN: 9781491966112, 2016

REFERENCE BOOKS / OER:

- The Docker Book: Containerization is the new virtualization – Book by James Turnbull, 2014.
- Cloud Native DevOps with Kubernetes by John Arundel & Justin Domingushttps://get.oreilly.com/rs/107-FMS-070/images/Next-Architecture.pdf?
- The Docker Book: Containerization is the new virtualization – Book by James Turnbull, 2014.
- Cloud Native DevOps with Kubernetes by John Arundel & Justin Domingushttps://get.oreilly.com/rs/107-FMS-070/images/Next-Architecture.pdf?

SEMESTER – VII

SYSTEM PROVISIONING AND CONFIGURATION MANAGEMENT	
Course Code: 25CDV4001	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
The Objective of this course is to give a strong foundation of System Provisioning and Configuration Management. 1. To introduce the Provisioning tools. 2. To teach the fundamental techniques and principles in Sonarqube tools. 3. To enable students to have skills in the system provisioning and configuration management. 4. To teach the provisioning on cloud.

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 provisioning. 2. Understand configuration management. 3. Learn automation, preventing errors, tracking of changes. 4. Understand the provisioning on Cloud.

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

	CLO1	**CLO 2**	**CLO 3**	**CLO 4**
CO 1	✔			
CO 2		✔		
CO 3			✔	
CO 4				✔
CO 5				

Mapped SDG: 4,9,11,12,16.

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Provisioning** Provisioning – Basic Definition, Software Definition, Concepts of Provisioning, Why Provisioning Should be Exclusive, Configuration Management, Configuration Management Tools, Provisioning Tools, Test Machines for Provisioning, Deployment, Relationship between Deployment and Provisioning
UNIT-II	**On Premise Provisioning** Understanding 'On Premise Provisioning, What is On Premise?, Provisioning Infrastructure, Server Templating, Server Templating, Connectivity with Servers, Client, Templating, Server Side Templating, Challenges of Server Side Templating, Advantages of Server Side Templating, Server Side Templating Vs Client Side Templating
UNIT-III	**Provisioning on Cloud** Introduction, Cloud Providers, Benefits of Cloud Computing, Types of Cloud Computing, Types of Deployment Model, Types of Service Model, Life Cycle of Provisioning on Cloud, Automated Provisioning on Cloud, What is Cloud Automation? Benefits of Cloud Automation, What is Sonarqube? Code Quality Checks
UNIT-IV	**Sonarqube** Features of Sonarqube, Code Scanner, Application of Code Scanner, Organizational Improvement Using Code Scanner, Organizational Improvement Using Code Scanner Application of Code Scanner, On Premise to Cloud Migration Strategies, What is Cloud Migration? Types of Cloud Migration Strategies, Benefits of Cloud Migration, Network Security Enablement from On-Premises to Cloud, What are Microservices?, Azure Kubernetes Service (AKS), Benefits of AKS, Benefits of EKS

UNIT-V	**System Provisioning and Configuration Management** State of Various Tools in Provisioning and Configuration, Infrastructure as Code, Continuous Integration/Continuous Deployment, Configuration Management, Configuration Management in DevOps, Monitoring, Reasons for Using Provisioning and Configuration Tools, Automation, Preventing Errors and Tracking of Changes, Tools and their Capabilities

TEXT BOOKS:

- Get started with Ansible –Book by Lorin Hochstein, O'Reilly Media, ISBN:
- 9781491965505, 2016.
- Ansible Configuration Management –Book by Daniel Hall, Packt Publication Limited, 2nd
- edition, ISBN: 9781785289521, 2016.

REFERENCE BOOKS / OER:

- Ansible for DevOps –Book by Jeff Geerling, Midwestern Mac, 1st edition, ISBN: 9780986393419, 2015.
- Terraform in Action. https://livebook.manning.com/book/terraform-in-action/chapter-1/v-11/
- Yevgeniy Brikman: O'Reilly Media: 2nd Edition, 2019 Practical guide for automated infrastructure provisioning using Terraform in cloud and hybrid environments.
- Betsy Beyer, Chris Jones, Jennifer Petoff, Niall Richard Murphy: O'Reilly Media: 1st Edition, 2016
- "Configuration Management and Automation" – MIT OpenCourseWare https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-828-operating-system-engineering-fall-2012/lecture-videos/
- "Ansible for the Absolute Beginner" – FreeCodeCamp.org (YouTube) https://www.youtube.com/watch?v=wgQ3rH4h-Yg
- "Kubernetes and Microservices" – Cloud Native Computing Foundation (CNCF) Course https://www.cncf.io/online-programs/

SYSTEM PROVISIONING AND CONFIGURATION MANAGEMENT LAB	
Course Code: 25CDV**4121**	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVES

The Objective of this course is to give a strong foundation of System Provisioning and Configuration Management.

1. To introduce the Provisioning tools.
2. To teach the fundamental techniques and principles in Sonarqube tools.
3. To enable students to have skills in the system provisioning and configuration
4. management.
5. To teach the provisioning on cloud.

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 provisioning.
2. Understand configuration management.
3. Learn automation, preventing errors, tracking of changes.
4. Understand the provisioning on Cloud.

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

	CLO 1	**CLO 2**	**CLO 3**	**CLO 4**
CO1	✔			
CO2		✔		
CO3			✔	
CO4				✔
CO5				

Mapped SDG: 4,9,11,12,16.

Experiment Number	CONTENTS
1	Working with Infrastructure as Code: Automation of your Infrastructure
2	AWS Configuration for Terraform
3	Open an AWS Account, Create IAM Admin User — Terraform
4	Work on Creating Security Group
5	Spinning up EC2 instance - github.com
6	Exploring Variables, Exploring Resources
7	Working with Modules
8	Working with State Management
9	Creating an AWS VPC using terraform
10	Creating an AWS security group using terraform
11	Creating an AWS IAM policy using terraform
12	Creating an AWS S3 bucket instance using terraform.

TEXT BOOKS:

- Get started with Ansible –Book by Lorin Hochstein, O'Reilly Media, ISBN:
- 9781491965505, 2016.
- Ansible Configuration Management –Book by Daniel Hall, Packt Publication Limited, 2nd
- edition, ISBN: 9781785289521, 2016.

REFERENCE BOOKS / OER:

- Ansible for DevOps –Book by Jeff Geerling, Midwestern Mac, 1st edition, ISBN: 9780986393419, 2015.
- Terraform in Action. https://livebook.manning.com/book/terraform-in-action/chapter-1/v-11/
- Yevgeniy Brikman: O'Reilly Media: 2nd Edition, 2019 Practical guide for automated infrastructure provisioning using Terraform in cloud and hybrid environments.
- Betsy Beyer, Chris Jones, Jennifer Petoff, Niall Richard Murphy: O'Reilly Media: 1st Edition, 2016
- "Configuration Management and Automation" – MIT OpenCourseWare https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-828-operating-system-engineering-fall-2012/lecture-videos/
- "Ansible for the Absolute Beginner" – FreeCodeCamp.org (YouTube) https://www.youtube.com/watch?v=wgQ3rH4h-Yg
- "Kubernetes and Microservices" – Cloud Native Computing Foundation (CNCF) Course https://www.cncf.io/online-programs/

CLOUD 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 Interpret the types and service models of any given cloud platform.
2. To assess the comparative advantages and disadvantages of Virtualization technology.
3. To offer the appropriate cloud computing solutions based on the application requirements.
4. To analyse and reveal the core issues in line with the security, privacy, and interoperability in cloud platform.
5. To create a cloud environment using open source software tools.

COURSE LEARNING OUTCOMES (CLO)

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

1. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
2. Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.
3. Apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost.
4. Analyze various cloud programming models and apply them to solve problems on the cloud.
5. Enable students exploring some important cloud computing driven commercial systems and applications.
6. Expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

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

	CLO 1	CLO 2	CLO 3	CLO4	CLO 5	CLO 6

CO1	✔					
CO2		✔				
CO3			✔			
CO4				✔		
CO5					✔	✔

SDG GOALS: 4,9,11,12,16.

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** Cloud computing history, architecture and essential characteristics, cloud service models, Cloud Deployment models, advantages of cloud computing, cloud v/s grid computing.
UNIT-II	**VIRTUALIZATION** Virtualization techniques, Benefits and drawbacks of virtualization, VM migration with its types, hypervisors, types of hypervisors, distributed management of virtual infrastructures, scheduling techniques for advance reservation of capacity, Service- oriented architectures, SOAP v/s REST.
UNIT-III	**PaaS** Introduction, advantages and disadvantages of PaaS, introduction to google app engine, GAE cost structure, Apache hadoop: MapReduce, HDFS, Hive, Mapreduce programming model, Hadoop as a service.
UNIT-IV	**MIGRATING INTO THE CLOUD:** Introduction, challenges in the cloud, legal issues in cloud computing, Cloud Economics and Capacity Management: Restricted Choices, Capacity Planning, Queuing and Response Time, Evidence Based Decision Making, Instrumentation (Measuring Resource Consumption), Bottlenecks, Key Volume Indicators.

UNIT-V	**CLOUD SECURITY** Security in clouds, protocols, algorithms, Security as a service, Tools and technologies to secure the data in Private and Public Cloud Architecture. Security Concerns, Legal issues and Aspects, Multi-tenancy issues Multi-cloud.

TEXT BOOKS:
● Cloud Computing Principles and Paradigms, Rajkumar Buyya, Wiley & Sons Pub, 1st Edition, ISBN: 978-0-470-88799-8.
● Cloud Computing Web-Based dynamic IT services: Christian Baun, 1st Edition, Springer.
● Barrie Sosinky, Cloud Computing: Bible, 1st edition, Wiley Publishing, Inc., 2011.

REFERENCE BOOKS / OER:
● Syed A.Ahson and Mohammed Ilyas, Cloud Computing and Software Services: Theory and Techniques, CRC Press, Taylor and Francis Group, 2010.
● Judith Hurwitz, Robin Bloor, Marcia Kaufman and Fern Halper, Cloud Computing for Dummies. Wiley- India edition, 2010, 3rd Edition global.
● NPTEL. *Cloud Computing*. IIT Madras / IIT Kanpur. https://onlinecourses.nptel.ac.in/noc21_cs39/preview.
● MIT OpenCourseWare. *Cloud Computing*. Massachusetts Institute of Technology. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-824-distributed-computer-systems-engineering-fall-2003/.
● Gupta, Indranil, instructor. *Cloud Computing Concepts*. Coursera. https://www.coursera.org/learn/cloud-computing.

CLOUD COMPUTING LAB	
Course Code: 25CS4113	Continuous Evaluation: 60 Marks
Pre-Requisite : NIL	End Semester Examination: 40 Marks
L T P : 0 0 2	
Credits: 1	

COURSE OBJECTIVE

1. Understand the fundamental concepts, service models (IaaS, PaaS, SaaS), and deployment models (public, private, hybrid) of cloud computing.
2. Analyze cloud architecture components and key technologies such as virtualization, containerization, and orchestration tools.
3. Apply cloud service provider tools (e.g., AWS, Azure, GCP) to develop and deploy cloud-based applications.
4. Evaluate security, privacy, governance, and compliance challenges associated with cloud platforms.
5. Design scalable, resilient, and cost-effective cloud solutions that meet industry and enterprise requirements.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus adhere 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. Describe key concepts of cloud computing, including service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid).
2. Explain virtualization and containerization technologies used in cloud infrastructure.
3. Demonstrate deployment and management of cloud resources using public cloud platforms like AWS, Azure, or GCP.
4. Analyze cloud architecture components such as compute, storage, and networking services.
5. Evaluate cloud security and privacy mechanisms including data encryption, identity management, and compliance.
6. Design scalable, resilient, and cost-effective cloud-based solutions for real-world applications.
7. Identify and discuss emerging trends in cloud computing such as serverless architecture, edge computing, and multi-cloud strategies.

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

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO 5	CLO 6	CLO 7
CO1	✔	✔					
CO2				✔			
CO3			✔	✔			
CO4					✔		
CO5						✔	
CO6							✔

PROGRAMS

1. **To Install and manage** virtual machines using latest **VirtualBox 7.x** or **GNOME Boxes** on
2. open-source Linux OS (Ubuntu/Fedora) with guest OS configurations for development.
3. To implement Infrastructure as a Service, Installing OpenStack and use it as Infrastructure as a Service.
4. To install Storage as Service. [Installation and understanding features of ownCloud as SaaS.
5. To implement identity management. [installing and using identity management feature of OpenStack
6. To write a program for web feed [PHP, HTML]
7. To simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
8. To install Hadoop single node cluster and run simple applications like wordcount.
9. To find a procedure to transfer the files from one virtual machine to another virtual machine.

10. To Install Google App Engine. Create hello world app and other simple web applications using python/java.

11. To demonstrate the usage of Google Drive as a cloud-based productivity tool for creating, editing, and sharing spreadsheets and notes in real-time.

12. To demonstrate the development and execution of programs in multiple programming languages using a cloud-based IDE environment.Working in Cloud9 to demonstrate different language.

13. To demonstrate how websites are provisioned, deployed, and scaled using a cloud-based development platform.

14. To configure a single-node Hadoop cluster for data processing tasks. **Tools Used**:Hadoop (Apache Hadoop – Open Source), Ubuntu/Debian Linux VM

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

TEXT BOOKS

- *Cloud Computing-A Practical Approach" Anthony T. Velte, Toby J. Velte, Robert Elsenpeter. McGraw-Hill.*
- *Tim Mather, SubraKumaraswamy, ShahedLatif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'ReillyMedia Inc.*
- *Barrie Sosinky, Cloud Computing: Bible, 1st edition, Wiley Publishing, Inc., 2011.*
- *Cloud Computing: A Practical Approach, Velte et al., McGraw-Hill, 2009*
- *Cloud Security and Privacy, Tim Mather et al., O'Reilly Media, 2009*
- *Cloud Computing: From Beginning to End, Ray J. Rafaels, CRC Press, 2nd Ed., 2021*

REFERENCE BOOKS/OER

- *Cloud Computing for Dummies, Judith Hurwitz et al., Wiley, 2nd Ed., 2013*
- *Cloud Computing and Software Services, Ahson & Ilyas, CRC Press, 2010*
- *Cloud Computing: Principles, Systems and Applications, Antonopoulos & Gillam, Springer, 2nd Ed., 2017*
- *Hybrid Cloud for Dummies, Judith Hurwitz et al., Wiley, 2021*
- *NIST Cloud Computing Guide: https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf*
- *Open Textbook (Cloud Architecture): https://opentextbc.ca/cloudcomputing/*
- *Coursera (IBM – Intro to Cloud): https://www.coursera.org/learn/introduction-to-cloud*
- *Microsoft Azure Learn: https://learn.microsoft.com/en-us/training/paths/azure-fundamentals/*
- *Google Qwiklabs: https://www.cloudskillsboost.google/*
- *AWS Training: https://www.aws.training*

Semester-VIII

AI DRIVEN DevOps	
Course Code: 25CD4002	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. Understand the concept and application of AI-assisted coding using tools like GitHub Copilot to enhance productivity and code quality.
2. Explore how AI enhances version control systems, focusing on collaboration, code suggestions, security, and automated features like commit message generation.
3. Analyze the role of cloud platforms and AI technologies in modern DevOps practices such as Infrastructure as Code (IaC), automation, and cost optimization.
4. Apply intelligent monitoring and observability techniques using AIOps tools that leverage AI for self-healing, anomaly detection, and incident response.
5. Evaluate the future of AI in DevOps, especially in security (DevSecOps), including automated threat detection, compliance, and predictive maintenance.

COURSE LEARNING OUTCOMES (CLO)

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

1. Explain the concept of AI-assisted coding and demonstrate the use of GitHub Copilot for generating and improving code.
2. Use AI tools in version control systems to enhance collaboration, suggest commit messages, and detect security vulnerabilities.
3. Apply AI and cloud technologies in DevOps workflows, including Infrastructure as Code and cloud cost forecasting.
4. Utilize AI-powered monitoring and observability tools for detecting anomalies, self-healing infrastructure, and incident management.
5. Evaluate AI applications in DevSecOps and cybersecurity, including automated threat detection, compliance, and emerging trends.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				

CO2		✔			
CO3			✔		
CO4				✔	
CO5					✔

SDG GOALS: 4,9,11,12,16.

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**GitHub Copilot & AI Tools** AI-assisted coding, Benefits of using AI in repositories, Role of AI in code quality, collaboration, and security, GitHub Copilot, Types of code suggestions (completions, functions, documentation), Setting up GitHub Copilot in Visual Studio Code, Writing code with Copilot assistance, Accepting, modifying, or rejecting AI code suggestions, Auto-suggesting commit messages, Using GitHub's built-in CodeQL (AI-enhanced) to find vulnerabilities
UNIT-II	**Role of Cloud in DevOps with AI** TheRole of Cloud in DevOps, Cloud for successful Ops, Secure Cloud Platforms for DevO ps, Cloud & IT Budgets, building a business case for cloud computing, Infrastructure as Code (IAC), AI-based cloud cost forecasting (AWS Cost Explorer with machine learning models), Enable and review AWS Cost Forecasting with Machine Learning.
UNIT-III	**Infrastructure Automation with AI** Infrastructure as Code (IaC) with AI: Terraform, Ansible AI, AI-powered configuration management: Chef Automate, Puppet Bolt, Self-healing Infrastructure: AI-based auto-scaling & self-recovery, AI-driven Cloud Cost Optimization & Auto-Healing Workloads, Ansible AI/Autopilot for infrastructure config

UNIT-IV	**Intelligent Monitoring & AIOps** Difference between Monitoring vs Observability, AI-powered Observability: How AI enhances traditional monitoring, Key Observability Components: Logs, Metrics, Traces, AI & Machine Learning in Observability: Self-healing & anomaly detection, AI for log analysis, observability, and performance monitoring, AI-powered incident detection & root cause analysis, AIOps Tools: Datadog AI, Dynatrace AI, ELK Stack with AI-based log insights, AI for Automated Alerts & Remediation, AI-based predictive maintenance tasks for infra health
UNIT-V	**Future of AI in DevOps & Security** AI-powered DevSecOps & Threat Detection, Automated Compliance & AI-based security scans, AI in DevOps Trends: Generative AI for DevOps automation, Case tudy: AI-powered incident response & anomaly detection, AI in Cybersecurity: Attack surface analysis & anomaly detection, AI-driven malware detection & endpoint security, Tools: CrowdStrike AI, Darktrace, SentinelOne AI, Case Study: AI-driven zero-day attack prevention.

TEXT BOOKS:

- **Kevin Scott et al.**, *Programming with GitHub Copilot: AI-Powered Code Completion in Visual Studio Code*, Microsoft Press, 2023.
- **Mitesh Soni**, *DevOps with Artificial Intelligence: Delivering Software Faster with Intelligent Automation*, Packt Publishing, 2023.
- **Yevgeniy Brikman**, *Terraform: Up and Running: Writing Infrastructure as Code*, 3rd Edition, O'Reilly Media, 2022.

REFERENCE BOOKS / OER:

- **tephen Chin et al.**, *DevOps Tools for AI: Managing AI/ML Pipelines with GitHub Actions and Kubernetes*, Apress, 2022.
- **Nathen Harvey & Michael Hausenblas**, *AI-Powered Observability: Monitoring, Tracing, and Logging with AIOps*, O'Reilly Media, 2023.
- **Andy Domeier**, *Modern Security Operations: Adapting to the Speed of Attack with AI and Automation*, O'Reilly Media, 2023.
- **Syed Omar Faruk Towaha**, *Learning Ansible 2.7 - Automation with Ansible for Beginners*, Packt Publishing, 2020.
- **Kief Morris**, *Infrastructure as Code: Dynamic Systems for the Cloud Age*, 2nd Edition, O'Reilly Media, 2021.

- **GitHub Copilot Documentation** https://docs.github.com/en/copilot
- **AWS Cost Explorer with ML Documentation** https://docs.aws.amazon.com/cost-management/latest/userguide/ce-forecast.html
- **Microsoft Learn: GitHub Copilot and DevOps with AI** https://learn.microsoft.com/en-us/training/modules/github-copilot-introduction

DevSecOps: Integrating security into DevOps practices	
Course Code: 25CD4003	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. Understand the DevOps lifecycle and the integration of security practices in a DevOp environment.
2. Learn methods to secure web applications and manage authentication and sessio security.
3. Apply access control and secure configurations in CI/CD pipelines and infrastructure.
4. Assess and mitigate security risks using advanced practices such as pen testing and red teaming.
5. Promote a culture of continuous security improvement within DevOps practices.

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 DevOps approach and continuous security concepts.
2. Identify and mitigate common web application threats like XSS, CSRF, and clickjacking.
3. Implement secure user authentication and session management practices.
4. Secure the software delivery pipeline using role-based access control and signed artifacts.
5. Assess risks and apply strategies like bug bounty programs and red teaming for DevOps security.
6. Integrate security continuously across the software development lifecycle (SDLC).

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

CLO CO	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO-01	✓					✓
CO-02		✓	✓			
CO-03			✓	✓		✓
CO-04				✓	✓	
CO-05					✓	✓

Mapped SDG: 4,9,11,12,16.

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Securing DevOps** The DevOps Approach (Continuous integration, Continuous delivery, Infrastructure as a service, Culture, and trust), Security in DevOps, Continuous Security (Test driven security, Monitoring and responding to attacks, assessing risks, and maturing Security).
UNIT-II	**Protecting Web Applications** Securing and testing web Apps, Website attacks, and content security (Cross-site scripting XSS, content security policy, cross-site request forgery CSRF, clickjacking, and Iframes protection), Methods for authenticating users (HTTP basic authentication, Password Management, Identity Providers, Sessions and cookie security, Testing Authentication), Managing Dependencies (Node.js package management, Python requirements)

UNIT-III	**Delivery Pipeline** Access control to code management infrastructure (managing permissions in GitHub Organization, Managing permissions between GitHub and CircleCI, Signing commits and Tags with GIT), Access control for container storage (Managing permissions between DockerHub and CircleCI, signing containers with Docker content trust), Access control for infrastructure management (Managing permissions using AWS roles and policies, Distributing secrets to production system)
UNIT-IV	**Maturing DevOps Security: Assessing Risks** Securing and testing web Apps, Website attacks, and content security (Cross-site scripting, content security policy, cross-site request forgery, clickjacking, and Iframes protection), Methods for authenticating users (HTTP basic authentication, Password Management, Identity Providers, Sessions and cookie security, Testing Authentication), Managing Dependencies (Node.js package management, Python requirements)
UNIT-V	**Maturing DevOps Security: Testing and Continuous Security** Testing Security: Maintaining Security, auditing internal Applications and Services, Red teams and External Pen Testing, and Bug Bounty Programs, Continuous Security: Practice and repetition: 10,000 hours of Security, Integrating Security into DevOps, Preparing for Worst, Driving the Change.

TEXT BOOKS:
● Securing DevOps" by Julien Vehent, Manning Publications (Latest Edition)

REFERENCE BOOKS / OER:
● OWASP Web Security Testing Guide ● GitHub Docs – Managing Access ● Docker Docs – Content Trust ● AWS IAM Documentation – Roles & Policies
Open Educational Resources (OERs): ● OWASP Cheat Sheet Series ● Red Team Village Resources ● Google DevOps Security Blog ● Secure Code Warrior – Learning Paths ● MITRE ATT&CK Framework ● DevSecOps Toolkit (GitHub)

Program Elective Courses

Professional Elective -I

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

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

COURSE LEARNING OUTCOMES (CLO)

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

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

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

	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**	**CLO6**
CO1	√					

CO2		√	√			
CO3				√		
CO4					√	
CO5						√

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

COURSE CONTENTS

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

TEXT BOOKS

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

REFERENCE BOOKS

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

Open Educational Resources (OERs)

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

Open-Access Journals and Research Repositories

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

Professional Elective -II

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

COURSE LEARNING OUTCOMES (CLO)

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

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

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

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

CO4			✔		
CO5			✔		✔

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

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	Concept of basic Machine, Properties and limitations of FSM, Moore and Mealy Machines, Equivalence of Moore and Mealy machines, pumping lemma. **Unit 1: Introduction to Formal Languages and Finite Automata** ● Alphabets, strings, languages, operations on languages ● Finite Automata (DFA, NFA, ε-NFA) ● Conversion: ε-NFA → NFA → DFA ● Equivalence of Finite Automata ● Minimization of DFA
UNIT-II	Regular expression conversion and vice versa. Conversion of NFA to DFA by Arden's Method. **Unit 2: Regular Languages and Grammars** ● Regular Expressions and their equivalence with FA ● Regular grammar (right-linear, left-linear) ● Closure properties of Regular Languages ● Pumping Lemma for Regular Languages ● Decision properties
UNIT-III	**Unit 3: Context-Free Grammars and Languages** ● CFG: Definition, Derivations, Parse Trees ● Ambiguity in CFGs ● Simplification: Removing null, unit, useless productions ● Normal forms: CNF, GNF ● Pumping Lemma for CFLs ● Closure properties
UNIT-IV	**Unit 4: Pushdown Automata and CFLs** ● Pushdown Automata (PDA): Definition, transition diagrams ● Acceptance by final state and empty stack ● Design of PDA for CFGs ● Deterministic v/s Non-deterministic PDA ● Applications of PDA

UNIT-V	**Unit 5: Turing Machines and Undecidability** ● Turing Machine: Basic model, design of TM ● Variants of TM: Multi-tape, non-deterministic ● Recursive and Recursively Enumerable Languages ● Church-Turing Thesis ● Undecidability: Halting Problem, Post Correspondence Problem, Rice's Theorem ● Closure properties of Turing machines.

TEXT BOOKS

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

REFERENCE BOOKS

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

Open Sources for Learning

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

Other Links

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

Professional Elective -III

PYTHON PROGRAMMING	
Course Code: 25CDPE321	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	COURSE CONTENTS
UNIT-I	**Setting Up The Python Environment** Installing Python, Anaconda, Jupyter Notebook, Spyder, Introduction to Python, Components, Versions and Distributions, Difference between Python 2 and Python3, Compiler vs Interpreter, Statically vs Dynamically typed languages.

UNIT-II	**Programming With Python** Python REPL, variables, control structures, functions, objects, First-class functions, Immutable data, Strict and non-strict evaluation, Recursion instead of an explicit loop state, Functions, Iterators, and Generators, Writing pure functions, Functions as first-class objects, Using strings, tuples and named tuples, Using lists, dicts, and sets, The Itertools Module, Best Practices, Clean coding, Reading data files into Python, manipulating rows and columns in files, writing files, Introduction to python libraries
UNIT-III	**Data Pre-Processing** Introduction to Pandas and Basic Concepts of Pandas, Data Cleaning and Preparation, Handling Missing Data, Filtering out Missing Data, Filling in Missing Data, Data Transformation, Removing Duplicates
UNIT-IV	**Data Pre-Processing Extended** Transforming Data Using a Function or Mapping, Replacing Values, Renaming Axis Indexes, Discretization and Binning, Detecting and Filtering Outliers, Permutation and Random Sampling, String Manipulation, Feature Engineering
UNIT-V	**Statistical Modeling** Derived Variables, Basic Exploratory Data Analysis, Methods for EDA and Examples, Statistical Modeling, Curve Fitting: Linear Regression, Nonlinear Regression

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

BIG DATA OVERVIEW	
Course Code: 25CDPE323	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE
The Objective of this course is to give a strong understanding of Big Data Concepts
1. To introduce the rate of data growth.
2. To teach different types of Data and Data Lake Essentials
3. To teach the types of Scalability and Load Balance.
4. To teach the fundamental techniques and principles in Big Data ecosystem.

COURSE LEARNING OUTCOMES (CLO)
The syllabus adhere 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. Understand the types of data generated.
2. Learn the Data Lake Essentials.
3. Understand the Scalability.
4. Explore the Big Data Ecosystem.

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

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

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS

UNIT-I	**Data Growth Explosion** Data is everywhere, Different sources of data, Types of data, Data explosion, What has led to data explosion?, Increase in Storage Capacities, Data Processing Abilities, Emerging Data Formats and Data Availability, of Data Explosion **,** Definition(s) of Big Data, Know the history, How Big is Big Data?, Sources of Big Data, Characteristics of Big Data - The Three, Know the numbers, Challenges, Velocity, Applications of the Velocity dimension, Challenges, Variety, Dimensions of variety, Challenges, Value- The Big V of Big Data, Drivers of Big Data Value, How to access and analyze big data, Benefits of Processing Big Data, Any other V's
UNIT-II	**Categories of Data** Data Classification, Organization of structured data, Examples of structured data, How Structured Data expands? Advantages and Disadvantages of Structured Data, What is unstructured data?, Examples of Unstructured Data, Advantages and Disadvantages of Unstructured Data, What is Semi- structured data?, Examples of semi-structured data, Advantages and disadvantages of semi-structured data, Comparison of structured, unstructured and semi-structured data
UNIT-III	**Data Lake Essentials** What is a data lake?, Key attributes of a data lake, Traditional Analytics Pipeline, Data Lake Pipeline, How Data Lake Compares to Enterprise Data Warehouse, Components of a Data Lake – Ingestion, Components of a Data Lake – Storage, Components of a Data Lake - Catalogue and Search, Components of Data Lake – Process, Security, Components of a Data Lake, Data Access and Visualization, Sources of Data to a Data Lake, Benefits, Use cases of data lake, stores used in data lake, Data Processing Requirements
UNIT-IV	**Scalability** Improve the Availability and Performance of Systems, Elasticity, Scalability, How to measure scalability?, Types of Scaling, Comparison of Horizontal and Vertical Scaling, Load Balancing, Ways to Balance Load, Database Scalability, Parallelism, Shared Nothing Architecture, Replication, Partitioning

UNIT-V	**Big Data Ecosystem** The Big Data Ecosystem, Big Data storage, NoSQL Databases, Distributed File Systems, Big Data Processing, MapReduce - An Introduction, Map, Reduce, Other User Interfaces of MapReduce, An Example for MapReduce – Wordcount, Daemons of MapReduce, Key Benefits of using MapReduce, Use case examples, Data Locality, Categories of Data Locality, Advantages of Data Locality, Challenges and Ways to Optimize Data Locality, Resiliency, Fault Tolerance

TEXT BOOKS

- Big Data Analytics with R and Hadoop – Book by Vignesh Prajapati, Packt Publishing Limited, ISBN: 9781782163282, 2013.
- Big Data: A Revolution That Will Transform How We Live, Work, and Think – Book by Kenneth Cukier and Viktor Mayer-Schönberger, Hodder and Stoughton Publication, ISBN: 9781848547926, 2013.

REFERENCE BOOKS/OER.

- Big Data: Principles and best practices of scalable realtime data systems – Book by Nathan Marz, Manning Publications, 1st edition, ISBN: 9781617290343, 2015
- Microsoft Azure Data Lake Overview (Documentation) https://learn.microsoft.com/en-us/azure/data-lake-store/data-lake-store-overview
- Data Lake vs Data Warehouse – Google Cloud Blog https://cloud.google.com/blog/topics/data-analytics/data-lake-vs-data-warehouse

Professional Elective –IV

SUPERVISED LEARNING	
Course Code: 25CD3022	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

The Objective of this course is to give a strong foundation of Supervised Learning Techniques Applied in the realm of Artificial Intelligence.

1. To introduce the Machine learning concepts.
2. To teach the fundamental techniques and principles in Regression techniques.
3. To teach the Decision tree and various Classification techniques.
4. To teach the Ensemble models.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus adhere 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. Understand the Machine Learning Concepts.
2. Understand the Regression Techniques.
3. Learn the different types of Supervised Algorithms.
4. Applications of Supervised Learning.

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

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

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

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Difference Between Supervised and Unsupervised Learning** Machine learning,why we need machine learning, machine learning process State the different types of learning: Supervised,unsupervised and reinforcement learning,, Detailing out on labeled data and its types,classification and regression models, unlabeled data and its types,clustering model; Gradient Descent-Overview**,**Gradient Descent, Finding a Minimum Using Gradient Descent, Estimating the Gradient, Using the Gradient Descent, Example, Loss Function, Different Loss Functions
UNIT-II	**Regression Techniques** Regression Technique, Origin of Regression, Regression in Real World, regression concepts, Regression Types, Linear Regression Types, Linear Regression Variance, Co-Variance, Linear Regression Correlation Coefficient, OLS, R Squared, Goodness of fit, Linear Regression Using Gradient Descent, Gradient Descent Explained with an Example, Stochastic Gradient Descent, Cost Function – Partial Derivative, Testing Model Using Cross Validation, Cross Validation Types, regularized regression, Ridge Regression, lasso regression, L1 vs L2 Norm – Regression, Generalized Linear Regression, RANDOM COMPONENT OF A GLM
UNIT-III	**Classification Techniques- Decision Tress** Classification Technique, Decision Tree, Decision Tree Illustration using Sample Dataset, concept of homogeneity., entropy, Entropy Explained with Rainfall Example, plot of entropy versus the proportionsm, Information Gain, Algorithms to Create a Decision Tree, Gini Index, Truncation and Pruning, Decision Tree Working Methodology, Decision Tree Tuning Parameters
UNIT-IV	**Classification Techniques- Naïve Bayes** Naïve Bayes, bayes theorem., Example, Naïve Bayes Algorithm for Categorical Data, Popular Naive Bayes Classifiers, Types of Naive Bayes Classifier, Naïve Bayes for Text Classification, popular naive bayes classifiers, Naïve Bayes Algorithm, K Nearest Neighbour classification , Curse of Dimensionality, K-Factor, Implementation of KNN using Python

UNIT-V	**Ensemble Methods** Ensemble Methods ,Why Ensemble?, Example, Methods for Constructing Ensemble, advantages and disadvantages of ensembling. Random Forest, Random Forest Example, Random Forest Use Case, Random Forest Algorithm, Comparing other Models Accuracy, Bootstrapping and Bagging, Out of Bag Error, OOB Score Before Tuning, OOB and Hyper Parameter Tuning, Ensemble Model Using Majority Voting, Gradient Boosting, Weak Learner, Gradient Boosting Example, Moving towards XGBoost, Parameters of XGBoost

TEXT BOOKS

- Python Machine Learning: Practical Guide for Beginners – Book by François Duval,CreateSpace Independent Publishing Platform, ISBN: 9781985670969, 2017.
- Understanding Machine Learning: From Theory to Algorithms – Book by Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 1st edition, ISBN: 9781107057135, 2014.
- *Introduction to Machine Learning with Python: A Guide for Data Scientists***:** Andreas C. Müller, Sarah Guido**:** O'Reilly Media**:** 1st Edition, 2016

REFERENCE BOOKS/OER

- Machine Learning For Absolute Beginners – Book by Oliver Theobald, Scatterplot Press, 2nd edition, 2017.
- *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow***:** Aurélien Géro**:** O'Reilly Media**:** 2nd Edition, 2019
- Google Machine Learning Crash Course
  https://developers.google.com/machine-learning/crash-course
- MIT OpenCourseWare – Machine Learning (MIT 6.036)
  https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-036-introduction-to-machine-learning-fall-2020/

DOMAIN-DRIVEN APPROACH TO DESIGN AND IMPLEMENT MICROSERVICESLEARNING	
Course Code: 25**CDV3024**	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

The Objective of this course is to give a strong foundation of applied DevOps.

1. To introduce the Service Oriented Architecture (SOA)
2. To introduce the design and to implement the Microservices.
3. To teach the fundamental techniques and principles in Security and Scaling Microservices.
4. To discuss various real world application.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus adhere 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. Understand the SOA
2. Learn the basics of Software Architectures and its Microservices components.
3. Understand the Domain Driven Approach to Design.
4. Understand the implementation Microservices in real world applicaton.

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

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

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

COURSE CONTENTS

UNIT NUMBER	**COURSE CONTENTS**

UNIT-I	**SOA Vs Microservices** Software Architecture and its Stakeholders, Architectural Patterns and Styles, Monolithic Architecture, Strengths and Limitations, SOA Architecture, Strengths and Limitations, SOA Components and its Principles, Microservices Architecture, Strengths and Limitations, Microservices Components and its Principles
UNIT-II	**Domain-Driven Approach to Design and Implement Microservices** Domain Driven Design Concepts, Strategic and Tactical Design, Domain, Bounded Context, Ubiquitous Language and Context Mapping, The Building Blocks of DDD, Strengths and Limitations of DDD, How Domain Driven Design Applies to Microservices, Designing Services Applying DDD Concepts, Service Communication, The API Gateway
UNIT-III	**Security and Scaling Microservices** Web Security Concepts, Information Security, The Top 10 Vulnerabilities and Risk, Stateless Vs Stateful Services, Containerization Vs Virtualization, Microservices with Containerization, Docker and its Role in Microservice, Microservices with Kubernetes, Microservices Observability with Use Case
UNIT-IV	**Microservices: Case Studies** One Detail Case Study , RainyDay Grocer, UBER, Multiple Case Studies

TEXT BOOKS

- **Sam Newman**, *Building Microservices: Designing Fine-Grained Systems*, 2nd Edition, O'Reilly Media, 2021.
- **Mark Richards**, *Software Architecture Patterns*, O'Reilly Media, 2020.
- **Eberhard Wolff**, *Microservices: Flexible Software Architecture*, Addison-Wesley Professional, 2016.
- **Sam Newman**, *Monolith to Microservices: Evolutionary Patterns to Transform Your Monolith*, O'Reilly Media, 2020.
- **Vlad Khononov**, *Learning Domain-Driven Design*, O'Reilly Media, 2021.
- **George Fairbanks**, *Just Enough Software Architecture: A Risk-Driven Approach*, Marshall & Brainerd, 2010.

REFERENCE BOOKS/OER

- **Len Bass, Paul Clements, Rick Kazman**, *Software Architecture in Practice*, 4th Edition, Addison-Wesley, 2022.
- **Bilgin Ibryam & Roland Huß**, *Kubernetes Patterns: Reusable Elements for Designing Cloud-Native Applications*, O'Reilly Media, 2022.
- **IBM Cloud Learning** – Microservices with Kubernetes (Free learning path, hands-on labs)
- **Microsoft Learn** – Microservices Architecture (eBook and modules)
- **Red Hat Developers** – SOA and Microservices (Articles and tutorials)
- **Nginx Blog & Resources** – Microservices Reference Architecture
- **OpenLibra** – Search for *Software Architecture*, *Microservices* (https://openlibra.com)

Professional Elective –V

ARTIFICIAL INTELLIGENCE & EXPERT SYSTEM	
Course Code: 25CS3002	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

1. Introduce the foundational concepts, evolution, and core application areas of Artificial Intelligence (AI), including intelligent agents and their architectures.
2. Develop the ability to model and solve real-world problems using search algorithms, adversarial game strategies, and constraint satisfaction techniques.
3. Enable students to apply reasoning under uncertainty using probabilistic models, fuzzy logic, and knowledge representation frameworks.
4. Equip learners with practical knowledge of AI-based planning, learning algorithms, and their implementation in autonomous and adaptive systems.
5. Provide exposure to Natural Language Processing and expert systems, emphasizing industrial applications, ethical AI practices, and alignment with Sustainable Development Goals.

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. Explain the fundamental concepts of Artificial Intelligence, types of AI systems, and the role of intelligent agents.
2. Apply appropriate search algorithms and game-playing strategies to model and solve AI problems.
3. Analyze and implement reasoning under uncertainty using probabilistic models, fuzzy logic, and logic-based inference.
4. Design AI systems using planning and learning approaches including supervised, unsupervised, and reinforcement learning.
5. Develop applications using NLP techniques and expert systems, and evaluate their ethical implications and SDG alignment.

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

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✔				
CO2		✔			

CO3			✔		
CO4				✔	
CO5					✔

Mapped SDGs: SDG-4,SDG-9,SDG-3,SDG-10,SDG-16

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT
UNIT-I	**Foundations of AI and Intelligent Agents:** Definition and History of AI, current trends and state-of-the-art systems , Types of AI: Reactive, Limited Memory, Theory of Mind, Self-aware AI,AI application areas: Healthcare, Finance, Robotics, Natural Language Processing, Autonomous Systems, AI Techniques: Machine learning, knowledge representation, search , Ethical Considerations: Bias in AI, Fairness, Transparency, Accountability, AI regulations and policies (e.g., GDPR, EU AI Act) **Agents**: Definition of agents, PEAS description Agent architectures: Reactive, Layered, Cognitive, Multi-agent systems: Collaborating agents, Competitive agents. **Case Studies:** ● AlphaGo (DeepMind): Reinforcement learning, deep neural networks, MCTS ● GPT (OpenAI): Transformer architecture, large language models, NLP ethics
UNIT-II	**Problem Solving and Search Algorithms** Problem formulation and State-Space Representation, Uninformed Search Algorithms: BFS, DFS, Iterative Deepening, Informed Search Algorithms: Hill climbing, A*, Heuristics, Means-End Analysis, Stochastic search. Constraint satisfaction problem (CSPs): Backtracking, Forward checking, Adversarial Search: Game theory, Minimax, Alpha-Beta pruning. **Case Study:** ● IBM Deep Blue: Heuristic search, pruning, and evaluation in chess AI

UNIT-III	**Reasoning under Uncertainty and Knowledge Systems** Monotonic Reasoning, Non-Monotonic Reasoning, Probabilistic Reasoning: Bayesian networks, Certainty factors, Fuzzy Logic: Membership functions, fuzzy rule **Knowledge-Based Systems:** Facts, rules, and logical inference, Propositional Logic, First-Order Predicate Logic (FOPL), Clausal Form, Resolution, Unification algorithm. Knowledge representation: Semantic nets, frames, ontologies, rules, MYCIN Expert System: Rule-based reasoning, uncertainty handling in medical diagnosis.
UNIT-IV	**Planning and Machine Learning:** **Planning:** The blocks world, Components of Planning Systems, Goal stack Planning, Nonlinear planning, Hierarchical planning, Conditional planning, **Learning paradigms:**, Supervised learning, unsupervised learning, Reinforcement learning, Inductive learning. Statistical learning, Neural networks: Perceptron (Single-layer, Multi-layer), Backpropagation **Case Study:** ● Autonomous Vehicles (Tesla, Waymo): Real-time planning, deep RL, sensor fusion
UNIT-V	**Natural Language Processing (NLP) and Expert Systems:** **Natural Language Processing:** Language models, Text classification, Information retrieval, and Semantic analysis, Named Entity Recognition (NER), Machine Translation, Speech recognition, Image-text alignment, pattern recognition. **Expert Systems:** , Architecture and components (Inference engine, knowledge base, ES shells), Rule base and decision tree-based Expert systems, non-monotonic reasoning in Expert Systems, Communication interfaces (chatbots, decision support) Case Studies: IBM Watson: NLP in healthcare, cancer diagnosis, question answering AI in Education: Personalized tutoring systems, adaptive learning environments

TEXT BOOKS
1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020. 2. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill.
REFERENCE BOOKS

1. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, PHI
2. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan-Kaufmann, 1998.
3. Biere, A., Heule, M., Van Maaren, H., Walsh, T., Handbook of Satisfiability, IOS Press, 2009.
4. Judea Pearl, Heuristics: Intelligent Search Strategies for Computer Problem Solving, Addison- Wesley Publishing Company, 1984.
5. Pattern Recognition and Machine learning , C.M. Bishop, Springer
1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning (ESL), Springer, 2009 (freely available online)
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective (MLAPP), MIT Press, 2012
3. Artificial Intelligence and Expert Systems – Import, 28 April 2020 by I. Gupta (Author), G. Nagpal (Author)

Open Educational Resources

1. **Stanford CS221: AI: Principles and Techniques**
   Free lecture slides and video overviews of AI history and agentsoftware Engineerin architectures.
   CS221 Course Materials (Stanford)
2. **MIT 6.034: Artificial Intelligence (Fall 2020)**
   Covers AI foundations, intelligent agents, PEAS models + in-depth agent work.
   MIT OpenCourseWare – 6.034

Professional Elective –VI

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

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

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

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

Mapped SDGs: SDG-4, 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-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
Andrew S. Tanenbaum, Maarten van Steen, Distributed Systems, —Principles and Pardigms, Pearson Education, 2002.
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

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

COURSE LEARNING OUTCOMES (CLO)

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

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

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

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

Mapped SDGs: SDG-4, 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

- https://www.youtube.com/c/NetworkChuck
- https://www.youtube.com/c/TheCyberMentor
- https://www.youtube.com/c/HackerSploit
- https://www.youtube.com/c/NullByteWHT
- https://www.youtube.com/c/JohnHammond010
- https://www.youtube.com/c/IppSec
- https://www.youtube.com/c/Cyberspatial

Other Sources

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

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 a software design.
4. To understand and learn design patterns.
5. To familiarize with the knowledge of design testing in DPIM.

COURSE LEARNING OUTCOMES (CLO)

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

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

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

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

Mapped SDGs: SDG-4, 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/OER

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 andDesign”,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., “Schuam’s Outline of UML”. New York: McGraw-Hill 2004
4. S. Perdita. “Using UML: Software Engineering with Objects and Components.” Addison-Wesley 2000
5. **NPTEL – Object Oriented Systems Development**
6. **Link:** https://nptel.ac.in/courses/106105153
   Instructor: Prof. Partha Pratim Das (IIT Kharagpur)**Contents:** OO Concepts, UML, Use Case, Class Diagrams, Design Patterns
7. **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 perceptron.
2. To get familiar with the principles of RBF, RNN, unsupervised learning.
3. To learn fuzzy set theory, fuzzy logic and understand the role of uncertainty in real-time applications.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. To introduce methodologies and modelling concept of ANN. To provide in depth detail of the perceptron. 2. To get familiar with the principles of MLP, RBF, Unsupervised learning. 3. To understand different types of associative memories, and RNN. 4. To learn fuzzy set theory, fuzzy logic and understand the role of uncertainty in realtime applications. 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, Boltzman 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/OER

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

SYLLABUS OF PROFESSIONAL ELECTIVE COURSES - VII

DIGITAL PRODUCT ENGINEERING and DESIGN THINKING	
Course Code: 25**CDV3024**	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

The Objective of this course is to give a strong foundation of Digital Product Engineering and Design Thinking.

1. To introduce the Digital Era.
2. To teach the fundamental techniques and principles in Product Management and Product Service.
3. To teach the fundamental techniques and principles in Product Management.
4. To teach the Digital Innovation and Lean Startup.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus adhere 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. Understand the Digital Transformation and its Advantages
2. Understand the Product Management & Service Mindset Elements.
3. Understand the Design Thinking and Minimum Viable Product.
4. Learn the Agile & Lean.

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

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

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

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**The Digital Era** Digital Era, Digital Transformation, Orinciples of DT, Advantages of DT, Business Model & Its Components, Business Model Canvas
UNIT-II	**Product Management and Service Mindset** Introduction and History of Product Management, Product Management,The Need for Product Management, Different Roles of Product Management, Definition of a Product Manager, Skill Sets of a Product Manager, Responsibilities of Product Managers, Building Digital Products and Services - Product Management Role, Setting a Product Vision, Idea Management, Planning, Product Roadmap, Product Roadmap, Ideation of Product, Product Feasibility Analysis, Business Case documentation, Definition of Product, Development of Product, Product Launch, Post-launch Feedback
UNIT-III	**Product Development Methodology** System Thinking, Definition, Systems Thinking Principles, The Iceberg Model in Systems Thinking, Systems Thinking in Software Product Development, Value Chain Analysis, Advantages of Value, Value Chain for Software Development, Capability Optimization, Capability Maturity Model (CMM), Business Integration Methods, Definition and Principles of Lean, Lean Methodology: Customer is King, Agile Methodology – Evolution, Birth of Agile, The Agile Manifesto, The Core Values of Agile, Twelve Principles of the Agile Manifesto
UNIT-IV	**Digital Innovation** Design Thinking , Different Phases, Empathy Map, Ideation Techniques, Shortlisting Ideas, Low Fidelity Prototype, Pros and Cons of Low Fidelity Prototyping, High Fidelity Prototype, Guidelines for a Test, Divergence, Emergence and Convergence of Design Thinking, Convergent Thinking, Emergent Thinking, Design Thinking vs. Agile vs. Lean, Challenges of Design Thinking, Design Sprint and its Phases, Setting up the stage, Sprints

UNIT-V	**Lean Startup** Minimum Viable Product (MVP), Building Your MVP, Approaches to Testing Your MVP, Benefits of MVP, Continuous Deployment – Definition, Best Practices for Continuous Deployment, Split Testing, The Process, Actionable Metrics: Definition and Methods, Pivot: definition and types, Build Measure Learn: Its Phases, Build-Measure-Learn: The Process

TEXT BOOKS
● **Jeff Gothelf and Josh Seiden**, *Lean UX: Designing Great Products with Agile Teams*, 3rd Edition, O'Reilly Media, 2021. ● **oman Pichler**, *Strategize: Product Strategy and Product Roadmap Practices for the Digital Age*, Pichler Consulting, 2020.
REFERENCE BOOKS/OER
● Agile and Lean Concepts for Teaching and Learning: Bringing Methodologies from Industry to the Classroom- David Parsons, Kathryn MacCallum ● Gene Kim, Jez Humble, Patrick Debois, John Willis, *The DevOps Handbook: How to Create World- Class Agility, Reliability, & Security in Technology Organizations*, 2nd Edition, IT Revolution Press, 2021. ● IDEO U – Design Thinking Resources ● Harvard Business School Online (Free Modules) – Business Model Canvas Coursera – Digital Product Management: Modern Fundamentals

SOFTWARE CRAFTMANSHIP OVERVIEW	
Course Code: 25**CDV4023**	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

The Objective of this course is to give a strong understanding of Software Design.

1. To introduce the Software Design and its Paradigms.
2. To teach the fundamental techniques and principles in Code Design, Code Structure.
3. To teach the fundamental techniques and principles inCode Formatting.
4. To teach the Test Driven Development and types of Test Debugging.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus adhere 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. Learn the Object Oriented Programming concepts.
2. Understand the Best practices in Coding.
3. Understand the Code Formatting
4. Understand the different of Testing Methods.

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

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

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

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Software Craftsmanship** Definition, History of the emergence of software craftsmanship, Software craftsmanship, Process versus paradigm, Software development processes, Software development models, Software design paradigms, Software development paradigms, Major programming paradigms Procedural programming paradigm, Object-oriented programming paradigm, Functional programming paradigm, Dimensions of craftsmanship, Craftsmanship - Mastery of the paradigm Describing and defining well-crafted code, Becoming a craftsman,The programming process
UNIT-II	**Code Design and structure** Clean code and its fundamental concepts, Code Design, Software design considerations, Kent Beck's principle of simple design, Fundamental characteristics of good design, Design Patterns: Reusing best practices, SOLID design principles, ProgrammingPrinciples, Classes, packages and methods: building blocks of code, organizing code: the size of methods and classes, What makes methods and classes "good", Software metaphors, Objects and data structures, data transfer objects, Using libraries, Overview of the best practices in structure: Law of demeter and open close principle
UNIT-III	**Code Formatting & Documentation** Introduction, Variants, Vertical Openness, Vertical Density, Distance and Ordering, Naming Best Practices, Intention-Revealing Names, Avoid Mental Mappings, Naming Classes, Methods and Functions, Comments, Writing Code Documentation

UNIT-IV	**Testing Debugging & Refactoring** Testing and Debugging, Basic Test-driven Development (TDD), Categories of TDD and Unit tests, Unit Testing Techniques, Automating Testing Using Junit, Refactoring: Improving Structure, Refactoring: Changing Code Structure without Changing Functionality, The need for Refactoring, The Refactoring Process and the Different Levels of Refactoring, Refactoring Strategies, Code Smells: Symptoms of Poorly Designed Code, Categories of Code Smells, Code Base, Using Frameworks & Tools
UNIT-V	**System Analysis and Design** Introduction to System Analysis and Design, Introduction, Objectives, Defining a System, System Life Cycle, Phases of System Development Life Cycle, Preliminary System Study, Feasibility Study, Detailed System Study, System Analysis, System Design, Coding, Testing, Implementation, Maintenance, What You Have Learnt, Terminal Questions, Key to Intext Questions

TEXT BOOKS

- **Sandro Mancuso**, *The Software Craftsman: Professionalism, Pragmatism, Pride*, Pearson Education, 2015.
- **Robert C. Martin**, *Clean Architecture: A Craftsman's Guide to Software Structure and Design*, Prentice Hall, 2017.
- **Kent Beck**, *Test-Driven Development: By Example*, Addison-Wesley, 2002.

REFERENCE BOOKS/OER

- Software craftsmanship Book by Pete McBreen
- Martin Fowler, *Refactoring: Improving the Design of Existing Code*, 2nd Edition, Addison-Wesley, 2018.
- Ian Sommerville, *Software Engineering*, 10th Edition, Pearson Education, 2015.
- Jason Gorman, *TDD for Software Craftsmanship*, Leanpub, 2019.
- MIT OpenCourseWare – Software Construction
- Code Smells Reference – Refactoring Guru (Code Smells & Refactoring Examples)
- Google's Engineering Practices Documentation – Google GitHub
- Software Engineering Body of Knowledge (SWEBOK) – SWEBOK Guide
- SourceMaking – Design Patterns and Refactoring

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

- Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, Starch Press, 2008.
- William Stallings, “Cryptography and Network Security: Principles and Practices”, Sixth Edition, Pearson Education, 2014.

REFERENCE BOOKS

- “The Shellcoder's Handbook: Discovering and Exploiting Security Holes”, 2nd Edition by Chris Anley et al.

- N. Ferguson, B. Schneier, and T. Kohno. “Cryptography Engineering: Design Principles and Practical Applications”. Wiley, 2010.
- Neil Daswani, Christoph Kern, and Anita Kesavan, “Foundations of Security: What Every Programmer Needs to Know”, First Edition, Apress, 2007.
- SNMP: A Guide to Network Management (MGH).
- Telecom Network Management by H.H. Wang (MGH).
- 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)**
3. **Link:** https://nptel.ac.in/courses/106105183
   Instructor: Prof. S. Misra (IIT Kharagpur)
   Covers: TCP/IP, Secure Socket Layer (SSL), IPSec, VPN

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 with the mechanisms for implementing security and trust mechanisms in MANETs and WSNs.
3. Enhance the basic knowledge about the principles and characteristics of wireless sensor networks (WSNs).
4. Understand how proactive and reactive protocols function and their implications on data transmission delay and bandwidth consumption along with design issues in wireless communication.
5. Understand the congestion control mechanism at transport layer and to acquire skills to design and implement a basic mobile ad hoc or wireless sensor network via simulations or programming of PDAs.

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

	CLO1	CLO2	CLO3	CLO4	CLO5

CO1	√				
CO2		√	√		
CO3				√	
CO4				√	√
CO5					√

Mapped SDGs: SDG-4, 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

1. C. S. Ram Murthy, B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall of India , 2007.
2. Andreas Willig and John H. Karl, Protocols & Architectures for Wireless Sensor Networks, Wiley, 2005

REFERENCE BOOKS

1. B. Tavli and W. Heinzelman, Mobile Ad Hoc Networks: Energy-Efficient Real-Time Data Communications, Springer , 1st Edition, 2006
2. Ramin Hekmat, Ad-hoc Networks: Fundamental Properties and Network Topologies, Springer , 1st Edition, 2006

OPEN EDUCATIONAL RESOURCES (OERs)

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**4035**	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- Sever computing – Sockets – Content and Protocols handlers – Developing distributed applications – RMI – Remote objects – Object serialization
UNIT-IV	**REMOTE METHOD INVOCATION** Remote Method Invocation (RMI): RMI Architecture, Designing RMI application, Executing RMI application.
UNIT-V	**RELATED JAVA TECHNIQUES** 3D graphics – JAR file format and creation – Internationalization. **SERVLETS** Java Servlets: Servlet Interaction & Advanced Servlets, Life cycle of Servlet, Java Servlet Development Kit, Javax.servlet package, Reading Servlet Parameters, Reading Initialization Parameters, The javax.servlet. http Package, Handling HTTP.

TEXT BOOKS
Jame Jaworski, "*Java Unleashed*", SAMS Techmedia Publications, 1999. H.M.Deitel and P.J.Deitel, "Java how to program with an Introduction to Visual J++", Pearson Education, 1998. Java: The Complete Reference, Ninth Edition Paperback by Herbert Schildt Advanced Java Programming, Uttam Kumar, Oxford Publications.
REFERENCE BOOKS/OER

- Campione, Walrath and Huml, "*The Java Tutorial*", Addison Wesley, 1999.
- Duane A.Bailey, "*Java Structures*", McGraw-Hill Publications, 1999.
- Jeff Frentzen and Sobotka, '*Java Script*", Tata McGraw-Hill, 1999.
- Jamie Jaworski, "*Java Unleashed*", SAMS Techmedia Publication, 1999.
- Jason Blooberg. Jeff Kawski, and Paul Treffers, "*Web Page Scripting Techniques",*Hayden books, 1996.
- **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
- **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)

DATA WAREHOUSING & DATA MINING	
Course Code: 25CS4025	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
CO 1	✓						
CO 2		✓					
CO 3			✓	✓	✓		✓

CO 4						✓	
CO 5			✓	✓	✓	✓	✓

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.
7. Managing the Data Warehouses- W.H.Inman, C.L.Gassey, 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**

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

1. **Link:** https://nptel.ac.in/courses/106105016
   Instructor: Dr. Srinivasan, IIT Madras
   Contents: Introduction to Grid Computing, Globus Toolkit, Middleware, Applications

2. **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

PREDICTIVE ANALYTICS	
Course Code: 25CSPE3036	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 Predictive Analytics.
2. To introduce the tools required For Predictive Analytics.
3. To review and explore data to look at data distributions and to identify data problems, including missing values.
4. 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 the completion of course the students will be able to:
1. Understand and critically apply the concepts and methods of Preditive analytics.
2. Understand and apply IBM SPSS Modeler in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined.
3. Apply and analyse how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency.
4. Evaluate the Model on the basis of different Predictive Methods.
5. Build and create advanced analytical model that leverage historical data to uncover real-time insights to predict future events.

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-I	**ANALYTICS OVERVIEW** Definition of business Analytics with real time examples, How Predictive analytics: Transforming data into future insights, Analytics trends: Past, Present & Future, Towards a Predictive enterprise.
UNIT-II	**IBM SPSS MODELER & DATA MINING** What is a Data Mining applications? Strategy for data mining: CRISP-DM, Identify nodes and streams, The framework of a Data – mining project, Brief the unit of analysis, Explain the type of dialog box.
UNIT-III	**UNIT OF ANALYSIS** Concepts of Unit of analysis (Distinct, Aggregate, SetToFlag), Integrate data, CLEM Expression, Role of Relationship between two fields, Identifying the modeling objective.
UNIT-IV	**ADVANCED DATA PREPARATION WITH IBM SPSS MODELER** Functions to enrich data, Method to transform data, Cross-record functions, Sampling, Partitioning and sampling data, Improving Efficiency.
UNIT-V	**PREDICTIVE ANALYTICS WITH IBM WATSON STUDIO** IBM Watson Studio, Watson studio Components, Data preparation, Watson Machine learning, Data Refinery, Watson Studio Neural Network Modeler, IBM Watson Studio jobs, Use case with AutoAI.
UNIT-VI	**PROJECT** Predicting using IBM SPSS Modeler & IBM Watson with real Case studies.

TEXT/REFERENCE BOOKS
IBM Courseware

Further suggested Readings
1. IBM Courseware
2. Predictive Analytics Mesmerizing & fascinating by ERIC SIEGEL

Open Educational Resources

1. **NPTEL – Data Science for Engineers (Includes Predictive Analytics)**

   Link: https://nptel.ac.in/courses/106106179
   Instructor: Prof. Raghunathan Rengaswamy (IIT Madras)
   Contents: Regression, classification, model evaluation, time series forecasting

2. **edX (Free Audit) – Predictive Analytics Using Python**

   Link: https://www.edx.org/course/predictive-analytics-using-python
   Institution: University of Edinburgh
   Contents: Machine learning, model fitting, evaluation, case studies

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.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND

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.

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**Introduction to Business Intelligence** Definition and significance of Business Intelligence (BI),Key components of BI,Data Sources: structured and unstructured,Data Integration (Extract-Transform-Load (ETL)/ ELT) processes,Data Storage: Data Warehousing, Data Lakes,and Data Lakehouses,Reporting, Dashboards and Visualization, Comparison with related fields:BI vs Data Analytics, BI vs Data Mining,Role of BI in informed decision-making, Applications across industries: retail, banking, healthcare, and logistics **Career pathways and future trends in BI**
UNIT-II	**Data Acquisition, Preparation and Cloud Integration** **Tools Used:** Python with Pandas (for data manipulation, cleaning, basic ETL scripting), SQL (for data extraction and transformation within databases), or KNIME or Talend Open Studio (For visual ETL workflow) **Primary Topics:**Introduction to open-source ETL tools,Cloud Data Integration concepts,Practical data preparation pipelines,Combining multiple data sources,Data type handling and formatting **Tutorial Exercises**: 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 ● Introduction to Online Analytical Processing (OLAP) ● Cube building and multidimensional queries ● Introduction to Cloud Data Warehouses ● Data Lake vs. Data Warehouse vs. Data Lakehouse ● Data Governance in Data Warehousing **Tutorial Exercises**: 1. Design a star schema for a university admissions dataset and implement 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

1. **NPTEL – Business Analytics and Data Mining Modeling Using R**

   Link: https://nptel.ac.in/courses/110106064
   Instructor: Prof. Gaurav Dixit (IIT Roorkee)
   Includes: BI fundamentals, data warehousing, data mining, BI tools using R

2. **Saylor Academy – Data Analysis and Decision-Making**

   Link: https://learn.saylor.org/course/view.php?id=98
   Course Code: BUS204
   Topics: Business data, BI applications, decision support

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

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 (OERs)

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 (OERs)

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

ADVANCED INTERNET OF THINGS	
Course Code: 25CSPE4041	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 1 0	
Credits: 4	

COURSE OBJECTIVES
1. To provide an in-depth understanding of advanced IoT concepts, architectures, and protocols, emphasizing the integration and interoperability of various IoT components.
2. To delve into the design and implementation of IoT sensor networks and the methods for collecting, processing, and analyzing IoT data.
3. To provide comprehensive knowledge of the security and privacy challenges in IoT, and the strategies to mitigate these challenges.
4. To explore various advanced IoT applications across different industries and analyze real-world case studies to understand the practical implementation of IoT solutions.
5. To investigate the emerging trends and future directions in IoT, including advancements in technologies, standards, and applications.

COURSE LEARNING OUTCOMES (CLOs)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Understand advanced concepts and principles of IoT
2. Design and implement IoT sensor networks.
3. Identify and analyze various IoT security threats and vulnerabilities and Implement security protocols and techniques to protect IoT systems.
4. Identify advanced IoT applications in different industries and analyse the real-world case studies of IoT implementations.
5. Evaluate the impact of emerging IoT technologies on various industries and develop a project that should demonstrate proficiency in IoT architecture, sensor networks, data analytics, security, and application development.

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

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

Mapped SDGs: SDG-2, SDG-3, SDG-9, SDG-11

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**Advanced IoT Concepts and Architectures** Overview of IoT and its evolution, Advanced IoT architectures and their components, IoT communication protocols (MQTT, CoAP, AMQP, etc.), IoT standards and frameworks, Interoperability challenges and solutions in IoT
UNIT-II	**IoT Sensor Networks and Data Analytics** Design and deployment of IoT sensor networks, Sensor data acquisition and preprocessing techniques, IoT data storage solutions, Data analytics and machine learning for IoT, Performance and scalability in IoT data analytics
UNIT-III	**IoT Security and Privacy** Security challenges in IoT, Common IoT security threats and vulnerabilities, IoT security protocols and best practices, Privacy concerns and data protection in IoT, Legal and regulatory considerations in IoT security
UNIT-IV	**IoT Applications and Case Studies** Advanced IoT applications in healthcare, agriculture, smart cities, etc., Case studies of successful IoT implementations, Challenges in IoT application deployment, Impact of IoT on business processes, Planning and managing IoT projects
UNIT-V	**Emerging Trends and Future Directions in IoT** Emerging IoT technologies and standards, Future directions in IoT research and development, Impact of emerging IoT technologies on different sectors, Research opportunities in IoT, Strategic planning for future IoT advancements

TEXT BOOKS
IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by David Hanes, Gonzalo Salgueiro, Rob Barton Released June 2017 Publisher(s): Cisco Press ISBN: 9780134307091
Enterprise Internet of Things Handbook by Arvind Ravulavaru Released April 2018 Publisher(s): Packt Publishing ISBN: 9781788838399
0. Analytics for the Internet of Things (IoT) by Andrew Minteer Released July 2017 Publisher(s): Packt Publishing ISBN: 9781787120730

REFERENCE BOOKS
Analytics: Data Science, Data Analysis and Predictive Analytics for Business" by Daniel Covington.

Artificial Intelligence for IoT: "IBM Reference Architecture for High Performance Data and AI in Healthcare and Life Sciences" by Dino Quintero, Frank N. Lee.

OPEN EDUCATIONAL RESOURCES (OERs)

1. **NPTEL – IoT: Communication Protocols**

   Link: https://nptel.ac.in/courses/106105195
   Instructor: Prof. Prabhakar T.V. (IISc Bangalore)
   Topics: MQTT, CoAP, 6LoWPAN, ZigBee, BLE, Protocol stack for IoT

2. **NPTEL – Sensor Networks and IoT**

   Link: https://nptel.ac.in/courses/106105173
   Instructor: Prof. Prabhakar T.V.
   Topics: WSN integration with IoT, edge computing, embedded systems

3. **edX – Embedded Systems and IoT (Advanced Level)**

   Link: https://www.edx.org/professional-certificate/harvardx-tinyml
   Focus: TinyML (Machine Learning on edge IoT devices)
   Topics: Edge AI, low-power devices, sensor data classification

ADVANCED BLOCKCHAIN	
Course Code: 25CSPE4047	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 Blockchain technology and the key concepts like cryptography and cryptocurrency concepts.
2. To gain a deep insight into Bitcoin, its network and how Bitcoin transactions are validated by miners
3. To interpret the prospects of Blockchain and assess how Blockchain can improve your business standards.
4. To deploy your private Blockchain on the web where you can visually see your chains & send transactions between nodes
5. To infer Hyperledger project, its architecture, APIs and network topology

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. Develop a deeper understanding of blockchain technical topics such as consensus, cryptography, privacy and security.
2. Understand how blockchain solutions are transforming the industry landscape.
3. Design and develop for a permissioned blockchain
4. Explore a variety of blockchain case studies, including food provenance, container tracking, payments, identity.
5. Acquire hands-on expertise using popular blockchain open source technology, including Hyperledger Fabric.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	√				
CO2		√			
CO3			√		

CO4				√	
CO5					√

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

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**Blockchain prerequisites and Introduction to Blockchain** Introduction to HTML 5 and Javascript Programming, Concept of callback, promises and Async/Await, NodeJS- Server side Javascript, Docker essentials, Containers Orchestration, Implementations Creating and Deplooying Docker containers, Introduction to Blockchain
UNIT-II	**Blockchain in detail and Blockchain Status** Understand the business context behind blockchain and the problems that blockchain aims to solve, Distinguish between blockchain for business and other blockchain implementations, Enumerate the broad categories of blockchain solutions, Understand the state of the blockchain industry in 2019, in terms of technologies, topics and communities, See how today's blockchain implementations vary, Look at the indicators that point to blockchain's future
UNIT-III	**Linux Foundation Hyperledger and Blockchain Use-Cases** Understand the background behind the Linux Foundation Hyperledger project, Enumerate and compare the different Hyperledger projects, Introduce Hyperledger Fabric, Learn about some successful blockchain projects, Evaluate good vs. bad blockchain ideas, Assess business value
UNIT-IV	**Blockchain Developer part 1:-** Block chain principles and its use in the enterprise, Blockchain infrastructure and applications, Identify participants, assets, transactions in a business network, Hyperledger Fabric, Blockchain solution architecture, Peers, smart contracts, channels, world state

UNIT-V	**Blockchain Developer part 2:-** Consensus, ordering service and transaction endorsement, Chaincode structure, lifecycle and deployment approaches., Blockchain deployment with Docker and Kubernetes, Blockchain security on Hyperledger Fabric
UNIT-VI	**PROJECT** Research Activities on Blockchain network

TEXT BOOKS

- **Imran Bashir**, *Mastering Blockchain*, 4th Edition, Packt Publishing, 2023.

REFERENCE BOOKS/OER

- Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps, Apress, 2017.
- Matt Zand, Xun Wu, Mark Morris, Hyperledger Fabric in Action, Manning Publications, 2022.
- Nigel Poulton, Docker Deep Dive, 4th Edition, Leanpub, 2021.
- Kelsey Hightower, Brendan Burns, Joe Beda, Kubernetes Up & Running, 3rd Edition, O'Reilly Media, 2022.
- BM Blockchain Essentials – https://cognitiveclass.ai/courses/blockchain-course
- Linux Foundation Hyperledger Course – https://www.edx.org/course/blockchain-for-business-an-introduction-to-hyperledger
- MDN Web Docs (HTML5 & JS) – https://developer.mozilla.org/
- Docker Curriculum – https://docker-curriculum.com/
- Kubernetes Documentation – https://kubernetes.io/docs/home/

SYLLABUS OF ABILITY ENHANCEMENT COURSES
COMMUNICATIVE ENGLISH

Communicative English (Common To All branches of B.Tech)	
Credits: 2	**Continuous Evaluation**:40 Marks
L T P: 2 0 0	**End Semester Examination**:60 Marks
Prerequisite: Nil	**Course Code:23AEC101**

(COMMON TO ALL BRANCHES OF B.TECH.)

COURSE OBJECTIVES (CO)

1. To prepare the students for their career which will require them to listen to, read, speak, and write in English both for their professional as well as interpersonal communication
2. To empower the students to improve both abilities to communicate and their linguistic competence and boost their confidence.
3. To enable the students to properly communicate and express themselves in writing.
4. To enable students to identify the common mistakes made by most learners of English and not make those errors both in their writing and speaking.
5. To study, understand and implement each unit according to National Education Policy 2020 and Bloom's Taxonomy.

COURSE LEARNING OUTCOMES (CLO)

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

1. Recall and identify English vocabulary words and grammatical structures.
2. Analyse the structure and organization of written texts, identifying the introduction, body, and conclusion.
3. Examine how the use of specific language techniques impacts the effectiveness of communication.
4. Assess and critique public speeches and presentations based on clarity, coherence, and persuasiveness.
5. Evaluate one's own language skills and identify areas for improvement.

Course Objective	**Course Learning Outcomes**				
	CLO 1	**CLO 2**	**CLO 3**	**CLO 4**	**CLO 5**
CO 1	✓	✓	✓		
CO 2		✓		✓	
CO 3					
CO 4				✓	✓
CO 5					✓

MAPPING MATRIX OF COURSE OBJECTIVES (CO) & COURSE LEARNING

COURSE CONTENTS

Unit-I: Introduction to Communication

• The importance of communication through English at the present time; the process of communication and factors that influence communication: sender, receiver, channel, code, topic, message, context, feedback, 'noise', filters and barriers;

• Verbal and non-verbal communication

• Listening Skills: Importance and types of Listening

• Identifying and rectifying common errors: Subject-verb agreement, Concord, Types of Sentences (Statements, interrogative, exclamatory and imperative, wh- questions, question-tags)

- Use of modals

• Vocabulary Building, word collocation

Unit-II: Workplace Communication

• Communication challenges in culturally diverse workforce; Ethics in Communication

• Bias-free communication

• Effective Business Presentations: Importance in workplace communication; Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Handling Questions; Power Point Presentation

Unit-III: Writing at Work

• Business letters

• Writing notices, circulars, emails.

• Writing reports and precis writing

• Writing CVs (for Technical Positions and Internships)

Unit-IV: Soft Skills/Life Skills

• Body Language

• Connected Speech (Intonation in Everyday Speaking and Conversation)

• Types of interviews, Planning and preparing for a Job Interview; Stages of an Interview; Mastering the art of giving interviews.

TEXT BOOKS

1. English Grammar in Use. Raymond Murphy. Cambridge UP.4th Edition.
2. Business Communication by Carol M Lehman, Debbie D Dufrene and Mala Sinha. Cengage Learning. 2nd Edition.
3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian [MACMILLAN]
4. Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman and Shalini Upadhyay. Cengage Learning. 2018 Edition.

REFERENCE BOOKS

1. Technical Communication, Principle and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford University Press.
2. Communication skill by Sanjay Kumar & Puspa Lata, Oxford University Press. 2nd Edition.
3. Business Communication Today by Courtland L Bovee and Thill, Pearson

SYLLABUS OF SKILL ENHANCEMENT COURSES
SEMESTER – III

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 (TO): -

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

Training Learning Outcomes (TLO): -

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

- TLO1. To communicate effectively and interact with people with confidence.
- TLO2. To demonstrate and differentiate between various forms of communication.
- TLO3. To apply effective communication skills confidently which a student need to get ahead in job and life.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
TRAINING LEARNING OUTCOMES (TLO) TRAINING OBJECTIVES (TO)	TLO1	TLO2	TLO3
TO1	√		
TO2	√	√	
TO3		√	√

Unit	**Course Contents**	**Student Engagement Activity**
Unit-I	**Verbal Communication Skills** ● Communication Process & its importance ● 7 C's of Communication ● Formal & Informal Conversation ● Requirements of effective verbal communication	Conversation Cards Activity
Unit-II	**Nonverbal Communication Skills** 1. Importance of nonverbal skills in effective communication 2. Types of nonverbal (body language) skills 3. 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** 1. Types of reading strategies to enhance improve reading skills 2. 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	1. ***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	1. ***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Effective Communication Skills Course

<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>Verbal Communication Skills</td><td>Speech Activity</td><td>15</td><td rowspan="3">Written Test</td><td rowspan="3">10</td></tr>
<tr><td>II</td><td>Non Verbal Communication Skills</td><td>Role Play</td><td>15</td></tr>
<tr><td>III</td><td>Listening Skills</td><td rowspan="3">Oral Assessment / Written Assessment</td><td>10</td></tr>
<tr><td>IV</td><td>Reading & Writing Skills</td><td>20</td><td rowspan="2">Viva</td><td rowspan="2">20</td></tr>
<tr><td>V</td><td>Visual Communication</td><td>10</td></tr>
</table>

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)

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

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

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. To make the students learn & demonstrate effective teamwork, leadership & interpersonal skills.
2. To equip the students with capability of handling stress and utilization of work time effectively.
3. 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. To be confident working in a team and leading it as well.
2. 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. To get benefitted from Emotional Quotient in building stronger professional relationships and achieving career and personal goals.
4. To face complex problems and effectively deal with it in the job due to Critical Thinking & Problem Solving Skills.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)				
Training Learning Outcomes (TLO) Training Objectives(TO)	TLO1	TLO2	TLO3	TLO4
TO1	√			
TO2		√		
TO3			√	√

Unit	Course Contents	gagement Activity
Unit - I	**Team Management** ● Team communication & team conflict resolution ● Role of a team leader ● Team goal setting & understanding team development ● Team dynamics & multicultural team activity ● Johari Window Model	Collaborative Working Game Activity
Unit-II	**Time Management** ● Time management matrix ● Pareto Principle (80/20 rule) ● Development process of plan of action	What You Did Yesterday Activity
Unit-III	**Leadership** ● Difference between leadership & management ● Types of leadership style ● Core leadership skills	Lead The Blindfolded Activity
Unit-IV	**Stress Management** ● Sign of stress & its impact ● Types of stress ● Techniques of handling stress	Keeping Cool Activity
Unit – V	**Emotional Intelligence** ● Emotional intelligence & emotional competence ● Components & behavioral skills of emotional intelligence	Guess The Emotion Game Activity
Unit – VI	**Critical Thinking** ● Types of thinking & Characteristics ● Critical thinking standards ● Barriers to critical thinking	Think Pair Share Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Teamwork & Interpersonal Skills

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Team Management	Role Play / Group Activity	10	Written Test	10
II	Time Management		10		
III	Leadership		10		
IV	Stress Management	Assignment	10	Viva	20
V	Emotional Intelligence	Written Test	10		
VI	Critical Thinking		20		

DESIGN THINKING AND AUGMENTED VIRTUAL REALITY	
Course Code: 25CS0202B	Continuous Evaluation: 40 Marks
Prerequisite: NIL	End Semester Examination:70 Marks
L T P : 0 0 2	
Credits: 1	

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

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

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

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

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

TRAINING CONTENTS

MODULE	**TRAINING CONTENT**	**STUDENTS ENGAGEMENT ACTIVITY**

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

Text and Reference Books:

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

Open Educational Resources (OERs):

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

Key Journal Articles

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

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING-LEVEL-II	
Course Code: 25CS0202	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination:60 Marks
L T P : 0 0 2	
Credits: 1	

TRAINING OBJECTIVES
● To understand the need of AI
● To describe basic AI algorithms (e.g., standard search algorithms).
● To learn about one of the learning method of AI that is Machine Learning.
● 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:
● Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem
● Understands the basics and need of AI and Machine learning in global view.
● Understands, apply and evaluate the supervised learning techniques.
● Design and implement the different applications using the concepts of AI and ML

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

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

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

TRAINING CONTENTS

MODULE	**TRAINING CONTENTS**	**STUDENTS ENGAGEMENT ACTIVITY**

I	**INTRODUCTION:** Introduction to AI: Definitions, Historical foundations, Basic Elements of AI, Characteristics of intelligent algorithm, AI application Area**.**	Classification of AI Problems into AI task Domains
II	**PROBLEM SOLVING:** Depth-first, breadth-first search, Problem Reduction, Constraint Satisfaction , Means-End Analysis.	Solving manually constraint satisfaction problem
III	**INTRODUCTION TO MACHINE LEARNING** Machine Learning Basics, Need of Machine Learning, Application Domains, Basic Learning Techniques.	Identification of ML Model based on Application
IV	**CLASSIFICATION PROBLEM** Machine learning Algorithms for classification problem	Design decision trees
V	**HANDS ON ACTIVITY :** Students will apply the methods learnt to design applications for a) Constraint Satisfaction Problem b) Robot Traversal c) Classification problems like COVID Detection, Spam classification etc.	Implement the given activity.

Learning Resources

- Introduction to Machine Learning, E. Alpaydin. MIT Press
- Machine Learning, T.M. Mitchell, Mc-Graw Hill

1. Stuart Russell, Peter Norvig, Artificial intelligence : A Modern Approach, Prentice Hall, Fourth edition, 2020.
2. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill.

SEMESTER – V

Department Of Training & Placement			
Training Cell			
Programme	**Faculty of Engineering & Technology**		
Year / Semester	**3 / 5**	**Course Category**	**SEC**
Course Code	**23SS553**	**Course Title**	**Presentation Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO):-

1. To develop the public speaking skills of the student.
2. To make the students learn and adapt to the necessary etiquettes required working and growing in corporate culture.
3. To make the students learn to speak in a debate session by putting his arguments and making others accept his viewpoint convincingly.

Training Learning Outcomes (TLO): -

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

1. To be confident in presenting himself in front of an audience.
2. To become professional in his approach towards work culture.
3. To enhance the level of communication skills while interacting with others.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
TLOs/TOs	TLO1	TLO2	TLO3
TO1	√	√	
TO2		√	
TO3		√	√

Unit	Course Contents	Student Engagement Activity
Unit-I	**Importance of Presentation Skills** ● 4 P's of presentation skills – plan, prepare, practice & present ● Guidelines for effective presentation	PPT Presentation Activity

Unit-II	**Storytelling Skills** ● 4 P's of storytelling skills – people, place, plot & purpose ● Types of storytelling techniques ● Importance of storytelling skills	Start From Where I Stopped Activity
Unit-III	**Corporate Culture Etiquettes** ● Importance of professional behavior at work place ● Understand & implementation of etiquettes at work place ● Importance of values & ethics ● Types of professional / corporate etiquettes	Etiquettes Role Play Activity
Unit-IV	**Debate / Extempore** ● Difference between debate, extempore & group discussion ● Learning argument /counter argument in debate	Current Affair Topic Speech Activity
Unit-V	**Art of Creating Impression** ● Importance of creating first impression ● 6 ways to master the art of creating impression	Speech Activity
Unit-VI	**Problem Solving** ● Types of problems & its solutions Problem solving process & tools	Think Pair Share Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

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

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Importance of Presentation Skills	Presentation Activity	20	Written Test	10

II	Storytelling Skills	Speech Activity	15		
III	Corporate Culture Etiquettes	Assignment	10		
IV	Debate/Extempore	Speech Activity / Written Activity	15	Viva	20
V	Art of Creating Impression		10		
VI	Problem Solving				

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)

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- 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

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4. 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.

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 (TO): -

1. To encourage students to learn and apply effective writing skills.
2. To make the students learn various types of business correspondence letters, cover letters & resume.
3. To encourage students to learn how to talk and convince people in GD & interview.
4. 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. To understand the importance of professional writing required in the workplace.
2. To explore different formats in resume, cover letters & other business related letters.
3. To develop knowledge, skills and understanding people in-group and individually.
4. 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.			√	√

Course Contents

Unit	Course Contents	Student Engagement Activity
Unit-I	**Email Writing** ● Importance of email communication skills ● Basic rules of effective email writing ● Structure of email – address, subject, message text, attachments, signature	Email Practice Activity
Unit-II	**Resume Writing** ● Difference between Resume, CV & Bio data ● Guidelines of resume writing ● Resume preparation of the student	Resume Making Activity
Unit-III	**Letter Writing** ● Types of Letter Writing – Application, Leave, etc. ● Cover letter	Letter Writing Activity
Unit--IV	**Group Discussion (GD)** ● Characteristics of GD & subject knowledge ● Do's & Don'ts in GD ● Strategies of GD ● Types of GD	Group Discussion Practice Activity
Unit-V	**Interview Skills** ● Preparation of the interview & company details information ● Do's & Don'ts in interview ● Types of Interviews ● Strategies of interview	Mock Interview Practice Activity
Unit-VI	**Negotiation Skills** ● Importance of negotiation skills ● Four phases of negotiation skills ● Barriers to negotiation & overcoming it ● Win-win negotiation	Win-Win Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Professional Skills

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Email Writing	Written Assignment	10	Written Test	10
II	Resume Writing		10		
III	Letter Writing		10		
IV	Group Discussion	Group Discussion Activity	15	Viva	20
V	Interview Skills	Mock Interview Activity	15		
VI	Negotiation Skills	Role Play	10		

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

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 (TO): -

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

Training Learning Outcomes (TLO): -

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

- TLO1. To understand the basic concepts of quantitative ability.
- TLO2. To solve campus placements aptitude papers covering Quantitative Ability.
- TLO3. To Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
TRAINING LEARNING OUTCOMES (TLO) TRAINING OBJECTIVES (TO)	TLO1	TLO2	TLO3
TO1	√		
TO2		√	
TO3			√

A-Quantitative Ability

UNIT - I

- Number System
- Percentage
- Profit, Loss and Discount
- Simple Interest and Compound Interest

UNIT – II

- Allegation and Mixture
- Average
- Ratio, Proportion and Variation, Problem on Ages and Numbers
- Time and Work
- Time, Speed and Distance

UNIT – III

- Permutation and Combination
- Probability
- Data Interpretation
- Geometry and Menstruations
- Sequence, Series & Progression and Logarithmic

B- Logical Reasoning

UNIT - IV

- Number Series and Alphabet Series
- Direction Sense Test
- Coding -Decoding
- Blood Relation

UNIT – V

- Syllogism
- Dice, Cube and Cuboids
- Seating Arrangement

UNIT – VI

- Clock and Calendar
- Critical Reasoning
- Order and Ranking, Ven diagram, Analogy

Learning Resources	
Text Books	***Quantitative Aptitude for Competitive Examinations*** by R S Aggarwal: S Chand Publishing, 2022.
	A Modern Approach to Logical Reasoning by R S Aggarwal: S Chand Publishing, 2022.

Pedagogy-

- The training will be based on the concept of learning by doing and practice.
- The training will involve 50% of the training time on teaching the concepts and the remaining 50% will be focusing on practice.
- The training will follow a circular approach where students are taught, evaluated and given feedback.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Aptitude & Reasoning

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Quantitative Ability	Written Assignment	10	Written Test	30
II			10		
III			10		
IV	Logical Reasoning		15		
V			15		
VI			10		

ESSENTIALS OF BLOCKCHAIN & IOT	
Course Code: 25CS0401D	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination:60 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) 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 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 OUTCOME (TLO)-TRAINING OBJECTIVE (TO) MAPPING

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

MAPPED SDGs:- SDG-4, SDG-9, SDG-11, SDG-13

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

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,	To design a simple application of LED lightning
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

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

SYLLABUS OF MULTIDISCIPLINARY COURSES

Department of Mathematics			
Multi-Disciplinary Course (MDC)			
Year/Semester	**1st Year/1st Semester**	**Course Category**	**Multidisciplinary Course**
Course Code	**25MDC101**	**Course Title**	**Statistical Methods**
Continuous Evaluation: 40		**End Semester Examination:60**	
Prerequisite: Basic Mathematics		**L T P : 2 0 2**	**Credits: 3**

Course Objectives (CO) - The Course is designed with the following objectives:

1. 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 (CLO) – The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

1. Compute and interpret different measures of central tendency, dispersion to summarize and analyze datasets.
2. Compute and interpret correlation coefficients 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	COURSE CONTENTS

UNIT-I	**Data Visualization** Data types and measurement scales, Graphical representation of data, Measures of Central Tendency- mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Skewness and Kurtosis. Application domain problems: Analyze, interpretation and significance of data
UNIT-II	**Bivariate Data Analysis** Bivariate Data, Scatter plot, Correlation, Karl Pearson's correlation coefficient, Rank correlation – Spearman's, Concept of errors, Principle of least squares, fitting of polynomial and exponential curves. Simple linear regression and its properties. Fitting of linear regression line and coefficient of determination. Application domain problems: Machine learning and data analysis
UNIT-III	**Probability** Probability: Introduction, random experiments, sample space, events, and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem, and its applications. Application domain problems: Decision making, forecasting, Naives Bayes analysis
UNIT-IV	**Testing of Hypothesis** Type I error and Type II error and power of test. Hypothesis testing for- population means, difference of two population means, population proportions, difference between two population proportions, population variance, ratio of two population variances. Chi square test: test of goodness of fit. Application domain problems: Decision making for the available data

TEXT BOOKS

1. Seymour Lipschutz, John Schiller, "Introduction to Probability and Statistics", Tata McGraw Hill,2017.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, "Probability & Statistics for Engineers & Scientists", 9th Edition, Prentice Hall, 2017.

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	1s Year/I or II	**Course Category**	**MDC**
Course Code	23MDC102	**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-1

Origin of the Earth:

Theories and hypothesis of the origin of earth- Oparin-Haldane hypothesis, Big bang theory, the material basis of life, geological time scale, evolution of earth's atmosphere and life through the geological time scale.

Unit-2

Internal Structure of the Earth:

Internal Structure of Earth, differentiation of the earth into core, mantle, crust. Formation of core, mantle, crust, atmosphere, hydrosphere, and biosphere. Convection in Earth's core and production of its magnetic field. Geothermal gradient and internal heat of the Earth. Earthquake and earthquake belts: seismic waves and internal constitution of the Earth. Volcanoes and volcanism, distribution of volcanoes.

Unit-3

Fundamentals of Earth process

Concepts Rocks, Formation of rocks, types of rock (Igneous rock, Metamorphic Rocks, and Sedimentary rocks), Continental drift theory, Plate tectonic, sea floor spreading. Basic concepts of weathering, erosion, and deposition of earth materials by water, wind and glaciers.

Unit-4

Geological Resources and Exploration:

Fundamentals of geological resources, their formation, reserves in minerals, coal, oil, gas geological constraints in their availability and use; environmental consequences of their exploitation to air, water, soil, climate, and life. Distribution of minerals in India.

Unit-5

Disaster Management:

Disaster introduction- disaster management, capability vulnerability, risk, preparedness and mitigation. Disaster management cycle. Hazard zonation and mapping- risk reduction measures. Landslide, Earthquake, Tsunami, Flood, Minamata Disaster, Bhopal Gas Disaster, 1984, Chernobyl Disaster, 1986, Fukushima Daiichi nuclear disaster, 2011. Role of geo-spatial technology in surveillance, monitoring, risk assessment, and disaster management Sendai Framework for Disaster Risk Reduction.

RECOMMENDED TEXTBOOKS:

1. Mukherjee, S. (2004). Text Book of Environmental remote Sensing. Published by Macmillan India Limited New Delhi ISBN: 1403922357.
2. Keller, E.A. (1996). Introduction to Environmental Geology. Prentice Hall, Upper Saddle River, New Jersey.
3. Disaster management by R. Subramanian, Vikash Publishing house, ISBN 9352718704

REFERENCE BOOKS

1. Keller, E.A. (1996). Introduction to Environmental Geology. Prentice Hall, Upper Saddle River, New Jersey.
2. J.R Jensen, Remote Sensing of the Environment: An Earth Resource Perspective, 2012

MANAGEMENT AND ORGANISATIONAL BEHAVIOUR	
Course Code: 24BS301	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. To help students understand the conceptual framework of management and organizational behaviour and correlate them to manage 21st century organizations.
2. To develop understanding about management and Applicability in the corporate world.
3. To enhance and develop the skills and competencies to understand the complexities of business problems.
4. To understand, retain and recall the basics of management.
5. To make them aware about the current scenario and identify themselves in terms of adaptability.
6. To develop their skills in analysing and understanding the human behaviour in an organization.

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:

6. Understand the concept of management.
7. Learn about different management skills requirements for the corporate world.
8. Demonstrate application of previous knowledge testing of Principles of Management in solving business problems.
9. Understand the human behaviour and its contribution at work place.
10. Understand the competitiveness in businesses.

COURSE CONTENT

UNIT NUMBER	COURSE CONTENTS
UNIT-I	***Fundamentals of Management and Evolution of Management Thought***: Concepts of Management, Meaning of Management, Nature and Characteristics of Management, Scope of Management; Levels of Management; Approaches and contributions of Management thinkers in the field of management, Social and Ethical issues in an organisation. Understanding an organisation: Introduction, Organisational Process- Vision, Mission, Strategy, Structure, System and Job task.

UNIT-II	***Managerial Functions and Social Responsibility of Managers****:* Planning - concept, significance, types; Planning, Organizing -concept, types of organizations, authority, responsibility, power, delegation, Centralization and Decentralization; Staffing concept and HR management; Directing; Coordinating; Control -nature, process, and techniques. The nature of CSR and Business ethics for engineers, Functional areas of management.
UNIT-III	***Introduction to Organisational Behaviour****:* The nature and determinants of organisational behaviour, need for knowledge of OB, contributing disciplines to the field, OB Model, individual differences, Learning, Values, attitudes, Personality, Emotional Intelligence, perception and its errors.
UNIT-IV	***Work Motivation and Group Behaviour****:* Process of motivation; Theories of motivation - need hierarchy theory, theory X and theory Y, two factor theory, Alderfer's ERG theory, Group: Types of Groups, Stages of Group Development, Group Cohesiveness, Implications of group process of organisation, Understanding Teamwork: Cross functional Teams, Designing a Team- Team Wheel.
UNIT-V	***Leadership, Organisation Culture, Conflict Management:*** Basic Approaches (Trait Theories, Behavioural Theories & Contingency Theories) & Contemporary Issues in Leadership and Transformational leadership, Role of leader in contemporary Business, Changing Organisational culture, Change management and leading change Strategically and Conflict management.

Reference Books:

1. Luthans Fred (2015): Organizational Behavior, Tata McGraw Hill. (12th Edition)
2. Stephen, P Robbins (2009): Organizational Behavior, Prentice Hall of India Private Limited, New Delhi.
3. Koontz & Heinz Weihrich: Essential of Management, McGraw Hill.
4. Tripathy & Reddy: Principles of Management, Tata McGraw-Hill Publications, New Delhi
5. Principles of Management by Terry, G.R.
6. Principles of Management by Neeru Vasishth and Vibhuti Vasishth, Taxmann Publication Private Limited, New Delhi

Management Process and Organizational Behaviour	
Course Code: 23MDC401	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
Prerequisite: NIL	Course Category: Multidisciplinary

COURSE OBJECTIVES

1. To understand the functions and responsibilities of managers.
2. To acquaint the students with the fundamentals of managing business.
3. To understand individual and group behaviour at work place so as to improve the effectiveness of an organization.
4. To analyse human behaviour in the organization setting in order to manage it in accordance to the intentions.

COURSE LEARNING OUTCOMES

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

1. Demonstrate the roles, skills and functions of management.
2. Analyse the causes and consequences of applying different business strategies.
3. Analyse and compare individual behaviour related to motivation and rewards.
4. Identify group behaviour, leadership styles and the role of leaders in a decision making process.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

Course Objectives (COs)	Course Learning Outcomes (CLOs)			
	CLO 1	CLO 2	CLO 3	CLO 4
CO 1	√	√		
CO 2		√		
CO 3			√	
CO 4				√

COURSE CONTENTS

Unit 1: Introduction to the management

Management Concept, Nature, Process and significance, levels of management, managerial skills, functions of management, management and administration, evolution of management, Role of management and insights from Indian practices and ethos.

Unit 2: Functions of the management

Planning: Types of Plans & The planning process; Organizing: Common organisational structures; Staffing: features and necessity; Leading: types of leaders; Controlling: functions and types

Unit 3: Introduction to Organizational Behaviour

Meaning, importance and scope of OB; abilities: meaning and forms, attitudes: framework, work related attitudes, personality: types, assessment, perception: process, factors influencing perception, perceptual errors

Unit 4: Foundation of Group Behaviour

Defining and classifying groups; need to join groups, stages of group development; group dynamics: group properties as roles, norms and size; group decision making techniques, conflict management

TEXT BOOKS

4. Stephen Robbins, Organizational Behavior, 16th edition (2012), Pearson Education.
5. K. Aswathappa, Organizational Behaviour, 13th edition (2016), Himalaya Publishing House.
6. 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	**23MDC302**	**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: Analyse the motive of media.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

	CO-1	**CO-2**	**CO-3**	**CO-4**
CLO-1	√			
CLO-2		√		
CLO-3			√	
CLO-4				√

COURSE CONTENTS:

UNIT-1: Library Collection

- 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-2: Information Services

- Bibliography: Type of Bibliography
- Reviews Literature
- Citation Style
- Citation Analysis: Web of Science and Scopus
- Online Databases : Structure and Retrieval

UNIT-3: Media Literacy

- Introduction to Media Literacy
- Type of media: Traditional versus social media
- Bias in media

UNIT-4: Motive of Media

- Media tycoons and conditions in which media 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

COMPUTER-BASED NUMERICAL AND STATISTICAL TECHNIQUES	
Course Code: 24MDC401B	**Internal Examination**: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: Engineering Mathematics – III	

COURSE OBJECTIVES (COs)

1. To become familiar with different operators which are useful in Numerical Analysis and introduce the concept of interpolation.
2. Familiar with numerical solutions of algebraic, transcendental and simultaneous equations. Also introduce numerical differentiation and integration with applications.
3. Familiarize yourself with numerical solutions of ordinary differential equations.
4. To equip the students with the knowledge of basic probability, Random variables, discrete as well as continuous distributions with their applications, correlation and regression.

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. Execute finite differences and interpolation.
2. Illustrate the numerical solution of equations and find the numerical differentiation and integration.
3. Demonstrate the numerical solutions of ordinary differential equations by different methods.
4. Solve statistical problems for real world scenarios.

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

CO \ CLO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

UNIT-I	**Finite Differences and Interpolation** First and higher order differences - Forward differences and backward differences and Central Differences - Differences of a polynomial - Properties of operators - Factorial polynomials - Shifting operator E - Relations between the operators. Interpolation - Newton-Gregory Forward and Backward Interpolation formulae - Divided differences - Newton's Divided difference formula - Lagrange's Interpolation formula. **Application domain problems:** Approximation and error analysis
UNIT-II	**Numerical Solution of Equations, Differentiation and Numerical integration** Bisection Method, Newton-Raphson method - Gauss Elimination method - Gauss Jacobi method - Gauss Seidel method. Numerical Differentiation and Integration: Newton's forward and backward differences formulae to compute first and higher order derivatives - The Trapezoidal rule - Simpson's one third rule and three eighth rule. **Application domain problems:** Finding the solution of complex problems of real-world problems
UNIT-III	**Numerical Solutions of Ordinary Differential Equations** Solution by Taylor's series - Euler's method, Modified Euler method – Runge - Kutta methods of second and fourth orders. **Application domain problems:** Finding the solution of nonlinear problems in real world
UNIT-IV	**Statistics** Introduction, Measures of Central tendency and dispersion, Moments - Skewness and kurtosis based on moments. **Application domain problems:** To Analyze, interpret, and make predictions from the data

TEXT BOOKS

1. Grewal B.S., "Numerical Methods in engineering and science", 11th Edition Mercury Learning and Information, 2018.
2. Sastry S.S., Introductory Methods of Numerical Analysis, Prentice Hall India Learning Private Limited, 5th Edition, 2012.
3. Balagurusamy E., Computer Oriented Statistical and Numerical Methods- Laxmi Publications, 2009.

REFERENCE BOOKS:

1. Jain M.K., Iyengar S. R. K. and Jain R.L., Numerical Methods for Scientific and Engineering Computation, NEW AGE; 6th edition, 2019.
2. Gupta S.C. and Kapoor V. K. , Fundamental of Mathematical Statistics, S Chand Publications, New Delhi, 12th edition, 202

PROBABILITY & RANDOM PROCESS	
Course Code: 24MDC101B	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: Engineering Mathematics-III	

COURSE OBJECTIVE (CEOs)

1. To familiarize the students with concepts of random variables, two dimensional random variables, distributions, random processes and linear systems with random inputs that are used in many engineering problems.
2. To introduce basic Probability theory and Random variables, its types and concept of moments.
3. To equip the students with the knowledge of Discrete and continuous probability distributions with their applications.
4. To get exposed to the students with the knowledge of two dimensional Random variables and their transformations.
5. To extend the concept of random variable to random process and its basics that are applicable in engineering problems.

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. Demonstrate knowledge of basic probability & random variables.
2. To understand techniques of developing discrete & continuous probability distributions and its applications.
3. Describe a random process in terms of its mean and correlation functions.
4. Gain knowledge in special processes like Poisson, Renewal processes.
5. Gain knowledge in spectral density, linear systems with random inputs.

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

CLO / CO	CLO-01	CLO-02	CLO-03	CLO-04	CLO-05
CO-01	✓				
CO-02		✓			
CO-03			✓		
CO-04				✓	

CO-05					✓

COURSE CONTENTS

Unit-I: Random Variables & Probability Distributions

Random variables, Discrete Random Variables, probability mass functions; continuous random variables, probability density functions, Expectation, Moments - Moment generating function, Bernouli distribution, Binomial distribution, Poisson distribution, Geometric distribution, uniform Distribution, Exponential distribution, Normal distributions,

Unit-II: Two Dimensional Random Variables

Two dimensional Random Variables - Marginal and conditional distributions, Coditional mean and variance, covariance, correlation and Linear regression - Transformation of Random Variables.

Unit-III: Random Processes, Correlation and Power Spectral Densities

Classification of Random processes - Stationarity - WSS and SSS processes, Random telegraph process, Ergodicity of Random Process, Poisson Random process, Autocorrelation function and its properties - Cross Correlation function and its properties. Spectral density function- Auto power spectral density and Cross power spectral density.

Unit-IV: Linear Systems with Random Inputs

Linear time and invariant system, system transfer function. Linear system with random inputs. System in the form of convolution - Unit Impulse Response of the System - Weiner-Khinchine Relationship.

TEXT BOOKS/ REFERENCE BOOKS

1. Veerarajan, T., Probability, Statistics and Random Processes, TMH, New Delhi, 2019.
2. Walpole R. E., Myers S. L., Ye K., Probability and Statistics for Engineers and Scientists, Pearson, 2017.
3. Moorthy M.B.K., Subramani K, Santha A. Probability and Random process. SciTech Publications, 7th edition 2018.
4. Trivedi K S, Probability and Statistics with reliability, Queueing and Computer Science Applications, Wiley-Blackwell; 2nd Edition, 2001.

BIOSTATISTICS	
Course Code: 24MDC101C	ContinuousEvaluation:40 Marks
Credits:3	End Semester Examination:60 Marks
LTP:3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (CEOs)

1. The objective of the course is to make the students familiar with basic of probability
2. The course is providing probability applications in biomedical engineering.
3. The basics of probability, conditional probability and Baye's theorem.
4. Understand the random variable and probability distributions.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP-2020). After completion of course, students would be able to explain

1. All descriptive statistics
2. Basic statistical concepts of probability.
3. Correlation and Regression analysis.
4. Testing of hypotheses.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUT COMES (CLOs)

CO \ CLO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

Unit-I: Graphical Representation and Descriptive Statistics

Quantitative and Qualitative Variables, Frequency Tables, Histograms, Bar Chart, Pie Chart, Box Plot, Measures of central tendency: Mean, Median and Mode, Measures of dispersion: Range,

Standard Deviation and Variance, Measures of Position :Quartiles and Percentiles.

Unit-II: Probability Theory

Introduction of Probability, Mutually Exclusive Events, Independent vs Dependent events, Experiment, Outcomes, Events and Sample Space, Conditional Probability, Total Probability and Bayes' theorem.

Unit-III: Correlation and Regression

Introduction to Correlation and regression. Correlation model, correlation coefficient, multiple correlation. Simple linear regression, multiple regression.

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, independence and heterogeneity.

TEXT BOOKS/REFERENCE BOOKS

1. Gupta, S.C. and Kapoor, V.K. , Fundamental of Mathematical Statistics, S Chand Publications, New Delhi 2017
2. Mann , P.S. ,Introductory Statistics, John Wiley& Sons, Global edition, 2017.
3. Daniel, W.W., Biostatistics- A foundation for analysis in health sciences, John Wiley &Sons;11th Edition, EMEA edition, 2019.
4. Lipschutz, Seymour and Schiller, John , Introduction to Probability and Statistics, Tata McGraw Hill,2017.
5. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists,9th Edition, Prentice Hall,2017.

NUMERICAL METHODS	
Course Code: 24MDC101D	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: Engineering. Mathematics – II	

COURSE OBJECTIVEs (COs)

1. To have a clear perception of the power of numerical techniques, ideas.
2. To demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.
3. To make familiar with error analysis and some numerical methods to solve equations which are not easily solved by algebraic methods**.**
4. To familiar with different operators which are useful in Numerical Analysis and introduce the concept of interpolation

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. Find solutions by various numerical methods to get approximation solutions of algebraic transcendental, simultaneous linear equations.
2. Get interpolating values by different numerical methods.
3. Do differentiation and integrations of tabular data.
4. To find numerical solutions of ordinary and partial differential equations.

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

CLO / CO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

Unit-I: Error Analysis and Numerical Solution of Equations

Approximations and error in computation: Significant figures, approximate numbers, Errors: Round- off Errors, Truncation Errors, Absolute Relative and Percentage Errors, Error in approximation of a function and series, Solution of algebraic and transcendental equation: basic properties of equation, Bisection method, Newton-Raphson method. Solution of simultaneous equations: Gauss Elimination method, Gauss Jacobi method, Gauss Seidel method.

Unit-II: Differences and Interpolation

Finite differences - Forward differences and backward differences, shifting operator E - Difference tables, relation between operators, Differences of a polynomial - Factorial polynomials -. Interpolation with equal intervals: Newton- Forward and Backward Interpolation formulae, Interpolation with unequal interval: Divided differences - Newton's Divided difference formula - Lagrange's Interpolation formula.

Unit-III: Numerical Differentiation and Integration

Numerical Differentiation: Newton's forward and backward differences formulae to compute first and higher order derivatives, Numerical Integration: The Trapezoidal rule - Simpson's one third rule and Simpson's three eighth rule.

Unit-IV: Numerical Solutions of Ordinary and Partial Differential equations

Solution by Taylor's series - Euler's method - Improved and modified Euler method - Runge-Kutta methods of second and fourth orders (No proof).Classification of Partial differential equations of the second order - Difference quotients - Laplace's equation and its solution by Liebmann's process

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TEXT BOOKS/ REFERENCE BOOKS

5. B.S. Grewal, “Numerical Methods in engineering and science”, Khanna Publishers, 42nd Edition, 2015.
6. Steven Chapra and Raymond Canale, Numerical Methods for Engineers, 8th Edition, McGraw Hill, 2020.
7. M.K. Venkataraman, Numerical Methods in Science and Engineering, National Publishing Co., 1999
8. Gerald C. F., Wheatley P. O., Applied Numerical Analysis, Pearson, 2011.
9. Arumugam S., Isaac A. T., Somasundaram A., Numerical Methods, Scitech Publications Pvt. Ltd, 2009.
10. S.S. Sastry, Introductory Methods of Numerical Analysis, 2012.
11. E. Balagurusamy, Computer Oriented Statistical and Numerical Methods- Laxmi Publications, 2009.

NUMERICAL METHODS IN BME	
Course Code: 24MDC106A	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite:	

COURSE EDUCTIONAL OBJECTIVES (CEOs)

1. To have a clear perception of the power of numerical techniques, ideas.
2. To demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.
3. To become familiar with error analysis and some numerical methods to solve equations which are not easily solved by algebraic methods.
4. To familiar with different operators which are useful in Numerical Analysis and introduce the concept of interpolation

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. Find solutions by various numerical methods to get approximation solutions of algebraic transcendental, simultaneous linear equations.
2. Get interpolating values by different numerical methods.
3. Do differentiation and integrations of tabular data.
4. To find numerical solutions of ordinary and partial differential equations.

MAPPING BETWEEN COURSE EDUCATIONAL OBJECTIVES (CEOs) AND COURSE LEARNING OUTCOME (CLOs)

CLO / CEO	CLO-01	CLO-02	CLO-03	CLO-04
CEO-01	✓			
CEO-02		✓		
CEO-03			✓	
CEO-04				✓

COURSE CONTENTS

UNIT-I	**Error in Computation and Numerical Solution of Equations** Approximations and error in computation: Significant figures, approximate numbers, Errors: Round- off Errors, Truncation Errors, Absolute Relative and Percentage Errors, Solution of algebraic and Transcendental equation: basic properties of equation, Bisection method, Newton-Raphson method Solution of simultaneous equation: Gauss Elimination method, Gauss Jacobi method, Gauss Seidel method. **Application domain problems:** Error Analysis
UNIT-II	**Interpolation with Equal and Unequal Interval** Finite differences - Forward differences and backward differences, difference tables, Interpolation with equal intervals: Newton- Forward and Backward Interpolation formulae, Interpolation with unequal interval: Divided differences - Newton's Divided difference formula - Lagrange's Interpolation formula. **Application domain problems:** To estimate missing data and make predictions
UNIT-III	**Numerical Differentiation and Integration** Numerical Differentiation and Integration: Newton's forward and backward differences formulae to compute first and higher order derivatives - The Trapezoidal rule - Simpson's one third rule and three eighth rule. **Application domain problems:** Approximation, error analysis.
UNIT-IV	**Numerical Solutions of Differential Equations** Solution by Taylor's series - Euler's method - Improved and modified Euler method – Runge - Kutta methods of fourth order (No proof). **Application domain problems:** Finding the solution of complex problems in BME

TEXT BOOKS

1. Grewal B.S., "Numerical Methods in engineering and science", 11th Edition MercuryLearning and Information, 2018.
2. Steven Chapra and Raymond Canale, Numerical Methods for Engineers, McGraw-Hill Education, 8th edition 2020.
3. Gerald C. F., Wheatley P. O., Applied Numerical Analysis, Pearson, 2011.
4. Sastry S.S., Introductory Methods of Numerical Analysis, Prentice Hall India Learning Private Limited, 5th Edition, 2012.

REFERENCE BOOKS

1. Balagurusamy E., Computer Oriented Statistical and Numerical Methods- Laxmi Publications, 2009.
2. Jain M.K., Iyengar S. R. K. and Jain R.L., Numerical Methods for Scientific and Engineering Computation, NEW AGE; 6th edition, 2019.
3. Kandasamy P., Thilagavathy K. and Gunavathi K., Numerical Methods, S Chand & Company; Reprint Edition, 2006.

DISCRETE MATHEMATICS	
Course Code: 24MDC 106B	Internal Examination: 40 Marks
Credits: 3	External Examination: 60Marks
L T P : 3 0 0	
Prerequisite:	

COURSE OBJECTIVES (COs)

1. To introduce most of the basic terminologies for Logical and Mathematical maturity that impart analytical ability to describe, analyze and solving mathematical problems
2. To get an idea about recurrence relation & algebraic systems.
3. To familiarize the students with Boolean algebra and its terminologies.
4. To solve practical problems to the respective branches of Engineering in a logical and systematic fashion

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. Write an argument using logical notation and determine if the argument is or is not valid.
2. Understand the basic principles of sets and operations in sets and prove basic set equalities.
3. Understanding recurrence relation and properties of algebraic structures such as groups, rings and fields.
4. Get an idea of Boolean algebra and its applications.

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

CLO / CO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

Unit-I: Mathematical Logic

Propositions and Logical operators - Truth tables and propositions generated by a set - Equivalence and Implication - Tautologies - Laws of logic - Proofs in Propositional calculus -Direct proofs - Conditional conclusions - Indirect proofs - Propositions over a universe -Mathematical Induction - The existential and universal quantifiers - Predicate calculus including theory of inference.

Unit-II: Set Theory & Relations

Laws of Set theory - Partition of a set – Relations – Binary relation - Domain and range of a relation– Inverse relation – Composite relation – Equivalence relation – Equivalence classes – Partitions – Quotient set – Graphs of relations - Hasse diagram - Matrices of relations - Closure operations on relations -Warshall's algorithm

Unit-III: Recurrence Relation & Algebraic Systems

Recurrence relations - Solving a recurrence relation - Recurrence relations obtained from solutions - Generating functions - Solution of a recurrence relation using generating functions- Closed form expression for generating function. Groups - Cyclic groups and subgroups -Normal subgroups - Coding theory - Group codes.

Unit-IV: Boolean Algebra, Posets and lattices

Definitions and Basic Properties of Boolean Algebra, Boolean Expressions, Logic Gates and Circuits, Boolean Function - Method to find Truth Table of a Boolean Function – Disjunctive Normal Form or Canonical Form - Karanugh map. Posets– Hasse Diagram, Chain and anti-chain, Dual of a poset- Isomorphic posets. Lattices –Properties of Lattices, sub-lattices, well ordered set - complete order - Complete lattice - Lattice Homomorphism. Application of Boolean algebra to switching theory.

TEXT BOOKS / REFERENCE BOOKS

1. B. Kolman, R. Busby, and S. C. Ross., Discrete Mathematical Structure, 6thedition.,Pearson's Publication,2017.
2. Sarkar S. K., Discrete Mathematics, S Chand & Co Ltd2016. Prentice Hall India Learning Private Limited; Second edition, 2014.
3. Keneth H. Rosen, Discrete Mathematics and its application, Tata Mcgraw Hill, 7th edition, 2017.
4. Bondy J. A., Murty U. S. R., Graph Theroy, Springer, 2013.
5. C.L. Liu, Elements of Discrete Mathematics, Tata McGraw Hill, 4th edition,2017.
6. Yadav S. K., Discrete Mathematics with Graph Theory, Anne Books Pvt. Ltd., 2013.

Year/Semester	**3rd /5th**	**Course Category**	**Multidisciplinary Course (MDC)**
Course Code	**23MDC301**	**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.

1. To provide students with a basic understanding of various types of IPR and its relevance for business.
2. To acquaint students with the strategies and management techniques associated with intellectual property assets, and the legal considerations and challenges involved.
3. To familiarize the students with the challenges and legal considerations related to intellectual property disputes.
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:

1. Define and discuss the various types of IPR and its relevance for business.
2. Discuss the adjudicating bodies and mechanisms under each of these IPRs.
3. Analyze and resolve business disputes relating to IPR.
4. Apply the learning to the real-life situations in business

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

	COURSE LEARNING OUTCOMES (CLOs)			
COURSE OBJECTIVES (COs)	**CLO1**	**CLO2**	**CLO3**	**CLO4**
CO1	√			
CO2		√		
CO3			√	
CO4				√

COURSE CONTENT

UNIT 1

INTRODUCTION TO INTELLECTUAL PROPERTY AND BUSINESS

- Concept of IPR in business and its types
- International Context - Introduction to the leading International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, TRIPS, The World Intellectual Property Organization (WIPO), World Trade Organization (WTO) and the UNESCO
- Innovation as a Business Strategy and relevance of protecting the ideas legally
- National IPR Policy

UNIT 2

COPYRIGHT

- Concept of Copyright and importance for businesses

- Media business – protecting performer's rights
- Performers' and Broadcasters' Rights Law
- Assignment, Transmission, Licensing of Copyrights
- Infringement of Copyrights and remedies

UNIT 3

TRADEMARKS

- Trademark – value of and relevance for businesses
- Protecting brand value- acquiring trademark nationally and internationally
- Trade mark disputes – case studies

UNIT 4

PATENTS

- Protecting innovation – acquiring patents nationally and internationally
- Product and process patents
- Assigning patents and its commercialization
- Patent Disputes

UNIT 5

INDUSTRIAL PROPERTIES

- Industrial designs – protection - Procedure for Registration of Designs • Copyright under Design
- Semiconductor Integrated Circuits Layout-Designs
- Plant varieties – commercialization - Monsanto cases
- Geographical Indications
- Biotechnology and IPR

UNIT 6

REGISTRATION AND ENFORCEMENT MECHANISMS

- Registration authorities of various IPRs
- IP Management and assertion of rights through declarations – use of copyright, trademark signs
- IP Litigation – Approach of courts – landmark cases

TEXT BOOKS:

- WIPO DL-101 General Course on Intellectual Property (online)
- Elizabeth Verkey and Jithin Saji Issac, *Intellectual Property*, Eastern Book Company 2021
- Anurag K. Agarwal, *Business and Intellectual Property: Protect your Ideas*, IIM Ahmedabad. Random House India (2016)
- *Handbook on IP Commercialisation - Strategies for Managing IPRs and Maximising Value* Jakarta: ASEAN Secretariat, November 2019

REFERENCES BOOKS:

- ICSI Study Material, Intellectual Property Rights: Law and Practice, A. Ramaiya, Guide to the Companies Act, LexisNexis, 19th Ed. 2020 (in 6 volumes)
- WIPO, *Enterprising Ideas A Guide to Intellectual Property for Startups*, 2023
- Manuals published by Office of the Controller General of Patents, Designs & Trade (CGPDTM), available at https://ipindia.gov.in/
- Guide Books by WIPO –Intellectual Property for Business, available at https://www.wipo.int/publications/en/series/index.jsp?id=181

Year/Semester	3rd / 6th	Course Category	Multidisciplinary Course
Course Code	23MDC304	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-I

Population and Human Development

Demographic trends and issues; education; health and malnutrition. Demographic features of India's population.

Unit-II

Growth and Distribution

Trends and policies in poverty; inequality and unemployment.

Unit-III

Agriculture

Importance of Agriculture; Causes of backwardness and low productivity; Land Reforms: Need, Implementation and Critical Evaluation

TEXT BOOKS:

1. Jean Dreze and Amartya Sen, 2013. *An Uncertain Glory:* India and *its Contradictions*, Princeton 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 of Planning, inK.L. Krishna and A. Vaidyanathan, editors, *Institutions and Markets in India's Development.*
5. Himanshu, 2010,—TowardsNew Poverty LinesforIndia, *Economicand Political Weekly*,January.

PROBABILITY AND STATISTICS	
Course Code: 24MDC605	Internal Examination: 40 Marks
Credits: 3	External Examination: 60Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES

1. To provide students with a fundamental understanding of probability theory and random variables.
2. To provide students with a comprehensive understanding of curve fitting techniques.
3. To equip students with the fundamental concepts of time series analysis, including trend identification, stochastic component characterization, and exploratory techniques for modeling and forecasting.
4. To provide students with a comprehensive understanding of time series analysis, including backshift operators, differencing, stationarity tests, and the modeling of AR, MA, ARMA, and ARIMA processes for forecasting.

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 moments, derive moment generating functions for various distributions, and apply probability theory concepts to solve problems involving random variables and their transformations, while utilizing Chebyshev's inequality for probabilistic bounds.
2. Apply appropriate statistical techniques (ANOVA, multiple comparison tests, and curve fitting) to analyze experimental data and draw valid conclusions.
3. Analyze time series data by decomposing trends, identifying stochastic properties, and applying appropriate methods for trend elimination and growth curve fitting.
4. Apply autoregressive (AR), moving average (MA), and ARIMA modeling techniques to analyze and forecast time series data using appropriate statistical tools and software.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES

CLO / CO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	

CO-04				✓

COURSE CONTENTS

UNIT-I	**Random variables and Probability Distributions** Probability theory - Random Variables - Moments - Moment generating function - Binomial, Poisson, Geometric, Exponential, Normal distributions, functions of Random Variables, Chebyshev inequality. **Application domain problems:** Network Traffic Modeling and Performance Analysis
UNIT-II	**Regression, ANOVA and Multiple Comparison Tests** Fitting of polynomial and exponential curves. ANOVA, one way and two-way classifications. Random effects. Multiple Comparison Tests - Least Significant Difference, Student-Newman–Keuls test, Duncan's Multiple Range test, Tukey's test. **Application domain problems:** Predicting software development effort
UNIT-III	**Time Series** Time Series – Concept, Objectives of Time Series Analysis - Trends and characteristics of stochastic components of time series - Exploratory Time Series Data Analysis - Elimination of trend – Growth curve. **Application domain problems:** Network security and performance monitoring in real-time systems.
UNIT-IV	**Stationary Time Series Models** Backshift Operator, Differencing, and Stationarity Test - Moving Average Models - Autoregressive Models - Autoregressive Moving Average (ARMA) Models - ARMA and ARIMA Modelling and Forecasting. **Application domain problems:** Network Traffic Forecasting and Anomaly Detection

TEXT BOOKS

1. Gupta S.C. and. Kapoor V.K, "Fundamental of Mathematical Statistics", S. Chand, 12th Edition, New Delhi, 2020.
2. Ross S., "A first Course in Probability", Pearson Education, India, 2010

REFERENCE BOOKS

8. Veera Rajan ,T, "Probability and Statistics," TMH, New Delhi-2010
9. Rohatagi V.K., Ehsan's Saleh A.K.Md., "An Introduction to Probability and Statistics," Wiley, Oxford, 2nd Ed. 2008.

Year/Semester	**3rd / 6th**	**Course Category**	**MDC**
Course Code	**23MDC305**	**Course Title**	**Electoral Literacy in India**
Continuous Evaluation : 40		**End Semester Examination : 60**	
Prerequisite: Nil		**L T P : 3 0 0**	**Credits: 3**

Course Objectives (CO) - The Course is designed with the following objectives:

1. To know the meaning and nature of the electoral democracy in India
2. To discuss electoral institutions in India
3. To understand the procedural aspect of elections in India
4. To grasp the significance of elections and electoral aspects of democracy, the electoral model code of conduct, issues, and challenges in India's democracy.

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

1. The student shall be able to understand the meaning, definition, and significance of elections in India.
2. The course will help the students to analyse and understand electoral institutions, and their role and functions in the conduct of free and fair elections.
3. The student shall be able to know the party system of India.
4. The course will help the student understand issues and challenges in conducting free and fair elections in India.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

Course Learning Objectives (Cos)	**Course Learning Outcome (CLOs)**				
	CLO1	**CLO2**	**CLO3**	**CLO4**	**CLO5**
CO1	√				
CO2		√	√		
CO3			√	√	
CO4					√

COURSE CONTENTS:

UNIT-1: Elections in India

- Suffrage, Types, and Methods of Elections
- Parliamentary elections: Lok Sabha & Rajya Sabha
- Presidential Elections
- State Legislative Assembly Elections
- Local Body Elections

UNIT-2: Electoral Institutions

- Election Commission (EC)
- State Election Commission
- Constitution: Part-15

UNIT-3: Political Parties in India

- One-party, Two Party, Multi-party system
- Model Code of Conduct, Party Funding, and Campaign

UNIT-4: Elections: Issues and Challenges

- Issues and challenges

RECOMMENDED TEXTBOOKS:

1. Subhash C. Kashyap, Our Political System, 2nd, National Book Trust, India, 2008, ISBN: 8123752520
2. D. D. Basu, Introduction to The Constitution Of India, 26th Edition, Lexis Nexis, ISBN: 978-9388548861
3. Bidyut Chakrabarty, Rajendra Kumar Pandey, Indian Government and Politics, Sage Text, ISBN: 8132100581

REFERENCE BOOKS:

1. Sanjay Kumar, Elections in India: An Overview, 1st, Routledge, ISBN: 9781032033136
2. https://eci.gov.in/
3. https://www.lokniti.org/
4. Websites of State Election Commission
5. NCERT, Chapter-3 Indian Constitution at Work

Creating Entrepreneurial Mind Set	
Course Code: 23MDC402	**Continuous Evaluation:** 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3-0-0	**Course Type:** MDC

COURSE OBJECTIVES

1. To disseminate knowledge about basics of entrepreneurship and forms of ownership.
2. To enlighten students regarding the relevance of creativity and innovation from an entrepreneurship point of view.
3. To give clarity to students regarding formulation of business plan.
4. To familiarize students with the upcoming trends in the entrepreneurship field.

COURSE LEARNING OUTCOMES

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

1. Understand basics of entrepreneurship and different types of ownerships.
2. Grasp relevance of creativity and innovation and its application in a business.
3. Acknowledge components of a business plan and ways to launch it.
4. Utilize conceptual building skills in interpreting trends for the entrepreneurs.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

Course Objectives (COs)	Course Learning Outcomes (CLOs)			
	CLO 1	CLO 2	CLO 3	CLO 4
CO 1				
CO 2				
CO 3				
CO4				

COURSE CONTENTS

UNIT	CONTENTS
UNIT-I	**Basics of Entrepreneurship** Entrepreneur: Definition, characteristics, functions, types of an entrepreneur; Concept of Entrepreneurship, types, role of entrepreneurship in economic development, Factors affecting Entrepreneurship.
UNIT-II	**Entrepreneurial Development Programme** Entrepreneurial Development Programme (EDP): meaning & concept; The Role and Relevance of Entrepreneurial Development Program in India; Role of Government in Organizing EDP's Critical Evaluation; Women Entrepreneurship- Meaning, Reasons for Slow Growth, Problems faced by Women Entrepreneurs, Development of women Entrepreneurship.

UNIT-III	**Business Planning** Opportunity Identification and selection, Formulation of business plan, External Environmental Analysis - Economic, Social, financial, technological, competitive, and legal. Financing: Sources, venture capital, export finance.
UNIT-IV	**Entrepreneurial Trends in the Digital Age** Definition and significance of digital entrepreneurship; Brief overview of key digital trends impacting businesses; Disruptive Technologies; Promoting innovation and adaptability in a digital ecosystem.

TEXT BOOKS

1. Burns, Entrepreneurship and small business, 4th edition (2016), Palgrave.
2. Norman M. Scarborough, Essentials of entrepreneurship and small business management, 9th edition (2018), Pearson.
3. Hisrich, R., & Peters, M., Entrepreneurship, 11th edition (2020), Tata McGraw Hill.
4. Prahalad, C. K. (2006). Fortune at the bottom of the pyramid, eradicating poverty through profits. Wharton school Publishing.
5. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries

SUGGESTED READINGS

4. Khandwalla, P., Corporate creativity, 7th edition (2017), Tata Mc. Graw Hill.
5. Mullins, J., New business road test, 4th edition (2013), Prentice Hall.
6. Drucker, P. F. (2006). Innovation and entrepreneurship: Practice and principles. USA: Elsevier.
7. 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.
8. Holt, D. H. (2004). Entrepreneurship new venture creation. New Delhi: Prentice Hall of India.

Year/Semester	**3rd / 5th**	**Course Category**	**MDC**
Course Code	**23MDC303**	**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):

1. To know the concepts in sociology relevant to the study of society.
2. To discuss classical sociological thoughts by sociologists.
3. To understand modern and post modern sociological thoughts.
4. To grasp the significance of sociological theories in understanding society.
5. 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:

1. Explain various sociological concepts important in the understanding of society.
2. Application of critical conceptual understanding that is central to sociological investigations.
3. Analyzing the social phenomena with respect to theoretical understanding of society.
4. Recommend analytical as well as methodological understanding to generate authentic knowledge.
5. 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–I: INTRODUCTION

- Definition, Scope, Nature and Importance of Sociology
- **SOME BASIC CONCEPTS:** Status & Role, Power & Authority, Social Structure & Function

UNIT-II : SOCIETY AND SOCIAL BEHAVIOUR

- **SOCIETY AND SOCIAL BEHAVIOUR**: Society: Meaning & Characteristics, Culture, Socialization: Definition & Agencies, Social Mobility: Meaning & Types, Social Group: Meaning and Types

UNIT-III : SOCIAL CONTROLS & SOCIAL BEHAVIOUR

- **MEANING AND NATURE OF SOCIAL CONTROL**: Social Controls & Social Behaviour : Types: Folkways, Mores, Norms, Values, Law
- **SOCIAL CONFORMITY AND DEVIANCE :** Meaning of Conformity & Deviance

UNIT-IV: THEORETICAL PERSPECTIVES

- **MACRO PERSPECTIVE:** Theoretical perspectives: Functionalism, Conflict, Structuralism.

UNIT-V: CLASSICAL THEORISTS

- **EMILE DURKHEIM:** Division of Labour in Society, Suicide
- **KARL MARX**: Historical Materialism, Class and Class Conflict, Alienation
- **MAX WEBER**: Authority, Social Action, Ideal Types

UNIT-VI : THEORIES OF MODERNITY

- Juggernaut of Modernity, McDonaldization, Risk Society
- **GLOBALIZATION AND INEQUALITY**: Global justice, Need for Global governance
- **MICRO PERSPECTIVE:** Theoretical perspectives: Symbolic Interactionism, Exchange Theory, Labelling Theory

TEXT BOOKS

1. Anthony Giddens, Sociology, Polity Press (2019)
2. Harlambos, M. Sociology: Themes and Perspectives, Oxford University Press
3. C.N. Shankar Rao, **Sociology: Principles Of Sociology With An Introduction To Social Thoughts**, S. Chand Publications, (2019)

REFERENCE BOOKS

1. Transformation: Theory and Society in India, Oxford University Press (2010)
2. Andre Beteille. Six Essays in Comparative Sociology, Oxford University Press
3. M. Francis, Abraham. Contemporary Sociology: An Introduction to Concepts and Theories, Oxford University Press (2014)
4. J.P.S. Uberoi. Mind and Society: From Indian Studies to General Sociology, Edited by Khalid Tyabji, Oxford University Press (2019).

PERSONAL FINANCIAL PLANNING	
Course Code: 23MDC403	**Continuous Evaluation**: 40
Credits: 03	**End Semester Examination**: 60
L T P : 3-0-0	**Course Type**: MDC
Prerequisite: 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				√

COURSE CONTENTS

UNIT NUMBER	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 103	**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	**CLO 2**	**CLO 3**	**CLO 4**	**CLO 5**
CO 1	√				
CO 2		√			
CO 3			√		
CO 4				√	
CO 5					√

<u>COURSE CONTENTS</u>:

UNIT-I: Health and Wellness

- Meaning Definition and Importance of Health and Wellness
- Dimensions of Health and Wellness
- Role of Exercise in maintaining Health and Wellness
- Stress and Its management through Exercise
- Nutrition for Health and Wellness
- Practical-Exercise for Health and Wellness
    - Warming –Up

- Stretching Exercises
- Strengthening Exercises
- Cardiovascular Exercises
- Flexibility and Agility Exercises
- Limbering Down
- Relaxation Techniques (IRT, QRT, DRT etc.)

UNIT-II Yoga and Fitness

- Importance of Yoga and Fitness
- Types and Principles of Asanas
- Fitness Components
- Specific Exercises for Strength,Flexibility, Speed,Agility & Coordinative Abilities
- Yoga, Fitness and Personality
- General Specific Warm up
- Aerobics / Zumba Dance
- Asanas
- Recreation for Fitness
- Report preparation, Records and PPT

UNIT-III Sports and Psychology

- Definition of Sports Psychology
- 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 Associations
- Visits to Recreational Clubs

RECOMMENDED TEXT BOOKS:

1. Foundations of Physical Education, Chales A. Bucher
2. Foundations of Physical Eduction, M.L.Kamlesh
3. History and Principles in Physical Education, Dr. Karan Singh
4. Essentials of Physical Education, Dr. Ajmer Singh
5. Foundations of Physical Education, Dr. A.K.Uppal
6. Physical Education, Manu Sood, New SP Books
7. Health the basis of life: Dr. John Maclay
8. Natural Health & Yoga, Brij Bhushan
9. Health Education, S.K.Mangal
10. Essential of Physical Education, Dr. Ajmer Singh & Dr. Bains

INDIAN CONSTITUTION & POLITY (COMMON TO ALL BRANCHES EXCEPT BIO MEDICAL ENGINEERING)	
Course Code: 23VAC102/202	Continuous Evaluation: 40 Marks
Credits: 2	End Semester Examination: 60 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)

Environmental Bioengineering			
Year/Semester	**1ST/I or II**	**Course Category**	
Course Code		**Course Title**	Environmental Bioengineering
Continuous Evaluation: 40		**End Semester Examination: 60**	
Prerequisite: Nil		**L T P : 2 0 0**	**Credits: 2**

Course Objectives (CO) - The Course is designed with the following objectives:

- To provide a comprehensive understanding of the relationship between humans and the environment.
- Aims to introduce students to the different components of the environment.
- To develop the understanding of pollution, its causes, and their effects
- To familiarize the students with the different biological concepts.

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020 and based on the UGC curriculum framework. Upon completion of this course, learners will be able to:

- Analyse the environmental pollution and sensitize themselves to adverse health impacts of pollution.
- Demonstrate to safeguard the Earth's environment and its resources.
- Explain sustainable development, its goals, challenges, and global strategies.
- Improve biological concepts using an engineering approach.

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

	COURSE LEARNING OUTCOMES (CLOs)			
COURSE OBJECTIVES (COs)	**CLO1**	**CLO2**	**CLO3**	**CLO4**
CO1	√			
CO2		√		
CO3			√	
CO4				√

COURSE CONTENTS

Unit-1

Human and Environment

Introduction to earth environment, Scope and importance. Components of the environment: Lithosphere, Hydrosphere, Biosphere, Atmosphere. The man- environment interaction, Population growth and natural resource exploitation, Industrial revolution, and its impact on the environment. Understanding of pollutant and pollution; Types of Pollution, Air pollution: Water pollution, Soil pollution and solid waste, Noise pollution, Thermal pollution and their impact on human health

Unit-2

Natural Resources, Sustainable Development & Sustainable living

Overview of natural resources, Classification of natural resources, Resources: Forests, wetlands, Status and challenges. Water resources: Types of water resources, issues and challenges; Soil and mineral resources, Energy resources: renewable and non-renewable sources of energy. Biodiversity and its distribution, Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges, and strategies for SDGs. Ways to live in a sustainable manner- Conservation of energy, water at home, plantation, waste segregation, kitchen gardening.

Unit-3

Introduction of Bioengineering:

Significance of biology, fundamental similarities, and differences between science and engineering- humans as the best machines, brain as a computer, comparison between eye camera, **Biomolecules**: molecules of the life –monomeric unit and polymeric structure, carbohydrates, proteins; nucleotides and lipids. bioengineering introduction and current status in Agriculture, Medicine (vaccine and biosensors) enzyme technology, and environment, and the role of artificial intelligence and robotics in human health monitoring.

Unit 4

Bioengineering in Environment Protection:

What is environmental bioengineering? applications of bioengineering in the environment protection.—global environmental problems and bioengineering approaches for their management. sewage treatment, biofertilizers, biofuels, bioreactors, bioremediation, and bioengineering for biomedical waste management. role of artificial intelligence in handling biomedical waste.

RECOMMENDED TEXT BOOKS:

1. Masters, G. M., & Ela, W. P. (2008). Introduction to environmental engineering and science Englewood Cliffs, NJ: Prentice Hall.
2. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
3. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press
4. Environmental Studies for Undergraduate Courses by Erach Bharucha, UGC New Delhi
5. Biology: a Gopal approach Campbell, N.A Reece, J.B Urry, Lisa; Cain M.L Wasserman, S.A Minorsky, P. V Jackson, R. B Person Education ltd.

REFERENCE BOOKS:

1. A.K De Environmental Chemistry New age Publisher, 2016.
2. "Ecology & Environment" P D Sharma, Rastogi Publications, 2009.
3. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/.
4. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/ standards.

Principles of Biochemistry (V Edition) by Nelson, D.L; and Cox, M. M. W. H Freeman and company.

Department of Environmental Sciences			
Programme: Undergraduate program			
Year/Semester	**1ST/I or II**	**Course Category**	**Value Added Course (VAC)**
Course Code	**23VAC101/23VAC201**	**Course Title**	Environmental Protection & Sustainable development
Continuous Evaluation: 40		**End Semester Examination: 60**	
Prerequisite: Nil		**L T P : 2 0 0**	**Credits: 2**

Course Objectives (CO) - The Course is designed with the following objectives:

- To provide a comprehensive understanding of the relationship between humans and the environment.
- Aims to introduce students to the different components of the environment.
- To develop the understanding of pollution, its causes, and their effects
- To gain the knowledge of climate change and the contemporary issues

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020 and based on the UGC curriculum framework. Upon completion of this course, learners will be able to:

- Demonstrate to safeguard the Earth's environment and its resources.
- Explain sustainable development, its goals, challenges, and global strategies.
- Analyse the environmental pollution and sensitize themselves to adverse health impacts of pollution.
- Appraise the concept of climate change, its science and response measures.

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

	COURSE LEARNING OUTCOMES (CLOs)			
COURSE OBJECTIVES (COs)	**CLO1**	**CLO2**	**CLO3**	**CLO4**
CO1	√			
CO2		√		
CO3			√	

CO4				√

COURSE CONTENTS

Unit-1

Human and Environment

Introduction to earth environment, Scope and importance. Components of environment: Lithosphere, Hydrosphere, Biosphere, Atmosphere. The man- environment interaction, Population growth and natural resource exploitation, Industrial revolution, and impact on the environment, Global environmental challenges at global, regional and local level.

Unit-2

Natural Resources, Sustainable Development & Sustainable living

Overview of natural resources: Definition of resource; Classification of natural resources-, renewable, and non-renewable. Resources: Forests, wetlands, Status and challenges. Water resources: Types of water resources, issues and challenges; Soil and mineral resources: Important minerals; Environmental problems due to extraction of minerals, Soil as a resource and its degradation. Energy resources: renewable and non-renewable sources of energy. Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges, and strategies for SDGs. Ways to live in sustainable manner- Conservation of energy, water at home, plantation, waste segregation, kitchen gardening.

Unit-3

Conservation of Biodiversity and Ecosystems

Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Major ecosystem types in India and their basic characteristics, forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems. Major conservation policies: in-situ and ex-situ conservation approaches; Major protected areas; National and International instruments for biodiversity conservation: The role of traditional knowledge, community-based conservation. Major International Environmental Agreements: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety, Ramsar Convention on Wetlands of International Importance, The Wildlife (Protection) Act, 1972, The Biological Diversity Act, 2002.

Unit-4

Environmental Pollution and Health

Understanding of pollutant and pollution; Types of Pollution, Air pollution: Sources of air pollution; Primary and secondary pollutants; Criteria pollutants, Indoor air pollution; Adverse health impacts of air pollutants, National Ambient Air Quality Standards. Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.

Unit-5

Climate Change: Impacts, Adaptation and Mitigation

Understanding climate change: Natural variations in climate, Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events, Climate change projections for the Indian sub-continent. Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health. the concept of vulnerability, adaptation and resilience, Synergies between adaptation and mitigation measures, Concept of carbon neutrality, net zero targets, Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs).

Unit 6

Case Studies and Field Work

The students are expected to be engaged in one of the following or similar identified activities.

Field visits to identify local issues, make observations including data collection and prepare a brief report, or Documentation of campus biodiversity or Campus environmental management activities such as solid waste disposal, water management, and sewage treatment.

RECOMMENDED TEXT BOOKS:

1) Masters, G. M., & Ela, W. P. (2008). Introduction to environmental engineering and science Englewood Cliffs, NJ: Prentice Hall.
2) Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
3) Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press
4) Environmental Studies for Undergraduate Courses by Erach Bharucha, UGC New Delhi

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/

SOFT SKILLS TRAINING MODULES/COURSES STRUCTURE SEMESTER WISE IN FACULTY OF ENGINEERING & TECHNOLOGY (UG COURSES)

SEMESTER – III

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 (TO):

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

Training Learning Outcomes (TLO):

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

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

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
TLOs/TOs	TLO1	TLO2	TLO3
TO1	√		
TO2	√	√	
TO3		√	√

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT	Student Engagement Activity
Unit-I	**Verbal Communication Skills** ● Communication Process & its importance ● 7 C's of Communication ● Formal & Informal Conversation ● Requirements of effective verbal communication	Conversation Cards Activity
Unit-II	**Nonverbal Communication Skills** ● Importance of nonverbal skills in effective communication ● Types of nonverbal (body language) skills ● Barriers to nonverbal communication	Power of Body Language Activity
Unit-III	**Listening Skills** ● Role of listening skills in effective communication ● Barriers to listening ● Overcoming listening barriers ● Empathetic listening & avoiding selective listening	Chinese Whisper Activity
Unit-IV	**Reading & Writing Skills** ● Types of reading strategies to enhance improve reading skills ● Types of written communication	The What IF Activity
Unit- V	**Visual Communication** ● Types of visual communication ● Importance of visual communication ● Picture narration/description technique	Interpret The Picture Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press,2019.

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged,

evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Effective Communication Skills Course

<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>Verbal Communication Skills</td><td>Speech Activity</td><td>15</td><td rowspan="3">Written Test</td><td rowspan="3">10</td></tr>
<tr><td>II</td><td>Non Verbal Communication Skills</td><td>Role Play</td><td>15</td></tr>
<tr><td>III</td><td>Listening Skills</td><td rowspan="3">Oral Assessment / Written Assessment</td><td>10</td></tr>
<tr><td>IV</td><td>Reading & Writing Skills</td><td>20</td><td rowspan="2">Viva</td><td rowspan="2">20</td></tr>
<tr><td>V</td><td>Visual Communication</td><td>10</td></tr>
</table>

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

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

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)				
Training Learning Outcomes (TLO) Training Objectives(TO)	TLO1	TLO2	TLO3	TLO4
TO1	√			

TO2		√		
TO3			√	√

Unit	Course Contents	Student Engagement Activity
Unit - I	**Team Management** ● Team communication & team conflict resolution ● Role of a team leader ● Team goal setting & understanding team development ● Team dynamics & multicultural team activity ● Johari Window Model	Collaborative Working Game Activity
Unit-II	**Time Management** ● Time management matrix ● Pareto Principle (80/20 rule) ● Development process of plan of action	What You Did Yesterday Activity
Unit-III	**Leadership** 1. Difference between leadership & management 2. Types of leadership style 3. Core leadership skills	Lead The Blindfolded Activity
Unit-IV	**Stress Management** ● Sign of stress & its impact ● Types of stress ● Techniques of handling stress	Keeping Cool Activity
Unit - V	**Emotional Intelligence** ● Emotional intelligence & emotional competence ● Components & behavioral skills of emotional intelligence	Guess The Emotion Game Activity
Unit - VI	**Critical Thinking** ● Types of thinking & Characteristics ● Critical thinking standards ● Barriers to critical thinking	Think Pair Share Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Teamwork & Interpersonal Skills

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Team Management	Role Play / Group Activity	10	Written Test	10
II	Time Management		10		
III	Leadership		10		
IV	Stress Management	Assignment	10	Viva	20
V	Emotional Intelligence	Written Test	10		
VI	Critical Thinking		20		

SEMESTER – V

Department Of Training & Placement			
Training Cell			
Programme	**Faculty of Engineering & Technology**		
Year / Semester	**3 / 5**	**Course Category**	**SEC**
Course Code	**23SS553**	**Course Title**	**Presentation Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO):-

1. To develop the public speaking skills of the student.
2. To make the students learn and adapt to the necessary etiquettes required working and growing in corporate culture.
3. To make the students learn to speak in a debate session by putting his arguments and making others accept his viewpoint convincingly.

Training Learning Outcomes (TLO): -

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

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

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

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

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)

I	Importance of Presentation Skills	Presentation Activity	20	Written Test	10
II	Storytelling Skills	Speech Activity	15		
III	Corporate Culture Etiquettes	Assignment	10		
IV	Debate/Extempore	Speech Activity / Written Activity	15	Viva	20
V	Art of Creating Impression		10		
VI	Problem Solving				

SEMESTER – VI

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

Training Objectives (TO): -

1. To encourage students to learn and apply effective writing skills.
2. To make the students learn various types of business correspondence letters, cover letters & resume.
3. To encourage students to learn how to talk and convince people in GD & interview.
4. 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. To understand the importance of professional writing required in workplace.
2. To explore different formats in resume, cover letters & other business related letters.
3. To develop knowledge, skills and understanding people in-group and individually.
4. To apply communication strategies either in-group or one on one basis and will be confident to lead the discussion among them.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)				
Training Learning Outcomes (TLO) ⍰ Training Objectives(TO)⍰	TLO1	TLO2	TLO3	TLO4
TO1	√			
TO2	√	√		
TO3		√	√	√
TO4.			√	√

Unit	Course Contents	Student Engagement Activity
Unit-I	**Email Writing** ● Importance of email communication skills ● Basic rules of effective email writing ● Structure of email – address, subject, message text, attachments, signature	Email Practice Activity
Unit-II	**Resume Writing** 5. Difference between Resume, CV & Bio data 6. Guidelines of resume writing 7. Resume preparation of the student	Resume Making Activity
Unit-III	**Letter Writing** ● Types of Letter Writing – Application, Leave, etc. ● Cover letter	Letter Writing Activity
Unit--IV	**Group Discussion (GD)** ● Characteristics of GD & subject knowledge ● Do's & Don'ts in GD ● Strategies of GD ● Types of GD	Group Discussion Practice Activity
Unit-V	**Interview Skills** ● Preparation of the interview & company details information ● Do's & Don'ts in interview ● Types of Interviews Strategies of interview	Mock Interview Practice Activity
Unit-VI	**Negotiation Skills** ● Importance of negotiation skills ● Four phases of negotiation skills ● Barriers to negotiation & overcoming it Win-win negotiation	Win-Win Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement

in training activities.

- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Professional Skills

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Email Writing	Written Assignment	10	Written Test	10
II	Resume Writing		10		
III	Letter Writing		10		
IV	Group Discussion	Group Discussion Activity	15	Viva	20
V	Interview Skills	Mock Interview Activity	15		
VI	Negotiation Skills	Role Play	10		

SEMESTER – VII

Department Of Training & Placement			
Training Cell			
Programme	**Faculty of Engineering & Technology**		
Year / Semester	**4 / 7**	**Course Category**	**SEC**
Course Code	**23AR755**	**Course Title**	**Aptitude & Reasoning**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO): -

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

Training Learning Outcomes (TLO): -

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

4. To understand the basic concepts of quantitative ability.
5. To solve campus placements aptitude papers covering Quantitative Ability.
6. 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			√

COURSE CONTENTS

A-Quantitative Ability

UNIT - I

- Number System
- Percentage
- Profit, Loss and Discount
- Simple Interest and Compound Interest

UNIT – II

- Allegation and Mixture
- Average
- Ratio, Proportion and Variation, Problem on Ages and Numbers
- Time and Work
- Time, Speed and Distance

UNIT – III

- Permutation and Combination
- Probability
- Data Interpretation
- Geometry and Menstruations
- Sequence, Series & Progression and Logarithmic

B- Logical Reasoning

UNIT - IV

- Number Series and Alphabet Series
- Direction Sense Test
- Coding -Decoding
- Blood Relation

UNIT – V

- Syllogism
- Dice, Cube and Cuboids
- Seating Arrangement

UNIT – VI

- Clock and Calendar
- Critical Reasoning
- Order and Ranking, Ven diagram, Analogy

Learning Resources	
Text Books	***Quantitative Aptitude for Competitive Examinations*** by R S Aggarwal: S Chand Publishing, 2022.
	A Modern Approach to Logical Reasoning by R S Aggarwal: S Chand Publishing, 2022.

Pedagogy-

- The training will be based on the concept of learning by doing and practice.

- The training will involve 50% of the training time on teaching the concepts and the remaining 50% will be focusing on practice.
- The training will follow a circular approach where students are taught, evaluated and given the feedback.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Aptitude & Reasoning

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Quantitative Ability	Written Assignment	10	Written Test	30
II			10		
III			10		
IV	Logical Reasoning		15		
V			15		
VI			10		