SCHOOL OF ENGINEERING

AND

TECHNOLOGY

B. Tech CSE (Cyber Security)

Undergraduate Course

2023-27

Preamble

Welcome to the School of Engineering and Technology at K. R. Mangalam University!

At the forefront of innovation and academic excellence, the School of Engineering and Technology is a vibrant hub of learning that nurtures aspiring engineers and technologists. Our commitment to fostering a dynamic learning environment, coupled with a passion for pushing the boundaries of knowledge, empowers our students to embark on a transformative educational journey.

With a blend of cutting-edge curriculum, state-of-the-art facilities, and a distinguished faculty, we are dedicated to equipping our students with the skills, insights, and practical experience they need to thrive in a rapidly evolving technological landscape. Our programs are designed not only to impart technical proficiency but also to cultivate critical thinking, creativity, and ethical leadership.

As we embrace the spirit of innovation and discovery, we invite students to engage in hands-on projects, collaborative research endeavors, and experiential learning opportunities. Through industry partnerships, internships, and exposure to real-world challenges, our students gain a holistic understanding of their fields, preparing them to make meaningful contributions to society.

At the School of Engineering and Technology, we believe in fostering a sense of community and camaraderie among students, faculty, and industry professionals. This collaborative ethos encourages the exchange of ideas, the pursuit of excellence, and the development of lifelong connections.

Whether you aspire to be a trailblazing engineer, a tech-savvy entrepreneur, or a visionary researcher, the School of Engineering and Technology is here to nurture your ambitions and empower you to shape a brighter future.

Welcome to a place where innovation knows no bounds, and where your journey towards academic and professional success begins.

Dean,

School of Engineering and Technology,

K. R. Mangalam University.

Preface

B.Tech. in CSE with specialization in Cyber Security imparts knowledge about the technologies, processes and practices designed to protect network, computer, programs and data from attack, damage or unauthorized access. B.Tech in CSE with specialization in Cyber Security at K R Mangalam University has been carefully designed to provide a sound foundation for a successful career in this critical role in line with the current trends of cyber security.

B.Tech. in CSE with specialization in Cyber Security Program prepares students to understand the

- Keylogging
- Packet Sniffing
- Bug Bounties
- Breaking Caesar Cipher
- SQL Injection
- Removing and Retrieving Files
- Blocking RFID
- Network security monitoring tools
- Encryption tools
- Web vulnerability scanning tools
- Penetration testing
- Antivirus software
- Network intrusion detection
- Packet sniffers
- Firewall tools
- Ethical hacking

Cyber Security is a specialized field in Information Technology (IT) which is regarded as a sub stream in Computer Science. Cyber Security courses aim to equip students with the knowledge and skills required to defend computer operating systems, networks, and data from cyber-attacks. Cyber Security as a profession is evolving over the years, the reason being the increasing rate of cybercrimes. Any industry that transacts online or carries

sensitive data is in need of a Cyber Security professional to safeguard its data from such delinquents. Cyberspace is a common platform that is accessed by anyone from every corner of the world, and the scope of cyber security is equally spread across the globe.

All industries from start-ups to multinational corporations in business are on the look-out for Cyber Security Engineer. Gartner, Inc.(technological research and consulting firm) Unveils the Cyber security predictions by 2025, 60% of organizations will use cyber security risk as a primary determinant in conducting third-party transactions and business engagements. By 2025, 80% of enterprises will adopt a strategy to unify web, cloud services and private application access from a single vendor's security service edge platform.

Objectives of the program

1. Fundamental Computer Science Knowledge: Provide students with a strong foundation in computer science concepts, algorithms, data structures, programming languages, and software development methodologies.

2. Cybersecurity Principles: Introduce students to the principles, practices, and methodologies of cybersecurity. This includes understanding the various types of cyber threats, vulnerabilities, and risk management strategies.

3. Network Security: Familiarize students with the techniques and tools used to secure computer networks and communication systems, including firewalls, encryption, and intrusion detection systems.

4. Information Security Management: Teach students about the governance, policies, and procedures required to manage information security in organizations, ensuring compliance with legal and ethical standards.

5. Ethical Hacking and Penetration Testing: Train students in ethical hacking techniques and penetration testing to identify and address vulnerabilities in computer systems, networks, and applications.

6. Cyber Incident Response: Prepare students to handle and respond effectively to cyber incidents, including incident detection, containment, eradication, and recovery.

7. Security in Software Development: Emphasize secure coding practices to develop robust and secure software applications, minimizing the risk of exploitable vulnerabilities.

8. Digital Forensics: Introduce students to the field of digital forensics, enabling them to investigate and analyze digital evidence related to cybercrimes.

9. Cybersecurity Compliance and Regulation: Educate students about the legal and regulatory frameworks related to cybersecurity, such as data protection laws and industry standards.

10. Research and Innovation: Encourage students to engage in research and innovation in the field of cybersecurity, contributing to the development of new technologies and solutions.

11. Teamwork and Communication: Foster teamwork and effective communication skills, as cybersecurity often involves collaboration with various stakeholders to address complex security challenges.

12. Real-world Projects and Internships: Provide opportunities for students to work on real-world cybersecurity projects and internships, allowing them to apply their knowledge in practical scenarios.

Career Avenues

There is a large scope of B.Tech Cyber Jobs for graduates in both the private and public sectors. After B.Tech CSE(Cyber Security) Graduation students pursuing the course are not limited to their specific areas resulting in a vast number of jobs.

B.Tech CSE(Cyber Security) Is one of the most diverse courses in terms of, not just employment opportunities across various domains, but also the scope of higher education for graduates. The scope of a B.Tech CSE(Cyber Security) Is quite vast whether a graduate chooses to work or study further.

Some of the areas of recruitment are

- Cyber Security Architect
- Information Security Lead
- Cyber Security Engineer
- Technical Trainee
- Lead Cyber Security Analyst
- Cyber Forensic Investigator
- Information Security Consultant
- Candidates can work in various private

Prospective Companies

- Symantec Corp.
- Quick Heal Technologies
- Microsoft
- IBM
- RSA
- McAfee
- AVG Technologies
- Valency Networks
- Alten Calsoft Labs
- Palo Alto Networks
- Deloitte Consulting
- KPMG
- Ernst & Young

Duration

4 Years (Full-Time)

Eligibility Criteria

The candidate should have passed 10+2 or its equivalent examination from a recognized Board with a minimum of 50% marks in aggregate. The reservation and relaxation for SC/ST/OBC/PWD and other categories shall be as per the rules of central/state government, whichever is applicable.

The program enables multiple exits & entry options for students as per the guidelines of NEP 2020

Exit Option	Naming convention for the award of Certification/Diploma/Degree	Minimum Credits required
Exit after 1st year	Undergraduate Certificate in Computer Science.	Students needs to earn a minimum of 40 credits.
Exit after 2nd year	Undergraduate Diploma in Computer Science	Students needs to earn minimum of 80 credits.
Exit after 3rd year	B.Sc Computer Science with Specialization in relevant domain.	Students needs to earn minimum of 120 credits.
Exit after 4th year	B.Tech in Computer Science & Engineering (Honors with Research) with Specialization in relevant domain	Students need to earn a minimum of 160 credits

Table of Contents

University Vision & Mission

Vision

KR Mangalam University aspires to become an internationally recognized institution of higher learning through excellence in inter-disciplinary education, research and innovation, preparing socially responsible life-long learners contributing to nation building.

Mission

- Foster employability and entrepreneurship through futuristic curriculum and progressive pedagogy with cutting-edge technology.
- Instill notion of lifelong learning through stimulating research, Outcomes-based education and innovative thinking.
- Integrate global needs and expectations through collaborative programs with premier universities, research centers, industries and professional bodies.
- Enhance leadership qualities among the youth having understanding of ethical values and environmental realities.

School Vision & Mission

Vision

To create, disseminate, and apply knowledge in science and technology to meet the higher education needs of India and the global society, to serve as an institutional model of excellence in scientific and technical education characterized by integration of teaching, research and innovation.

Mission

- To create an environment where teaching and learning are prioritised, with all support activities being held accountable for their success.
- To strengthen the institution's position as the school of choice for students across the State & Nation.
- To promote creative, immersive, and lifelong learning skills while addressing societal concerns.
- To promote co- and extra-curricular activities for over-all personality development of the students.
- To promote and undertake all-inclusive research and development activities.
- To instill in learners an entrepreneurial mindset and principles.
- Enhance industrial, institutional, national, and international partnerships for symbiotic relationships.
- To help students acquire and develop knowledge, skills and leadership qualities of the 21st Century and beyond.

About School

The School of Engineering and Technology at K. R. Mangalam University started in 2013 to create a niche of imparting quality education, innovation, entrepreneurship, skill development and creativity. It has excellent infrastructure, state of the art Labs, and a team of qualified and research-oriented faculty members.

School of Engineering & Technology (SOET) brings together outstanding academicians, industry professionals, and experienced researchers to impart hands-on and multi-disciplinary learning experience. The curriculum of the programs caters to the ever-changing needs and demands of industry. The school has state-of-the-art infrastructure and domain-specific labs.

The school is offering undergraduate programs (B. Tech, BCA, B. Sc), postgraduate programs (M. Tech, MCA) and Ph. D (all disciplines). We are offering B. Tech programs in recent areas of specializations like AI & ML, Data Science, Cyber Security, Automotive Designs & Electrical Vehicle, Sustainable Development & Smart Cities, Full stack development, UI/UX development etc.

Our curriculum, being one of our highlights, has been designed in line with the requirements of the new National Education Policy 2020, Pedagogy of Employment, Sustainable Development Goals, IR 4.0 etc. The curriculum focuses on problem-solving, design, development, and application of various emerging technologies with a focus on innovative teaching learning methodologies. It is our endeavor to constantly evolve curriculum support, so our students stay abreast with the latest updates in this technologically developed world.

SOET aims at transforming the students into competitive engineers with adequate analytical skills, making them more acceptable to potential employers in the country. There is a great focus on experiential & project-based learning with Industry collaborations. Our B. Tech programs are in collaborations with Industries like IBM, Siemens, Samatrix, Xebia, ImaginXP etc. Our students get an opportunity to learn directly by professionals from industry.

Program Objectives (PO)

PO 1 Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO 2 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.

PO 3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4 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.

PO 5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering employability.

PO 7 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.

PO 8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects through entrepreneurship skills and in multidisciplinary environments.

PO 12 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 through skill development.

Program Educational Objectives (PEO)

PEO1 - Acquire a strong foundation in Computer Science and Engineering with a specialization in Cyber Security, develop expertise in the latest tools, techniques, and best practices related to Cyber Security with a focus on lifelong learning to facilitate progressive careers in industry and in pursuit of higher studies.

PEO2 - Apply critical thinking, analytical, and problem-solving skills to develop innovative solutions that address complex real-world applications in the field of Cyber Security and related issues.

PEO3 - To provide our students with the necessary communication and interpersonal skills, multidisciplinary teamwork, and leadership abilities so they can achieve their professional obligations.

PEO4 - To make students aware of current concerns so they can develop morals and sense of responsibility for themselves, their coworkers, society, and the nation.

Program Specific Outcomes (PSO)

PSO1 - Develop a strong foundation in Computer Science and Engineering concepts, including core courses such as algorithms, data structures, operating systems, and software engineering, with a specialization in Cyber Security that includes courses in cryptography, network security, web security, and malware analysis.

PSO2 - Acquire expertise in the latest tools, techniques, and best practices related to Cyber Security, including but not limited to penetration testing, intrusion detection, and incident response, and keep up-to-date with advancements in the field through lifelong learning.

PSO3 - Apply critical thinking, analytical, and problem-solving skills to identify and analyze Cyber Security issues and develop innovative solutions that address them, using appropriate tools and techniques.

PSO4 - Develop effective communication and interpersonal skills to collaborate effectively with multidisciplinary teams, present technical information to both technical and non-technical audiences, and work as a productive member of a professional team.

Program Highlights

- Professionally qualified, competent and committed teaching faculty.
- Embedding of world-renowned EC Council certifications.
- Training from certified Industry professional to make the students industry ready
- Consistent interaction with renowned academicians and experts.
- Emphasis on project-based learning, techno-pedagogy, field projects, research projects, internships, continuous and comprehensive evaluation.
- Access to certification courses, ability & skill development programmes, value-added courses besides core curriculum.
- Effective career counselling, guidance and mentoring programme to excel in professional and personal spheres of life.
- Special programmes for advanced and slow learners with focus on inclusion and student diversity.
- Focus on career progression through training, placements and preparation for higher studies.
- Centre of excellence in cyber security.

Program Scheme

Semester I

SNo	Category	Course Code	Course Title	L	T	P	C
1	Major	ENMA101	Engineering Calculus	3	1	0	4
2	Minor	ENSP101	Clean Coding with Python	4	0	0	4
3	Major	ENPH101/ENCH101	Engineering Physics / Engineering Chemistry	3	1	-	4
4	Minor	ENSP151	Clean Coding with Python Lab	0	0	2	1
5	VAC-I		VAC-I [Environmental Studies & Disaster Management] (Online Moodle)	2			2
6	SEC	SEC033	Engineering Drawing & Workshop Lab	-	-	4	2
7	Major	ENPH151/ENCH151	Engineering Physics lab / Engineering Chemistry lab	-	-	2	1
TOTAL				**12**	**2**	**8**	**18**

Semester II

S. No.	Category	Course Code	Course Title	L	T	P	C
1	Major	ENMA102	Linear Algebra and Ordinary Differential Equations	3	1	-	4
2	Minor	ENSP106	Network Defence Essentials Series (NDE) [Training by EC Council]	4	0		4
3	Major	ENCH101/ENPH101	Engineering Chemistry / Engineering Physics	3	1	-	4
4	Minor	ENSP156	Network Defence Essentials Series (NDE) Lab	-	-	2	1
5	Major	ENEE101	Basics of Electrical & Electronics Engineering	4	-	-	4
6	Major	ENCH151/ENPH151	Engineering Chemistry Lab/Engineering Physics lab	-	-	2	1
7	Major	ENEE151	Basics of Electrical & Electronics Engineering Lab	-	-	2	1
8	VAC II		Extention Activities(community engagement service)	2	-	-	2
9	Open Elective		Open Elective-1	3	-	-	3
TOTAL				**19**	**2**	**6**	**24**

Semester III

S. No.	Category	Course Code	Course Title	L	T	P	C
1	Major	ENCS203	Discrete Mathematics	3	1	-	4
2	Major	ENCS205	Data Structures	3	1	-	4
3	Major	ENCS201	Java Programming	4	-	-	4
4	SEC	SEC047	Network Defense Essentials (NDE) Certification [*Students are required to clear the certification]	2	-	-	2
5	Major	ENCS253	Data Structures Lab	-	-	2	1
6	Major	ENCS251	Java Programming Lab	-	-	2	1
7	MC		(Open Elective- II)	3	0	0	3
8	VAC		VAC III	2	-	-	2
9	AEC	AEC011	Life Skills for Professionals-I	3	-	-	3
10	INT/PROJ	ENSI251	Summer Internship/Project-I	-	-	-	2
TOTAL				**20**	**2**	**4**	**26**

Semester IV

S. No.	Category	CODE	Semester IV	L	T	P	Credits
1	Major	ENCS202	Analysis and Design of Algorithms	3	1	0	4
2	Major	ENCS204	Database Management Systems	3	1	0	4
3	Minor	ENSP206	Certified Cyber Security Technician (CCT)	4	-	-	4
4	Major	ENCS256	Analysis and Design of Algorithms lab	-	-	2	1
5	Major	ENCS254	Database Management Systems lab	-	-	2	1
6	Minor	ENSP256	Cyber Security Technician (CCT) Lab	-	-	2	1
7	MC		(Open Elective- III)	3	-	-	3
8	VAC		VAC IV	2	-	-	2
9	AEC	AEC012	Life Skills for Professionals-II	3	-	-	3
10	PROJ	ENSI252	Minor Project-I	-	-	-	2
	TOTAL			**18**	**2**	**6**	**25**

Semester V

S. No.	Category	Code	Semester V	L	T	P	Credits
1	Major	ENCS301	Theory of Computation	3	1	-	4
2	Major	ENCS303	Operating Systems	4	-	-	4
3	SEC	SEC048	Cyber Security Technician (CCT) Certification Exam	2	-	-	2
4	Major	ENCS307	Cryptography	4	-	-	4
5	Major	ENCS309	Fundamentals of Cloud Computing and its Security	4	-	-	4
6	Major	ENCS351	Operating Systems Lab	-	-	2	1
7	Major	ENCS353	Fundamentals of Cloud Computing and its Security Lab	-	-	2	1
8	AEC	AEC013	Life Skills for Professionals-III	3	-	-	3
9	INT/PROJ	ENSI351	Summer Internship/Project-II	-	-	-	2
TOTAL				**20**	**1**	**4**	**25**

Semester VI

S. No.	Category	CODE	Semester VI	L	T	P	Credits
1	Major	ENCS302	Computer Organization & Architecture	3	1	-	4
2	Minor		Department Elective-I	4	-	-	4
3	Major	ENCS304	Computer Networks	3	1	-	4
4	Minor	ENSP312	Introduction to Ethical Hacking*	4	0	0	4
5	Minor		Department Elective-I Lab	-	-	2	1
6	Major	ENCS352	Computer Networks Lab	-	-	2	1
7	Minor	ENSP362	Ethical hacking Lab	-	-	2	1
8	Major	ENCS356	Introduction to Linux with Bash Scripting Lab			4	2
9	PROJ	ENSI352	Minor Project-II	-	-	-	2
10	SEC	SEC036	Competitive Coding Lab	-	-	4	2
	TOTAL			**14**	**2**	**14**	**25**

Department Elective-I (Cyber Security)							
1	Minor	ENSP301	Secure Coding and Vulnerabilities	4	0	0	4
	Minor	ENSP351	Secure Coding and Vulnerabilities lab	-	-	2	1
2	Minor	ENSP303	Cyber Crime Investigation & Digital Forensics	4	0	0	4
	Minor	ENSP353	Cyber Crime Investigation & Digital Forensics lab	-	-	2	1
3	Minor	ENSP305	AI in Cyber Security	4	0	0	4
	Minor	ENSP355	AI in Cyber Security Lab	-	-	2	1
4	Minor	ENSP307	Social Media Security	4	0	0	4
	Minor	ENSP357	Social Media Security Lab	-	-	2	1

Semester VII

S.N	Category	Code	Semester VII	L	T	P	Credits
1	SEC	SEC049	EC Council Certified Ethical Hacker (CEH) Certification [*Students are required to clear the EC Council certification]	2	-	-	2
2	Minor		Department Elective-II	4	-	-	4
3	Minor		Department Elective-III Lab	3	1	-	4
4	Minor		Department Elective II Lab	-	-	2	1
5	Minor		Department Elective-III Lab	-	-	2	1
		ENSI451	Minor Project-III				2
TOTAL				**9**	**1**	**4**	**14**
OR							
1	INT	ENSI453	Professional Internship from Industry	-	-	-	12
2	SEC	SEC049	EC Council Certified Ethical Hacker (CEH) Certification [*Students are required to clear the EC Council certification]	2	-	-	2

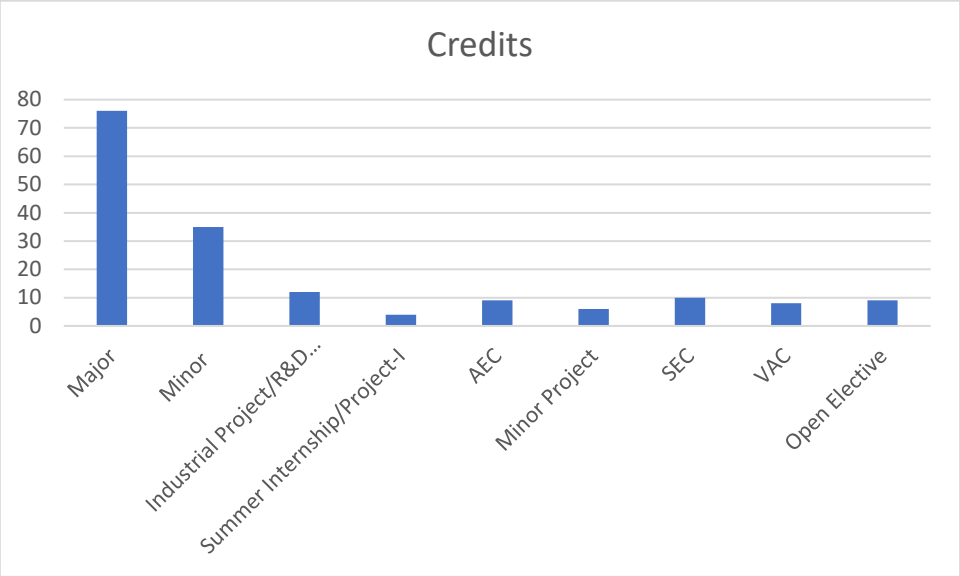
*** Students have the option to do Professional Internship from Industry with 12 Credits as an alternate to Elective 1 & 2. EC Council certification is compulsory for all**

Department Elective - II (Cloud Computing)							
(i)	Minor	ENSP401	Computational Services in The Cloud	4	-	1	4
	Minor	ENSP451	Computational Services in The Cloud Lab	-	-	2	1
(ii)	Minor	ENSP403	Microsoft Azure Cloud Fundamentals	4	-	1	4
	Minor	ENSP453	Microsoft Azure Cloud Fundamentals Lab	-	-	2	1
(iii)	Minor	ENSP405	Storage and Databases on Cloud	4	-	1	4
	Minor	ENSP455	Storage and Databases on Cloud Lab	-	-	2	1
(iv)	Minor	ENSP407	Application Development and DevOps on Cloud	4	-	1	4
	Minor	ENSP457	Application Development and DevOps on Cloud Lab	-	-	2	1
Department Elective - III (Full Stack Development)							
(i)	Minor	ENSP409	Mobile Application Development using iOS	4	-	-	4
	Minor	ENSP459	Mobile Application Development using iOS Lab	-	-	2	1
(ii)	Minor	ENSP411	DevOps & Automation	4	-	-	4
	Minor	ENSP461	DevOps & Automation Lab	-	-	2	1
(iii)	Minor	ENSP413	.Net FRAMEWORK	4	-	-	4
	Minor	ENSP463	.Net FRAMEWORK Lab	-	-	2	1
(iv)	Minor	ENSP415	New Age Programming languages	4	0	0	4
	Minor	ENSP465	New Age Programming languages Lab	0	0	2	1

Semester VIII

S. No.	Category	Course Code	Course Title	L	T	P	C
1	PROJ		Industrial Project/R&D Project/Start-up Project	-	-	-	12
TOTAL							**12**

Categorization of Courses



Syllabus

Semester I

Department:	**Department of Computer Science and Engineering**		
Course Name: Engineering Calculus	**Course Code**	**L-T-P**	**Credits**
	ENMA101	3-1-0	4
Type of Course:	Major		
Pre-requisite(s), if any: Calculus Knowledge at Higher Secondary Level			
Brief Syllabus: The objective of this course is to familiarize the graduate engineers with techniques in calculus, multivariate calculus, vector calculus and their applications. It aims to equip the students with standard concepts and tools from intermediate to advanced level that will enable them to tackle more advanced level of mathematics and applications that they would find useful in their disciplines.			
UNIT WISE DETAILS			
Unit Number: 1	**Title: Differential Calculus- I**	**No. of hours: 10**	
Content Summary: Introduction to limits, continuity and differentiability, Rolle's Theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem, Taylor's Series. Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates), Successive Differentiation (nth order derivatives), Leibnitz theorem and its application, Curve tracing: Cartesian and Polar co-ordinates.			
Unit Number: 2	**Title: Multivariable Calculus (Partial Differentiation and applications)**	**No. of hours: 10**	
Content Summary:			

Partial derivatives, Total derivative, Euler's Theorem for homogeneous functions, Taylor and Maclaurin's theorems for a function of one and two variables, Maxima and Minima of functions of several variables, Lagrange Method of Multipliers, Jacobians.

Unit Number: 3	**Title: Multivariable Calculus-II (Integration)**	**No. of hours: 10**

Content Summary:

Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form), Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals. Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals), Center of mass and center of gravity (Constant and variable densities).

Unit Number: 4	**Title: Vector Calculus**	**No. of hours: 10**

Content Summary:

Vector differentiation: Gradient, Curl and Divergence and their Physical interpretation, Directional derivatives, Tangent and Normal planes. Vector Integration: Line integral, Surface integral, Volume integral, Gauss's Divergence theorem, Green's theorem, Stoke's theorem (without proof) and their application.

***Self-Learning Components**: **mention 4-5 topics for students in bullet points**

Please Note:

Students are supposed to complete one online course of minimum 40 hours related to Engineering Calculus with certificate

https://onlinecourses.nptel.ac.in/noc22_ma75/preview

At least 5-10 % syllabus will be asked in end term exams from self-learning components

Text Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition,Pearson, Reprint, 2002.

Reference Books/Material:

1. B. V. Ramana, Higher Engineering Mathematics, Tata Mc Graw-Hill Publishing Company Ltd., 2008.

2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
3. R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002
4. E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.
5. Ray Wylie C and Louis C Barret, Advanced Engineering Mathematics, Tata Mc-Graw-Hill; Sixth Edition.

Web references:

1. Link to NPTEL course contents: https://onlinecourses.nptel.ac.in/noc18_ma05/preview
2. Link to topics related to course: https://www.whitman.edu/mathematics/calculus_online/chapter14.html

Course Outcomes (CO)

COs	Statements
CO1	**Apply** the knowledge of differential calculus in the field of engineering.
CO2	To deal with functions of several variables that are essential in optimizing the results of real life problems.
CO3	Multiple integral tools to deal with engineering problems involving centre of gravity, volume etc.
CO4	**Deal** with vector calculus that is required in different branches of Engineering to graduate engineers.
CO5	**Apply** Geometrical approach to the mean value theorems and their application to the mathematical problems
CO6	**Evaluation** of surface areas and volumes of revolutions of curves.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C1	-	P1
CO2	C2	-	P2
CO3	C2	-	P2
CO4	C3, C4	-	P3
CO5	C5	-	P4, P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	2	-	-	-	-	-	-	2
CO2	3	3	2	2	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	2	-	-	-	-	2
CO4	-	-	3	-	-	-	-	-		-	2	3
CO5	3	2	-	3	-	-	-	-	-	-	-	2

Justification for mapping must be relevant

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	2	-	-	-
CO2	-	3	-	-
CO3	3	-	-	-
CO4	-	-	2	-
CO5	-	-	-	3

Relevance of the Syllabus to various indicators

Unit I	**Differential Calculus- I**
Local	Understanding differential calculus can aid in solving local engineering and scientific problems.
Regional	Understanding differential calculus can be applied to regional projects or research in engineering fields.
National	Differential calculus plays a significant role in various national engineering and scientific endeavors.
Global	Differential calculus is fundamental to global scientific research, engineering projects, and innovations.
Employability	Knowledge of differential calculus enhances employability in various technical and engineering professions.
Entrepreneurship	Knowledge of differential calculus can inspire entrepreneurial opportunities in engineering-based ventures.
Skill Development	Learning differential calculus develops analytical and problem-solving skills for engineering applications.
Professional Ethics	Applying differential calculus with integrity ensures ethical practices in engineering and scientific fields.
Gender	Differential calculus education is equally important for individuals of all genders pursuing engineering.
Human Values	Applying differential calculus with ethical considerations contributes to human-centered engineering solutions.
Environment & Sustainability	Differential calculus can be used to model and optimize environmentally sustainable engineering practices.
Unit II	**Multivariable Calculus (Partial Differentiation and applications)**
Local	Understanding multivariable calculus can aid in solving local engineering and scientific problems.
Regional	Understanding multivariable calculus can be applied to regional projects or research in engineering fields.

National	Multivariable calculus plays a significant role in various national engineering and scientific endeavors.
Global	Multivariable calculus is fundamental to global scientific research, engineering projects, and innovations.
Employability	Knowledge of multivariable calculus enhances employability in various technical and engineering professions.
Entrepreneurship	Knowledge of multivariable calculus can inspire entrepreneurial opportunities in engineering-based ventures.
Skill Development	Learning multivariable calculus develops analytical and problem-solving skills for engineering applications.
Professional Ethics	Applying multivariable calculus with integrity ensures ethical practices in engineering and scientific fields.
Gender	Multivariable calculus education is equally important for individuals of all genders pursuing engineering.
Human Values	Applying multivariable calculus with ethical considerations contributes to human-centered engineering solutions.
Environment & Sustainability	Multivariable calculus can be used to model and optimize environmentally sustainable engineering practices.
Unit III	**Multivariable Calculus-II (Integration)**
Local	Understanding integration can aid in solving local engineering and scientific problems.
Regional	Understanding integration can be applied to regional projects or research in engineering fields.
National	Integration plays a significant role in various national engineering and scientific endeavors.
Global	Integration is fundamental to global scientific research, engineering projects, and innovations.
Employability	Knowledge of integration enhances employability in various technical and engineering professions.
Entrepreneurship	Knowledge of integration can inspire entrepreneurial opportunities in engineering-based ventures.

Skill Development	Learning integration develops analytical and problem-solving skills for engineering applications.
Professional Ethics	Applying integration with integrity ensures ethical practices in engineering and scientific fields.
Gender	Integration education is equally important for individuals of all genders pursuing engineering.
Human Values	Applying integration with ethical considerations contributes to human-centered engineering solutions.
Environment & Sustainability	Integration can be used to model and optimize environmentally sustainable engineering practices.
Unit IV	**Vector Calculus**
Local	Understanding vector calculus can aid in solving local engineering and scientific problems.
Regional	Understanding vector calculus can be applied to regional projects or research in engineering fields.
National	Vector calculus plays a significant role in various national engineering and scientific endeavors.
Global	Vector calculus is fundamental to global scientific research, engineering projects, and innovations.
Employability	Knowledge of vector calculus enhances employability in various technical and engineering professions.
Entrepreneurship	Knowledge of vector calculus can inspire entrepreneurial opportunities in engineering-based ventures.
Skill Development	Learning vector calculus develops analytical and problem-solving skills for engineering applications.
Professional Ethics	Applying vector calculus with integrity ensures ethical practices in engineering and scientific fields.
Gender	Vector calculus education is equally important for individuals of all genders pursuing engineering.
Human Values	Applying vector calculus with ethical considerations contributes to human-centered engineering solutions.

Environment & Sustainability	Vector calculus can be used to model and optimize environmentally sustainable engineering practices.
SDG	(SDG) 4, Quality Education.
NEP 2020	Subject aligns with the objectives of the National Education Policy 2020.
POE/4th IR	Subject is relevant to the Fourth Industrial Revolution and emerging technologies.

1. Department:	Department of Computer Science and Engineering		
2. Course Name: Clean Coding with Python	3. Course Code	4. L-T-P	5. Credits
	ENSP101	4-0-0	4
6. Type of Course:	Minor		
7. Pre-requisite(s), if any:			
8. Frequency of offering (check one): Odd semester			

Brief Syllabus:

This course covers essential Python concepts, data structures, functions, error handling, advanced modules, and real-world applications like web scraping and database handling. Students will gain a strong foundation in Python programming and be equipped to work on a variety of projects and applications.

9. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.

COs	
CO 1	Work with user input to create fun and interactive programs.
CO 2	Develop, run and manipulate Python programs using Core data structures like Lists, Dictionaries, and use of Strings Handling methods.
CO 3	Develop, run and manipulate Python programs using File Operations and searching pattern using regular expressions.
CO 4	Determine the need for scraping websites and working with CSV, JSON and other file formats.
CO5	Create simple games with images, animations, and audio using our custom beginner-friendly programming library.

12. UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Python	No. of hours: 8

Content Summary:

Python Introduction and Setup: Command Line Basics, Installation of Python. Text Editor (VS Code, PyCharm, Anaconda)
Python basics and control structures: Python data types,Numbers, Variables, Getting input from the user, Operators,Statements (If, else, elif), Nested statements, Loops and loop control statements (Break, continue and pass), Strings (Indexing, slicing and formatting).

Unit Number: 2	Title: Python Data Structure	No. of hours: 8

Content Summary:

Python Data Structures: Lists, Tuples, Sets, Dictionaries.
Methods and Functions: Introduction to functions, def keyword, *args and **kwargs in python, exercise on functions, Lambda expressions, Map and Filter functions.

Unit Number: 3	Title: Python Decorators and generators	No. of hours: 8

Content Summary:

Modules and Package : Installation using pip
Errors and Exception Handling: Errors, Exceptions, Try and Except Statement, Catching Specific Exception, Try with else, Finally, Keyword, Raising an exception.
File Handling using Python

Unit Number: 4	Title: Python advanced modules	No. of hours: 8

Content Summary:

Python advanced modules: Datetime module, Math and Random module, OS module
Regular Expressions: RE module
Web Scraping using Python: Web Scraping libraries and practical implementation Working with images using python

Unit Number: 5	Title: Working with Excel sheets and CSV files	No. of hours: 8

Content Summary:

Python GUI programming: Tkinter, Adding Widgets, Buttons etc.SQL queries (DDL, DML, DCL, TCL) – Joins, Sub-Queries, Constraints and Inbuilt functions (Date, String, Math)Database handling in python using MySQL db. – Fetching and Inserting data using MySQL db

Self-Learning Components:

Students are expected to gain working knowledge of various IDE like Anaconda, Pytorch, Spider etc, various components of Anaconda Navigator. Use Github, Kaggle, Google Colab etc

At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books:

1. J. Peterson, A. Silberschatz, and P. Galvin, "Operating System Concepts", Addison Wesley. 2012
2. A. V. Aho, R. Sethi, and J. D. Ullman, "Compilers: Principles, Techniques and Tools", Addison-Wesley. 2013
3. R. El. Masri and S. B. Navathe, "Fundamentals of Data Base Systems", Benjamin Cummings. 2013

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	3	1	1	1	2	3	1	2	2
CO2	2	2	1	2	1	2	2	1	2	1	3	1
CO3	1	1	3	3	1	1	1	3	3	1	3	3
CO4	2	2	3	2	2	2	2	3	2	2	2	2
CO5	1	1	3	3	1	1	1	3	3	1	2	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	1	2	3	1
CO2	2	1	2	2
CO3	1	3	3	3
CO4	2	3	2	2
CO5	1	3	3	1

Relevance of the Syllabus to various indicators

Unit I	Introduction to Python
Local	Addresses local understanding of the Internet and its impact on society
Regional	Addresses regional internet connectivity and network infrastructure requirements
National	Government and Policy Development: Python supports evidence-based policymaking by providing tools for analysing government data, conducting surveys, and evaluating policy interventions. It assists in monitoring and evaluating public programs, assessing their impact, and identifying areas for improvement. Python open-source nature allows governments to leverage existing resources, reducing costs associated with proprietary software.
Global	-
Employability	Lead to positions such as data visualization specialist, data scientist, business intelligence analyst, or data engineer
Entrepreneurship	-
Skill Development	Helps data scientists perform complex data analysis, recognizing patterns, and understanding datasets
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Python Data Structure**
Local	
Regional	-
National	Research and Development: Python is widely used in academic research, contributing to advancements in various fields such as social sciences, economics, healthcare, and environmental

	studies. Its flexibility and extensive statistical capabilities make it an invaluable tool for researchers and scientists to analyze complex data and generate reliable research outcomes
Global	
Employability	Lead to positions such as data visualization specialist, data scientist, business intelligence analyst, or data engineer
Entrepreneurship	-
Skill Development	
Professional Ethics	Collaboration and Knowledge Sharing:-The Python community is vibrant and globally connected. By embracing R, nations can tap into this collaborative ecosystem, enabling researchers, analysts, and policymakers to share knowledge, exchange best practices, and collaborate on solving complex problems.
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Python decorators and generators**
Local	
Regional	-
National	Research and Development: Python is widely used in academic research, contributing to advancements in various fields such as social sciences, economics, healthcare, and environmental studies. Its flexibility and extensive statistical capabilities make it an invaluable tool for researchers and scientists to analyze complex data and generate reliable research outcomes
Global	Cost Savings: Python is an open-source programming language, which means it is freely available to use. This can result in cost savings for government entities, educational institutions, and businesses that rely on data analysis. The availability of numerous R packages and libraries further enhances the cost-effectiveness of data analysis tasks

Employability	Python programming skills are in high demand in the job market, particularly in fields such as data science, analytics, and research. By promoting the use of python, nations can foster the development of a skilled workforce capable of performing data analysis tasks, thereby driving economic growth and attracting investment in data-driven industries.
Entrepreneurship	-
Skill Development	Develops knowledge and skills in client-server programming and network security
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-Helps students to work on social issues
Unit IV	Python Advanced modules
Local	
Regional	Infrastructure Planning and Optimization: Python can be utilized in infrastructure planning and optimization tasks. It can help analyze large datasets related to transportation, energy, and urban planning to identify patterns, make predictions, and optimize resource allocation, leading to more efficient and sustainable infrastructure development
National	
Global	
Employability	Python is extensively used in economic research and business analytics. Its statistical modeling and machine learning capabilities enable economists and analysts to study economic indicators, forecast market trends, and optimize business strategies. R's visualization capabilities also aid in presenting complex economic data in a clear and meaningful manner, facilitating evidence-based decision-making.
Entrepreneurship	-

Skill Development	Python programming skills are in high demand in the job market, particularly in fields such as data science, analytics, and research. By promoting the use of R, nations can foster the development of a skilled workforce capable of performing data analysis tasks, thereby driving economic growth and attracting investment in data-driven industries.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	Public Health and Epidemiology: Python plays a vital role in public health and epidemiological studies. It is extensively used for analysing health-related data, tracking disease outbreaks, modelling infectious diseases, and conducting statistical studies to inform public health policies and interventions.
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts of internet telephony, multimedia applications, and SEO

Department:	**Department of Computer Science and Engineering**		
Course Name: Clean Coding with Python Lab	**Course Code**	**L-T-P**	**Credits**
	ENSP151	0-0-2	1
Type of Course:	Minor		
Pre-requisite(s), if any: Concepts of Python			

Defined Course Outcomes

COs	
CO 1	Develop, run and manipulate Python programs using Core data structures like Lists, Dictionaries, and use of Strings Handling methods.
CO 2	Develop, run and manipulate Python programs using File Operations and searching pattern using regular expressions.
CO 3	Determine the need for scraping websites and working with CSV, JSON and other file formats.
CO 4	Create simple games with images, animations, and audio using our custom beginner-friendly programming library.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Write a program to print a poem.	CO1
2	Write a program to add two numbers using the input function numbers.	CO2
3	Write a program to find the reminder when divided by 2	CO2
4	Using all operators perform the practical on it and also write its data types.	CO1
5	Write a program to find the square root using input function	CO1

6	Write a program of string function and type casting.	CO2
7	Write a program to calculate the grade of student.	CO2
8	Write a program to print a table using for and while loop.	CO3
9	Write a program to find whether the student is pass or fail A) if it require 40% to pass. B) if atleast 33% in each subject to pass.	CO3
10	Write a program to input 8 numbers from the user and display all unique numbers.	CO3
11	Create an empty dictionary allow 4 students to enter their favorite subject as value and use key as their name.	CO3
12	Write a program to find greatest of four number enter by user .	CO3
13	Write a program to find a number is prime or not.	CO2
14	Write a program to find the sum of first 10 natural number using for and while loop.	CO2
15	Write a program to print the name in a list and write in a sorted common list.	CO2
16	Use for, .split(), and if to create a statement that will print out words that start with 's'. St= "print only the words that start with s in this sentence".	CO1
17	Use list comprehension to create a list of all numbers between 1 to 50 that are divisible by 5.	CO3
18	Go through the string below and if the length of a word is even print "even!" St= "print every word in this sentence that has an even number of letters"	CO3
19	Write a program using function to find greatest of three numbers.	CO2
20	Write a program using function to convert Celsius to Fahrenheit.	CO1
21	Write a program using function to print good morning +"name".	CO1

22	Write a program using lambda, find the square and cube.	CO2
23	Write a program using function and to find the length of a variable using arguments.	CO2
24	Write a program using arguments, key arguments to find out the sum, multiplication of n numbers.	CO2
25	Write a program using map, lambda, and filter to find the even numbers from the list.	CO3

Projects Title:

- **Weather Forecasting App**
- **Web scraping Facebook bot**
- **Tic tac toe game**
- **Snake and ladder game**
- **Multiplayer Game - Connect4**

Department:	Department of Computer Science and Engineering		
Course Name: Engineering Chemistry	Course Code	L-T-P	Credits
	ENCH101	3-1-0	4
Type of Course:	Major		

Pre-requisite(s), if any: Nil

Brief Syllabus:

Engineering Chemistry is a course that aims to provide engineering students with a foundational understanding of various chemical principles and their practical applications in engineering.

UNIT WISE DETAILS

Unit Number: 1	Title: Water technology	No. of hours: 8

Content Summary:

Introduction, water analysis: Hardness-determination by EDTA method-, Alkalinity-determination by double indicator method, Treatment of boiler feed water: Internal treatment (Phosphate,Colloidal and Calgon conditioning). External treatments: Ion exchange and lime-soda process, Zeolite processes. Determination of dissolved oxygen by Winkler's method and Determination of chemical oxygen demand, Boiler scales formation and ill effects, methods of prevention of scales. Numerical problems.

Unit Number: 2	Title: Chemical Fuels	No. of hours: 8

Content Summary:

Fuels: Introduction, classification, calorific value (HCV & LCV), Determination of calorific value of fuel using Bomb calorimeter.

Solid fuel: Coal- its analysis by proximate and ultimate analysis, Numerical problems.

Liquid fuels: Refining of petroleum, Petroleum cracking, Reformation of petrol-explanation with reactions, Knocking in IC engine, its ill effects and prevention of knocking. Anti-knocking agent: Leaded and unleaded petrol. Power alcohol and its advantages. Synthetic petrol - Bergius process.

Gaseous fuels: LPG, CNG and their applications.

Unit Number: 3	Title: Battery Technology	No. of hours: 8

Content Summary:

Introduction - Galvanic cell, electrode potential, EMF of the cell and cell representation. Batteries and their importance, Classification of batteries- primary, secondary and reserve batteries with examples. Battery characteristics - voltage, capacity, energy density, power density, energy efficiency, cycle life and shelf life.

Basic requirements for commercial batteries. Construction, working and applications of: Ni-Cd, and Lithium-ion battery.

Fuel Cells- Differences between battery and a fuel cell, Classification of fuel cells -based on type of fuel, electrolyte and temperature.

Unit Number: 4	Title: Polymer	No. of hours: 8

Content Summary:

Basic concepts of polymer, Types of polymers, Thermoplastic & thermosetting plastics, Preparation and application of some industrially important polymers (Natural rubber, Buna S, Buna-N, Neoprene, Isoprene, Nylon-6, nylon-6,6, Decron and Terylene). Conducting and biodegradable polymers.

***Self-Learning Components:**

Please Note:

Students are supposed to complete one online course of minimum 40 hours related to Engineering Calculus with certificate

Basics of electrochemistry:

https://mrcet.com/downloads/digital_notes/HS/4%20ENGINEERING%20CHEMISTRY.pdf

Basics of polymer:

https://gnindia.dronacharya.info/APS/Downloads/SubjectInformation/Chemistry/Unit2/Lecture_1_13022019.pdf

At least 5-10 % syllabus will be asked in end term exams from self-learning components

References Books:

1. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, S. Nagin Chand and Co.
2. Text book of Physical Chemistry by Soni and Dharmatha, S. Chand & Sons.
3. Text book of Polymers science by Gowarikar and Vishwanathan.

4. Corrosion Engineering by M. G. Fontana, Mc Graw Hill Publications.
5. Engineering Chemistry by Jain and Jain.

Course Outcomes (CO)

COs	Statements
CO1	**Understand** the methods for water hardness and alkalinity testing, and the basics of boiler water treatment.
CO2	**Explain** the process of dissolved oxygen determination and chemical oxygen demand analysis.
CO3	**Determine** various methods to enhance the quantity & quality of Fuel.
CO4	**Identify** between hard and soft water, solve the related numerical problems on water purification and its significance in industry and daily life.
CO5	**Articulate** basic concepts of chemistry in daily life.
CO6	**Design** efficient process for water analysis and purification

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C2		P1
C02	C3		P5

CO3	C2		-
CO4	C3		P3
CO5	C6		P4
CO6	C6		P4

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	3
CO2	-	-	3	-	2	-	-	-	-	-	-	2
CO3	-	3	-	-	-	-	-	-	-	-	-	2
CO4	-	3	-	-	-	-	2	-	-	-	-	3
CO5	3	-	-	-	-	-	-	-	-	-	-	2
CO6	3	3	-	-	-	-	-	-	-	-	-	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	3	-	-	-
CO2	2	-	-	3
CO3	2	-	-	-
CO4	2	-	2	-
CO5	-	1	-	-
CO6	2	-	3	3

Relevance of the Syllabus to Various indicators

Unit I	Water technology
Local	Address the evaluation of water characteristics like dissolved oxygen, hardness, alkalinity for specific water bodies such as lakes, rivers, and groundwater sources.
Regional	Address the evaluation of water characteristics like dissolved oxygen, hardness, alkalinity for specific water bodies within a particular geographic area
National	Addresses national problem of water pollution and its impact on society at the national level by analyzing water quality data from various regions across the country.
Global	Addresses transboundary water issues and global water challenges.
Employability	Professionals in the field of water management, environmental science, and sustainability
Entrepreneurship	-
Skill Development	Develops basic knowledge of characteristics of water and methods to remove the hardness
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	To assess and address water-related challenges at various levels for a sustainable environment
Unit II	Chemical Fuels
Local	Addresses the immediate consequences of fuel-related pollution and environmental degradation in local region
Regional	-
National	Exploration, extraction, and management of fossil fuel resources, as well as the development and deployment of non-renewable and renewable energy sources,

Global	Aligns with global trends for exploration, extraction, and management of fossil fuel resources, as well as the development and deployment of non-renewable and renewable energy sources,
Employability	Develops skills to use semiconductor photochemistry in energy harnessing and optical sensors
Entrepreneurship	-
Skill Development	Develops basic knowledge about the characteristics of good fuels
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	Assess environmental impact, emissions, and contribution of fuels to climate change to encourage the adoption of renewable and sustainable alternatives.
Unit III	Battery Technology
Local	To address the application of fuel cells for power buildings, homes, and small-scale distributed energy systems at local level.
Regional	-
National	To address the applications of battery technology include powering electric vehicles (EVs), storing renewable energy generated from solar panels or wind turbines, and backup power for homes and businesses at national level.
Global	To address the international efforts to reduce greenhouse gas emissions and address climate change challenges.
Employability	Develops skills to fabricate fuel cell-related technologies and their applications
Entrepreneurship	-
Skill Development	Develops knowledge and skills in fuel cell technologies
Professional Ethics	-

Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Polymer
Local	Addresses local application of polymer such as for packaging materials, household products, textiles, and construction materials
Regional	-
National	Contributes to synthesis and application of polymer at national level
Global	Aligns with global trends in to synthesis and application of polymer
Employability	Develops skills in synthesis of polymer and its applications
Entrepreneurship	-
Skill Development	Develops knowledge and skills in synthesis and application of polymer
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	

Department:	**Department of Computer Science and Engineering**		
Course Name: Engineering Chemistry lab	**Course Code**	**L-T-P**	**Credits**
	ENCH151	0-0-2	1
Type of Course:	Major		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	
CO1	Students will learn and **apply** various experimental techniques commonly used in chemistry labs, such as titrations, distillations, extractions, chromatography, spectroscopy, and electrochemical methods.
CO2	Students will **acquire** proficiency in handling and operating laboratory equipment, including but not limited to balances, pipettes, burettes, spectrophotometers, pH meters, and other analytical instruments.
CO3	Students will **develop** skills in recording and analysing experimental data, including data interpretation of results.
CO4	Students will gain hands-on experience in synthesizing various chemical compounds and organic polymers
CO5	Students will learn to write **concise** and accurate laboratory reports, including experimental procedures, observations, results, and conclusions.
CO6	Students will **understand** the ethical responsibilities and laboratory safety protocols associated with conducting experiments.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Determination of temporary and permanent hardness in water sample using EDTA.	CO1, CO3, CO5
2	Determination of alkalinity in the given water sample.	CO1, CO3, CO5
3	Determination of viscosity of given liquid.	CO2, CO3, CO5
4	Determination of surface tension of given liquid.	CO2, CO3, CO5
5	Determination of pH by pH-metric titration.	CO1, CO3, CO5
6	Preparation of Phenol-formaldehyde and Urea-formaldehyde resin	CO4, CO5, CO6
7	To determine the iron concentration in the given water sample by Spectrophotometer using potassium thiocyanate as colour developing agent.	CO1, CO3, CO5
8	Determination of chloride content in water sample.	CO1, CO3 CO5, CO6
9	Estimation dissolved oxygen (DO) content in the given water sample by Winkler's method.	CO1, CO3,CO5
10	Determination of iron content in the given solution by Mohr's method.	CO1, CO3, CO5
11	Determination of rate constant of hydrolysis of esters.	CO3, CO5
12	To determine the Iron content in the given salt by using external indicator	CO1, CO3, CO5
13	Determination of wavelength of absorption maximum and colorimetric estimation of Fe3+ in solution	CO2, CO3, CO5
14	Determination of molar absorptivity of a compound (KMnO4 or any water-soluble food colorant).	CO2, CO3, CO5
15	Preparation of a nickel complex [Ni(NH3)6]Cl2 and estimation of nickel by complexometric titration.	CO4, CO5, CO6
16	Synthesis of drug like Aspirin, /Paracetamol etc.	CO4, CO5, CO6

<table>
<tr><td>Department:</td><td colspan="3">Department of Mechanical Engineering</td></tr>
<tr><td rowspan="2">Course Name:
Engineering Drawing and Workshop Lab</td><td>Course Code</td><td>L-T-P</td><td>Credits</td></tr>
<tr><td>SEC033</td><td>0-0-4</td><td>2</td></tr>
<tr><td>Type of Course:</td><td colspan="3">SEC</td></tr>
<tr><td colspan="4">Pre-requisite(s), if any:</td></tr>
<tr><td colspan="4">Brief Syllabus:

This course is to acquaint engineering students regarding drawings, projections of planes, projection of solid and isometric projection and workshop Technology.</td></tr>
<tr><td colspan="4">UNIT WISE DETAILS</td></tr>
<tr><td>Unit Number: 1</td><td colspan="2">Title:</td><td>No. of hours:01</td></tr>
<tr><td colspan="4">Content Summary:

Introduction of drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD Commands
Orthographic Projections:
Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines.</td></tr>
<tr><td>Unit Number: 2</td><td colspan="2">Title:</td><td>No. of hours: 01</td></tr>
<tr><td colspan="4">Content Summary:

Orthographic Projections of Plane Surfaces:
Introduction, Definitions–projections of plane surfaces
Projections of Solids: Introduction, Definitions – Projections of right regular</td></tr>
</table>

tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.

Isometric Projection: Introduction, Isometric scale, Isometric projection of simple plane

Unit Number: 3	Title: Wood Working and Fitting Shop	No. of hours:01

Wood Working Shop: Making of various joints, Pattern making.

Fitting Shop: Learning use of fitting hand tools, marking tools, marking gauge. Exercises: Jobs made out of MS Flats, making saw - cut filling V-cut taper at the corners, circular cut, fitting square in square, triangle in square

Unit Number: 4	Title: Welding and Sheet Metal Shop	No. of hours:1

Welding Shop: Electric Arc Welding, Edge Preparations, Exercises making of various joints. Bead Formation in horizontal, Vertical and Overhead positions. Gas Welding: Oxy-Acetylene welding and cutting of ferrous metals.

Sheet Metal Shop: Learning use of sheet-metal tools, Exercises: Making jobs out of GI sheet metal.

Reference Books:

1. Engineering Graphics - K.R. Gopala Krishna, edition Subash Publishers Bangalore.
2. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, -Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Workshop practice manual - K.Venkata Reddy, B.S.Publications.
4. Mechanical workshop practice.- K.C. John, PHI.

Define Course Outcomes (CO)

COs	Statements
CO1	Understand the polygons, circles and lines with different geometric conditions
CO2	Draw the projection of points, lines and planes under different conditions and orthographic views from isometric views of simple objects
CO3	Determine manufacturing methods in different fields of engineering and Practical exposure to different fabrication techniques
CO4	Creation of simple components using different materials
CO5	Exposure to some of the advanced and latest manufacturing techniques being employed in the industry.

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	2	3	-	-	-	-	-	-	-
CO2	3	-	3	2	3	-	-	-	-	-	-	-
CO3	3	-	3	2	3	-	-	-	-	-	-	-
CO4	3	-	3	2	3	-	-	-	-	-	-	-
CO5	3		3	2	3							

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	3	2		
CO2	3		2	
CO3	3	2		
CO4	3		2	
CO5	3	2		

Defined Course Outcomes

COs	Statements
CO1	Understand the polygons, circles and lines with different geometric conditions
CO2	Draw the projection of points, lines and planes under different conditions and orthographic views from isometric views of simple objects
CO3	Determine manufacturing methods in different fields of engineering and Practical exposure to different fabrication techniques
CO4	Creation of simple components using different materials
CO5	Exposure to some of the advanced and latest manufacturing techniques being employed in the industry.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
	Engineering Drawing	
1	To study Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD Commands.	CO1
2	Orthographic Projection: Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants.	CO1
3	Study of Projections of straight lines True and apparent lengths, True and apparent inclinations to reference planes.	CO1
4	To study orthographic projection of plane surfaces.	CO2
5	To study orthographic projection of solids with examples.	CO2
6	To study sections and development of surfaces of solids with examples.	CO1
7	To study conversion of pictorial views into orthographic projections with examples.	CO1, CO2
8	To study isometric projections of solids with examples.	CO1, CO2
	Workshop:	
9	To make Different types of joints in carpentry shop.	CO, CO4
10	To make Double V-Butt and Lap joint in welding shop.	CO3, CO4
11	To prepare a Job on Lathe machines with step turning and chamfering operation.	CO3, CO4
12	To prepare a Job on Shaper/milling/grinding for finishing of a job.	CO3
13	To prepare a practice job in fitting shop.	CO3
14	To Study about the various machine tools	CO5
15	To make saw - cut filling V-cut taper at the corners, circular cut in fitting shop.	CO4

Syllabus- Semester II

Department:	**Department of Computer Science and Engineering**		
Course Name: Linear Algebra and Ordinary Differential Equations	**Course Code**	**L-T-P**	**Credits**
	ENMA102	3-1-0	4
Type of Course:	Major		

Pre-requisite(s), if any: single variable calculus, Matrices, differentiation and integration

Brief Syllabus:

The purpose of the course Linear Algebra and Ordinary Differential Equations is to provide students with a foundational understanding of key concepts and techniques in linear algebra and differential equations. The course helps students develop a strong mathematical foundation by studying fundamental topics in linear algebra and differential equations. These areas of mathematics are essential in various scientific, engineering, and mathematical disciplines. This course is to equip students with the mathematical tools, problem-solving skills, and foundational knowledge required to understand and apply linear algebra and differential equations in various academic and professional settings.

UNIT WISE DETAILS

Unit Number: 1	**Title: Matrices and Systems of Linear Equations**	**No. of hours: 10**

Content Summary:

Matrix with operation, Types of Matrix (Symmetric and skew symmetric matrix, Hermitian and skew Hermitian matrix, unitary and orthogonal matrix), Determinant of Matrix, Inverse and transpose of matrices, Elementary row operations, Systems of Linear Equations, Homogeneous and non-homogeneous systems, Solutions of linear systems Gaussian, elimination and row echelon form, Rank of matrix.

Unit Number: 2	**Title: Eigenvalues and Eigenvectors**	**No. of hours: 10**

Content Summary:

Definition and properties of eigenvalues and eigenvectors, Diagonalization of matrices, Eigenvalues and eigenvectors of symmetric, skew symmetrix, hermition, skew

hermition, unitary and orthogonal matrices, Calyey Hamilton Theorem, Rank and nullity of a matrix, Diagonalization of matrices, Minimal polynomial, characteristic polynomial, and generalized eigenvectors. The Jordan Normal Form Theorem for linear operators on a finite dimensional complex vector space, Quadratic forms, Applications of eigenvalues and eigenvectors.

Unit Number: 3	**Title: Vector Spaces**	**No. of hours: 10**

Content Summary:

Introduction to vector spaces, Subspaces and spanning sets, Linear independence and basis, Dimension of vector spaces, Row space, column space, and null space, Linear transformations, Matrix representation of linear transformations, Inner Product Spaces,Inner products and orthogonality, Orthonormal bases and Gram-Schmidt process, Orthogonal projections and least squares approximations, Applications of Linear Algebra, Markov chains and transition matrices.

Unit Number: 4	**Title: Ordinary Differential Equations**	**No. of hours: 10**

Content Summary:

Introduction to ordinary differential equations, Definition and classification of differential equations, First-order linear differential equations, Separable differential equations, Exact differential equations, Integrating factors, Applications of first-order differential equations, Second-order linear differential equations, Homogeneous differential equations, Method of undetermined coefficients, Variation of parameters, Applications of second-order differential equations.

***Self-Learning *Self-Learning Components: mention 4-5 topics for students in bullet points**

Please Note:

Students are supposed to complete one online course of minimum 40 hours related to Linear Algebra and Ordinary Differential Equations with certificate

https://archive.nptel.ac.in/courses/111/108/111108081

At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books/Material:

1. Christian Constanda, Differential Equations. Second Edition, Springer 2017, ISBN-13: 978-3-319-50223-6.

2. We will use the book by Sheldon Axler, Linear Algebra Done Right, third edition, Springer Nature, ISBN 978-3-319-30765-7
3. Elementary Linear Algebra: Applications Version, Howard Anton and Chris Rorres, 11/E Wiley
4. Elementary Linear Algebra w/Applications (Classic Verson), Kolman & Hill, 9/E, Pearson
5. Linear Algebra and Its Applications, Lay, Lay and McDonald, 5/E, Pearson.

Course Outcomes (CO)

COs	Statements
CO1	**Identify and analyze** the properties of various types of matrices, such as symmetric, skew-symmetric, Hermitian, skew Hermitian, unitary, and orthogonal matrices.
CO2	**Analyze** quadratic forms and apply eigenvalues and eigenvectors in practical situations.
CO3	**Define and comprehend** vector spaces, subspaces, linear independence, and basis.
CO4	**Determine** the dimension of vector spaces and compute row space, column space, and null space of matrices.
CO5	**Solve** first-order linear, separable, exact, and homogeneous differential equations.
CO6	**Apply** differential equations to real-life applications.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C1	-	P1
CO2	C2	-	P2
CO3	C2	-	P2
CO4	C3, C4	-	P3
CO5	C5	-	P4, P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	2	-	-	-	-	-	-	2
CO2	3	3	2	2	-	-	-	-	-	-	-	3
CO3	3	-	--	-	-	-	2	-	-	-	-	2
CO4	-	-	3	-	-	-	-	-		-	2	3
CO5	3	2	-	3	-	-	-	-	-	-	-	2

Justification for mapping must be relevant.

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	2	-	-	-
CO2	-	3	-	-
CO3	3	-	-	-
CO4	-	-	2	-
CO5	-	2	-	1

Relevance of the Syllabus to various indicators

Unit I	**Matrices and Systems of Linear Equations**
Local	Understanding matrices and systems of linear equations can aid in solving local engineering and scientific problems.
Regional	Understanding matrices and systems of linear equations can be applied to regional projects or research in engineering fields.
National	Matrices and systems of linear equations play a significant role in various national engineering and scientific endeavors.
Global	Matrices and systems of linear equations are fundamental to global scientific research, engineering projects, and innovations.
Employability	Knowledge of matrices and systems of linear equations enhances employability in various technical and engineering professions.
Entrepreneurship	Knowledge of matrices and systems of linear equations can inspire entrepreneurial opportunities in engineering-based ventures.
Skill Development	Learning matrices and systems of linear equations develops analytical and problem-solving skills for engineering applications.
Professional Ethics	Applying matrices and systems of linear equations with integrity ensures ethical practices in engineering and scientific fields.
Gender	Matrices and systems of linear equations education is equally important for individuals of all genders pursuing engineering.
Human Values	Applying matrices and systems of linear equations with ethical considerations contributes to human-centered engineering solutions.
Environment & Sustainability	-
Unit II	**Eigenvalues and Eigenvectors**
Local	Understanding eigenvalues and eigenvectors can aid in solving local engineering and scientific problems.
Regional	Understanding eigenvalues and eigenvectors can be applied to regional projects or research in engineering fields.

National	Eigenvalues and eigenvectors play a significant role in various national engineering and scientific endeavors.
Global	Eigenvalues and eigenvectors are fundamental to global scientific research, engineering projects, and innovations.
Employability	Knowledge of eigenvalues and eigenvectors enhances employability in various technical and engineering professions.
Entrepreneurship	Knowledge of eigenvalues and eigenvectors can inspire entrepreneurial opportunities in engineering-based ventures.
Skill Development	Learning eigenvalues and eigenvectors develops analytical and problem-solving skills for engineering applications.
Professional Ethics	Applying eigenvalues and eigenvectors with integrity ensures ethical practices in engineering and scientific fields.
Gender	Eigenvalues and eigenvectors education is equally important for individuals of all genders pursuing engineering.
Human Values	Applying eigenvalues and eigenvectors with ethical considerations contributes to human-centered engineering solutions.
Environment & Sustainability	-
Unit III	**Vector Spaces**
Local	Understanding vector spaces can aid in solving local engineering and scientific problems.
Regional	Understanding vector spaces can be applied to regional projects or research in engineering fields.
National	Vector spaces play a significant role in various national engineering and scientific endeavors.
Global	Vector spaces are fundamental to global scientific research, engineering projects, and innovations.
Employability	Knowledge of vector spaces enhances employability in various technical and engineering professions.
Entrepreneurship	Knowledge of vector spaces can inspire entrepreneurial opportunities in engineering-based ventures.

Skill Development	Learning vector spaces develops analytical and problem-solving skills for engineering applications.
Professional Ethics	Applying vector spaces with integrity ensures ethical practices in engineering and scientific fields.
Gender	Vector spaces education is equally important for individuals of all genders pursuing engineering.
Human Values	Applying vector spaces with ethical considerations contributes to human-centered engineering solutions.
Environment & Sustainability	-
Unit IV	**Ordinary Differential Equations**
Local	Understanding ordinary differential equations can aid in solving local engineering and scientific problems.
Regional	Understanding ordinary differential equations can be applied to regional projects or research in engineering fields.
National	Ordinary differential equations play a significant role in various national engineering and scientific endeavors.
Global	Ordinary differential equations are fundamental to global scientific research, engineering projects, and innovations.
Employability	Knowledge of ordinary differential equations enhances employability in various technical and engineering professions.
Entrepreneurship	Knowledge of ordinary differential equations can inspire entrepreneurial opportunities in engineering-based ventures.
Skill Development	Learning ordinary differential equations develops analytical and problem-solving skills for engineering applications.
Professional Ethics	Applying ordinary differential equations with integrity ensures ethical practices in engineering and scientific fields.
Gender	Ordinary differential equations education is equally important for individuals of all genders pursuing engineering.
Human Values	Applying ordinary differential equations with ethical considerations contributes to human-centered engineering solutions.

Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	-

Department:	Department of Computer Science and Engineering		
Course Name: **Network Defense Essentials Series (NDE)**	**Course Code**	**L-T-P**	**Credits**
	ENSP106	4-0-0	4
Type of Course:	Minor		
Pre-requisite(s), if any:			

Brief Syllabus:

Network Defense Essentials covers the fundamental concepts of information security and network defense. This introductory cybersecurity course is designed for today's entry-level information security or cybersecurity careers and is ideal for learners aspiring to pursue a career in cybersecurity.

The course gives a holistic overview of the key components of information security such as Identification, Authentication and Authorization, Virtualization and Cloud Computing, Wireless Networks, Mobile and IoT Devices, and Data Security. The interactive labs component of this course ensures that learners receive the hands-on, practical experience required for a future in cybersecurity.

UNIT WISE DETAILS

Unit Number: 1	**Title: Network Security Fundamentals, Identification, Authentication and Authorization**	**No. of hours: 8 hrs**

Content Summary: Understand Fundamentals of Network Security, Discuss Essential Network Security Protocols, Discuss Access Control Principles, Terminologies and Models, Discuss Identity and Access Management (IAM) Concepts.

Unit Number: 2	**Title: Network Security Controls - Administrative Controls, Physical Controls and Technical Controls**	**No. of hours: 8 hrs**

Content Summary: Discuss Various Regulatory Frameworks, Laws and Acts, Learn to Design and Develop Security Policies, Learn to conduct Different Types of Security and Awareness Training, Understand the Importance of Physical Security, Discuss Various Physical Security Controls, Describe Workplace Security, Describe

Various Environment Controls, Understand Different Types of Network Segmentation, Understand Different Types of Firewalls and their Role, Understand Different Types of IDS/IPS and their Role, Understand Different Types of Honeypots, Understand Different Types of Proxy Servers and their Benefits, Discuss Fundamentals of VPN and its importance in Network Security, Discuss Security Incident and Event Management (SIEM), Discuss User Behaviour Analytics (UBA), Understand Various Antivirus/Anti-malware Software.

Unit Number: 3	**Title: Virtualization and Cloud Computing**	**No. of hours: 8 hrs**

Content Summary: Understand Virtualization Essential Concepts and OS Virtualization Security, OS Virtualization Security and Concerns, OS Virtualization Security Best Practices, Understand Cloud Computing Fundamentals, Discuss the Insights of Cloud Security and Best Practices.

Unit Number: 4	**Title: Wireless Network Security, Mobile Device Security, and IoT Device Security**	**No. of hours: 8 hrs**

Content Summary: Understand Wireless Network Fundamentals, Understand Wireless Network Encryption Mechanisms, Discuss Different Types of Wireless Network Authentication Methods, Discuss and Implement Wireless Network Security Measures, Understand Various Mobile Device Connection Methods, Discuss Mobile Device Management Concepts, Discuss Common Mobile Usage Policies in Enterprises, Discuss Security Risks and Guidelines Associated with Enterprises Mobile Usage Policies, Discuss and Implement Enterprise-level Mobile Security Management Solutions, Discuss and Implement General Security Guidelines and Best Practices on Mobile Platforms, Understand IoT Devices, Application Areas and Communication Models, Discuss the Security in IoT-enabled Environments.

Unit Number: 5	**Title: Cryptography and PKI, Data Security and Network Traffic Monitoring**	**No. of hours: 8 hrs**

Content Summary: Discuss Cryptographic Techniques, Discuss Various Cryptographic Algorithms, Discuss Various Cryptographic Tools, Discuss Public Key Infrastructure (PKI), Understand Data Security and its Importance, Discuss Various Security Controls for Data Encryption, Discuss Data Backup and Retention, Discuss Data Loss Prevention Concepts, Understand the Need and Advantages of Network Traffic Monitoring, Determine Baseline Traffic Signatures for Normal and Suspicious Network Traffic, Perform Network Monitoring for Suspicious Traffic.

***Self-Learning Components:** Students are required to study the following tools: Wireshark: Network protocol analyzer for packet inspection and analysis Nmap: Network mapping and port scanning tool Research and presentations on emerging network security concepts, such as Software-Defined Networking (SDN), Zero Trust Networking, and Threat Intelligence Network Defense essential certification by EC Council
Reference Books: Network Defense Essentials v1 **Reference Books & Links:** • https://www.eccouncil.org/academia/network-defense-essentials-nde/ • William Stallings, Lawrie Brown, Computer Security: Principles and Practice, 3rd edition,2014 • Cryptography and Network security, Behrouz A. Forouzan , Debdeep Mukhopadhyay, Mcgraw Hill Education, 2 nd Edition, 2011 • Machine Intelligence and Big Data Analytics for Cybersecurity Applications. Studies in Computational Intelligence, vol 919. Springer, Cham, 2021 • Cryptography and Network Security - Principles and Practice | Seventh Edition | By Pearson by Stallings William

Define Course Outcomes (CO)

COs	
CO1	**Understand** the fundamental concepts of information security and its importance in network defense.
CO2	**Gain** knowledge of ethical hacking fundamentals and the role of penetration testing in identifying vulnerabilities.
CO3	**Identify** information security threats and vulnerabilities through effective vulnerability assessment techniques.
CO4	**Implement** appropriate countermeasures and defensive strategies to mitigate network-level, web application, wireless, mobile, IoT, OT, and cloud computing attacks.
CO5	**Conduct** basic penetration tests and **Evaluate** the security of network systems and applications.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C2	A1	P1
CO2	C1	A1	P1
CO3	C2	A2	P2
CO4	C3	A3	P3
CO5	C5	A4	P4

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	2	2	2	-	-	-	3
CO2	-	2	1	2	2	2	2	3	2	2	2	3
CO3	-	1	2	3	2	2	2	3	2	2	-	2
CO4	3	2	2	3	3	3	3	-	2	2	2	2
CO5	1	2	1	3	2	2	-	2	2	-	1	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	-	-
CO2	2	3	1	1	1
CO3	1	1	2	1	-
CO4	-	2	3	-	2
CO5	-	3	2	2	1

Relevance of the Syllabus to various indicators

Unit I	**Network Security Fundamentals**
Local	Security policies, physical security, and workplace security contribute to local security requirements.
Regional	-
National	-
Global	Network security controls address global challenges in securing information and preventing cyber threats.
Employability	-
Entrepreneurship	-
Skill Development	Develops skills in implementing network security controls and understanding security policies.
Professional Ethics	Emphasizes the importance of confidentiality, integrity, and availability of information.
Gender	-
Human Values	Promotes values of integrity, privacy, and responsible use of technology
Environment & Sustainability	-
Unit II	**Network and Web Application Security**
Local	-
Regional	-
National	-
Global	Understanding ethical hacking, penetration testing, and countermeasures contribute to global cybersecurity efforts.
Employability	Knowledge of network and web application security enhances employability in cybersecurity roles.
Entrepreneurship	-
Skill Development	Develops skills in identifying vulnerabilities, conducting penetration testing, and implementing countermeasures.
Professional Ethics	Emphasizes ethical hacking and responsible disclosure of vulnerabilities.
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Wireless and Mobile Security**
Local	-
Regional	-
National	-
Global	Contributes to global efforts in securing communication technologies.
Employability	-
Entrepreneurship	-

Skill Development	Develops skills in securing wireless networks, mobile devices, and incident response.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**IoT, Virtualization and Cloud Computing Security**
Local	-
Regional	-
National	-
Global	Enhancing IoT and cloud computing security contributes to global cybersecurity strategies.
Employability	Knowledge of IoT, virtualization, and cloud computing security enhances employability in cybersecurity roles, particularly in IoT security.
Entrepreneurship	-
Skill Development	Develops skills in securing IoT devices, understanding virtualization security concerns, and addressing cloud computing security threats.
Professional Ethics	Emphasizes responsible use of IoT devices and adherence to cloud computing security best practices.
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	4,9
NEP 2020	Provides knowledge and skills for information security control
POE/4th IR	The course aligns with the need for network defense and cybersecurity in the context of the fourth industrial revolution, emphasizing the importance of securing networks and protecting against cyber threats.

Department:	**Department of Computer Science and Engineering**		
Course Name: **Network Defense Essentials Series (NDE) Lab**	**Course Code**	**L-T-P**	**Credits**
	ENSP156	0-0-2	1
Type of Course:	Minor		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	
CO 1	This lab demonstrates how to manage objects in Active Directory using different types of accounts and how to apply account policies using GPO (Group Policy Object) in a Windows machine.
CO 2	This lab demonstrates how to create a GPO from the GPMC; this group policy will implement a common password policy to enable the use of complex and lengthy passwords in the AD domain.
CO 3	This lab demonstrates how to detect malicious network traffic using HoneyBot.
CO 4	This lab will demonstrate how to capture network traffic.
CO 5	This lab will demonstrate the various hardening techniques on a wireless router.
CO 6	This lab will demonstrate how to audit the security of a default Docker installation on an Ubuntu host using Docker-Bench-Security Tool and how to fix some of the identified security warnings.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Implementing Access Controls in Windows Machine	CO2
2	Implementing Role-Based Access Control in Windows Admin Center (WAC)	CO2
3	Implementing Password Policies using Windows Group Policy	CO2
4	Implementing Host-Based Firewall Protection with iptables	CO3
5	Implementing Host-Based Firewall Functionality using Windows Firewall	CO3
6	Implementing Network-Based Firewall Functionality: Blocking Unwanted Website Access using pfSense Firewall	CO3
7	Implementing Network-Based Firewall Functionality: Blocking Insecure Ports using pfSense Firewall	CO3
8	Implementing Host-Based IDS Functionality using Wazuh HIDS	CO3
9	Implementing Network-Based IDS Functionality using Suricata IDS	CO3
10	Detect Malicious Network Traffic using HoneyBOT	CO3
11	Establishing Virtual Private Network Connection using SoftEther VPN	CO4
12	Auditing Docker Host Security Using Docker-Bench-Security Tool	CO2
13	Implementing AWS Identity and Access Management	CO4
14	Securing Amazon Web Services Storage	CO3
15	Configuring Security on a Wireless Router	CO1
16	Implementing Enterprise Mobile Security using Miradore MDM Solution	CO2
17	Securing IoT Device Communication using TLS/SSL	CO1
18	Calculate One-way Hashes using HashCalc	CO1
19	Calculate MD5 Hashes using HashMyFiles	CO1
20	Create a Self-signed Certificate	CO1
21	Perform Disk Encryption using VeraCrypt	CO1

22	File Recovery using EaseUS Data Recovery Wizard	CO2
23	Backing Up and Restoring Data in Windows	CO2
24	Implementing Network-Based Firewall Functionality: Blocking Unwanted Website Access using pfSense Firewall	CO3
25	Implementing Network-Based Firewall Functionality: Blocking Insecure Ports using pfSense Firewall	CO4
26	Implementing Host-Based IDS Functionality using Wazuh HIDS	CO2
27	Implementing Network-Based IDS Functionality using Suricata IDS	CO2
28	Capturing Network Traffic using Wireshark	CO3
29	Applying Various Filters in Wireshark	CO4
30	Analyzing and Examining Various Network Packet Headers in Linux using tcpdump	CO5

<table>
<tr><td>Department:</td><td colspan="3">Department of Computer Science and Engineering</td></tr>
<tr><td rowspan="2">Course Name:

Engineering Physics</td><td>Course Code</td><td>L-T-P</td><td>Credits</td></tr>
<tr><td>ENPH101</td><td>3-1-0</td><td>4</td></tr>
<tr><td>Type of Course:</td><td colspan="3">Major</td></tr>
<tr><td colspan="4">Pre-requisite(s), if any: Integration/Differentiation</td></tr>
<tr><td colspan="4">Brief Syllabus:

This course provides an introduction to the principles and applications of optoelectronics, as well as an overview of new engineering materials. The course is divided into four units, each focusing on different aspects of the subject matter. By the end of the course, students will have a solid foundation in optoelectronics principles, including lasers and fiber optics, as well as an understanding of new engineering materials and their applications</td></tr>
<tr><td colspan="4">UNIT WISE DETAILS</td></tr>
<tr><td>Unit Number: 1</td><td colspan="2">Title: Mechanics</td><td>No. of hours: 10</td></tr>
<tr><td colspan="4">Content Summary:

Centre of mass, centre of mass of two particle system and a rigid body, Rotational motion, Moment of Inertia and its physical significance, Radius of gyration, Acceleration due to gravity, simple harmonic motion, differential equation of S.H.M., Examples of S.H.M. (simple and compound pendulum)</td></tr>
<tr><td>Unit Number: 2</td><td colspan="2">Title: Optics</td><td>No. of hours: 10</td></tr>
<tr><td colspan="4">Content Summary:

Light: Introduction of light, properties of light, Dual Nature of light, refraction, Refraction by prism, Interference of light, interference by divison of wavefront (Young's double slit experiment), Interference by division of wave amplitude (Newton's ring), difference between diffraction and interference, types of diffraction, Fraunhoffer diffraction (single and double slit), theory of plane diffraction grating, determination of wavelength of a spectral line using transmission grating
Laser: Introduction, principle of Laser, stimulated and spontaneous emission, Ruby laser, He-Ne Laser, Application of Lasers.</td></tr>
<tr><td>Unit Number: 3</td><td colspan="2">Title: Polarization</td><td>No. of hours: 10</td></tr>
</table>

Content Summary:

Polarization: Polarization by reflection and refraction, Brewster's law, double refraction, nicol prism, quarter and half-wave plates, Production and analysis of circularly and elliptically polarized light

Unit Number: 4	**Title: New Engineering Materials**	**No. of hours: 10**

Content Summary:

Dielectric materials: Definition – Dielectric Breakdown – Dielectric loss – Internal field – Claussius Mossotti relation.

Superconducting materials: Introduction – Properties- Meissner effect – Type I & Type II superconductors – BCS theory-Applications.

Nanomaterials: Introduction – Synthesis of nano materials – Top down and Bottom-up approach- Ball milling- PVD method- Applications. Smart materials: Shape memory alloys- Biomaterials (properties and applications)

***Self-Learning Components:**

Crystal Structure - https://youtu.be/UXqWixel_f8

[1] Classification of solids
[2] Types of crystal systems
[3] Bonding in solids

Please Note:

1)Students are supposed to learn the components on self-basis

2) At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books:

1. N. Subrahmanyam, B. Lal, M.N.Avadhanulu,Optics (S.Chand).
2. A Text Book of Engineering Physics, M.N.Avadhanulu, P.G. Kshirsagar (S.Chand)
3. Ajoy Ghatak, Optics (Tata McGraw Hill).
4. http://www.gpcet.ac.in/wp-content/uploads/2018/09/UNIT-1-EP-PDF.pdf
5. https://fractory.com/fibre-lasers-explained/
6. https://www.brainkart.com/article/Modern-Engineering-Materials_6830/

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** the principles and applications of lasers, fiber optics, and electromagnetic waves.
CO2	**Apply** the concepts of polarization to analyze and manipulate light in various optical systems.
CO3	**Evaluate** the properties and applications of dielectric materials, superconducting materials, and nanomaterials in engineering contexts.
CO4	**Design** and propose innovative applications of lasers, fiber optics, and smart materials for specific engineering challenges.
CO5	**Analyze and solve** problems related to the behavior of electromagnetic waves, polarization, and optical communication systems**.**

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 7. Knowledge 8. Understand 9. Apply 10. Analyze 11. Evaluate 12. Create	Affective levels(A) 6. Receiving 7. Responding 8. Valuing 9. Organizing 10. Characterizing	Psychomotor levels(P) 6. Imitation 7. Manipulation 8. Precision 9. Articulation 10. Improving
CO1	C1	-	P5
CO2	C3	-	P2
CO3	C5	-	P4
CO4	C6	-	P3
CO5	C4	-	P3

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	2	-	-	-	-	-	-	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-
CO3	3	-	--	-	-	-	2	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-		-	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	2			
CO2		3		
CO3	3			
CO4			2	
CO5				3

Relevance of the Syllabus to various indicators

Unit I	**Mechanics**
Local	Mechanics is essential for understanding local physical structures, infrastructures, and natural phenomena.
Regional	Relevant to regional infrastructure, architectural planning, and transportation systems.
National	Contributes to national standards in construction, engineering, and transportation.
Global	Integral to global physics research, technological advancements, and architectural standards.
Employability	Fundamental for careers in engineering, physics, automotive design, and other technical fields.
Entrepreneurship	Essential knowledge for any startup in the tech, automotive, or engineering sector.
Skill Development	Helps in enhancing problem-solving, analytical skills, and understanding of physical systems.
Professional Ethics	Understanding and applying mechanics ethically is crucial, especially in construction and tech.
Gender	Mechanics as a subject doesn't directly address gender issues. However, promoting gender equality in mechanical fields is vital.
Human Values	Mechanics fosters an appreciation for the natural laws and the intricacies of the physical world.
Environment & Sustainability	Understanding mechanics can lead to the development of more efficient and sustainable machinery and technologies.
Unit II	**Optics**
Local	The understanding of light and its properties directly affects numerous local tools and technologies, such as eyeglasses, microscopes, and various optical tools. Laser technologies can also be employed in local surgeries, treatments, and commercial applications.
Regional	Optics plays a significant role in regional optical communication systems, architectural designs considering light, and in regional healthcare for surgeries and treatments involving lasers.

National	At the national level, optics becomes integral in broader research initiatives, national defense optics, and broader communication infrastructures. Laser technologies might be used in defense, medical surgeries, and other state-of-the-art applications.
Global	On a global scale, advances in optics, especially laser technologies, play a pivotal role in surgeries, communications, entertainment, research, and defense applications that have international implications.
Employability	Proficiency in optics is essential for careers in optometry, photonics, engineering, research, and more. Understanding laser technology is beneficial for professions in medical technology, defense, entertainment tech, etc.
Entrepreneurship	Innovations in optical technologies present numerous startup opportunities, especially with the rise of augmented reality (AR), virtual reality (VR), and other advanced optical applications. Lasers also offer entrepreneurial opportunities in medical, tech, and cosmetic sectors.
Skill Development	Studying optics boosts the understanding of light behavior, vital in many technical professions. Lasers add an advanced layer to optical understanding.
Professional Ethics	Using optics, especially lasers, requires ethical considerations, especially when used in surveillance, medical, and defense applications to ensure privacy, safety, and correct use.
Gender	While the subject itself doesn't differentiate, there's a broader need to ensure gender equality in optical and laser research, application, and professions.
Human Values	Optics, being a manifestation of natural phenomena, helps instill a sense of wonder and appreciation for the natural world and the intricacies of light. Lasers bring to fore the debate about responsible use vs. misuse.
Environment & Sustainability	Efficient and environmentally conscious use of optical technologies can aid in energy conservation. The sustainable use and disposal of laser equipment also have environmental implications.
Unit III	**Polarization**
Local	Local institutions and organizations involved in optical research or communications can benefit from the understanding and application of polarization, especially in fields like photography and telecommunication.

Regional	Polarization has implications for regional optical communication systems, educational institutions teaching advanced optics, and in medical applications where certain optical tools are used.
National	Polarization plays a role in the national telecommunication infrastructure, defense optics, and broader optical research initiatives.
Global	In the global arena, polarization is integral for cutting-edge optical research, international communications systems, and advanced technologies involving light manipulation.
Employability	Understanding polarization is crucial for careers in photonics, telecommunications, optical research, and other technical fields that involve advanced optics.
Entrepreneurship	Startups or businesses dealing with advanced optical tools, communication systems, or optical research might benefit from innovations in polarization techniques.
Skill Development	Studying polarization aids in honing analytical skills, enhances understanding of light behavior, and offers hands-on experience with optical tools.
Professional Ethics	Correct and ethical application of polarization, especially in surveillance, medical, or defense contexts, ensures the safety and privacy of individuals and data.
Gender	The topic of polarization doesn't inherently address gender issues, but there's an importance to promote gender inclusivity in optical research and professions.
Human Values	Studying the intricacies of polarization can instill a sense of wonder and appreciation for the complexities of the natural world. It underscores the importance of objective observation and the pursuit of knowledge.
Environment & Sustainability	Sustainable use and manufacturing of materials/tools that utilize polarization can contribute to environmental conservation.
Unit IV	**New Engineering Materials**
Local	Local manufacturing and industries can benefit from the understanding and application of new materials for enhanced product quality and efficiency.
Regional	Regional tech hubs, educational institutions, and manufacturing zones can incorporate advanced materials for better product outcomes, innovative research, and technology development.

National	At a national level, understanding and producing these new materials can lead to advanced infrastructure, defense capabilities, health technologies, and improved national R&D standings.
Global	New engineering materials contribute to global advancements in tech, medicine, defense, and more. Countries or entities leading in material research can have a global influence.
Employability	Knowledge in this field opens doors in R&D departments, high-tech industries, medical tech, and more.
Entrepreneurship	Innovations in material science present numerous startup opportunities, from tech gadgets to medical tools, to sustainable solutions.
Skill Development	It aids in the development of research skills, analytical thinking, and hands-on laboratory skills.
Professional Ethics	Correct and ethical applications of new materials, especially in medical and defense, are crucial. Ensuring materials are safe and don't infringe on privacy or security rights is vital.
Gender	While the material itself doesn't differentiate by gender, ensuring gender equality in material research, application, and professions is essential.
Human Values	Developing new materials fosters a sense of curiosity, wonder, and appreciation for technological advancements and their positive implications for human life.
Environment & Sustainability	Sustainable production and utilization of these materials, especially nanomaterials, are vital. The development of eco-friendly materials can revolutionize sustainable tech and industries.
SDG	SDG 4
NEP 2020	-
POE/4th IR	-

Department:	**Department of Computer Science and Engineering**		
Course Name: **Engineering Physics Lab**	**Course Code**	**L-T-P**	**Credits**
	ENPH151	0-0-2	1

Defined Course Outcomes

COs	
CO 1	Understand the principles and concepts related to the experiments involving bar pendulum, flywheel, Kater's pendulum, Newton's ring apparatus, plane diffraction grating, spectrometer, and half shade polarimeter.
CO 2	Apply the principles and concepts learned to conduct experiments and analyze experimental data, plot graphs, and interpret the results to determine various physical quantities.
CO 3	Evaluate the accuracy and reliability of experimental measurements and results obtained from the conducted experiments.
CO 4	Apply critical thinking and problem-solving skills to troubleshoot experimental setups, identify sources of errors, and propose solutions to improve the accuracy and precision of measurements

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	To plot a graph between the distance of the knife edge from the centre of gravity and the time period of the bar pendulum. From the graph, find the acceleration due to gravity, the radius of gyration and the moment of inertia of the bar about an axis.	CO2, CO3
2	To determine the moment of inertia of a flywheel about its own axis of motion.	CO1, CO2, CO3, CO4
3	To determine the value of acceleration due to gravity using Kater`s pendulum.	CO1, CO2, CO3, CO4
4	To determine the wavelength of sodium light using Newton`s ring apparatus.	CO1, CO2, CO3
5	To determine the wavelength of prominent lines of mercury by plane diffraction grating.	CO1, CO2, CO3
6	To determine the refractive index of the material of the prism for the given colours (wavelengths) of mercury light with the help of spectrometer.	CO1, CO2, CO3
7	To determine the specific rotation of cane sugar solution with the help of half shade polarimeter.	CO1, CO2, CO3, CO4
8	To determine the wavelength of He-Ne LASER using transmission diffraction grating.	CO1, CO2, CO3

Department:	Department of Electrical & Electronics Engineering		
Course Name: Basics of Electrical & Electronics Engineering	**Course Code**	**L-T-P**	**Credits**
	ENEE101	4-0-0	4
Type of Course:	Major		

Pre-requisite(s), if any: NA

Frequency of offering (check one): Either semester

Brief Syllabus:

The subject deals with the study and application of basic electrical and electronics devices in daily life and technology integration level. It encompasses various principles and concepts related to the electronic devices and systems. Analysis of circuits using theorems for both AC and DC types. Also, it includes familiarization with CRO, function generator and power supplies, electrical measuring meters and different components. Lastly the concept of Integrated circuit and role of semiconductors in major industrial segments are conceptualized with examples.

UNIT WISE DETAILS

Unit Number: 1	Title: Circuit Analysis:	No. of hours: 10

Content Summary:

Ohm's Law, KCL, KVL Mesh and Nodal Analysis, Circuit parameters, energy storage aspects, Superposition, Thevenin's, Norton's, Reciprocity, Maximum Power Transfer Theorem, Millman's Theorem, Star-Delta Transformation. Application of theorem to the Analysis of D.C. circuits.

Unit Number: 2	Title: A.C. Circuits & CRO	No. of hours: 8

Content Summary:

A.C. Circuits: R-L, R-C, R-L-C circuits (series and parallel), Time Constant, Phasor representation, Response of R-L, R-C and R-L-C circuit to sinusoidal input Resonance-series and parallel R-L-C Circuits, Q-factor, Bandwidth.

Cathode Ray Oscilloscope: Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its component

Unit Number: 3	Title: Semiconductor Physics	No. of hours: 8

Content Summary:

Semiconductor Physics: Basic concepts, Intrinsic and extrinsic semiconductors, diffusion and drift currents. P-N junction diode: Ideal diode, P-N junction under open-circuit and closed-circuit, Diode Current Equation, Diode Resistance, Transition and Diffusion Capacitance, Effect of Temperature, Carrier Life Time, Continuity Equation. Special Diodes: Zener Diode, Photodiode, Light Emitting Diodes, applications of Diodes.

Unit Number: 4	Title: Digital Electronics	No. of hours: 8

Content Summary:

Digital Electronics: Boolean algebra, Truth tables of logic gates (AND, OR, NOT), NAND, NOR as universal gates. Bipolar junction transistor: Introduction to transistors: construction, transistor operations, BJT characteristics, load line, operating point, leakage currents. Application of BJT: CB, CE configurations, Introduction to FETs and MOSFETs.

Self-Learning Components:

Students will be capable of recognizing the small electronics components utilized in their daily households. Also, better classification practices can be developed in students over the types of devices working on AC or DC current. Even inbuilt structures of household devices can also be illustrated all along with studies

Mini Project: Small circuits can be built up using components identified initially and afterword's testing using the mustimeter and CRO can be carried out to justify the working feasibility of components studied in the syllabus.

Please Note:

1)Students are supposed to learn the components on self-basis

2) At least 5-10 % syllabus will be asked in end term exams from self-learning components

Contents beyond Syllabus: working on 7 segment device using breadboard basic idea

And students hands on with battery and count display from 0 to 9.

Reference Books:

1. D.P. Kothari & I J Nagrath, Basic Electrical Engineering, Tata McGraw Hill , New Delhi.

2. B L Thareja – A text book of Electrical Technology

3. Boylestad & Nashelsky, "Electronic Devices & Circuits", Pearson Education, 10th Edition.

4. V. K. Mehta & Rohit Mehta, "Principles of Electronics", S. Chand Publishers, 27th Edition.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_ee113/preview
2. https://www.edx.org/learn/electrical-engineering
3. https://www.classcentral.com/course/youtube-electrical-engineering-basics-54532
4. https://www.electronics-tutorials.ws/

Define Course Outcomes (CO)

Course Outcomes (COs)

Possible usefulness of this course after its completion i.e., how this course will be practically useful to him once it is completed.

COs	Statements
CO 1	**Describe** and learn the basic Knowledge of AC and DC Circuits in making real-time projects to solve engineering difficulties of real time.
CO 2	**Understands its** utilization in day-to-day work dealing with pure AC circuits. R L and basic C circuits effect over-voltage and ac wave will be studied.
CO 3	**Compare** and **Contrast** various logic gates. Demonstrate the ability to identify series, parallel complex circuits. Utilization of the preliminary knowledge gained to obtain real existing power-related problems.
CO 4	**Differentiate** about the understanding of semiconductor devices application to existing apparatuses
CO 5	**Distinguish** the devices used in multipurpose electronics devices.

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	-	1	-	-	-	-
CO2	-	1	1	-	-	-	1	-	1	1	1	-
CO3	2	2	-	2	2	3	2	-	-	-	-	-
CO4	-	-	-	2	2	-	-	2	1	2	2	-
CO5	3	-	-	-	-	-	-	2	-	3	3	-

CO-PSO Mapping

PO	PSO1	PSO2	PSO3
CO1	-	-	1
CO2	-	2	2
CO3	1	-	2
CO4	1	-	3
CO5	2	-	-

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C1	-	-
CO2	C2	-	-
CO3	C3	A4	-
CO4	C6	-	P5
CO5	-	-	-

Relevance of the Syllabus to various indicators

Unit I	**Circuit Analysis:**
Local	In the local context, circuit analysis plays a role in electrical infrastructure, power distribution, and ensuring safe electrical connections within a community. It is crucial for local electricians, engineers, and technicians to understand circuit analysis principles to maintain and troubleshoot electrical systems efficiently.
Regional	In the regional context, circuit analysis is applied to larger electrical networks and power grids that serve multiple cities or areas. Engineers and policymakers use circuit analysis to design and optimize the regional power distribution, taking into account factors like load balancing, transmission losses, and system reliability.
National	At the national level, circuit analysis becomes even more critical for the stability and efficiency of the entire electrical grid. National power grids require careful planning, monitoring, and maintenance, making circuit analysis indispensable for energy security and sustainability.
Global	In the global context, circuit analysis is essential for understanding international power interconnections and the challenges of exchanging electricity across borders. Engineers and researchers collaborate to create harmonized standards and protocols for global power transmission.
Employability	Circuit analysis skills are highly sought after in various industries, especially in electrical engineering, electronics, telecommunications, and renewable energy. Proficiency in circuit analysis enhances one's employability, enabling individuals to contribute to the development and maintenance of cutting-edge technologies.
Entrepreneurship	For entrepreneurs in the electronics or renewable energy sector, a solid understanding of circuit analysis is essential. This knowledge allows them to design innovative products, optimize energy-efficient systems, and develop sustainable solutions to real-world problems.

Skill Development	Learning circuit analysis helps individuals develop critical analytical and problem-solving skills. It fosters logical thinking and the ability to approach complex challenges systematically, which is valuable not only in the field of engineering but also in various other domains.
Professional Ethics	Circuit analysis professionals must adhere to ethical principles while designing, implementing, and maintaining electrical systems. Ethical considerations include ensuring safety standards, complying with regulations, and prioritizing the well-being of end-users.
Gender	Encouraging gender diversity and inclusion in circuit analysis and electrical engineering is essential for creating a more balanced and innovative workforce. Efforts to promote equality and eliminate gender biases in STEM fields, including circuit analysis, are crucial for societal progress.
Human Values	Circuit analysis contributes to human values by improving the quality of life through efficient power distribution, renewable energy solutions, and advancements in electronic devices that enhance communication and connectivity.
Environment & Sustainability	Understanding circuit analysis is vital for designing energy-efficient systems and integrating renewable energy sources into the power grid. By optimizing energy consumption and promoting sustainable practices, circuit analysis can contribute to environmental preservation.
Unit II	**A.C. Circuits & CRO**
Local	AC Circuits: In the local context, AC circuits are used in various electrical devices and systems found in homes, offices, and local infrastructure. They power lights, appliances, and other electronics, ensuring daily convenience and functionality. CRO: Local technicians and engineers may use CROs to diagnose and troubleshoot electronic equipment and electrical systems in the community, ensuring their proper functioning.
Regional	• AC Circuits: At the regional level, AC circuits are utilized in larger-scale electrical installations, such as power distribution networks, substation systems, and regional electrical infrastructure, ensuring efficient and reliable electricity supply.

	• CRO: Regional engineering teams might use CROs to analyze complex waveforms in power distribution systems, helping to identify irregularities and optimize electrical performance.
National	• AC Circuits: Nationally, AC circuits play a crucial role in the power generation, transmission, and distribution systems across the country, contributing to the stability and security of the national power grid. • CRO: National laboratories and research institutions may use high-end CROs for advanced studies in electronics, communications, and signal processing, contributing to technological advancements on a national scale.
Global	• AC Circuits: At the global level, AC circuits connect countries through intercontinental power transmission lines, enabling the exchange of electricity across borders and promoting international collaboration in energy distribution. • CRO: Cutting-edge research and development in CRO technology may have global impacts on various fields, such as telecommunications, electronics, and high-tech industries.
Employability	• AC Circuits: Knowledge of AC circuits is essential for electrical engineers, technicians, and electricians in various industries. Employers seek professionals who can design, analyze, and troubleshoot AC circuits efficiently. • CRO: Understanding CRO operation and waveform analysis is valuable for professionals working in electronics, telecommunications, and research fields, making them more employable.
Entrepreneurship	• AC Circuits: Entrepreneurs may explore opportunities in renewable energy solutions, energy-efficient products, or smart grid technologies, which heavily rely on AC circuits for efficient power distribution. • CRO: Entrepreneurs with innovative ideas in electronic instrumentation or specialized CRO applications may start their ventures to cater to niche markets.

Skill Development	• AC Circuits: Learning about AC circuits fosters expertise in electrical engineering, enhancing analytical and problem-solving skills for professionals in the field. • CRO: Skill development in CRO usage enables engineers and researchers to gain insights from complex waveforms, facilitating advanced studies and product development.
Professional Ethics	• AC Circuits: Practicing electrical engineers must adhere to professional ethics to ensure the safety, reliability, and compliance of AC circuit installations. • CRO: Ethical considerations in CRO use involve respecting intellectual property rights, conducting honest research, and handling sensitive data responsibly.
Gender	• AC Circuits: Efforts to promote gender diversity and inclusion in electrical engineering professions, including AC circuit design and analysis, contribute to a more balanced and diverse workforce. • CRO: Encouraging women's participation in STEM fields, including electronics and instrumentation (such as CRO technology), helps bridge the gender gap in the industry.
Human Values	• AC Circuits: AC circuits improve human life by providing electricity for everyday needs, enhancing living standards, and facilitating technological advancements that benefit society. • CRO: CRO technology supports various scientific and engineering endeavors that contribute to human knowledge, healthcare, and technological progress.
Environment & Sustainability	• AC Circuits: The efficient design and implementation of AC circuits in renewable energy systems contribute to environmental sustainability by reducing reliance on fossil fuels. • CRO: CROs aid in the development of energy-efficient electronic devices, which align with sustainability goals and eco-friendly practices.
Unit III	Semiconductor Physics
Local	Semiconductor Physics: In the local context, semiconductor physics may be relevant to industries and businesses that use electronic devices and components. Local electronics

	manufacturers and technology companies may utilize semiconductor physics to design, produce, and troubleshoot electronic devices commonly used in the community.
Regional	Semiconductor Physics: At the regional level, research and development centers and academic institutions may delve into semiconductor physics to develop advanced materials, devices, and technologies. Collaborations among regional industries and research institutions can lead to regional technological advancements.
National	• Semiconductor Physics: Nationally, semiconductor physics plays a vital role in the semiconductor industry, which is critical for various sectors, including electronics, telecommunications, and renewable energy. National investments in semiconductor research can lead to technological breakthroughs and economic growth.
Global	• Semiconductor Physics: Globally, semiconductor physics drives the semiconductor industry, which has significant impacts on various aspects of modern life. It is a foundation for global technological innovation and the development of cutting-edge electronic devices •
Employability	• Semiconductor Physics: Understanding semiconductor physics is highly sought after in industries related to electronics, semiconductor manufacturing, telecommunications, and integrated circuit design. Professionals with expertise in semiconductor physics are in demand for various research and development roles.
Entrepreneurship	• Semiconductor Physics: Entrepreneurs can explore opportunities in the semiconductor industry by starting companies that develop novel semiconductor materials, manufacturing processes, or semiconductor-based devices. •
Skill Development	• Semiconductor Physics: Skill development in semiconductor physics is crucial for researchers, engineers, and scientists working in the semiconductor and electronics fields. It involves understanding semiconductor properties, band theory, carrier dynamics, and quantum mechanics.

Professional Ethics	• Semiconductor Physics: Professionals working in semiconductor research and development must adhere to ethical principles concerning safety, environmental protection, and responsible use of semiconductor technology.
Gender	• Semiconductor Physics: Encouraging gender diversity and inclusion in semiconductor physics and related fields is essential for creating a more balanced and diverse workforce. Efforts to promote gender equity in STEM fields help increase representation and opportunities for women. •
Human Values	• Semiconductor Physics: The advancements in semiconductor technology have improved human life through various electronic devices, communication systems, medical equipment, and energy-efficient solutions. •
Environment & Sustainability	• Semiconductor Physics: Research in semiconductor physics contributes to the development of energy-efficient electronic devices, renewable energy technologies, and environmental monitoring systems, which align with sustainability goals.
Unit IV	**Digital Electronics**
Local	• Digital Electronics: In the local context, digital electronics is used in everyday electronic devices found in homes and businesses. Local electronics retailers and repair services utilize digital electronics knowledge to provide and maintain electronic products in the community. •
Regional	• Digital Electronics: At the regional level, digital electronics plays a role in the development of regional technology hubs and manufacturing centers. Collaboration among regional industries and research institutions may lead to advancements in digital electronics applications. •
National	• Digital Electronics: Nationally, digital electronics is vital for the electronics industry, contributing to the design

	and production of integrated circuits, microprocessors, and electronic systems. National investments in research and development can lead to technological innovations and economic growth. •
Global	• Digital Electronics: Globally, digital electronics is at the heart of the information age, enabling global communication, computing, and connectivity. Global collaborations and standardizations shape the advancement and implementation of digital technologies worldwide. •
Employability	• Digital Electronics: Understanding digital electronics is essential for professionals in the electronics, computer hardware, and telecommunications industries. Skills in digital logic design, microprocessor programming, and digital system troubleshooting are highly sought after.
Entrepreneurship	• Digital Electronics: Entrepreneurs can explore opportunities in digital electronics by starting companies that develop innovative digital products, embedded systems, or IoT devices. •
Skill Development	• Digital Electronics: Skill development in digital electronics involves learning about binary systems, logic gates, digital circuit design, FPGA programming, and microcontroller applications. These skills are valuable for engineers and technologists in various industries. •
Professional Ethics	• Digital Electronics: Professionals working with digital electronics must adhere to ethical principles concerning data privacy, cybersecurity, and responsible use of digital technology. •
Gender	• Digital Electronics: Efforts to promote gender diversity and inclusion in digital electronics and related fields aim to bridge the gender gap in STEM professions, creating more opportunities for women in technology. •
Human Values	• Digital Electronics: Digital electronics contributes to human values by enabling efficient communication, improved healthcare through medical devices, and enhanced quality of life through various electronic innovations. •

Environment & Sustainability	• Digital Electronics: Advancements in digital electronics have led to energy-efficient computing and power management systems, contributing to environmental sustainability by reducing energy consumption and electronic waste.
SDG	SDG 4, SDG 8
NEP 2020	-
POE/4th IR	Aligns with concept of making energy efficient devices and sensor building approaches

Department:	Department of Electrical & Electronics Engineering		
Course Name: Basics of Electrical & Electronics Lab	Course Code	L-T-P	Credits
	ENEE151	0-0-2	1
Type of Course:	Major		

Defined Course Outcomes

COs	
CO 1	To learn using basic instruments for measuring real time values.
CO 2	To implement learned theorems in separate Dc and AC Circuits
CO 3	Capability to perform small circuit-based experiments using digital logics
CO 4	Desire to obtain wave forms of various device to analyse its actual functioning.

Proposed Lab Experiments

Ex No	Experiment Title	Mapped CO/COs
1	To get familiar with the working knowledge of the following instruments: a) Cathode ray oscilloscope (CRO) b) Multimeter (Analog and Digital) c) Function generator d) Power supply	CO4 CO1
2	To measure phase difference between two waveforms using CRO To measure an unknown frequency from Lissajous figures using CRO	CO4 CO1
3	To Verify the Thevenin' s and Norton's theorem	CO2
4	To Verify the Superposition theorem	CO2
5	To measure voltage, current and power in an A.C. circuit by LCR impedance method	CO3
6	To study the frequency response curve in series and parallel-L-C circuit	CO3

7	a) Plot the forward and reverse V-I characteristics of P-N junction diode b) Calculation of cut-in voltage B.Tech. c) Study of Zener diode in breakdown region	CO3
8	To plot and study the input and output characteristics of BJT in common-emitter configuration.	CO2
9	Verification of truth tables of logic gates (OR, AND, NOT, NAND, NOR).	CO1 CO4
10	To get familiar with the working and use of seven-segment display.	CO4

Syllabus- Semester III

Department:	**Department of Computer Science and Engineering**		
Course Name: Discrete Mathematics	**Course Code**	**L-T-P**	**Credits**
	ENCS203	3-1-0	4
Type of Course:	Major		
Pre-requisite(s), if any: Basic of Mathematics			

Brief Syllabus:

This course will discuss fundamental concepts and tools in discrete mathematics with emphasis on their applications to computer science. Topics include logic and Boolean circuits, sets, functions, relations, deterministic algorithms and randomized algorithms, analysis techniques based on counting methods and recurrence relations, trees and graphs etc.

UNIT WISE DETAILS

Unit Number: 1	**Title: Propositional Logics & Relations**	**No. of hours: 10**

Content Summary:

Mathematical Logic: Introduction to Mathematical Thinking, Propositional and Predicate Logic , Propositional Equivalences, Sets, Binary Relation, Equivalence Relation, Logical operations, Conditional Statements, Tautologies, Contradictions, Logical Equivalence, The use of Quantifiers, Normal Forms, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference. Sets and Relations: Set Operations, Representation and Properties of Relations & Functions, Equivalence Relations, Partially Ordering .

Unit Number: 2	**Title: Counting, Mathematical Induction and Discrete Probability**	**No. of hours: 10**

Content Summary:

Basics of Counting, Pigeonhole Principle, Permutations and Combinations Inclusion-Exclusion Principle Mathematical Induction, Probability, Bayes' Theorem, Discrete Probability Theory, Discrete Structures in Computing, Counting Principles, Permutations and Combinations, Probability Theory, Discrete Random Variables, Discrete Optimization - Optimization Problems and Algorithms Linear Programming, Integer Programming, Algebraic Structures - Groups (Definition, Properties, Subgroups, Cyclic

Groups), Rings (Definition, Properties, Integral Domains, Fields), Isomorphisms and Homomorphisms , Counting and combinatorics .

Unit Number: 3	Title: Group Theory & Discrete Probability	No. of hours: 10

Content Summary:

Groups, Subgroups, Semi Groups, Product and Quotients of Algebraic Structures, Isomorphism, Homomorphism , Automorphism, Rings, Integral Domains, Fields, Applications of Group Theory , Combinatorial optimization: basic concepts and algorithms, Sample spaces, events, and probability axioms, Conditional probability and Bayes' theorem.

Unit Number: 4	Title: Graph Theory	No. of hours: 10

Content Summary:

Simple Graph, Multigraph, Weighted Graph, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits , Hamiltonian Paths and Circuits, Planner graph, Graph Coloring, Bipartite Graphs, Trees and Rooted Trees, Prefix Codes, Tree Traversals, Spanning Trees and Cut-Sets, digraphs , Graph Coloring, Euler's formulae, Graph Theory, Networks and Flows .

***Self-Learning Components:**

1. Applications of Graph Coloring: Time table Scheduling ("Discrete Mathematics and Its Applications" by Kenneth H. Rosen: Chapter 10.3: Graph Coloring)
2. Network Analysis, Routing & Optimization, using graph theory [OSSU].(Introduction to Graph Theory" by Richard J. Trudeau)
3. Combinatorial Optimization & Error Detection & correction using The Pigeonhole Principle [OSSU].("Combinatorial Optimization: Algorithms and Complexity" by Christos H. Papadimitriou and Kenneth Steiglitz)
4. Scheduling and Task Prioritization, using Partial orderings [OSSU] ("Introduction to Scheduling" by Yves Robert and Frederic Vivien)
5. Rules based system and Algorithm design using conditional statements [OSSU]. (Chapter 10, 22, 23, of Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig).

Online Certification Courses for Discrete Mathematics (With Links):

1. Discrete Mathematics: https://www.coursera.org/learn/discrete-mathematics
2. Discrete Math Series : Propositional Logic masterclass https://www.udemy.com/course/discretemathematics/

3. Master Discrete Mathematics: Sets, Math Logic, and More: https://www.udemy.com/course/master-discrete-mathematics/
4. Master Math by Coding in Python: https://www.udemy.com/course/math-with-python/
5. Discrete Mathematics for Computer Science in C, Java, Python: https://www.udemy.com/course/discrete-mathematics-and-its-applications/
6. Discrete Mathematics - Complete Course: https://www.udemy.com/course/discrete-mathematics-complete-course/
7. Discrete Optimization: https://www.coursera.org/learn/discrete-optimization
8. Introduction to Discrete Mathematics for Computer Science Specialization: https://www.coursera.org/specializations/discrete-mathematics

NPTEL Lecture Links for Discrete Mathematics (With Links):

1. Discrete Mathematics _ IIITB, IIIT Bangalore, Prof. Ashish Choudhury: https://nptel.ac.in/courses/106108227
2. Discrete Mathematics, IIT Ropar: https://nptel.ac.in/courses/106106183

Please Note:

1) At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books/Material:

1. Elements of Discrete Mathematics, C. L Liu, McGraw-Hill Inc, 1985. Applied Combinatorics, Alan Tucker.
2. Concrete Mathematics, Ronald Graham, Donald Knuth, and Oren Patashnik, 2nd Edition - Pearson Education Publishers.
3. Combinatorics: Topics, Techniques, Algorithms by Peter J. Cameron, Cambridge University Press.
4. Topics in Algebra, I.N. Herstein, Wiley.
5. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
6. Satinder Bal Gupta: A Text Book of Discrete Mathematics and Structures, University Science Press, Delhi.

Web references:

1. Discrete Mathematics: An open Introduction, by Oscar Levin, 3rd Edition: https://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf
2. Lecture Notes on Discrete Mathematics, IITK, https://home.iitk.ac.in /~arlal /book/mth202.pdf
3. Mathematical Foundations And Aspects of Discrete Mathematics, Jean Gallier and Jocelyn Quaintance, https://www.cis.upenn.edu/~jean/disc math-root-b.pdf

4. Discrete Mathematics for Computer Science, Gary Haggard, John Schlipf, Sue Whitesides, https://www2.cs.uh.edu/~arjun/courses/ds/DiscMaths4ComPSc.pdf
5. DISCRETE MATHEMATICS FOR COMPUTER SCIENCE, Herbert Edelsbrunner and Brittany Fasy, https://courses.cs.duke.edu/spring09/cps102/Lectures/Book.pdf
6. Discrete Mathematics and its Applications, Rosen, https://faculty.ksu.edu.sa/sites/default/files/rosen_discrete_mathematics_and_its_applications_7th_edition.pdf

Course Outcomes (CO)

COs	Statements
CO1	**Understand** foundational concepts: Gain a solid understanding of fundamental concepts in discrete mathematics, including logic, sets, relations, and functions
CO2	**Express** proficiency in logical reasoning and constructing mathematical proofs using various proof techniques such as direct proofs, proof by contradiction, and mathematical induction.
CO3	**Determine** methods to Explore various discrete structures, such as sets, sequences, functions, relations, and formal languages. Understand the properties and applications of these structures.
CO4	**Identify** and develop problem-solving skills by applying discrete mathematics concepts to solve mathematical problems and real-world scenarios. Enhance logical thinking and analytical reasoning abilities.
CO5	**Articulate** real-world applications of discrete mathematics in computer science, cryptography, network analysis, optimization problems, scheduling, and decision-making.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 13. Knowledge 14. Understand 15. Apply 16. Analyze 17. Evaluate 18. Create	Affective levels(A) 11. Receiving 12. Responding 13. Valuing 14. Organizing 15. Characterizing	Psychomotor levels(P) 11. Imitation 12. Manipulation 13. Precision 14. Articulation 15. Improving
CO1	C2	A1	P1
CO2	C3	A2	P2
CO3	C3	A5	P5
CO4	C6	A5	P5
CO5	C2	A5	P1

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	-	2	-	-	-	-	2
CO2	1	2	-	1	3	2	1	-	-	-	-	2
CO3	-	-	-	1	3	-	2	-	-	3	-	2
CO4	-	2	-	-	3	1	2	-	-	3	-	2
CO5	-	2	-	-	3	-	2	-	-	3	-	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	3	2	2	1
CO2	2	3	2	1
CO3	2	3	2	1
CO4	2	3	2	1
CO5	2	3	2	1

Relevance of the Syllabus to Various indicators

Unit I	Propositional Logics & Relations
Local	-
Regional	-
National	-
Global	It lays a solid foundation for further studies in mathematics, computer science, and related fields while fostering critical thinking and analytical skills.
Employability	Equips with problem-solving techniques to analyse and process data, design algorithms, and make informed decisions.
Entrepreneurship	-
Skill Development	Discrete mathematics allows students to think abstractly, develop formal mathematical arguments, and engage in rigorous problem-solving.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Counting, Mathematical Induction and Discrete Probability
Local	-
Regional	-
National	-
Global	Probability, Bayes' theorem, and statistical analysis provide a framework for understanding and interpreting real-world phenomena that involve uncertainty and data.
Employability	It is beneficial in areas such as probability theory, statistics, optimization, cryptography, and network analysis
Entrepreneurship	skills obtained are valuable in various fields, including computer science, mathematics, law, and philosophy.

Skill Development	Enhances your ability to analyze problems logically, identify patterns, and draw logical conclusions. These skills are valuable in various fields, including computer science, mathematics, law, and philosophy.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Group Theory & Discrete Probability
Local	-
Regional	-
National	-
Global	Group theory is widely used in physics, chemistry, crystallography, and other fields where symmetry is a fundamental concept.
Employability	This develops ability to think conceptually, make connections between different mathematical structures, and develop a broader perspective on mathematics as a whole.
Entrepreneurship	-
Skill Development	Group theory, in particular, is essential for studying symmetry and transformations. It provides a framework for analysing the symmetries of objects, understanding transformational properties, and solving problems related to symmetry.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Graph Theory

Local	-
Regional	-
National	-
Global	By studying these topics, the students will gain the ability to model and analyse various real-world scenarios, including social networks, transportation networks, communication networks, and data dependencies.
Employability	Understanding concepts such as shortest paths, network connectivity, and digraphs allows students to design efficient and reliable routing algorithms, analyze network performance, and ensure optimal data
Entrepreneurship	-
Skill Development	Graph theory provides a powerful framework for representing and analyzing relationships between objects or entities.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 9
NEP 2020	-
POE/4th IR	Aligns with the concepts of Design, Efficiency ,Problem Solving

Department:	**Department of Computer Science and Engineering**		
Course Name: Data Structures	**Course Code**	**L-T-P**	**Credits**
	ENCS205	3-1-0	4
Type of Course:	Major		
Pre-requisite(s), if any: Basics of Computer Programming			

Brief Syllabus:

Solving computational problems requires the knowledge of efficient data organization and the ability to make effective choices among multiple solutions. In this course, we will explore several fundamental data structures in computer science and learn to implement them. The course aims to teach the fundamentals of data structures, their design, implementation and effective use in problem solving approach. With the knowledge of data structures and practical experience in implementing them, students can become much more effective designer and developer. The course will start with the basic introduction of linear such as arrays, stack and queues as well as non-linear data structures such as trees and graphs. They will further proceeds with the programming intensive task of implementing them.

UNIT WISE DETAILS

Unit Number: 1	**Title: Introduction to Data Structure**	**No. of hours: 12**

Content Summary:

Introduction to Data Structures: Definition of data structures and abstract data types, Static and Dynamic implementations, Examples and real life applications; Arrays: ordered lists, representation of arrays in memory

Basic Analysis: Differences among best, average, and worst case behaviours of an algorithm, Asymptotic analysis of upper and expected complexity bounds, Big O notation: formal definition and use, big omega and big theta notation , Complexity classes, such as constant, logarithmic, linear, quadratic, and exponential, Time and space trade-offs in algorithms, Recurrence relations , Analysis of iterative and recursive algorithms.

Unit Number: 2	**Title: Stacks, Queues and Linked List**	**No. of hours: 12**

Content Summary:

Stacks: ADT Stack and its operation, Array based implementation of stacks, Examples: Infix, postfix, prefix representation, Conversions of an arithmetic expression from Infix to postfix, Applications: Tower of Hanoi Problem, Algorithms and their complexities

Queues: ADT Queue and its operation, Array based implementation of linear Queues, Circular Queues, Priority queues, Application of queues: Process Scheduling.

Linked List: Definition, Components of linked list, Representation of linked list, Advantages and Disadvantages of linked list. Types of linked list: Singly linked list, Doubly linked list, Circular linked list and circular doubly linked list. Operations on different types of linked list : creation, insertion, deletion, search and display (based on the different position as specified by the user).Linked representation of Stacks & Queues, Algorithms and their complexities.

Unit Number: 3	**Title: Trees and Graphs**	**No. of hours: 12**

Content Summary:

Trees: Basic Terminology, Binary Trees and their representation, expression evaluation, Complete Binary trees, Extended binary trees, traversing binary trees, Searching, Insertion and Deletion in binary search trees. AVL trees, Threaded trees, algorithms and their analysis.

Graphs: Terminology and Representations, Graphs & Multigraphs, Directed Graphs, Sequential representation of graphs, Adjacency matrices, Transversal Connected Component and Spanning trees, algorithms and their analysis.

Unit Number: 4	**Title: Sorting and Searching**	**No. of hours: 8**

Content Summary:

Sorting Algorithms: Introduction, Sorting by exchange, selection sort, insertion sort, Bubble sort, Selection sort, Efficiency of above algorithms, Shell sort, Performance of shell sort, Merge sort, Quick sort Algorithm analysis, Heap sort: Heap Construction, Heap sort, bottom – up, Top – down Heap sort approach

Searching Algorithms: Straight Sequential Search, Binary Search (recursive & non–recursive Algorithm

***Self-Learning Components**: **mention 4-5 topics for students in bullet points**

1. Students should explore Platforms like LeetCode, HackerRank for Data structure
2. Students can refer the following courses as per the Open Source University Curriculum
3. "Algorithms, Part I" by Robert Sedgewick and Kevin Wayne (available on Coursera)
4. "Algorithms, Part II" by Robert Sedgewick and Kevin Wayne (available on Coursera)

Please Note:

1) At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books/Material:

1. E. Horowitz and S. Sahani, "Fundamentals of Data Structures", Galgotia Book source Pvt. Ltd.
2. Data Structures & Algorithms in Python by John Canning, Alan Broder, Robert Lafore Addison-Wesley Professional ISBN: 9780134855912.
3. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.
4. Problem Solving with Algorithms and Data Structures Using Python" by Brad Miller and David Ranum.

Course Outcomes (CO)

COs	Statements
CO1	**Analyze** the algorithms to determine the time and space complexity and justify the correctness.
CO2	**Design** a given Search problem (Linear Search and Binary Search).
CO3	**Articulate** Data Structure concepts such as Stack, Queue, Linked list, Graph and traversal techniques and their use in programs
CO4	**Design & implement** the algorithm for Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap sort. Compare their performance in term of Space and time complexity

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C1	A3	P5
CO2	C2	A3	P4
CO3	C3,C4	A4	P3
CO4	C5	A2	P2

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	1	-	-	-	-	-	3
CO2	3	3	2	-	-	-	-	-	-	-	-	3
CO3	3	3	3	-	-	-	-	-	-	-	-	3
CO4	3	3	3	-	-	-	-	-	-	-	-	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	3	3	2	-
CO2	3	3	1	-
CO3	3	3	-	-
CO4	3	3	-	-

Relevance of the Syllabus to Various indicators

Unit I	**Introduction to Data Structure**
Local	-
Regional	-
National	It provides foundational knowledge in data structures and algorithm analysis, which are fundamental concepts in computer science and software engineering.
Global	The principles taught in this course are applicable worldwide and form the basis of software engineering practices globally.
Employability	Understanding these concepts is crucial for technical interviews and can enhance job prospects in various technology companies.
Entrepreneurship	It helps in developing efficient and scalable software solutions, which are essential for building successful tech startups or innovative ventures.
Skill Development	Develop skills that are fundamental to computer science and software development and can be applied in various programming languages and contexts.
Professional Ethics	Applying good coding practices and software engineering principles align with professional ethics in the field.
Gender	-
Human Values	It encourages students to approach problems analytically and develop efficient solutions that can positively impact human lives.
Environment & Sustainability	-
Unit II	**Stacks, Queues and Linked List**
Local	-
Regional	-
National	These data structures are used extensively in computer science and software engineering, and the skills learned in this course

	can be applicable to various industries and sectors across the country.
Global	The principles taught in this course are applicable worldwide and form the basis of software engineering practices globally.
Employability	Understanding these data structures and their operations is important for solving problems efficiently and implementing optimized algorithms, which are highly sought after skills in the job market.
Entrepreneurship	Knowledge of data structures like stacks, queues, and linked lists is valuable for entrepreneurship in the technology sector.
Skill Development	Understanding and applying concepts related to stacks, queues, and linked lists enhances programming skills and helps in developing efficient algorithms to solve real-world problems.
Professional Ethics	-
Gender	-
Human Values	Fostering critical thinking, problem-solving skills, and logical reasoning, which are important qualities in a technology-driven society which can improve productivity and streamline processes, thus positively impacting human lives.
Environment & Sustainability	-
Unit III	**Trees and Graphs**
Local	-
Regional	-
National	The skills learned in this course can be applicable to various industries and sectors across the country.
Global	The principles taught in this course are applicable worldwide and form the basis of software engineering practices globally.
Employability	Knowledge of data structures such as trees and graphs is highly relevant to employability in the field of software development and computer science.
Entrepreneurship	These data structures are commonly used in designing and developing software solutions, and understanding their

	implementation and applications can help entrepreneurs build innovative and scalable products.
Skill Development	Understanding and applying concepts related to trees and graphs enhances programming skills and helps in developing efficient algorithms to solve real-world problems.
Professional Ethics	Following best practices in data structure implementation and algorithm design promotes code readability, maintainability, and overall software quality.
Gender	-
Human Values	Understanding data structures like trees and graphs enables students to develop efficient algorithms that can improve productivity, streamline processes, and positively impact human lives.
Environment & Sustainability	-
Unit IV	**Sorting and Searching**
Local	-
Regional	Understanding and applying these algorithms are fundamental to computer science and software development, making them relevant at a regional level.
National	It provides foundational knowledge in sorting and searching algorithms.
Global	Sorting and searching algorithms are fundamental building blocks in computer science and software development, used globally.
Employability	Understanding these algorithms and their efficiency helps in developing optimized software solutions, which are highly sought-after skills in the job market.
Entrepreneurship	These algorithms are used extensively in data processing, information retrieval, and optimization problems, which are essential in building innovative and scalable software products.
Skill Development	Understanding and applying sorting and searching algorithms enhances programming skills and helps in developing efficient algorithms to solve real-world problems.

Professional Ethics	Following best practices in algorithm design and implementation promotes code readability, maintainability, and overall software quality.
Gender	-
Human Values	Understanding sorting and searching algorithms enables students to develop efficient solutions that improve productivity, streamline processes, and positively impact human lives.
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts of Design, Efficiency, Problem Solving, Abstraction and System Analysis

Department:	**Department of Computer Science and Engineering**		
Course Name: Java Programming	**Course Code**	**L-T-P**	**Credits**
	ENCS201	4-0-0	4
Type of Course:	Major		
Pre-requisite(s), if any: C Programming			

Brief Syllabus:

The objective is to impart programming skills used in this object-oriented language java. The course explores all the basic concepts of core java programming like object, classes, data types, features, operators, control structures, interfaces, packages, applets, AWT, Swings. The students are expected to learn it enough so that they can develop the basic applications as well as web solutions like creating applets etc.

UNIT WISE DETAILS

Unit Number: 1	**Title: Introduction to Java**	**No. of hours: 12**

Content Summary:

Concepts of OOP, Features of Java, How Java is different from C++, Environmental setup, Basic syntax, Objects and classes, Basic Data Types, Variable Types, Modifier Types, Basic operators, Loop Control, Decision Making, Strings and Arrays, Methods, I/O. Introducing classes, objects and methods: defining a class, adding variables and methods, creating objects, constructors.

Unit Number: 2	**Title: Arrays and Strings**	**No. of hours: 8**

Content Summary:

Classes: String and String Buffer classes, Wrapper classes: Basics types, using super, Multilevel hierarchy, abstract and final classes, Object class, Access protection, Inheritance, Overriding, Polymorphism, Abstraction, Encapsulation, Interfaces, Packages, Exploring java.util package.

Unit Number: 3	**Title: Exceptional Handling & Multithreading**	**No. of hours: 12**

Content Summary:

Exception Hierarchy, Exception Methods, Catching Exceptions, Multiple catch Clauses, Uncaught Exceptions Java's Built-in Exception. Creating, Implementing and Extending thread,

thread priorities, synchronization suspending, resuming and stopping Threads, Multi-threading.

Unit Number: 4	Title: Input/output Programming & Event Handling	No. of hours: 8

Content Summary:

Basics Streams, Byte and Character Stream, predefined streams, Reading and writing from console and files. Event handling Mechanism, Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Java GUI Programming:

Introduction to Swing, Swings components, Generics and Collections: Generics and type parameters, Collections framework (List, Set, Map).

***Self-Learning Components**: **mention 4-5 topics for students in bullet points**

Students should explore Platforms like LeetCode, HackerRank for JAVA and JAVA IDE like eclipse, Netbeans etc.

Students can refer the following courses as per the Open Source University Curriculum

1. "Java Programming Masterclass for Software Developers" on Udemy by Tim Buchalka
2. "Java Fundamentals: The Java Language" on Pluralsight by Jesse Liberty.

Please Note:

1) At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books/Material:

1. Herbert Schildt, —Java – The Complete Reference||, Oracle Press.
2. Cay S. Horstmann, —Core Java Volume – I Fundamentals||, Pearson.

Course Outcomes (CO)

COs	Statements
CO1	**Recognize** features of object-oriented design such as encapsulation, polymorphism inheritance and composition of systems based on object identity.
CO2	**Articulate** re-usable programming components using Abstract Class, Interfaces and other permitted ways in packages.
CO3	**Apply** access control mechanism to safeguard the data and functions that can be applied by the object.
CO4	**Design** GUI applications using pre-built frameworks available in Java.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C2	A1	P1
CO2	C3	A2	P2
CO3	C3	A5	P5
CO4	C6	A5	P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	-	2	-	-	-	-	2
CO2	1	2	-	-	3	-	1	-	-	-	-	2
CO3	-	-	-	-	3	-	2	1	-	3	-	2
CO4	-	-	-	-	3	-	2	-	-	3	-	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	3	2	2	1
CO2	2	3	2	1
CO3	2	3	2	1
CO4	2	3	2	1

Relevance of the Syllabus to Various indicators

Unit I	**Introduction to Java**
Local	-
Regional	-
National	-
Global	Java is widely used worldwide, and the skills gained from the course have global relevance in software development.
Employability	Understanding object-oriented programming and Java is valuable in the job market, as many industries and organizations rely on Java for software development.
Entrepreneurship	contribute to entrepreneurship by providing individuals with the skills and knowledge needed to develop software applications or start a technology-related business
Skill Development	contributes to skill development, particularly in programming, object-oriented design, and Java development
Professional Ethics	encourages ethical programming practices, such as writing clean code, following best practices, and respecting intellectual property rights
Gender	These concepts are equally applicable and accessible to individuals of all genders pursuing careers in software development.
Human Values	promotes human values such as teamwork, collaboration, and effective communication, which are essential in the software development industry.

Environment & Sustainability	promoting efficient programming practices and emphasizing code optimization
Unit II	**Arrays and Strings**
Local	-
Regional	-
National	It contributes to the development of software infrastructure, applications, and systems that support national industries, governance, and public services.
Global	Java is widely used worldwide, and the skills gained from the course have global relevance in software development.
Employability	Understanding object-oriented programming and Java is valuable in the job market, as many industries and organizations rely on Java for software development.
Entrepreneurship	contribute to entrepreneurship by providing individuals with the skills and knowledge needed to develop software applications or start a technology-related business
Skill Development	contributes to skill development, particularly in programming, object-oriented design, and Java development
Professional Ethics	encourages ethical programming practices, such as writing clean code, following best practices, and respecting intellectual property rights
Gender	These concepts are equally applicable and accessible to individuals of all genders pursuing careers in software development.
Human Values	promotes human values such as teamwork, collaboration, and effective communication, which are essential in the software development industry.
Environment & Sustainability	promoting efficient programming practices and emphasizing code optimization
Unit III	**Exceptional Handling & Multithreading**
Local	-
Regional	-

National	It contributes to the development of software infrastructure, applications, and systems that support national industries, governance, and public services.
Global	Java is widely used worldwide, and the skills gained from the course have global relevance in software development.
Employability	Understanding object-oriented programming and Java is valuable in the job market, as many industries and organizations rely on Java for software development.
Entrepreneurship	contribute to entrepreneurship by providing individuals with the skills and knowledge needed to develop software applications or start a technology-related business
Skill Development	contributes to skill development, particularly in programming, object-oriented design, and Java development
Professional Ethics	encourages ethical programming practices, such as writing clean code, following best practices, and respecting intellectual property rights
Gender	These concepts are equally applicable and accessible to individuals of all genders pursuing careers in software development.
Human Values	Promotes human values such as teamwork, collaboration, and effective communication, which are essential in the software development industry.
Environment & Sustainability	promoting efficient programming practices and emphasizing code optimization
Unit IV	**Input/output Programming & Event Handling**
Local	-
Regional	-
National	-
Global	Java is widely used worldwide, and the skills gained from the course have global relevance in software development.
Employability	Understanding object-oriented programming and Java is valuable in the job market, as many industries and organizations rely on Java for software development.

Entrepreneurship	contribute to entrepreneurship by providing individuals with the skills and knowledge needed to develop software applications or start a technology-related business
Skill Development	contributes to skill development, particularly in programming, object-oriented design, and Java development
Professional Ethics	encourages ethical programming practices, such as writing clean code, following best practices, and respecting intellectual property rights
Gender	These concepts are equally applicable and accessible to individuals of all genders pursuing careers in software development.
Human Values	promotes human values such as teamwork, collaboration, and effective communication, which are essential in the software development industry.
Environment & Sustainability	promoting efficient programming practices and emphasizing code optimization
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts of Design, Efficiency ,Problem Solving, Abstraction and System Analysis

Department:	Department of Computer Science and Engineering		
Course Name: Data Structures Lab	**Course Code**	**L-T-P**	**Credits**
	ENCS253	0-0-2	1
Type of Course:	Major		
Pre-requisite(s), if any: Data Structure Concepts			

Defined Course Outcomes

COs	
CO 1	**Equip** the students with knowledge of algorithms and analysis of space and time complexity of the algorithms
CO 2	**Demonstrate** the use of stack ,queues and linked list
CO 3	**Equip** the students with tree and graph data structures and their practical applications
CO 4	**Implementing and analysing** searching and sorting algorithms

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	To design, implement and analyze the complexity of Linear search algorithm	CO4
2	To design, implement and analyze the complexity of Binary search algorithm	CO4
3	Implement and compare the time complexity of bubble sort, insertion sort and selection sort. Calculate their running times for best, worst & best cases. Draw the three cases in a single graph to justify its observed time complexities.	CO4
4	Implement and analyse the working of Recursive Algorithms	CO1

5	Implement Quick sort algorithm and calculate its running times for best, worst & best cases. Draw the three cases in a single graph to justify its observed time complexities.	CO4
6	Implement the linear data structure : Stack by performing Push and Pop operation	CO2
7	Implement Postfix and Prefix Expression using Stack	CO2
8	Implement reverse of a String using Stack	
9	Implement the linear data structure : Queue by performing Insertion and Deletion operation	CO2
10	Implement Circular Queue by performing Insertion and Deletion operation	
11	Implement the dynamic data structure : single linked list also analyse their time complexities in three cases: a. Inserting a new node at the beginning b. Inserting a new node at the end c. Deleting a node from the beginning	CO2
12	Consider a linked list L reverse the linked list	CO2
13	Implement the dynamic data structure : doubly linked list also analyse their time complexities in three cases: a. Inserting a new node at the beginning b. Inserting a new node in the middle c. Deleting a node from the end	CO2
14	Implement the dynamic data structure : circular linked list also analyse their time complexities in three cases: a. Inserting a new node at the beginning b. Inserting a new node in the middle c. Deleting a node from the end	CO2
15	Implement and analyse Stack implementation using Linked list	CO2
16	Implement and analyse Queue implementation using Linked list	
17	Implement and analyse the tree traversal algorithms 1. Inorder 2. Preorder 3. Post order	CO3
18	Implement and analyse the following operations of Binary Search tree a. Creating and inserting a new node b. Searching a node	CO3

	c. Deleting an existing node from BST	
19	Implement AVL tree with insertion, deletion and searching operation	CO3
20	Implement the graph traversal techniques: Depth First search and Breadth First search algorithms	CO3
21	To understand and implement the minimum spanning tree in Graphs using Kruskal Algorithm	CO3
22	To understand and implement the minimum spanning tree in Graphs using Prims Algorithm	CO3
23	Implement Merge sort algorithm and calculate its running times for best, worst & best cases. Draw the three cases in a single graph to justify its observed time complexities.	CO4
24	Implement Heap sort algorithm and calculate its running times for best, worst & best cases. Draw the three cases in a single graph to justify its observed time complexities.	CO4
25	Implement a priority queue using a heap and calculate its running times for best, worst & best cases. Draw the three cases in a single graph to justify its observed time complexities.	CO4

Projects to be covered: (atleast 4-5 projects). Please provide objectives of the project

1. **Mini Project 1**: Create a student management system that stores and manages student records using various data structures. The system should allow users to perform operations such as adding new students, searching for students, deleting students, and displaying all student records.
2. **Mini Project 2**: Implement a maze solver using data structures like stacks or queues. The program should take an input maze, find a path from the starting point to the goal, and output the solution. You can use depth-first search (DFS) or breadth-first search (BFS) algorithms to solve the maze.
3. **Mini Project 3**: Implement a social network analysis tool using data structures like graphs. The tool should be able to read a network of users and their connections, and perform operations like finding the shortest path between two users, identifying influential users, or recommending friends.

Department:	Department of Computer Science and Engineering		
Course Name: Java Programming Lab	Course Code	L-T-P	Credits
	ENCS251	0-0-2	1
Type of Course:	Major		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	
CO 1	**Apply** the concepts learned of operators, if-else, loops and arrays to java based application development.
CO 2	**Demonstrate** the use of various types of inheritances, polymorphisms, class objects, inheritances, packages and other concepts to basic and complex java programming problems.
CO 3	**Demonstrate** graphical applications based on java applets, swings and event handling
CO 4	**Apply** knowledge of event handling and AWT controls to create some new dynamic graphical applications.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Sample Programs using Objects and classes, Variable Types, Modifier Types, operators, Loops Decision Making, Strings and Arrays, a. WAP to display "Hello, it's a first program in java". b. WAP to find sum of two integers taken as input from user at runtime. c. WAP to find sum of two float numbers taken as command line arguments d. WAP to find changed case of entered character. e. WAP to find maximum of 3 integer numbers taken as input from user at runtime.	CO1
2	Sample Programs using Inheritance, Overriding, Polymorphism, Interfaces, Packages a. WAP in java to illustrate the concept of interfaces. b. Write a program in java to showcase uses of super keyword	CO1
3	Sample Programs using exception handling and threads a. Write a program to demonstrate the use of nesting of try-catch block b. WAP in java to illustrate the concept of using multiple catch clauses to handle different types of exceptions. c. WAP in java to create a user defined Exception and throw it explicitly.	CO2
4	Sample Programs using event handling and AWT controls	CO1
5	Sample Programs using swings Write an applet which will display "HAPPY" and "DEEPAVALI" as: The word "HAPPY" will roll from top to bottom and "DEEPAVLI" from bottom to "top" . Both will run at the same speed and stop simultaneously at the center of the applet.	CO3
6	WAP in java to create a frame with various AWT controls (like choice, list, TextField and Buttons) and handle the events thrown by them.	CO3

7	WAP in java to create a frame with AWT controls (like label, push buttons, Checkbox, Checkbox Group) and handle various events generated by them.	CO4
8	WAP to create a package as MyPack having a class with three methods: max, fact and show. Use it in other folder with setting classpath and without setting class path.	CO2
9	WAP to create a frame and illustrate the concept of using an adapter class in place of interfaces for handling various mouse events generated over frame window.	CO3
10	Write a program to display "hello" in different color where user clicks left mouse button and "world" where right mouse button is clicked. Use black background.	CO2
11	a. Demonstrate thread using Thread class and Runnable interface b. Demonstrate various thread methods using a program	CO3
12	Write a java program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contain only the method printArea( ) that prints the area of the given shape.	CO4
13	a. WAP to create class with "name" as String and "age" as integer data members. The class should have two methods to take input from user and display the data. b. WAP to find factorial of a number using class and object.	CO3
14	Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.	CO4
15	Create an Frame with one single button with caption "Click". On clicking the button will open a new Frame with title "Factorial". The frame will have two three controls: TextField, Label and button. On clicking button calculate the factorial entered in TextField control.	CO4

16	**Project 1:** Simple Calculator: Build a basic calculator application that performs arithmetic operations like addition, subtraction, multiplication, and division. You can add a user interface using Java Swing or JavaFX for a more interactive experience.	CO4
17	**Project 2:** Tic-Tac-Toe Game: Implement the classic Tic-Tac-Toe game where two players take turns marking X or O on a 3x3 grid. Allow players to play against each other.	CO4
18	**Project 3:** Quiz Application: Design a quiz application that presents multiple-choice questions to users and keeps track of their scores. Include features like a timer, question randomization, and a scoring system.	CO4
19	**Project 4:** Hangman Game: Create a Hangman game where players guess letters to uncover a hidden word. Include features such as displaying the word's progress, tracking incorrect guesses, and providing hints.	CO4

Department:	**Department of Computer Science and Engineering**		
Course Name: **Life Skills for Professionals - I**	**Course Code**	**L-T-P**	**Credits**
	AEC011	3-0-0	3
Type of Course:	AEC		
Pre-requisite(s), if any:			
Brief Syllabus: Through this comprehensive course, the learners will develop a solid foundation in communication skills, enabling them to express themselves confidently, listen actively, and build strong relationships in personal and professional contexts.			
UNIT WISE DETAILS			
Unit Number: 1	**Title: Communication: An Introduction**	**No. of hours: 4**	
Content Summary: Definition, Nature and Scope of Communication, Importance and Purpose of Communication, Process of Communication, Types of Communication, Barriers to Communication, Essentials of Effective Communication			
Unit Number: 2	**Non-Verbal Communication**	**No. of hours: 8**	
Content Summary: Personal Appearance, Gestures, Postures, Facial Expression, Eye Contacts, Body Language (Kinesics) Time language, Tips for Improving Non-Verbal Communication			
Unit Number: 3	**Title: Basic number system**	**No. of hours: 8**	

Content Summary:

Divisibility • Unit digit • Last two digit • Remainder • Number of zero • Factor • LCM & HCF • Simplification • Mixture • Average • Ratio • Partnership

Unit Number: 4	Title: Number system	No. of hours: 8

Content Summary:

Factor • LCM & HCF • Simplification • Mixture • Average • Ratio • Partnership

Unit Number: 5	Title: Time Management	No. of hours: 4

Content Summary:

Time management strategies, Setting goals, organizing, and planning ahead, Making the most of your time Deal with distractions, Procrastination and Avoiding distractions

*Self-Learning Components:

https://onlinecourses.nptel.ac.in/noc21_hs02/preview

Please Note:

1)Students are supposed to learn the components on self-basis

2) At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books:

Aggarwal, R. S. (2014). Quantitative aptitude (Revised edition).
Gladwell, M. (2021). Talking to strangers.
Scott, S. (2004). Fierce conversations.

Define Course Outcomes (CO)

COs	Statements
CO1	**Perform** calculations related to number systems, percentages and averages, quickly and accurately.
CO2	**Exhibit** confidence in tackling multiple-choice questions, time-constrained tests and competitive examinations.
CO3	**Demonstrate** active listening techniques, including attentive listening and reflection
CO4	**Articulate** and speak with confidence and express ideas clearly and coherently.
CO5	**Improve** confidence and display open and positive non-verbal communication.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 19. Knowledge 20. Understand 21. Apply 22. Analyze 23. Evaluate 24. Create	Affective levels(A) 16. Receiving 17. Responding 18. Valuing 19. Organizing 20. Characterizing	Psychomotor levels(P) 16. Imitation 17. Manipulation 18. Precision 19. Articulation 20. Improving
CO1	C3		-
CO2	C2		-
CO3	C2		P4
CO4	C6		-
CO5	C6		P5

CO-PO Mapping

CO	P01	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	2	-	-	-	-	-	1		1	3	3	-	1	-
CO2	-	3	-	-	1	-	-	-	-	-	-	3	3	1	-	-
CO3	-	1	-	1	-	-	2	-	-	-	1	3	1	1	-	-
CO4	-	2	-	-	2	-	-	-	-	3	-	3	2	2	3	-
CO5	-	-	3	2			1	-	-	-	1	3	3	1	-	-

Justification for mapping must be relevant

1=weakly mapped
2= moderately mapped
3=strongly mapped

Relevance of the Syllabus to various indicators

Unit I	**Communication: An Introduction**
Local	Improve number sense, enhance basic communication skills.
Regional	Recognize the importance of continuous learning and practice to maintain and further develop mental ability.
National	Practice time management strategies for solving problems within time constraints, as in competitive exams.
Global	Aligns with global trends in employment
Employability	Develop skills in real-life situations, such as academic exams, job interviews, and problem-solving scenarios.
Entrepreneurship	Learn to share ideas, listen to others, build consensus, and manage conflicts to achieve common goals in collaborative settings.

Skill Development	Develops Skills in public speaking, interpersonal communication, professional writing, and persuasive communication.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Non-Verbal Communication**
Local	Recognize the importance of continuous learning and practice to maintain and further develop mental ability.
Regional	Practice attentive listening techniques, such as paraphrasing and asking clarifying questions.
National	Attentively listen to others, understand their perspectives, and respond appropriately while exhibiting techniques such as maintaining eye contact, asking clarifying questions, and paraphrasing.
Global	Aligns with global trends in employment
Employability	Develop skills in participating and contributing to group discussions, meetings, or presentations.
Entrepreneurship	Learn to share ideas, listen to others, build consensus, and manage conflicts to achieve common goals in collaborative settings.
Skill Development	Apply skills in real-life situations, such as academic exams, job interviews, and problem-solving scenarios.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

Unit III	Number system
Local	Improve number sense, enhance basic arithmetic skills and strengthen mental math abilities and speed.
Regional	-
National	Learn about number systems, ratios, proportions, and percentages
Global	Recognize the importance of continuous learning and practice to maintain and further develop mental ability.
Employability	Develop skills in participating and contributing to group discussions, meetings, or presentations.
Entrepreneurship	-
Skill Development	Recognize the importance of continuous learning and practice to maintain and further develop mental ability.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Time Management
Local	Attentively listen to others, understand their perspectives, and respond appropriately with timelines
Regional	-
National	Contributes to develop skill and improved productivity
Global	Aligns with global trends in understanding the deadlines.
Employability	Enhance the employability of individuals by developing essential skills and competencies sought by employers
Entrepreneurship	-
Skill Development	Strengthening critical thinking, problem-solving, memory, and other cognitive functions to improve overall mental agility and performance.

Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts employability

Syllabus- Semester IV

Department:	**Department of Computer Science and Engineering**		
Course Name: Analysis and Design of Algorithms	**Course Code**	**L-T-P**	**Credits**
	ENCS202	3-1-0	4
Type of Course:	Major		
Pre-requisite(s), if any: Data Structure			

Brief Syllabus:

The analysis and design of algorithm course introduce students to the design of computer algorithms, as well as analysis of sophisticated algorithms. Students will learn how to analyse the asymptotic performance of algorithms as well as provides familiarity with major algorithms and data structures. This course introduces basic methods for the design and analysis of efficient algorithms emphasizing methods useful in practice. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures. The following important computational problems will be discussed: sorting, searching, elements of dynamic programming and greedy algorithms, advanced data structures, graph algorithms (shortest path, spanning trees, tree traversals), string matching, elements of computational geometry, NP completeness.

UNIT WISE DETAILS

Unit Number: 1	**Title: Introduction to Algorithms**	**No. of hours: 8**

Content Summary:

Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behaviour, Performance measurements of Algorithm, Time and Time and space trade- offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Unit Number: 2	**Title: Fundamental Algorithmic Strategies**	**No. of hours: 8**

Content Summary:

Brute -Force, Greedy, Dynamic Programming, Branch-and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for

Problem-Solving, Bin Packing, Knap Sack. Heuristics – characteristics and their application domains. Heaps and priority queues, Hash tables and hash functions. String matching.

Unit Number: 3	**Title:** Graph and Tree Algorithms	**No. of hours: 8**

Content Summary:

Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm. Graph Colouring and matching algorithms.

Unit Number: 4	**Title: Tractable and Intractable Problems**	**No. of hours: 8**

Content Summary:

Computability of Algorithms, Computability classes – P, NP, NP complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques. Advanced Topics: Approximation algorithms, Randomized algorithms, Online algorithms, Quantum algorithms.

***Self-Learning Components:**

Container loading problem, stable marriage problem, Coin Change problem.

Please Note:

1) At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books/Material:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.

Course Outcomes (CO)

COs	Statements
CO1	**Understand** fundamental algorithmic concepts and how to analyze Complexities.

CO2	**Analyze and evaluate** algorithm performance.
CO3	**Design** efficient algorithms in terms of space and time.
CO4	**Apply** algorithmic problem-solving strategies.
CO5	**Develop** algorithm implementation skills.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C2	-	P1
CO2	C4	-	P2
CO3	C3	-	P3
CO4	C4	-	-
CO5	C6	-	P3

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										2
CO2		3		3	2							1
CO3			3									3
CO4					2				2			
CO5				3						2		

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	3	3		
CO2		3		3
CO3	3	2		
CO4		3	3	
CO5		2	3	

Relevance of the Syllabus to Various indicators

Unit I	Introduction to algorithm
Local	Addresses local understanding of the problems and how to find its solutions
Regional	Addresses regional understanding of the problems and how to find its solutions
National	Addresses national understanding of the problems and how to find its solutions
Global	Addresses global understanding of the problems and how to find its solutions
Employability	After having knowledge about how to solve real world problems, new problems can be addressed to develop their algorithms.

Entrepreneurship	-
Skill Development	Develops basic knowledge and skills to develop analytical skills
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Fundamental Algorithmic Strategies
Local	Understanding and applying algorithm design methodologies enhances programming and problem-solving skills at the local level.
Regional	Knowledge of algorithm design methodologies allows individuals to develop innovative solutions and potentially start their own businesses in the region
National	Adhering to ethical principles in algorithm design ensures professionalism and ethical practices at the national level.
Global	Employability: Proficiency in algorithm design techniques enhances employability opportunities globally.
Employability	Employability: Proficiency in algorithm design techniques enhances employability opportunities globally.
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills to develop analytical skills
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Graph and Tree Algorithms
Local	Addresses local understanding of the problems and how to find its solutions

Regional	Addresses regional understanding of the problems and how to find its solutions
National	Addresses national understanding of the problems and how to find its solutions
Global	Addresses global understanding of the problems and how to find its solutions
Employability	After having knowledge about how to solve real world problems, new problems can be addressed to develop their algorithms.
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills to develop analytical skills
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Tractable and Intractable Problems
Local	Addresses local understanding of the problems and how to find its solutions
Regional	Addresses regional understanding of the problems and how to find its solutions
National	Addresses national understanding of the problems and how to find its solutions
Global	Addresses global understanding of the problems and how to find its solutions
Employability	After having knowledge about how to solve real world problems, new problems can be addressed to develop their algorithms.
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills to develop analytical skills
Professional Ethics	-

Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4, 8, 9
NEP 2020	-
POE/4th IR	-

Department:	Department of Computer Science and Engineering		
Course Name: Analysis and Design of Algorithms Lab	Course Code	L-T-P	Credits
	ENCS256	0-0-2	1
Type of Course:	Major		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	
CO1	**Analyze** the time and space complexities of algorithms and evaluate their performance
CO2	**Apply** algorithmic problem-solving strategies to solve complex computational problems
CO3	**Design and develop** innovative algorithms for solving complex computational problems.
CO4	**Generate** algorithmic solutions that consider trade-offs between time complexity, space complexity, and problem constraints.

Ex. No	Experiment Title	Mapped CO/COs
1	Sort a given set of elements using the Quicksort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator	CO1
2	Design an algorithm to find the maximum and minimum elements in an unsorted array.	CO1

3	Implement Largest Common Subsequence.	CO1
4	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.	CO1
5	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.	CO2
6	To Implement Optimal Binary Search Tree.	CO2
7	To Implement Strassen's matrix multiplication Algorithm	CO2
8	Design an algorithm to find the maximum subarray sum in an array.	CO2
9	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.	CO2
10	Implement 0/1 Knapsack Problem using Dynamic algorithm concepts.	CO2
11	d. To implement Bellman Ford's Algorithm.	CO2
12	To implement Depth First Search and Breadth First Search Algorithm.	CO2
13	d. To implement Naïve String-matching Algorithm.	CO3
14	d. Implement N Queen's problem using Back Tracking.	CO3
15	Design an algorithm to check if a given graph is acyclic (a DAG).	CO3
16	Obtain the Topological ordering of vertices in a given digraph.	CO3
17	4. Compute the transitive closure of a given directed graph using Warshall's algorithm	CO3
18	d. Design an algorithm to find the nth Fibonacci number using dynamic programming.	CO3
19	Design an algorithm to solve the 3-SAT problem using a backtracking approach.	CO4
20	Implement the brute-force algorithm to solve the Subset Sum Problem.	CO4

21	Design an algorithm to solve the Independent Set Problem using the branch and bound approach.	CO4
22	Design an algorithm to solve the Vertex Cover Problem using the 2-approximation algorithm.	CO4

Department:	**Department of Computer Science and Engineering**		
Course Name: Database Management Systems	**Course Code**	**L-T-P**	**Credits**
	ENCS204	3-1-0	4
Type of Course:	Major		
Pre-requisite(s), if any:			

Brief Syllabus:

This course introduces the basic concept of database, Database modelling languages, E-R modelling, Transaction Processing and Database security.

UNIT WISE DETAILS

Unit Number: 1	**Title: Introduction to database**	**No. of hours: 8**

Content Summary:

Introduction to DBMS: Database system architecture: Data Abstraction, Data Independence, Types of databases: distributed, centralized, non-centralized, cloud and NoSQL databases, Data models: network model, relational and object-oriented data models. Entity-relationship model: Relationship model, constraints, keys, Design issues, Extended E-R features- Generalization, Specialization, Aggregation, Translating E-R model into Relational model, integrity constraints in relational model.

Mini project: Draw ER diagram to design a database to manage university course registration, including student records, courses, instructors, prerequisites, and enrolment.

Unit Number: 2	**Title: Relational Query Languages**	**No. of hours: 12**

Content Summary:

Relational query languages: Relational algebra: Tuple and domain relational calculus, SQL, DDL, DML and DCL constructs. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.

PL/SQL: Introduction to pl/sql, the generic pl/sql block, pl/sql execution environment, declaration, assignment, control statement, exception, cursor, sub-program, trigger, procedure and function.

Mini project: Create Client_master with the following fields(ClientNO, Name, Address, City, State, bal_due)

a) Insert five records
b) Find the names of clients whose bal_due> 5000.
c) Change the bal_due of ClientNO " C123" to Rs. 5100.
d) Change the name of Client_master to Client12.
e) Display the bal_due heading as "BALANCE".

Unit Number: 3	**Title: Relational Database Design**	**No. of hours: 8**

Content Summary:

Relational database design: Database anomalies, domain and data dependency, Armstrong's Axioms, Normal Forms (1NF, 2NF, 3NF, BCNF, 4NF), Dependency preservation and lossless design.

Mini project: Design a database to manage a library's catalog, including books, authors, genres, and borrower information. Normalize the database to eliminate data duplication and maintain consistency.

Unit Number: 4	**Title: Transaction Processing and Security**	**No. of hours: 12**

Content Summary:

Storage strategies: File Organization, Indices, B-tree and B+ tree, hashing. Transaction Processing: Concurrency Control, ACID properties, serializability of scheduling, locking and time-stamp based scheduler, multi-version and optimistic concurrency control schemes, database recovery. Database Security: Authentication, Authorization and access control. Introduction to Data warehousing and data mining: Data warehouse architecture and design, ETL process.

***Self-Learning Components:**

- MongoDB
- PostgreSQL

Please Note:

1) At least 5-10 % syllabus will be asked in end term exams from self-learning components
Reference Books/Material: 1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill. 2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J.D. Ullman, Computer Science Press. 3. https://github.com/ossu/computer-science#databases.(OSSU computer science curriculum).

Course Outcomes (CO)

COs	Statements
CO1	**Recall** fundamental concepts, terminology, and principles of database management systems.
CO2	**Understand** basic database storage structures and integrity concepts.
CO3	**Apply** database design principles to create a normalized and efficient database schema to optimize database performance.
CO4	**Analyze** and **evaluate** transaction processing, concurrency control and database recovery protocols in databases.
CO5	**Design and implement** RDBMS using SQL and PL/SQL to meet specific data retrieval and manipulation requirements.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C1	A1	P1
CO2	C2	A2	P2
CO3	C3	A4	P3
CO4	C4, C5	A3	P4
CO5	C6	A5	P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	-	-	-	-	-	-	-	1	2
CO2	3	2	-	-	-	2	-	-	-	-	-	2
CO3	3	3	3	-	3	-	-	-	2	2	2	2
CO4	2	2	-	3	2	2	-	-	-	-	2	2
CO5	3	3	3	-	3	2	-	-	3	3	2	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	3	1	-	-
CO2	3	1	-	-
CO3	-	-	3	-
CO4	-	3	-	-
CO5	-	3	2	-

Relevance of the Syllabus to Various indicators

Unit I	**Introduction**
Local	Knowledge of the entity-relationship model, relationship model, constraints, keys, and design issues is important for individuals at the local level working on database design and development.
Regional	Understanding the basics of DBMS is important for professionals in the regional IT industry
National	These concepts are crucial for efficient data management and can have a direct impact on the performance and scalability of databases. National indicators often involve large volumes of data that need to be managed effectively, and the ability to abstract data and achieve data independence can contribute to streamlined data processing and analysis.
Global	Knowledge of database system architecture is essential for professionals working in the global IT industry
Employability	Understanding the fundamentals of DBMS, including its architecture, data abstraction, data independence, and different types of databases, enhances employability by providing valuable skills sought after in the industry.
Entrepreneurship	Knowledge of the entity-relationship model, its design issues, extended E-R features, and the translation of the E-R model into the relational model can support entrepreneurship by enabling individuals to design and develop efficient and scalable database solutions for their entrepreneurial ventures.
Skill Development	Learning about different data models, such as the network model, relational model, and object-oriented data models, fosters skill development by enhancing one's ability to analyze and choose appropriate data models for specific applications or scenarios.
Professional Ethics	Understanding the principles and practices of DBMS, including data abstraction, data independence, and database system architecture, contributes to professional ethics by promoting responsible handling of sensitive data, maintaining data privacy and security, and ensuring ethical data management practices.

Gender	-
Human Values	Understanding different data models, such as the network model, relational model, and object-oriented data models, can promote human values by emphasizing data integrity, accuracy, and relevance, and by fostering a human-centric approach to data management
Environment & Sustainability	The topics related to DBMS, such as database system architecture and types of databases, have indirect relevance to environment and sustainability. While efficient data storage and retrieval techniques can contribute to reduced energy consumption, the direct environmental impact of DBMS is not a primary focus.
Unit II	**Relational Query Languages**
Local	Understanding PL/SQL and its various components, including the generic PL/SQL block, execution environment, declaration, assignment, control statements, exceptions, cursors, sub-programs, triggers, procedures, and functions, is important at the local level for individuals involved in database programming and development.
Regional	Knowledge of query processing and optimization techniques, including the evaluation of relational algebra expressions, query equivalence, and join strategies, is relevant at the regional level for professionals in the IT industry. Understanding open-source and commercial DBMS like MySQL, Oracle, DB2, and SQL Server is also important in regional contexts.
National	Data Definition Language (DDL) is used to define and modify the structure of the database, ensuring proper representation of indicators.
Global	It involves large datasets, and efficient query processing is essential for timely retrieval and analysis.
Employability	Employability: Understanding relational query languages, such as relational algebra, SQL, DDL, DML, and DCL constructs, enhances employability by equipping individuals with the necessary skills for database-related job roles.

Entrepreneurship	Entrepreneurs leveraging indicator data can benefit from query optimization to provide fast and responsive data-driven services or applications.
Skill Development	Learning about query processing and optimization, including the evaluation of relational algebra expressions, query equivalence, and join strategies, contributes to skill development in the field of database management.
Professional Ethics	Understanding relational query languages and their constructs, such as relational algebra, SQL, DDL, DML, and DCL, promotes professional ethics by emphasizing the responsible and ethical use of database systems and data.
Gender	-
Human Values	Learning PL/SQL and its various components, such as declaration, assignment, control statements, exceptions, cursors, sub-programs, triggers, procedures, and functions, fosters the development of human values, such as logical thinking, problem-solving, and attention to detail, which are important for ethical and responsible database programming.
Environment & Sustainability	Studying query processing and optimization techniques, including evaluating relational algebra expressions, query equivalence, and join strategies, can contribute to environmental sustainability by optimizing database operations, reducing resource consumption, and improving energy efficiency
Unit III	**Relational Database Design**
Local	Understanding relational database design provides individuals with the necessary skills to create efficient and well-structured databases at a local level. This knowledge enables them to design databases that meet the specific needs of local businesses and organizations.
Regional	Relational database design is relevant at a regional level as it allows individuals to design databases that can be utilized by multiple organizations or departments within a specific region. This ensures data consistency and coherence across regional entities.
National	At a national level, relational database design becomes even more significant as it enables the creation of large-scale

	databases that can be utilized by multiple organizations or government entities within a country. This facilitates efficient data management and sharing on a national scale.
Global	Relational database design has implications at a global level as well. It provides individuals with the skills to design databases that can be used globally, accommodating diverse languages, cultures, and data requirements. This ensures data interoperability and facilitates global collaborations.
Employability	Understanding relational database design principles, including identifying and resolving database anomalies, ensuring data dependency, and adhering to normalization forms, enhances employability by equipping individuals with the necessary skills and knowledge to work with and design efficient and reliable databases in various job roles related to database management and administration.
Entrepreneurship	Relational database design knowledge, including the ability to address database anomalies, normalize data, and preserve dependencies, can be valuable for entrepreneurs who need to design and develop efficient and scalable databases for their business ventures.
Skill Development	Learning about relational database design and related concepts such as database anomalies, normalization forms, dependency preservation, and lossless design helps individuals develop important technical skills in database management, data modeling, and database optimization. These skills are essential for various roles in the field of information technology and contribute to skill development.
Professional Ethics	Relational database design principles and concepts, including the identification and resolution of database anomalies, adherence to normalization forms, and ensuring dependency preservation and lossless design, contribute to professional ethics by promoting data integrity, accuracy, and responsible database management practices.
Gender	-
Human Values	Relational database design, including the prevention of data anomalies, adherence to normalization forms, and ensuring dependency preservation and lossless design, aligns with

	human values by emphasizing the importance of accurate, reliable, and meaningful data representation and storage.
Environment & Sustainability	-
Unit IV	**Transaction Processing and Security**
Local	Local businesses or organizations may employ specific file organization techniques to manage their data efficiently within their premises.
Regional	Regional databases may require advanced concurrency control mechanisms to handle multiple users accessing data simultaneously and ensure data integrity.
National	National-level databases may require sophisticated authentication, authorization, and access control mechanisms to protect sensitive data from unauthorized access or breaches.
Global	Introduction to Data Warehousing and Data Mining: Global databases may incorporate data warehousing and data mining concepts to extract meaningful insights and patterns from large-scale datasets spanning multiple regions or countries.
Employability	Knowledge of concurrency control mechanisms, ACID properties, and scheduling techniques is valuable for professionals working with transactional databases and distributed systems.
Entrepreneurship	Awareness of authentication, authorization, and access control enables entrepreneurs to protect their business data and ensure compliance with privacy regulations.
Skill Development	Gaining knowledge of authentication, authorization, and access control enhances skills in securing databases and protecting sensitive information.
Professional Ethics	Applying efficient file organization techniques and data structures demonstrates professionalism and adherence to best practices in data management.
Gender	-

Human Values	Implementing concurrency control mechanisms and database recovery protocols reflects the values of consistency, reliability, and trustworthiness in handling data transactions.
Environment & Sustainability	-
SDG	SDG8 and SDG9
NEP 2020	Competency-based approach to education: The syllabus topics provide a foundation of knowledge and skills necessary for understanding and working with relational databases. By covering concepts such as data abstraction, data independence, entity-relationship modeling, and database security, the syllabus supports the development of competencies related to database management and data governance.
POE/4th IR	The syllabus provides students with the foundational knowledge and skills necessary to navigate the data-driven landscape of the 4IR and apply entrepreneurial principles when managing and utilizing databases for business purposes.

Department:	**Department of Computer Science and Engineering**		
Course Name: Database Management Systems Lab	**Course Code**	**L-T-P**	**Credits**
	ENCS254	0-0-2	1
Type of Course:	Major		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	
CO 1	**Apply** the basic concepts of Database Systems and create model using ER Diagrams
CO 2	**Understand** the basics of SQL and construct queries for database creation and interaction
CO 3	**Understand** PL/SQL statements: Exception Handling, Cursors, and Triggers
CO 4	**Analyse** and **implement** Join operations to extract information from more than one table.

Proposed Lab Experiments

Ex. No	**Experiment Title**	**Mapped CO/COs**
1	Consider following databases and draw ER diagram and convert entities and relationships to relation table for a given scenario: COLLEGE DATABASE: STUDENT (USN, SName, Address, Phone, Gender) SEMSEC (SSID, Sem, Sec) CLASS (USN, SSID) SUBJECT (Subcode, Title, Sem, Credits) IAMARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA)	CO1
2	Consider following databases and draw ER diagram and convert entities and relationships to relation table for a given scenario:	CO1

	COMPANY DATABASE: EMPLOYEE (SSN, Name, Address, Sex, Salary, SuperSSN, DNo) DEPARTMENT (DNo, DName, MgrSSN, MgrStartDate) DLOCATION (DNo,DLoc) PROJECT (PNo, PName, PLocation, DNo) WORKS_ON (SSN, PNo, Hours)	
3	Consider the below Database: Movies (title, director, making_year, rating), actors (actor, acting_year), acts(actor, title), directors (director, director_year) Write relation algebra queries for given relations: 1. Find movies made after 1997 2. Find movies made by Hanson after 1997 3. Find all movies and their ratings 4. Find all actors and directors 5. Find Coen's movies with McDormand	CO2
4	**Database Schema for a customer-sale scenario** Customer(**Cust id : integer,** cust_name: string) Item(**item_id: integer,** item_name: string, price: integer) Sale(**bill_no: integer,** bill_data: date, **cust_id: integer, item_id: integer**, qty_sold: integer) For the above schema, perform the following— i. Create the tables with the appropriate integrity constraints. ii. Insert around 10 records in each of the tables. iii. List all the bills for the current date with the customer names and item numbers. iv. List the total Bill details with the quantity sold, price of the item and the final amount. v. List the details of the customer who have bought a product which has a price>200. vi. Give a count of how many products have been bought by each customer vii. Give a list of products bought by a customer having cust_id as 5. viii. List the item details which are sold as of today. ix. Create a view which lists out the bill_no, bill_date, cust_id, item_id, price, qty_sold, amount. x. Create a view which lists the daily sales date wise for the last one week	CO2
5	**Consider the following table:** **Table: CLASS** Id | Name 1 | Bravo 2 | Alex 4 | Cheng Give the output of the following SQL script:	CO2

	> INSERT INTO class VALUES (5,'Rahul'); > COMMIT; > UPDATE class SET name = 'Abhijeet' WHERE id= '5'; > SAVEPOINT A; > INSERT INTO class VALUES (6, 'Chris'); > SAVEPOINT B; > INSERT INTO class VALUES (7, 'Bravo'); > SAVEPOINT C > SELECT * FROM class; > ROLLBACK TO B; > SELECT * FROM class; > ROLLBACK TO A;	
6	(Exercise on retrieving records from the table) EMPLOYEES (Employee_Id, First_Name, Last_Name, Email, Phone_Number, Hire_Date, Job_Id, Salary, Commission_Pct, Manager_Id, Department_Id) a) Find out the employee id, names, salaries of all the employees b) List out the employees who works under manager 100 c) Find the names of the employees who have a salary greater than or equal to 4800 d) List out the employees whose last name is 'AUSTIN' e) Find the names of the employees who works in departments 60,70 and 80 f) Display the unique Manager_Id.	CO2
7	(Exercise on updating records in table) Create Client_master with the following fields(ClientNO, Name, Address, City, State, bal_due) a) Insert five records b) Find the names of clients whose bal_due> 5000 . c) Change the bal_due of ClientNO " C123" to Rs. 5100 d) Change the name of Client_master to Client12. e) Display the bal_due heading as "BALANCE"	CO2
8	Rollback and Commit commands Create Teacher table with the following fields(Name, DeptNo, Date of joining, DeptName, Location, Salary) a) Insert five records b) Give Increment of 25% salary for Mathematics Department . c) Perform Rollback command d) Give Increment of 15% salary for Commerce Department e) Perform commit command	CO2

9	(Exercise on order by and group by clauses) Create Sales table with the following fields(Sales No, Salesname, Branch, Salesamount, DOB) a) Insert five records b) Calculate total salesamount in each branch c) Calculate average salesamount in each branch d) Display all the salesmen, DOB who are born in the month of December as day in character format i.e. 21-Dec-09 e) Display the name and DOB of salesman in alphabetical order of the month.	CO2
10	Consider the following tables namely "DEPARTMENTS" and "EMPLOYEES" Their schemas are as follows, Departments (dept _no , dept_ name , dept_location); Employees (emp_id , emp_name , emp_salary,dept_no); a) Develop a query to grant all privileges of employees table into departments table b) Develop a query to grant some privileges of employees table into departments table c) Develop a query to revoke all privileges of employees table from departments table d) Develop a query to revoke some privileges of employees table from departments table a) e) Write a query to implement the save point.	CO2
11	Using the tables "DEPARTMENTS" and "EMPLOYEES" perform the following queries a) Display the employee details, departments that the departments are same in both the emp and dept. b) Display the employee name and Department name by implementing a left outer join. c) Display the employee name and Department name by implementing a right outer join. d) Display the details of those who draw the salary greater than the average salary	CO4
12	Employee Database An Enterprise wishes to maintain a database to automate its operations. Enterprise is divided into certain departments and each department consists of employees. The following two tables describes the automation schemas Dept (deptno, dname, loc) Emp (empno, ename, job, mgr, hiredate, sal, comm, deptno) a) Update the employee salary by 15%, whose experience is greater than 10 years. b) Delete the employees, who completed 30 years of service. c) Display the manager who is having maximum number of employees working under him?	CO2

	d) Create a view, which contain employee names and their manager	
13	Using Employee Database perform the following queries a) Determine the names of employee, who earn more than their managers. b) Determine the names of employees, who take highest salary in their departments. c) Determine the employees, who are located at the same place. d) Determine the employees, whose total salary is like the minimum Salary of any department. e) Determine the department which does not contain any employees.	CO2
14	Write a PL/SQL program to demonstrate Exceptions.	CO3
15	Write a PL/SQL program to demonstrate Cursors.	CO3
16	Write a PL/SQL program to demonstrate Functions.	CO3
17	Write a PL/SQL program to demonstrate Packages.	CO3
18	Write PL/SQL queries to create Procedures.	CO3
19	Write PL/SQL queries to create Triggers.	CO3

Department:	**Department of Computer Science and Engineering**		
Course Name: **Certified Cybersecurity Technician (CCT)**	**Course Code**	**L-T-P**	**Credits**
	ENSP206	4-0-0	4
Type of Course:	Minor		
Pre-requisite(s), if any:			

Brief Syllabus:

The CCT is an entry-level cybersecurity program engineered by EC-Council, to address the global need and demand for cybersecurity technicians with strong foundational skills. CCT provides the foundational skills essential for starting a career in cybersecurity, focusing on four disciplines: network defense, ethical hacking, digital forensics, and security operations. The CCT certification prepares IT and cybersecurity professionals to handle a wide range of complex issues related to securing software, networks, and IT systems against common cyberthreats and attacks.

UNIT WISE DETAILS

Unit Number: 1	**Title: Information Security Threats and Vulnerabilities, Attacks, Network Security Fundamentals, Identification, Authentication, and Authorization**	**No. of hours: 8**

Content Summary: Define Threats Sources, Define Threat Actors/Agents, Define Malware and its Types, Define Vulnerabilities, Understand Different Types of Vulnerabilities, Understand Information Security Attacks, Describe Hacking Methodologies and Frameworks, Understand Network-level Attacks, Understand Application-level and OS-level Attacks, Understand Social Engineering Attacks, Understand Wireless Network-specific Attacks, Understand IoT, OT, and Cloud Attacks, Understand Cryptographic Attacks, Discuss Information Security Fundamentals, Discuss Network Security Fundamentals, Discuss Access Control Principles, Terminologies, and Models, Discuss Identity and Access Management (IAM).

Unit Number: 2	**Title: Network Security Controls – Administrative Controls, Physical**	**No. of hours: 8**

	Controls and Technical Controls, Network Security Assessment Techniques and Tools and Application Security	

Content Summary: Discuss Various Regulatory Frameworks, Laws, and Acts, Understand Information Security Governance and Compliance Program, Learn to Design and Develop Security Policies, Learn to Conduct Different Types of Security and Awareness Training, Understand the Importance of Physical Security, Discuss Various Physical Security Controls, Describe Workplace Security, Describe Various Environmental Controls, Discuss Essential Network Security Protocols, Discuss Security Benefits of Network Segmentation, Understand Different Types of Firewalls and their Role, Understand Different Types of IDS/IPS and their Role, Understand Different Types of Honeypots, Understand Different Types of Proxy Servers and their Benefits, Discuss Fundamentals of VPN and its importance in Network Security, Discuss Other Network Security Controls, Discuss Importance of Load Balancing in Network Security, Understand Various Antivirus/Anti-malware Software, Discuss Threat Hunting, Discuss Various Threat Intelligence Feeds and Sources, Discuss Vulnerability Assessment, Discuss Ethical Hacking Concepts, Understand Fundamentals of Penetration Testing and its Benefits, Understand the Fundamentals of Configuration Management and Asset Management, Understand Secure Application Design and Architecture, Understand Software Security Standards, Models, and Frameworks, Understand Secure Application, Development, Deployment, and Automation, Application Security Testing Techniques and Tools.

Unit Number: 3	**Title: Virtualization and Cloud Computing, Wireless Network Security, Mobile Device Security and IoT and OT Security**	**No. of hours: 8**

Content Summary: Understand Virtualization Essential Concepts and OS Virtualization Security, OS Virtualization Security and Concerns, OS Virtualization Security Best Practices, Understand Cloud Computing Fundamentals, Discuss the Insights of Cloud Security and Best Practices, Understand Wireless Network Fundamentals, Understand Wireless Network Encryption Mechanisms, Discuss Different Types of Wireless Network Authentication Methods, Discuss and Implement Wireless Network Security Measures, Understand Various Mobile Device Connection Methods, Discuss Mobile Device Management Concepts, Discuss Common Mobile Usage Policies in Enterprises, Discuss Security Risks and Guidelines Associated with Enterprises Mobile Usage Policies, Discuss and Implement Enterprise-level Mobile Security Management Solutions, Discuss and Implement General Security Guidelines and Best Practices on Mobile Platforms, Understand IoT Devices, Application Areas, and Communication Models, Discuss the Security in IoT-enabled Environments, Understand OT Concepts, Devices, and Protocols, Discuss the Security in OT-enabled Environments.

Unit Number: 4	**Title: Cryptography, Data Security, Network Troubleshooting, Network Traffic Monitoring, Network Logs Monitoring and Analysis**	**No. of hours: 8**

Content Summary: Discuss Cryptographic Security Techniques, Discuss Various Cryptographic Algorithms, Discuss Various Hash Functions and Cryptography Tools, Discuss PKI and Certificate Management Concepts, Discuss Other Applications of Cryptography, Understand Data Security and its Importance, Discuss Various Data Security Controls, Discuss Data Backup, Retention, and Destruction, Discuss Data Loss Prevention Concepts, Discuss Network Troubleshooting, Learn Troubleshooting Basic Network Issues using Utilities and Tools, Understand the Need and Advantages of Network Traffic Monitoring, Determine Baseline Traffic Signatures for Normal and Suspicious Network Traffic, Perform Network Monitoring for Suspicious Traffic, Understand Logging Concepts, Discuss Log Monitoring and Analysis on Windows Systems, Discuss Log Monitoring and Analysis on Linux, Discuss Various Log Management Tools.

Unit Number: 5	**Title: Incident Response, Computer Forensics, Business Continuity and Disaster Recovery and Risk Management**	**No. of hours: 8**

Content Summary: Understand Incident Response Concepts, Understand the Role of First Responder in Incident Response, Describe Incident Handling and Response Process, Understand the Fundamentals of Computer Forensics, Understand Digital Evidence, Identify the Roles and Responsibilities of a Forensic Investigator, Understand the Forensic Investigation Process and its Importance, Discuss Various Forensic Investigation Phases, Digital Evidence Sources to Support Forensic Investigation, Collecting the Evidence, Securing the Evidence, Overview of Data Acquisition, Performing Evidence Analysis, Understanding Business Continuity (BC) and Disaster Recovery (DR) Concepts, Discuss BC/DR Activities, Understanding Business Continuity Plan (BCP) and Disaster Recovery Plan (DRP), Understand Risk Management Concepts, Discuss Various Risk Management Phases, Understand Various Risk Management Frameworks.

***Self-Learning Components:**

Students should explore Platforms like Wireshark tool for capturing and analyzing network traffic.

Reference Books:

1. Certified Cybersecurity Technician v1

2. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software Authors: Michael Sikorski, Andrew Honig
3. Hacking: Computer Hacking, Security Testing, Penetration Testing, and Basic Security, Author: John Slavio

Define Course Outcomes (CO)

COs	Statements
CO1	Understand the fundamentals of cybersecurity, such as data privacy, encryption methods, risk mitigation, and security protocols.
CO2	Demonstrate the ability to install, configure, maintain, and troubleshoot cybersecurity hardware and software.
CO3	Develop strong password security practices and encryption techniques.
CO4	Identify the different types of threats, attacks, and vulnerabilities in computer systems.
CO5	Apply system hardening methods to reduce potential attack surface area.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C2	A1	P1
CO2	C3	A2	P2
CO3	C3	A5	P3
CO4	C1	A5	-
CO5	C1	A5	P1

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	-	2	-	-	-	-	2
CO2	1	2	-	-	3	-	1	-	-	-	-	2
CO3	-	-	-	-	3	-	2	1	-	3	-	2
CO4	-	-	-	-	3	-	2	-	-	3	-	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	2	3	2	1
CO3	2	3	2	1
CO4	2	3	2	1

Relevance of the Syllabus to various indicators

Unit I	**Introduction to Information security**
Local	Understanding information security threats and vulnerabilities, network security fundamentals, and network troubleshooting can be valuable at the local level for securing local networks and protecting local systems from potential risks
Regional	-
National	-
Global	The concepts covered in the course, including cryptography, data security, and cloud computing security, have global relevance in the field of cybersecurity.
Employability	Proficiency in information security, network security, and related concepts is crucial for employability in the cybersecurity industry
Entrepreneurship	Understanding information security, network security controls, and risk management is essential for entrepreneurs in the cybersecurity industry. These concepts enable them to design innovative security solutions and services, establishing their ventures successfully
Skill Development	contributes to skill development the fundamental principles and concepts of information security, network security, and related topics. These skills include threat assessment, incident response, and network troubleshooting.
Professional Ethics	The course indirectly promotes ethical practices by emphasizing the importance of protecting data, respecting privacy, and adhering to legal and regulatory requirements.
Gender	These concepts are equally applicable and accessible to individuals of all genders pursuing careers in Cyber security
Human Values	promotes human values by emphasizing the importance of protecting sensitive information, ensuring privacy, and safeguarding the integrity of systems and networks.
Environment & Sustainability	contributes to sustainability efforts by emphasizing secure and efficient use of resources, such as cloud computing and network infrastructure.
Unit II	Network Security Controls

Local	Understanding information security threats and vulnerabilities, network security fundamentals, and network troubleshooting can be valuable at the local level for securing local networks and protecting local systems from potential risks
Regional	-
National	-
Global	The concepts covered in the course, including cryptography, data security, and cloud computing security, have global relevance in the field of cybersecurity.
Employability	Proficiency in information security, network security, and related concepts is crucial for employability in the cybersecurity industry
Entrepreneurship	Understanding information security, network security controls, and risk management is essential for entrepreneurs in the cybersecurity industry. These concepts enable them to design innovative security solutions and services, establishing their ventures successfully
Skill Development	contributes to skill development the fundamental principles and concepts of information security, network security, and related topics. These skills include threat assessment, incident response, and network troubleshooting.
Professional Ethics	The course indirectly promotes ethical practices by emphasizing the importance of protecting data, respecting privacy, and adhering to legal and regulatory requirements.
Gender	These concepts are equally applicable and accessible to individuals of all genders pursuing careers in Cyber security
Human Values	promotes human values by emphasizing the importance of protecting sensitive information, ensuring privacy, and safeguarding the integrity of systems and networks.
Environment & Sustainability	contributes to sustainability efforts by emphasizing secure and efficient use of resources, such as cloud computing and network infrastructure.
Unit III	**Wireless Security**
Local	Understanding information security threats and vulnerabilities, network security fundamentals, and network troubleshooting can

	be valuable at the local level for securing local networks and protecting local systems from potential risks
Regional	-
National	-
Global	The concepts covered in the course, including cryptography, data security, and cloud computing security, have global relevance in the field of cybersecurity.
Employability	Proficiency in information security, network security, and related concepts is crucial for employability in the cybersecurity industry
Entrepreneurship	Understanding information security, network security controls, and risk management is essential for entrepreneurs in the cybersecurity industry. These concepts enable them to design innovative security solutions and services, establishing their ventures successfully
Skill Development	contributes to skill development the fundamental principles and concepts of information security, network security, and related topics. These skills include threat assessment, incident response, and network troubleshooting.
Professional Ethics	The course indirectly promotes ethical practices by emphasizing the importance of protecting data, respecting privacy, and adhering to legal and regulatory requirements.
Gender	These concepts are equally applicable and accessible to individuals of all genders pursuing careers in Cyber security
Human Values	promotes human values by emphasizing the importance of protecting sensitive information, ensuring privacy, and safeguarding the integrity of systems and networks.
Environment & Sustainability	contributes to sustainability efforts by emphasizing secure and efficient use of resources, such as cloud computing and network infrastructure.
Unit IV	Network Traffic Monitoring
Local	Understanding information security threats and vulnerabilities, network security fundamentals, and network troubleshooting can be valuable at the local level for securing local networks and protecting local systems from potential risks

Regional	-
National	-
Global	The concepts covered in the course, including cryptography, data security, and cloud computing security, have global relevance in the field of cybersecurity.
Employability	Proficiency in information security, network security, and related concepts is crucial for employability in the cybersecurity industry
Entrepreneurship	Understanding information security, network security controls, and risk management is essential for entrepreneurs in the cybersecurity industry. These concepts enable them to design innovative security solutions and services, establishing their ventures successfully
Skill Development	contributes to skill development the fundamental principles and concepts of information security, network security, and related topics. These skills include threat assessment, incident response, and network troubleshooting.
Professional Ethics	The course indirectly promotes ethical practices by emphasizing the importance of protecting data, respecting privacy, and adhering to legal and regulatory requirements.
Gender	These concepts are equally applicable and accessible to individuals of all genders pursuing careers in Cyber security
Human Values	promotes human values by emphasizing the importance of protecting sensitive information, ensuring privacy, and safeguarding the integrity of systems and networks.
Environment & Sustainability	contributes to sustainability efforts by emphasizing secure and efficient use of resources, such as cloud computing and network infrastructure.
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts of Design, Efficiency ,Problem Solving, Abstraction and System Analysis

Department:	**Department of Computer Science and Engineering**		
Course Name: Certified Cybersecurity Technician (CCT) Lab	**Course Code**	**L-T-P**	**Credits**
	ENSP256	0-0-2	1
Type of Course:	Minor		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	
CO 1	The objective is to provide expert knowledge about information security, threats, and vulnerabilities. This includes knowledge of the following tasks: Creating a trojan, virus, and worm to gain access to the target machine, Monitoring user activities on a remote machine & Finding vulnerabilities using exploit sites.
CO 2	The objective is to provide expert knowledge in identifying, authenticating, and authorizing users who access critical assets and resources. This lab includes the following tasks: Implementation of access control policies in Windows and Linux machines, Implementation of role-based access control using tools such as Windows Admin Center (WAC), Implementation of centralized authentication using Windows utilities.
CO 3	The objective is to provide expert knowledge in assessing network security. This includes knowledge of the following tasks: Collecting data using search engines, gathering threat intelligence feed using threatfeeds.io, Performing vulnerability research using Common Weakness Enumeration (CWE) & Performing vulnerability assessment to identify vulnerabilities in the target system or network.
CO 4	The objective is to provide expert knowledge in securing IoT and OT devices. This includes knowledge of the following tasks: Implementation of secure IoT device communication using TLS/SSL
CO 5	The objective is to provide expert knowledge in network traffic monitoring. This includes knowledge of the following tasks: Intercepting network traffic using various tools such as Wireshark and tcpdump, exploring various filters in Wireshark, analyzing and examining various network packet headers in Linux using tools such as tcpdump, performing scan on network to identify machines in the local network.

CO 6	The objective is to provide expert knowledge in conducting computer forensics. This includes knowledge of the following tasks: Creating a disk image file of a hard disk partition, acquiring RAM and volatile information from a Windows system, analyzing file system of a Linux image using tools such as Autopsy, Capturing and analyzing memory dump on Linux System & Viewing contents of forensics image file.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Create a Trojan to Gain Access to the Target System	CO1
2	Find Vulnerabilities on Exploit Sites	CO1
3	Perform a Man-in-the-Middle (MITM) Attack using Cain & Abel	CO2
4	Perform a DoS Attack on a Target Host using hping	CO2
5	Perform an SQL Injection Attack Against MSSQL to Extract Databases using sqlmap	CO2
6	Implement Access Controls in Windows Machine	CO3
7	Implement Centralized Authentication Mechanism	CO3
8	Implement Password Policies using Windows Group Policy	CO3
9	Implement a Secure Network Policy	CO3
10	Implement Host-based Firewall Functionality Using Windows Firewall	CO3
11	Detect Malicious Network Traffic using HoneyBOT	CO2
12	Scan System for Viruses using Kaspersky Internet Security	CO1
13	Collect Data through Search Engines	CO1
14	Perform Vulnerability Research in Common Weakness Enumeration (CWE)	CO2
15	Detect Injection Vulnerability using Burp Suite	CO2
16	Perform Web Server Footprinting using Various Footprinting Tools	CO2

17	Audit Docker Host Security using Docker-Bench-Security Tool	CO2
18	Implement AWS Identity and Access Management	CO2
19	Configure Security on a Wireless Router	CO4
20	Implement Enterprise Mobile Security using Miradore MDM Solution	CO4
21	Secure IoT Device Communication using TLS/SSL	CO2
22	Calculate One-way Hashes using HashCalc	CO1
23	Create and Manage Certificates using OpenSSL	CO1
24	Perform Disk Encryption using BitLocker Drive Encryption	CO2
25	Implement Built-in File System-level Encryption on Windows	CO2
26	Network Troubleshooting using Nmap	CO2
27	Intercept Network Traffic using Wireshark and tcpdump	CO4
28	Configure, View, and Analyze Windows Event Logs	CO2
29	Analysis and Validation of Malware Incident	CO5
30	View Contents of Forensic Image File	CO2

Department:	**Department of Computer Science and Engineering**		
Course Name: **Life Skills for Professionals - II**	**Course Code**	**L-T-P**	**Credits**
	AEC012	3-0-0	3
Type of Course:	AEC		
Pre-requisite(s), if any:			

Brief Syllabus:

This course is a multifaceted initiative designed to enhance and optimize learner's communication practices across various platforms. This program integrates a range of strategies, tools, and techniques to foster effective communication, facilitate collaboration, and promote a cohesive information flow within the learner's area. This course is structured and comprehensive initiative designed to develop and improve individuals' aptitude across various cognitive and behavioral domains. This course incorporates a range of assessments, training modules, and activities to enhance critical thinking, problem-solving, decision-making, and other essential aptitudes required for personal and professional success.

UNIT WISE DETAILS

Unit Number: 1	**Title: Personality Improvement**	**No. of hours: 4**
Content Summary: Asking for and giving information, Offering and responding to offers, Requesting and responding to requests, Congratulating people on their success, Asking questions and responding politely, Apologizing and forgiving		
Unit Number: 2	**Title: Ratio & its application**	**No. of hours: 8**
Content Summary: Time & Work, Time & Distance, Train, Boat & Stream, Permutation & combination, Probability		

Unit Number: 3	Title: Arithmetic	No. of hours: 8
Content Summary: Inequalities, Log, progression, Mensuration, BODMAS		
Unit Number: 4	**Title: Presentation Skills**	**No. of hours: 8**
Content Summary: Presentation Skills, Telephone etiquettes, LinkedIn Profile and professional networking, Video resumes & Mock interview sessions.		
Unit Number: 5	**Title: Leadership skills**	**No. of hours: 4**
Content Summary: Nurturing future leaders, Increasing productivity of the workforce, Imparting Self-leadership, Executive leadership		

***Self-Learning Components:**

https://onlinecourses.nptel.ac.in/noc21_hs02/preview

Please Note:

1) Students are supposed to learn the Interactive Learning Modules on the internet.

2) At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books:

Aggarwal, R. S. (2014). Quantitative aptitude (Revised edition).
Gladwell, M. (2021). Talking to strangers.
Scott, S. (2004). Fierce conversations.

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** and apply the fundamental theories, models, and principles of communication.

CO2	**Apply** ability to communicate effectively through spoken and written forms. It includes developing skills in public speaking, interpersonal communication, professional writing, and persuasive communication.
CO3	**Evaluate** the development of teamwork and collaboration skills. It includes activities such as group projects, team-building exercises, and simulations that allow students to practice effective communication and collaboration within diverse teams
CO4	**Improve** their communication skills in different professional and personal contexts, such as interviews, networking events, customer interactions, and interpersonal relationships
CO5	**Analyze** ideas and information clearly and concisely through spoken language. They will develop the ability to articulate their thoughts, use appropriate vocabulary, and convey their message with clarity.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 25. Knowledge 26. Understand 27. Apply 28. Analyze 29. Evaluate 30. Create	Affective levels(A) 21. Receiving 22. Responding 23. Valuing 24. Organizing 25. Characterizing	Psychomotor levels(P) 21. Imitation 22. Manipulation 23. Precision 24. Articulation 25. Improving
CO1	C2		-
CO2	C3		-
CO3	C5		
CO4			P5
CO5	C5		P5

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	-	-	-	-	-	-	-	-	3	3
CO 2	3	2	-	-	-	-	-	-	-	-		3
CO 3	-	2	3	-	-	2	-	-	-	-	-	2
CO 4	-	3	2	-	-	-	-	2	-	-	-	3
CO 5	-	-	3	2	-	-	-		-	-	-	3

Justification for mapping must be relevant.

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

CO	PSO1	PSO2	PSO3	PSO4
CO 1	3	2	-	-
CO 2		2	-	-
CO 3	1	-	-	3
CO 4		2	-	-
CO 5	-	-	3	-

Relevance of the Syllabus to various indicators

Unit I	**Personality Improvement**
Local	Improve personality, enhance basic communication skills.
Regional	Recognize the importance of continuous learning and practice to maintain and further develop interpersonal ability.
National	Practice leadership strategies for solving problems within time constraints, as in competitive exams.
Global	Aligns with global trends in employment
Employability	Develop skills in real-life situations, such as academic exams, job interviews, and problem-solving scenarios.
Entrepreneurship	Learn to share ideas, listen to others, build consensus, and manage conflicts to achieve common goals in collaborative settings.
Skill Development	Develops Skills in public speaking, interpersonal communication, professional writing, and persuasive communication.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Ratio & its application**
Local	Recognize the importance of continuous learning and practice to maintain and further develop mental ability.
Regional	Practice attentive listening techniques, such as paraphrasing and asking clarifying questions.
National	Attentively listen to others, understand their perspectives, and respond appropriately.
Global	Aligns with global trends in employment
Employability	Develop skills in participating and contributing to group discussions, meetings, or presentations.

Entrepreneurship	Learn to share ideas, listen to others, build consensus, and manage conflicts to achieve common goals in collaborative settings.
Skill Development	Apply skills in real-life situations, such as academic exams, job interviews, and problem-solving scenarios.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Arithmetic**
Local	Improve number sense, enhance basic arithmetic skills and strengthen mental math abilities and speed.
Regional	-
National	Learn about Inequalities, Log, progression, Mensuration, BODMAS
Global	Recognize the importance of continuous learning.
Employability	Develop skills in participating and contributing to group discussions, meetings, or presentations.
Entrepreneurship	-
Skill Development	Recognize the importance of continuous learning and practice to maintain and further develop mental ability.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Presentation Skills**
Local	Attentively listen to others, understand their perspectives, and respond appropriately with timelines

Regional	-
National	Contributes to develop skill and improved productivity
Global	Aligns with global trends in understanding the deadlines.
Employability	Enhance the employability of individuals by developing essential skills and competencies sought by employers
Entrepreneurship	-
Skill Development	Strengthening critical thinking, problem-solving, memory, and other cognitive functions to improve overall mental agility and performance.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts employability

MINOR PROJECT-I

Department:	**Department of Computer Science and Engineering**		
Course Name: Minor Project-I	**Course Code**	**L-T-P**	**Credits**
	ENSI252	---	2
Type of Course:	Project		
Pre-requisite(s), if any: NA			

- Students expected to develop a basic project that demonstrates the application of learnings from studied subjects.
- Students are required to submit a hard copy of project file as per the template (Provided at the end of Handbook). File needs to be submitted in spiral bind.
- Project will be evaluated on the scale of 100 with following evaluation criteria.
  - Project idea & features (10)
  - Literature review (10)
  - Tools & Techniques employed (10)
  - Methodology (10)
  - Presentation of Results and its usefulness (20)
  - Implementation and its understandability (10)
  - Meetings & comments by guide (20)
  - Research paper (10)

File format for Minor project

1.	Abstract	Page No.
2.	Introduction (description of broad topic)	
3.	Motivation	
4.	Literature Review	
5.	Gap Analysis	
6.	Problem Statement	
7.	Objectives	
8.	Tools/platform used	
9.	Methodology	
10.	Experimental Setup	
11.	Evaluation Metrics	
12.	Results And Discussion	
13.	Conclusion & Future Work	
14.	References	
15.	Annexure I: Responsibility Chart	
16.	Annexure II: Screenshots of all the MS-Team Meetings with links (online)/ handwritten comments(offline) from guide	
17.	Annexure III Complete implementation code	
18.	Annexure IV Research Paper (Published/Submitted)	

Semester V

Department:	**Department of Computer Science and Engineering**		
Course Name: Theory of Computation	**Course Code**	**L-T-P**	**Credits**
	ENCS301	3-1-0	4
Type of Course:	Major		
Pre-requisite(s), if any:			
Brief Syllabus: This course provides a formal connection between algorithmic problem solving and the theory of languages and automata and develop them into a mathematical view towards algorithmic design and in general computation itself. The course should in addition clarify the practical view towards the applications of these ideas in the engineering part of computer science.			
Unit Number: 1	**Title: Introduction to Finite automata**	**No. of hours: 12**	
Content Summary: **Finite automata:** Review of Automata, its types and regular expressions, Equivalence of NFA, DFA and €-NFA, Conversion of automata and regular expression, Applications of Finite Automata to lexical analysis			
Unit Number: 2	**Title: PDA and Parser**	**No. of hours: 10**	
Content Summary: **PDA and Parser:** Parse Trees, Ambiguity in grammars and languages, Push down automata, Context Free grammars, Top down and Bottom up parsing. Closure Properties of CFL.			
Unit Number: 3	**Title: Chomsky hierarchy and Turing Machine**	**No. of hours: 08**	
Content Summary: **Chomsky hierarchy and Turing Machine:** Chomsky hierarchy of languages and recognizers, Context Sensitive features like type checking, Turing Machine as language acceptors and its design.			
Unit Number: 4	**Title: Code generation and optimization**	**No. of hours: 10**	
Content Summary: **Code generation and optimization:** Syntax directed translation, S-attributed and L-attributed grammars, Intermediate code generation, type conversions, and equivalence of type expression, Code generation and optimization.			

***SELF-LEARNING COMPONENTS:** https://onlinecourses.nptel.ac.in/noc21_cs83/preview **Please Note:** 1)Students are supposed to learn the components on self-basis 2) At least 5-10 % syllabus will be asked in end term exams from self-learning components.
Text Books 1. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computations", second Edition, Pearson Education. **Reference Books/Materials** 1. H.R. Lewis and C.H. Papadimitriou, "Elements of the theory of Computation", Second Edition, Pearson Education. 2. Thomas A. Sudkamp," An Introduction to the Theory of Computer Science, Languages and Machines", Third Edition, Pearson Education. 3. Raymond Greenlaw an H.James Hoover, "Fundamentals of Theory of Computation, Principles and Practice", Morgan Kaufmann Publishers. 4. MichealSipser, "Introduction of the Theory and Computation", Thomson Brokecole. 5. J. Martin, "Introduction to Languages and the Theory of computation" Third Edition, Tata Mc Graw Hill.

Define Course Outcomes (CO)

COs	Statements
CO1	To solve the problems related to regular expression, regular grammar, and Finite Automata
CO2	To write a formal notation for strings, languages and machines
CO3	To identify the phases of compilers for a programming language and construct the parsing table for a given syntax
CO4	To discover syntax directed translation rules for a given context free grammar by examining S-attributed and L-attributed grammars
CO5	To construct grammars and machines for a context free and context sensitive languages
CO6	To build the intermediate code by applying various code optimization strategies.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels©	Affective levels(A)	Psychomotor levels(P)
	1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C3	A2	P3
CO2	C2	A1	P4
CO3	C4	A2	P3
CO4	C4	A4	P4
CO5	C5	A3	P2
CO6	C6	A5	P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										
CO2	2	2										
CO3	2	3	3	3			3					
CO4	3	3	3	3			3	3	3			
CO5	1			2	3		1					
CO6						3						

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1
CO2	3	2	2	2
CO3	3	3	2	2
CO4	2	3	2	3
CO5	3	3	2	3

Relevance of the Syllabus to various indicators

Unit I	**Introduction to formal proof**
Local	-
Regional	-
National	-
Global	In the global context, formal proof and finite automata have significant relevance as they are fundamental concepts in computer science and mathematics. The global technology industry heavily relies on formal proof techniques for developing secure software systems, cryptography, and algorithmic design.
Employability	-
Entrepreneurship	-
Skill Development	Studying formal proof and finite automata develops critical thinking, logical reasoning, and problem-solving skills. These skills are transferable and applicable to various domains beyond computer science, including mathematics, engineering, and natural sciences. They enhance overall skill development and promote a deeper understanding of computational processes and structures.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Regular Expression**
Local	-
Regional	-
National	-
Global	In the global context, regular expressions and automata have significant relevance as they are fundamental concepts in computer science and information processing.
Employability	-

Entrepreneurship	-
Skill Development	Studying regular expressions and automata develops critical thinking, problem-solving, and logical reasoning skills. These skills are transferable and applicable to various domains beyond computer science, including linguistics, mathematics, and data analysis.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Context-Free Grammar (CFG)**
Local	-
Regional	-
National	-
Global	In the global context, context-free grammars and automata play a significant role in programming language design, parsing algorithms, and language translation tools.
Employability	-
Entrepreneurship	-
Skill Development	Studying context-free grammars and automata develops critical thinking, problem-solving, and algorithmic design skills. These skills are transferable and applicable to various domains beyond computer science, such as linguistics, mathematics, and formal reasoning.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**A language that is not Recursively Enumerable (RE)**
Local	-
Regional	-
National	-
Global	The study of languages that are not recursively enumerable (RE) has global significance as it forms the basis of theoretical computer science. Researchers and academics worldwide collaborate to explore undecidable problems, develop new mathematical models, and advance the understanding of computability.
Employability	-
Entrepreneurship	-
Skill Development	Studying languages that are not recursively enumerable (RE) enhances critical thinking, problem-solving, and analytical skills. The exploration of undecidable problems requires creativity,

	logical reasoning, and the ability to work with complex mathematical concepts.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4, 9
NEP 2020	Context-free grammars and automata align with NEP 2020 in the following ways: Integration of Emerging Technologies, Multidisciplinary Approach and Skill Development.
POE/4th IR	Context-free grammars and automata contribute to the Fourth Industrial Revolution (IR 4.0) in the following ways: Advancements in Computing, Data Processing and Analysis, Technological Disruption and Interdisciplinary Collaboration.

Department:	Department of Computer Science and Engineering		
Course Name: OPERATING SYSTEM	Course Code	L-T-P	Credits
	ENCS303	4-0-0	4
Type of Course:	MAJOR		

Pre-requisite(s), if any: Basics of programming

Brief Syllabus:

Operating systems course is intended as a general introduction to the techniques used to implement operating systems and related kinds of systems software. The topics covered will be functions and structure of operating systems, process management (creation, synchronization, and communication); processor scheduling; deadlock prevention, avoidance, and recovery; main-memory management; virtual memory management (swapping, paging, segmentation and page-replacement algorithms); control of disks and other input/output devices; file-system structure and implementation; and protection and security.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Operating System and Process Scheduling	No. of hours: 8

Content Summary:

Introduction to Operating System: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Functions of an Operating System Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.

The Abstraction: The Processes definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.

Scheduling Algorithms: Pre-emptive and Non-preemptive, FCFS, SJF, RR.

Unit Number: 2	Title: Memory & File Management	No. of hours: 12

Content Summary:

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit– Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Unit Number: 3	Title: Process-Synchronization, Deadlocks & I/O Systems	No. of hours: 10

Content Summary:

Process-Synchronization & Deadlocks: Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Deadlocks: Definition of Deadlocks, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery. Memory and I/O Management: Introduction Memory Allocation Techniques: Fragmentation, Segmentation.

I/O Systems: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers.

Unit Number: 4	Title: Distributed Operating Systems & Concurrent System	No. of hours: 10

Content Summary:

Distributed Operating Systems: Introduction, Issues, Communication Primitives, Distributed Deadlock Detection, Issues, Centralized Deadlock-Detection Algorithms Distributed Deadlock-Detection Algorithms. Agreement Protocols, Classification-Solutions, Applications. Distributed Resource Management: Distributed File systems, Architecture, Mechanisms, Design Issues, Distributed Shared Memory, Architecture, Algorithm, Protocols-Design Issues. Distributed Scheduling, Issues, Components, Algorithms.

Concurrent System: Failure Recovery and Fault Tolerance: Basic Concepts-Classification of Failures, Basic Approaches to Recovery; Recovery in Concurrent System; Synchronous and Asynchronous Check-pointing and Recovery; Check pointing in Distributed Database Systems; Fault Tolerance.

***Self-Learning Components:**

1. Case study on UNIX and WINDOWS Operating System.

2. Practice of System calls

3. Students can refer the following book as well:

Operating Systems: Three Easy Pieces by Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau

https://pages.cs.wisc.edu/~remzi/OSTEP/

4. Students can refer the following courses as per the Open-Source University Curriculum

- "Operating system courses" on Udemy.
- " Introduction to Operating Systems Specialization" Coursera.
- "Introduction to Operating Systems" by Udacity.

Reference Books:

1. MukeshSinghal and N. G. Shivaratri, "Advanced Concepts in Operating Systems", McGrawHill, 2000
2. Abraham Silberschatz, Peter B. Galvin, G. Gagne, "Operating System Concepts", Sixth Addison Wesley Publishing Co., 2003.
3. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Addison Wesley, 2001.
4. Tannenbaum, "Operating Systems", PHI, 4th Edition.
5. William Stallings, "Operating Systems Internals and Design Principles", PHI

Define Course Outcomes (CO)

COs	Statements
CO1	Recall and explain the fundamental concepts and principles of operating systems.
CO2	Compare and contrast different types of operating systems, their architectures, and their services.

CO3	Apply knowledge of process management and scheduling algorithms to solve problems.
CO4	Evaluate the performance of scheduling algorithms and memory management techniques by analyzing system metrics, such as CPU utilization, throughput, turnaround time, waiting time, and response time.
CO5	Design and create programs to simulate file management, virtual memory, and distributed operating systems concepts.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 7. Knowledge 8. Understand 9. Apply 10. Analyze 11. Evaluate 12. Create	Affective levels(A) 6. Receiving 7. Responding 8. Valuing 9. Organizing 10. Characterizing	Psychomotor levels(P) 6. Imitation 7. Manipulation 8. Precision 9. Articulation 10. Improving
CO1	C2	A1	P4
CO2	C4	A3	P4
CO3	C3	A4	P2
CO4	C5	A4	P3
CO5	C6	A5	P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	1	-	-	1
CO2	3	2	-	-	-	1	-	-	-	-	-	1
CO3	3	3	2	-	-	-	-	-	-	-	-	1
CO4	-	3	-	3	-	-	-	-	-	2	-	-

CO5	3	-	3	-	2	-	-	-	1	-	-	1

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1
CO2	3	2	2	2
CO3	3	3	2	2
CO4	2	3	2	3
CO5	3	3	2	3

Relevance of the Syllabus to various indicators

Unit I	**Introduction to Operating System and Process Scheduling**
Local	Can help students to build a strong foundation in computer science.
Regional	
National	Widely used across industries and organizations
Global	Applicable in various global industries and organizations.
Employability	Covers essential concepts and skills related to operating systems.
Entrepreneurship	Understanding of operating systems can be beneficial for entrepreneurs in the technology industry.
Skill Development	Students will develop skills in understanding operating system concepts, system calls, and kernel functionalities
Professional Ethics	-
Gender	-
Human Values	-

Environment & Sustainability	-
Unit II	**Memory & File Management**
Local	-
Regional	To meet the demand for skilled professionals in the region.
National	It provides fundamental knowledge about processes, threads, and process scheduling, which are essential for the functioning of computer systems in various national industries and organizations.
Global	Relevant globally as processes, threads, and process scheduling are fundamental concepts in operating systems used worldwide.
Employability	It covers essential concepts and skills related to processes, threads, and process scheduling in operating systems.
Entrepreneurship	-
Skill Development	Provides foundational knowledge and skills related to processes, threads, and process scheduling.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Process-Synchronization, Deadlocks & I/O Systems**
Local	-
Regional	-
National	It is important for national educational institutions to offer this course to produce skilled graduates who can contribute to the national workforce.

Global	Fundamental concepts are applicable in various global industries and organizations.
Employability	Concepts are crucial for various roles in software development
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Distributed Operating Systems & Concurrent System**
Local	-
Regional	-
National	Can contribute to the national workforce and address the challenges of concurrent programming.
Global	It can be applied globally in various industries and organizations that deal with concurrent programming and need professionals who understand these concepts.
Employability	Graduates with knowledge of these concepts are highly sought after by companies that develop concurrent software applications.
Entrepreneurship	Can be beneficial for entrepreneurs in the technology industry, especially those involved in developing software systems that require efficient concurrent processing.
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

SDG	SDG 4, 8, 9, 11
NEP 2020	OS supports collaborative learning environments, which are encouraged under NEP 2020 to promote interactive and engaging teaching practices.
POE/4th IR	OS contributes to the development of smart systems, autonomous devices, and intelligent algorithms that are central to the 4IR and POE.

Department:	**Department of Computer Science and Engineering**		
Course Name: OPERATING SYSTEM LAB	**Course Code**	**L-T-P**	**Credits**
	ENCS351	0-0-2	1
Type of Course:	MAJOR		
Pre-requisite(s), if any: Basics of programming			

Defined Course Outcomes

COs	
CO 1	Recall the concepts and principles of CPU scheduling algorithms used in operating systems.
CO 2	Compare and contrast different CPU scheduling algorithms and their advantages and disadvantages.
CO 3	Implement CPU scheduling algorithms, such as Round Robin and Priority, using Python programming.
CO 4	Evaluate the performance of CPU scheduling algorithms by analyzing and interpreting the generated Gantt charts and calculating average waiting time and turnaround time.
CO 5	Design Python programs to simulate various file allocation strategies and memory management techniques, such as sequential, indexed, linked, and paging.

List of Programs

Ex No	Experiment Title	Mapped CO/COs
1	Write Python programs to simulate the following CPU Scheduling algorithm: First-Come, First-Served (FCFS)	CO1
2	Write Python programs to simulate the following CPU Scheduling algorithm: Shortest Job First (SJF)	CO1
3	Write Python programs to simulate the following CPU Scheduling algorithms: Round Robin	CO1
4	Write Python programs to simulate the following CPU Scheduling algorithms: Priority	CO1

5	Given the list of processes, their CPU burst times, and arrival times, write a Python program to display/print the Gantt chart for Priority and Round Robin scheduling algorithms. Compute and print the average waiting time and average turnaround time for each scheduling policy.	CO4
6	Write a Python program to simulate the following file allocation strategies like Sequential	CO5
7	Write a Python program to simulate the following file allocation strategies like Indexed	CO5
8	Write a Python program to simulate the following file allocation strategies like linked.	CO5
9	Write Python programs to simulate the following contiguous memory allocation techniques: a) Worst-fit b) Best-fit c) First-fit	CO5
10	Write programs using the I/O system calls of UNIX/Linux operating system (open, read, write, close, fcntl, seek, stat, opendir, readdir).	CO1
11	Write program to simulate the MVT (Multiple Variable Tasks) memory management technique.	CO5
12	Write program to simulate the MFT (Multiple Fixed Tasks) memory management technique.	CO5
13	Write program to simulate the Banker's Algorithm for Deadlock Avoidance and Prevention.	CO5
14	Write program to implement the Producer-Consumer problem using semaphores using UNIX/Linux system calls.	CO3
15	Write programs to illustrate the following IPC (Inter-Process Communication) mechanisms: a) Pipes	CO3
16	Write programs to illustrate the following IPC (Inter-Process Communication) mechanisms: a) FIFOs (Named Pipes)	CO3
17	Program to implement process synchronization using semaphores in Python.	CO4
18	Program to implement a basic File allocation strategy like sequential file allocation in Python.	CO5
19	Program to demonstrate the use of signals in Python for process management.	CO1
20	Program to create and manipulate threads in Python.	CO3

21	Program to implement memory management techniques (e.g., paging, segmentation) in Python.	CO5
22	Program to simulate file system operations (e.g., open, read, write, close) in Python.	CO1
23	Program to implement process synchronization using mutex locks in Python.	CO4
24	Program to simulate the working of virtual memory in Python.	CO5
25	Program to simulate disk file management operations (e.g., allocation, deallocation) in Python.	CO5
26	Program to implement file locking mechanisms (e.g., advisory, mandatory) in Python.	CO5
27	Write a Python program to simulate the following file organization techniques Two level directories	CO5
28	Write Python programs to simulate the paging in memory management techniques	CO5
29	Write Python programs to simulate the segmentation in memory management techniques	CO5
30	Write a Python program to simulate the following file organization technique: Single level directory	CO5

Department:	**Department of Computer Science and Engineering**		
Course Name: Fundamentals of Cloud Computing and its Security	**Course Code**	**L-T-P**	**Credits**
	ENCS309	4-0-0	4
Type of Course:	MAJOR		
Pre-requisite(s), if any:			

Brief Syllabus:

This course aims to introduce students to the core concepts of cloud computing, its various models, and the principles of cloud security. Students will gain hands-on experience with cloud platforms, virtualization technologies, and security mechanisms to protect cloud-based systems and data. The course will also cover aspects of cyber security relevant to cloud environments.

UNIT WISE DETAILS

Unit Number: 1	**Title: Introduction to Cloud Computing**	**No. of hours: 8**

Content Summary:

Definition and characteristics of cloud computing, Cloud service models: IaaS, PaaS, SaaS, Deployment models: Public, Private, Hybrid, Community clouds, Cloud Infrastructure and Virtualization

Virtualization technologies: Hypervisors, Containers, Cloud data centers and network architecture, Cloud storage models: Object storage, Block storage

Unit Number: 2	**Title: Cloud Security Fundamentals**	**No. of hours: 12**

Content Summary:

Cloud Security Fundamentals, Cloud security challenges and threats, Identity and Access Management (IAM) in the cloud, Encryption and key management,

Cloud Security Services: Cloud security providers and tools, Intrusion Detection and Prevention Systems (IDPS) in the cloud, Web Application Firewalls (WAF)

Unit Number: 3	**Title:** Cloud Data & Network Security	**No. of hours: 10**

Content Summary:

Cloud Data Security: Data privacy and compliance in the cloud, Data loss prevention and backup strategies, Data encryption techniques

Cloud Network Security: Securing cloud communication channels, Virtual Private Clouds (VPCs) and Network Access Control Lists (NACLs), Distributed Denial of Service (DDoS) protection

Unit Number: 4	**Title: Distributed Operating Systems & Concurrent System**	**No. of hours: 10**

Content Summary:

Cloud Security Management: Incident response and management in the cloud, Security monitoring and auditing, Cloud compliance and governance

Cyber Security in Cloud Computing: Cloud-specific cyber threats and attacks, Cloud-based malware and ransomware, Security considerations for IoT devices in the cloud

***Self-Learning Components:**

Students may enroll any of the following online courses
Coursera:

- Course: "Cloud Computing Specialization" offered by the University of Illinois at Urbana-Champaign.
- Course: "Google Cloud Platform Fundamentals: Core Infrastructure" by Google Cloud.

edX:

- Course: "Cloud Computing for Enterprises" by the University of Maryland.
- Udemy:
- Course: "AWS Certified Cloud Practitioner" by DolfinEd.
- Course: "Azure Fundamentals" by Alan Rodrigues.

Reference Books:

Define Course Outcomes (CO)

COs	Statements
CO1	Understand the fundamentals of cloud computing and its service models.
CO2	Evaluate the security risks associated with cloud computing.
CO3	Analyze the architectural components of cloud systems and services.
CO4	Explore cyber security challenges specific to cloud computing and corresponding solutions.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 13. Knowledge 14. Understand 15. Apply 16. Analyze 17. Evaluate 18. Create	Affective levels(A) 11. Receiving 12. Responding 13. Valuing 14. Organizing 15. Characterizing	Psychomotor levels(P) 11. Imitation 12. Manipulation 13. Precision 14. Articulation 15. Improving
CO1	C2	A1	P4
CO2	C4	A3	P4
CO3	C3	A4	P2
CO4	C5	A4	P3
CO5	C6	A5	P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	1	-	-	1
CO2	3	2	-	-	-	1	-	-	-	-	-	1

CO3	3	3	2	-	-	-	-	-	-	-	-	1
CO4	-	3	-	3	-	-	-	-	-	2	-	-
CO5	3	-	3	-	2	-	-	-	1	-	-	1

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1
CO2	3	2	2	2
CO3	3	3	2	2
CO4	2	3	2	3
CO5	3	3	2	3

Department:	**Department of Computer Science and Engineering**		
Course Name: Fundamentals of Cloud Computing and its Security Lab	**Course Code**	**L-T-P**	**Credits**
	ENCS353	0-0-2	1
Type of Course:	MAJOR		
Pre-requisite(s), if any: Basics of programming			

Defined Course Outcomes

COs	
CO 1	Learn how to set up access controls and user management in the cloud.
CO 2	Apply encryption techniques to protect data in transit and at rest.
CO 3	Configure network security measures to safeguard cloud environments.
CO 4	Apply best practices for securing cloud-based applications and data.

List of Programs

Ex No	Experiment Title	Mapped CO/COs
1	Deploy a simple web application on an IaaS cloud platform (e.g., AWS EC2 or Azure VM).	CO1
2	Set up a PaaS environment (e.g., AWS Elastic Beanstalk or Google App Engine) to deploy a sample application.	CO1
3	Use a SaaS application (e.g., Office 365 or Google Workspace) and explore its functionalities.	CO1
4	Create and manage virtual machines using a hypervisor (e.g., VirtualBox or VMware).	CO1
5	Deploy a containerized application using Docker or Kubernetes on a cloud platform.	CO4
6	Create IAM users and groups with appropriate permissions in a cloud provider.	CO5
7	Configure Role-Based Access Control (RBAC) for different cloud resources.	CO5

8	Encrypt sensitive data using cloud-native encryption services.	CO5
9	Set up secure data storage using encrypted volumes or object storage.	CO5
10	Implement data backup and recovery strategies.	CO1
11	Set up a Virtual Private Cloud (VPC) with subnets and network access control rules.	CO5
12	Create a bastion host or jump box for secure remote access to instances.	CO5
13	Configure a cloud-based firewall to control incoming and outgoing traffic.	CO5
14	Set up monitoring and logging for cloud resources.	CO3
15	Generate and analyze cloud security logs.	CO3
16	Simulate a security incident and practice incident response procedures.	CO3
17	Design and implement a disaster recovery plan for critical cloud services.	CO4
18	Analyze cloud security architecture and identify potential vulnerabilities.	CO5
19	Implement security best practices for cloud-native application development.	CO1
20	Assess and enhance cloud security posture using industry-standard frameworks.	CO3

Department:	Department of Computer Science and Engineering		
Course Name: Cryptography and Applications	**Course Code**	**L-T-P**	**Credits**
	ENCS307	4-0-0	4
Type of Course:	Major		
Pre-requisite(s), if any:			

Brief Syllabus:

Cryptography is an indispensable tool for protecting information in computer systems. In this course students will learn the inner workings of cryptographic systems and how to correctly use them in real-world applications. The course begins with a detailed discussion of how two parties who have a shared secret key can communicate securely when a powerful adversary eavesdrops and tampers with traffic. Students will examine many deployed protocols and analyze mistakes in existing systems. The second half of the course discusses public-key techniques that let two parties generate a shared secret key. Throughout the course participants will be exposed to many exciting open problems in the field and work on fun (optional) programming projects. In a second course (Crypto II) we will cover more advanced cryptographic tasks such as zero-knowledge, privacy mechanisms, and other forms of encryption.

UNIT WISE DETAILS

Unit Number: 1	**Title: Introduction to Cryptography**	**No. of hours: 10**

Content Summary:

Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services and Mechanisms – A Model for Network Security – Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography – Foundations of modern cryptography: Perfect security – Information Theory – Product Cryptosystem – Cryptanalysis.

Unit Number: 2	Title: Cryptographic Security, Pseudo Randomness and Symmetric Key Ciphers	No. of hours: 10

Content Summary:

Shannon's theory, Perfect secrecy, Entropy, Spurious keys and unicity distance; Bit generators, Security of pseudorandom bit generators. Substitution-permutation networks, Data encryption standard (DES), Description and analysis of DES; Advanced encryption standard (AES), Description and analysis of AES; Stream ciphers, Trivium

Unit Number: 3	Title: Basics of Number Theory and Public-Key Cryptography	No. of hours: 10

Content Summary:

Basics of number theory; Introduction to public-key cryptography, RSA cryptosystem, Implementing RSA; Primality testing, Legendre and Jacobi symbols, SolovayStrassen algorithm, MillerRabin algorithm; Square roots modulo *n*, Factoring algorithms, Pollard *p* 1 algorithm, Pollard rho algorithm, Dixon's random squares algorithm, Factoring algorithms in practice; Rabin cryptosystem and its security.

Unit Number: 4	Title: More on Public-Key Cryptography, Hash Functions and Signature Schemes	No. of hours: 10

Content Summary:

Basics of finite fields; ElGamal cryptosystem, Algorithms for the discrete logarithm problem, Shanks' algorithm, Pollard rho discrete logarithm algorithm, PohligHellmanalgorithm; Discrete logarithm algorithms in practice, Security of ElGamal systems, Bit security of discrete logarithms.

Hash functions and data integrity, SHA-3; RSA signature scheme, Security requirements for signature schemes, Signatures and Hash functions, ElGamal signature scheme, Security of ElGamal signature scheme, Certificates.

***Self-Learning Components:**

https://seedsecuritylabs.org/Labs_16.04/Crypto/

https://cse29-iiith.vlabs.ac.in/List%20of%20experiments.html

https://cyberlab.pacific.edu/courses/comp178/resources

At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books:

1. Jeffrey Hoffstein, Jill Pipher& Joseph H. Silverman (2014). An Introduction to Mathematical Cryptography (2ndedition). Springer.
2. Neal Koblitz (1994). A Course in Number Theory and Cryptography (2nd edition). Springer- Verlag.
3. Christof Paar& Jan Pelzl (2014). Understanding Cryptography. Springer.
4. Simon Rubinstein-Salzedo (2018). Cryptography. Springer.
5. Douglas R. Stinson & Maura B. Paterson (2019). Cryptography Theory and Practice

Define Course Outcomes (CO)

COs	Statements
CO1	Understand network security services and mechanisms.
CO2	Understand and apply Symmetrical and Asymmetrical cryptography.
CO3	Analyze Data integrity, Authentication, Digital Signatures

CO4	Understand various network security applications, IPSec, Firewall, IDS, Web security, Email security, and malicious software etc.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 31. Knowledge 32. Understand 33. Apply 34. Analyze 35. Evaluate 36. Create	Affective levels(A) 26. Receiving 27. Responding 28. Valuing 29. Organizing 30. Characterizing	Psychomotor levels(P) 26. Imitation 27. Manipulation 28. Precision 29. Articulation 30. Improving
CO1	C3	A1	P1
C02	C3	A2	P2
CO3	C3	A1	P3
CO4	C3	A1	P1
CO5	C3	A2	P1

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	1	2	2	1	1	2	1	1
CO2	2	2	2	2	2	2	1	1	2	2	2	2
CO3	2	2	2	2	2	3	2	1	2	2	2	3
CO4	2	3	2	2	2	3	2	1	2	3	2	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	1	1	2	1
CO2	2	1	1	2

CO3	1	2	2	1
CO4	2	1	1	2

Relevance of the Syllabus to various indicators

Unit I	**Introduction to Cryptography**
Local	
Regional	
National	
Global	The course in Cryptography is relevant at all levels as secure communication and data protection are essential for individuals, businesses, and governments worldwide.
Employability	Knowledge of Cryptography is highly valuable in the digital age, enhancing employability in various sectors like cyber security, IT, and data protection.
Entrepreneurship	
Skill Development	The course equips students with foundational knowledge in cryptography and prepares them to contribute to secure digital communication and data protection across various sectors and industries.
Professional Ethics	The course emphasizes ethical practices in handling sensitive information and respecting privacy rights.
Gender	
Human Values	
Environment & Sustainability	
Unit II	**Cryptographic Security, Pseudo Randomness and Symmetric Key Ciphers**
Local	
Regional	
National	
Global	As societies become more reliant on digital communication, understanding cryptography becomes essential for protecting

	sensitive information, ensuring cyber security, and fostering trust in online transactions and data exchange at global level.
Employability	By studying this course, students can enhance their employability in industries like IT, cyber security, and government agencies that require data protection and secure communication.
Entrepreneurship	
Skill Development	The course enhances equips students with in-demand skills in cyber security, data protection, and cryptography.
Professional Ethics	
Gender	
Human Values	
Environment & Sustainability	
Unit III	**Basics of Number Theory and Public-Key Cryptography**
Local	
Regional	
National	
Global	As the world becomes increasingly interconnected, the need for secure communication and data protection is paramount at global levels.
Employability	Knowledge of cryptography can open up opportunities for individuals to work in challenging and well-paying roles.
Entrepreneurship	The course enhances employability and entrepreneurship prospects as it provides learners with specialized skills in cryptography, a field that is in high demand in various sectors, including IT, cybersecurity, finance, and government agencies.
Skill Development	The course equips learners with essential knowledge and skills related to information security and encryption, which are crucial for protecting sensitive data and communication
Professional Ethics	The course addresses professional ethics by emphasizing the responsible use of cryptography to ensure data privacy and

	protect against cyber threats. It encourages the adoption of ethical practices in handling sensitive information.
Gender	
Human Values	
Environment & Sustainability	Cryptography can also contribute to environmental sustainability by securing online transactions, reducing paper-based processes, and promoting a digital economy.
Unit IV	**More on Public-Key Cryptography, Hash Functions and Signature Schemes**
Local	
Regional	
National	
Global	It addresses concerns related to data protection, privacy, and secure transactions, making it relevant at the global levels.
Employability	Students can pursue careers as security analysts, cryptographers, or cyber security specialists, contributing to the growth of the digital economy.
Entrepreneurship	
Skill Development	Understanding cryptographic principles and techniques develops critical skills to address digital security challenges.
Professional Ethics	Cryptography has ethical implications related to data privacy, confidentiality, and responsible use of technology.
Gender	
Human Values	
Environment & Sustainability	
SDG	4,9
NEP 2020	It aligns with the NEP's focus on developing practical skills and preparing students for employability.

POE/4th IR	The course on Cryptography is highly relevant as it addresses the critical need for safeguarding data and maintaining privacy in a digitally connected world

Department:	Department of Computer Science and Engineering		
Course Name: Life Skills for Professionals -III	Course Code	L-T-P	Credits
	AEC013	3-0-0	3
Type of Course:	AEC		
Pre-requisite(s), if any:			

Brief Syllabus:

This Course designed to enhance the employability of individuals by developing essential skills and competencies sought by employers. This program equips participants with a wide range of skills necessary for success in the modern job market. To engage in interactive workshops, practical exercises, role-playing, and real-world simulations to reinforce their learning. The course is designed to be inclusive and caters to individuals from diverse backgrounds and career aspirations. The course is designed to enhance and develop various cognitive skills and mental abilities. This course focuses on strengthening critical thinking, problem-solving, memory, and other cognitive functions to improve overall mental agility and performance.

UNIT WISE DETAILS

Unit Number: 1	Title: Data interpretation	No. of hours: 4

Content Summary: Table chart, Line graph, Bar graph, Pie chart

Unit Number: 2	Title: Logical Reasoning	No. of hours: 8

Content Summary: Coding & Decoding, Sitting arrangement, Calendar, Clock, Direction Sense, Blood relation, Syllogism.

Unit Number: 3	Title: Logical & Non-verbal reasoning	No. of hours: 8

Content Summary: Series, Puzzle Text, Statement & Arguments, Cube & Dice, Non-verbal Reasoning

Unit Number: 4	Title: Understanding Stress	No. of hours: 8

Content Summary:
Introduction to Stress (i) Introduction to stress: Meaning, Definition, Eustress, Distress, (ii) Types of stress: Acute stress, Episodic Acute stress and chronic stress, signs and Symptoms
Sources of stress (i) Psychological, Social, Environmental (ii) Academic, Family and Work stress
Impact of stress

Unit Number: 5	Title: Employability skills	No. of hours: 4

Content Summary: Identifying job openings, Enhancing interpersonal skills, including teamwork, Applying for a job, Preparing Cover letters, preparing a CV/Resume and Effective Profiling, Group Discussions, Preparing for and Facing a Job Interview, Mock Interview, Feed Back – Improvement

***Self-Learning Components:**

https://onlinecourses.nptel.ac.in/noc21_hs02/preview

Please Note:

1)Students are supposed to learn the components on self-basis

2) At least 5-10 % syllabus will be asked in end term exams from self-learning components.

Reference Books:

Aggarwal, R. S. (2014). Quantitative aptitude (Revised edition).
Gladwell, M. (2021). Talking to strangers.
Scott, S. (2004). Fierce conversations.

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** their critical thinking skills and become adept at analyzing and evaluating information, identifying problems, generating innovative solutions, and making informed decisions.
CO2	**Apply** digital literacy skills necessary for the modern workplace and become proficient in using online platforms relevant to their field.

CO3	**Evaluate** Contribute positively, respect different perspectives, resolve conflicts, and achieve shared goals.
CO4	**Improve** and develop skills related to career planning, job search strategies, and personal branding
CO5	**Create** leadership skills and to motivate and inspire others, manage projects effectively, and demonstrate a proactive and responsible approach to their spoken language.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 37. Knowledge 38. Understand 39. Apply 40. Analyze 41. Evaluate 42. Create	Affective levels(A) 31. Receiving 32. Responding 33. Valuing 34. Organizing 35. Characterizing	Psychomotor levels(P) 31. Imitation 32. Manipulation 33. Precision 34. Articulation 35. Improving
CO1	C2		
CO2	C3		
CO3	C5		
CO4			P5
CO5	C6		

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	-	-	-	-	-	-	-	-	-	3
CO 2	3	2		1	1	-	-	-	-	-	-	3
CO 3	2	3	-	-	-	-	1	-	-	-	-	3
CO 4	2	2	1	1	-	-	-	-	-	3	-	3
CO 5	-	-	1	3	3	-	-	-	-	-	-	3

Justification for mapping must be relevant

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PO Mapping

CO	PSO1	PSO2	PSO3	PSO4
CO 1	3	1	-	-
CO 2	3	-	-	-
CO 3	2	2	-	-
CO 4	3	-	-	2
CO 5	3	2	3	-

Relevance of the Syllabus to various indicators

Unit I	Data interpretation
Local	Improve personality, enhance basic mental ability skills.
Regional	Recognize the importance of continuous learning and practice to maintain and further develop mental ability.
National	Practice leadership strategies for solving problems within time constraints, as in competitive exams.
Global	Aligns with global trends in employment
Employability	Develop skills in real-life situations, such as academic exams, job interviews, and problem-solving scenarios.
Entrepreneurship	Learn to share ideas, listen to others, build consensus, and manage conflicts to achieve common goals in collaborative settings.
Skill Development	Develops Skills in public speaking, interpersonal communication, professional writing, and persuasive communication.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Logical Reasoning
Local	Recognize the importance of continuous learning and practice to maintain and further develop mental ability.
Regional	Practice attentive listening techniques, such as paraphrasing and asking clarifying questions.
National	Attentively listen to others, understand their perspectives, and respond appropriately.
Global	Aligns with global trends in employment
Employability	Develop skills in participating and contributing to group discussions, meetings, or presentations.

Entrepreneurship	Learn to share ideas, listen to others, build consensus, and manage conflicts to achieve common goals in collaborative settings.
Skill Development	Apply skills in real-life situations, such as academic exams, job interviews, and problem-solving scenarios.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Logical & Non-verbal reasoning
Local	Improve number sense, enhance basic arithmetic skills and strengthen mental math abilities and speed.
Regional	-
National	Learn about Series, Puzzle Text, Statement & Arguments, Cube & Dice, Non-verbal Reasoning
Global	Recognize the importance of continuous learning.
Employability	Develop skills in participating and contributing to group discussions, meetings, or presentations.
Entrepreneurship	-
Skill Development	Recognize the importance of continuous learning and practice to maintain and further develop mental ability.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Understanding Stress

Local	Attentively listen to others, understand their perspectives, and respond appropriately
Regional	-
National	Contributes to develop skill and improved productivity
Global	Aligns with global trends in encouraged to establish professional connections and learn effective techniques for engaging in informational interviews or networking events
Employability	Enhance the employability of individuals by developing essential skills and competencies sought by employers
Entrepreneurship	-
Skill Development	Strengthening critical thinking, problem-solving, memory, and other cognitive functions to improve overall mental agility and performance.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit V	Employability skills
Local	Attentively listen to others, understand their perspectives, and respond appropriately with timelines
Regional	-
National	Contributes to develop skill and improved productivity
Global	Aligns with global trends in understanding importance of networking during the job search process
Employability	Enhance the employability of individuals by developing essential skills and competencies sought by employers
Entrepreneurship	-
Skill Development	Strengthening critical thinking, problem-solving, memory, and other cognitive functions to improve overall mental agility and performance.

Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts employability

Semester VI

Department:	**Department of Computer Science and Engineering**		
Course Name: **Computer Organization & Architecture**	**Course Code** ENCS302	**L-T-P** 3-1-0	**Credits** 4
Type of Course:	Major		
Pre-requisite(s), if any: Concepts of Digital Electronics			
Brief Syllabus: Computer Organization & Architecture (COA) covers topics in computer architecture and organization focusing on multicore, graphics-processor unit (GPU), and heterogeneous SOC multiprocessor architectures and their implementation issues (architect's perspective). The objective of the course is to provide in-depth coverage of current and emerging trends in computer organization and architecture focusing on performance and the hardware/software interface. The course emphasis is on analysing fundamental issues in architecture design and their impact on application performance.			
UNIT WISE DETAILS			
Unit Number: 1	**Title: Introduction**	**No. of hours: 10**	
Content Summary: Role of abstraction, basic functional units of a computer, Von-Neumann model of computation, A note on Moore's law, Notion of IPC, and performance. Data representation and basic operations.			
Unit Number: 2	**Title: Instruction Set Architecture (RISC-V)**	**No. of hours: 10**	
Content Summary: CPU registers, instruction format and encoding, addressing modes, instruction set, instruction types, instruction decoding and execution, basic instruction cycle, Reduced			

Instruction Set Computer (RISC), Complex Instruction Set Computer (CISC), RISC-V instructions; X86 Instruction set.

Unit Number: 3	Title: The Processor	No. of hours: 10

Content Summary:

Revisiting clocking methodology, Amdahl's law, Building a data path and control, single cycle processor, multi-cycle processor, instruction pipelining, Notion of ILP, data and control hazards and their mitigations.

Unit Number: 4	Title: Memory hierarchy, Storage and I/O	No. of hours: 10

Content Summary:

SRAM/DRAM, locality of reference, Caching: different indexing mechanisms, Trade-offs related to block size, associativity, and cache size, Processor-cache interactions for a read/write request, basic optimizations like writethrough/write-back caches, Average memory access time, Cache replacement policies (LRU), Memory interleaving.

Introduction to magnetic disks (notion of tracks, sectors), flash memory. I/O mapped, and memory mapped I/O. I/O data transfer techniques: programmed I/O, Interrupt-driven I/O, and DMA.

***Self-Learning Components:**

1. BSim Documentation

References:

1. https://www.nand2tetris.org/
2. https://www.coursera.org/learn/computer-organization-design
3. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-823-computer-system-architecture-fall-2005/

Please Note:

At least 5-10 % syllabus will be asked in end term exams from self-learning components

Text Book:

1. "Computer Organization and Design: The Hardware/Software Interface", David A. Patterson and John L. Hennessy, 5th Edition, Elsevier.

Reference Books:

1. "Computer Organization & Architecture", Smruti Ranjan Sarangi, McGraw Hill
2. "Computer System Architecture", Mano M. Morris, Pearson.
3. "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraHill Higher Education
4. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill
5. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.

Online References:

1. https://learning.edx.org/course/course-v1:MITx+6.004.2x+3T2015/block-v1:MITx+6.004.2x+3T2015+type@sequential+block@c3s1/block-v1:MITx+6.004.2x+3T2015+type@vertical+block@c3s1v1
2. RIPES: https://freesoft.dev/program/108505982
3. GEM5: https://www.gem5.org/documentation/learning_gem5/introduction/
4. CACTI: https://github.com/HewlettPackard/cacti
5. PIN: https://www.intel.com/content/www/us/en/developer/articles/tool/pin-a-binary-instrumentation-tooldownloads.html
6. TEJAS: https://www.cse.iitd.ac.in/~srsarangi/archbooksoft.html
7. XILINX(VHDL/Verilog tools): https://www.xilinx.com/support/university/students.html

Course Outcomes (CO)

COs	Statements
CO1	Understand the basics of instructions sets and their impact on processor design
CO2	Demonstrate an understanding of the design of the functional units of a digital computer system
CO3	Evaluate cost performance and design trade-offs in designing and constructing a computer processor including memory.
CO4	Design a pipeline for consistent execution of instructions with minimum hazards
CO5	Manipulate representations of numbers stored in digital computers using I/O devices and store them into memory

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels(C) 19. Knowledge 20. Understand 21. Apply 22. Analyze 23. Evaluate 24. Create	Affective levels(A) 16. Receiving 17. Responding 18. Valuing 19. Organizing 20. Characterizing	Psychomotor levels(P) 16. Imitation 17. Manipulation 18. Precision 19. Articulation 20. Improving
CO1	C2	A1	P1
C02	C3	A4	P1
CO3	C5	A2	P2
CO4	C6	A1	P4
CO5	C4	A2	P3

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3		-	-	-	-	-	-	3
CO4	-	-	3	-	-		-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	2			3
CO2	2	2		2
CO3		2		
CO4				3
CO5		2		2

Relevance of the Syllabus to various indicators

Unit I	**Introduction**
Local	Data representation and basic operations: Local, as it focuses on specific techniques and algorithms used within a computer system. Notion of IPC: Local, as it refers to the communication and interaction between processes or components within a computer system.
Regional	-
National	-
Global	-
Employability	-
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Instruction Set Architecture (RISC-V)**
Local	-
Regional	-
National	
Global	Addressing modes: Global, as they are a fundamental concept in computer architecture and are used in various CPU architectures worldwide.

	Instruction set: Global, as it refers to the collection of instructions supported by a CPU architecture, which is applicable across different computer systems.
Employability	-
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**The Processor**
Local	-
Regional	-
National	-
Global	Global, as they are techniques used to improve performance and increase instruction-level parallelism, relevant across different computer architectures.
Employability	
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

Unit IV	**Memory hierarchy, Storage and I/O**
Local	-
Regional	-
National	-
Global	Introduction to magnetic disks, notion of tracks, sectors, flash memory: Global, as they are fundamental concepts and technologies applicable to computer storage systems worldwide.
Employability	-
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4, SDG 8, SDG 9
NEP 2020	Promoting universal access to education, holistic development, multidisciplinary approach, skill development, critical thinking, creativity, ICT integration, research and development, global competencies, and professional ethics.
POE/4th IR	Aligns with the concepts of parallel computing, advanced processors, and memory architectures.

Department:	Department of Computer Science and Engineering		
Course Name: Computer Networks	Course Code	L-T-P	Credits
	ENCS304	3-1-0	4
Type of Course:	Major		
Pre-requisite(s), if any:			

Brief Syllabus:

This course provides a comprehensive study of computer networks, covering fundamental concepts, protocols, and technologies. It emphasizes hands-on learning and explores open-source tools commonly used in the field of computer networking. Through practical assignments and projects, students will gain a solid understanding of network design, implementation, security, and management.

UNIT WISE DETAILS

Unit Number: 1	Title: Evolution of Computer Networking	No. of hours: 6

Content Summary:

Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Access networks, physical media, Forwarding, routing; packet switching; circuit switching; a network of network, packet delay and loss, end-end throughput.

Unit Number: 2	Title: Data Link Layer Design Issues	No. of hours: 12

Content Summary:

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA.

Unit Number: 3	Title: Introduction to Network Layer and Transport Services	No. of hours: 12

Content Summary:

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols. Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit Number: 4	Title: Principles of Network Applications	No. of hours: 12

Content Summary:

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

***Self-Learning Components:**

https://gaia.cs.umass.edu/kurose_ross/videos/1/

Cisco Networking Academy: network fundamentals, routing and switching, and network security. They provide free learning materials and hands-on practice: https://www.netacad.com/

Open-Source Networking Tools and Technologies

- Open-source network monitoring tools (e.g., Nagios, Zabbix)
- Open-source network management tools (e.g., OpenNMS)
- Open-source network security tools (e.g., Snort, Suricata)

Text Book:

1. Computer Networks (Fifth Edition) – Andrew S. Tanenbaum (Prentice Hall of India)
2. Data communication and Networking(Fourth Edition)- Behrouz A Forouzan(Tata Mcgraw Hill)

Reference Books:

3. Computer Networking A Top-Down Approach(Fifth Edition)-James F. Kurose-Keith W. Ross (Pearson)
4. Computer Networks – Protocols, Standards and Interfaces (Second Edition) – UylessBlack(Prentice Hall of India Pvt. Ltd.)

Define Course Outcomes (CO)

COs	Statements
CO1	Understand the fundamental concepts and principles of computer networks.
CO2	Demonstrate knowledge of network hardware and software components.
CO3	Develop skills in network administration and management.
CO4	Choose appropriate protocol for desired communication service.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 25. Knowledge 26. Understand 27. Apply 28. Analyze 29. Evaluate 30. Create	Affective levels(A) 21. Receiving 22. Responding 23. Valuing 24. Organizing 25. Characterizing	Psychomotor levels(P) 21. Imitation 22. Manipulation 23. Precision 24. Articulation 25. Improving
CO1	C1		
CO2	C2		
CO3	C3	A4	
CO4	C6		P5
CO5			

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2		2	2									
CO3				3								
CO4				3								

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	2			
CO2				
CO3			2	
CO4				
CO5				

Relevance of the Syllabus to various indicators

Unit I	**Evolution of Computer Networking**
Local	Computer networking enables local communication and connectivity within communities, businesses, and educational institutions. It facilitates information sharing, collaboration, and resource sharing at the local level.
Regional	Networking infrastructure connects regions and nations, promoting economic growth, social development, and knowledge sharing. It enables efficient communication, e-commerce, and government services across regions and countries.
National	-
Global	The global network infrastructure, such as the internet, connects people worldwide. It fosters global communication, cultural exchange, international trade, and enables the global dissemination of knowledge and information.
Employability	Computer networking skills are in high demand across industries. Proficiency in networking technologies and protocols enhances employability prospects in fields such as network administration, cybersecurity, cloud computing, and telecommunications.
Entrepreneurship	Networking knowledge is crucial for entrepreneurs to establish and manage their businesses effectively. It enables the creation of scalable, secure, and interconnected systems that support business operations, communication, and data exchange.
Skill Development	Computer networking cultivates essential technical skills, such as network design, configuration, troubleshooting, and optimization. It also fosters critical thinking, problem-solving, and analytical skills required to address complex network challenges.
Professional Ethics	Computer networking professionals must adhere to ethical standards and guidelines. They need to respect user privacy, ensure data security, and practice responsible use of network resources. Professional ethics in networking include principles like confidentiality, integrity, accountability, and respect for intellectual property rights.

Gender	Promoting gender diversity and inclusivity in computer networking is crucial. Encouraging women's participation in networking fields helps bridge the gender gap and fosters diverse perspectives and innovative solutions.
Human Values	Computer networking should prioritize human values, such as accessibility, equity, and social responsibility. Access to network resources and services should be inclusive, regardless of geographical location or socioeconomic background. Networking technologies should be leveraged to bridge digital divides and empower underserved communities.
Environment & Sustainability	Networking can contribute to environmental sustainability by enabling remote work, reducing the need for commuting, and minimizing carbon emissions. It also facilitates energy-efficient network infrastructure design and management, leading to reduced power consumption and environmental impact.
Unit II	**Data Link Layer Design Issues**
Local	Data Link Layer design issues are relevant at the local level as they affect the efficiency and reliability of local area networks (LANs). Local network connectivity is vital for businesses, educational institutions, and communities to facilitate communication and data exchange.
Regional	Efficient Data Link Layer design ensures seamless connectivity within regions and nations, enabling smooth data transmission across a wide range of industries and sectors.
National	-
Global	In the global context, the design of the Data Link Layer plays a crucial role in ensuring interoperability and standardization across networks worldwide. Global communication and data exchange rely on well-designed protocols and technologies at this layer.
Employability	Proficiency in Data Link Layer design is valuable for networking professionals seeking employment in roles such as network engineers, system administrators, and network architects. Employers look for individuals with a strong understanding of data link protocols and the ability to design reliable and efficient data link connections.

Entrepreneurship	Data Link Layer design knowledge is also essential for entrepreneurs who need to establish and manage their network infrastructure effectively. It enables the creation of secure and efficient data links to support business operations and communication.
Skill Development	Understanding Data Link Layer design issues contributes to the development of technical skills in network engineering and administration. It involves knowledge of protocols, error detection and correction techniques, flow control, and media access control.
Professional Ethics	Data Link Layer design should adhere to professional ethics, including principles of integrity, privacy, and security. Designers must ensure the confidentiality and integrity of transmitted data, implement appropriate access control mechanisms, and protect against unauthorized access or data breaches.
Gender	Promoting gender diversity and inclusivity in Data Link Layer design is important to ensure a diverse range of perspectives and innovative solutions. Efforts should be made to encourage and support the participation of underrepresented groups in networking fields.
Human Values	Data Link Layer design should consider human values such as accessibility, reliability, and user-friendliness. Networks should be designed to provide reliable and efficient data transmission, ensuring that users have access to network resources without discrimination or unnecessary barriers.
Environment & Sustainability	Sustainable Data Link Layer design involves optimizing network performance and reducing power consumption. Energy-efficient network technologies, such as link aggregation and power-saving modes, can contribute to environmental sustainability by minimizing energy consumption and reducing carbon emissions.
Unit III	**Introduction to Network Layer and Transport Services**
Local	Local: The Network Layer and Transport Services enable local connectivity and communication within communities, organizations, and institutions. They facilitate local data transmission and routing within a network.
Regional	Regional and National: These networking components play a vital role in regional and national connectivity, enabling data

	transmission across networks and facilitating communication between different regions and countries.
National	-
Global	Global: The Network Layer and Transport Services are essential for global connectivity, enabling data transmission across the internet and connecting individuals and organizations worldwide.
Employability	Proficiency in the Network Layer and Transport Services is highly relevant for networking professionals seeking employment. It enhances employability in roles such as network engineers, network administrators, and system architects. Employers value individuals with expertise in network design, routing, and transport protocol selection.
Entrepreneurship	Understanding the Network Layer and Transport Services is crucial for entrepreneurs who need to design and manage their network infrastructure effectively. It allows for scalable and efficient data transmission, supporting business operations and facilitating communication.
Skill Development	Skill development in these areas also enhances critical thinking, problem-solving, and troubleshooting skills, as network professionals need to analyze and resolve issues related to routing, congestion control, and reliability.
Professional Ethics	Ethical considerations are important when working with the Network Layer and Transport Services. Networking professionals must ensure the confidentiality, integrity, and availability of data during transmission. They must also respect user privacy and adhere to ethical standards in handling network traffic and data.
Gender	Encouraging gender diversity and inclusivity in the Network Layer and Transport Services is crucial to foster diverse perspectives and innovative solutions. Efforts should be made to promote the participation and representation of underrepresented groups in networking fields.
Human Values	The Network Layer and Transport Services should prioritize human values such as accessibility, reliability, and user-friendliness. Networks should be designed to provide reliable and efficient data transmission, ensuring equitable access and usability for all users.

Environment & Sustainability	Sustainable network design involves optimizing the Network Layer and Transport Services to minimize resource consumption and reduce environmental impact. This includes implementing efficient routing algorithms, congestion control mechanisms, and energy-saving techniques to reduce power consumption and promote environmental sustainability.
Unit IV	**Principles of Network Applications**
Local	Principles of computer network applications enable local communication and connectivity within communities, organizations, and institutions. Local network applications facilitate information sharing, collaboration, and resource utilization at the local level.
Regional	These principles play a crucial role in regional and national connectivity, allowing for efficient communication and data exchange across networks within a region or country.
National	-
Global	The principles of computer network applications are essential for global connectivity, enabling the exchange of data and information across the internet on a global scale.
Employability	Proficiency in the principles of computer network applications enhances employability in various roles such as application developers, network engineers, and system administrators. Employers seek individuals with a strong understanding of network protocols, application design, and development.
Entrepreneurship	Understanding these principles is crucial for entrepreneurs who need to develop and manage networked applications effectively. It enables the creation of innovative and scalable applications to support business operations and provide value to users.
Skill Development	The principles of computer network applications contribute to the development of technical skills in application development, network programming, and protocol implementation. It involves knowledge of network protocols, application layer protocols (e.g., HTTP, FTP), and client-server communication.
Professional Ethics	Ethical considerations are important when working with computer network applications. Professionals should prioritize user privacy, data security, and responsible use of network resources. Adhering to ethical guidelines ensures the

	confidentiality, integrity, and availability of data during application communication.
Gender	Promoting gender diversity and inclusivity in computer network applications is important to ensure diverse perspectives and inclusive designs. Efforts should be made to encourage and support the participation of underrepresented groups in application development and networking fields
Human Values	Principles of computer network applications should prioritize human values such as accessibility, usability, and user-friendliness. Applications should be designed to provide seamless and intuitive user experiences, ensuring equitable access and usability for all users.
Environment & Sustainability	Sustainable application design involves optimizing network communication to minimize resource consumption and reduce environmental impact. This includes implementing efficient data transfer mechanisms, minimizing unnecessary data transmission, and promoting energy-efficient application architectures.
SDG	SDG 4
NEP 2020	-
POE/4th IR	

Department:	Department of Computer Science and Engineering		
Course Name: Computer Networks Lab	Course Code	L-T-P	Credits
	ENCS352	0-0-2	1
Type of Course:	Major		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	
CO 1	To gain hands-on experience working with network hardware, software, and tools.
CO 2	Network Configuration and Troubleshooting.
CO 3	Network Design and Implementation.
CO 4	To measure and evaluate network performance using tools and techniques.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Create a simple network with multiple PCs, switches, and routers.	CO1
2	Assign IP addresses to devices and configure basic connectivity.	CO1
3	Test connectivity between PCs using ping and trace routes.	CO2
4	Configure VLANs on switches and assign ports to specific VLANs.	CO2
5	Enable inter-VLAN routing using a router or Layer 3 switch.	CO1
6	Test connectivity between PCs in different VLANs.	CO2

7	Set up a network with multiple routers.	CO1
8	Configure static routes on routers to enable communication between networks.	CO2
9	Verify routing tables and test connectivity between networks.	CO2
10	Set up a network with a private IP address space.	CO1
11	Configure NAT on a router to enable translation between private and public IP addresses.	CO2
12	Test connectivity between devices on the private network and the Internet.	CO3
13	Create a wireless network using access points and wireless clients.	CO1
14	Simulate network issues such as connectivity problems, routing errors, or misconfigurations.	CO4
15	Design and implement a network traffic monitoring.	CO4
16	Setting up small computer networks and Hands on networking commands: Set up a small wired and wireless network of 2 to 4 computers using Hub/Switch/Access point.	CO3
17	Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes.	CO2
18	Write a program for error detection and correction for 7/8 bits ASCII codes using CRC.	CO2
19	Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in peer to peer mode. Further extend it to real implementation of Flow Control over TCP protocol.	CO2
20	Design and deploy TCP based Multithreaded HTTP client server for accessing student activity data in the institute.	CO4
21	Design and deploy TCP based Multithreaded FTP client server to share institute level notices.	CO4
22	Design and deploy TCP based Multithreaded Chat client server for your class.	CO4
23	Design and deploy UDP based Multithreaded Chat client server for your class.	CO4

24	Examining real-world network deployments.	CO4
25	Case studies of network failures and their resolutions.	CO3

Department:	**Department of Computer Science and Engineering**		
Course Name: Introduction to Linux with BASH scripting Lab	**Course Code**	**L-T-P**	**Credits**
	ENCS356	0-0-4	2
Type of Course:	Major		
Pre-requisite(s), if any:			

Proposed List of Experiment

Ex. No	**Experiment Title**	**Mapped CO/COs**
1	**Installing Linux Operating System:** • Learn how to install VirtualBox 7 on Windows. • Installing Linux Using an OVA (Open Virtual Appliance File) with VirtualBox	CO1
2	**Exploring the System:** Starting Up and changing run levels, Using the man utility, Using built-in help switches for commands, Using Auto completion	CO1
3	**Working with Files & Directories:** • Listing Files and Understanding LS Output • Explain File and Directory Permissions • Finding Files and Directories • Viewing Files and the Nano Editor • Editing Files in Vi editor	CO1
4	**Deleting, Copying, Moving, and Renaming Files:** Using commands like Touch, mv, cp, cat, Redirection, rm	CO1
5	**Searching for files:** grep, frep and similar command	CO1
6	Preamble, Virtual terminals, Setting up a basic display, X clients, Window Managers, Display Manager, xinit and startx, system-config-display	CO1
7	**Managing Users and Groups in Linux:**	CO1

	Manually creating a new user, Manually creating a new groups, automatically creating a new user, automatically creating new groups, using sticky bits, share the file between users and groups.	
8	**Linux Package Mangement with rpm And YUM:** Installing, Querying and Uninstalling Packages, Third party tools, Building Software from Source	CO1
9	**Mounting and Unmounting** : Determining device type, Creating devices, mounting and unmounting devices	CO1
10	**Understanding different kinds of Shells:** shell, bash shell, Korn shell and others, A simple Script, Using variables in scripts	CO1, CO3
11	**Commands related to Inode** I/O redirection, piping, process control commands, mails.	CO1, CO3
12	**Shell Programming:** shell script exercise based on following: • Interactive shell script • Positional parameters • Arithmetic • If-then-fi, if-then-else-fi, nested if-else • Logical operators • Else + if equals elif, case structure • While ,for loop • Meta characters	CO2, CO4
13	Write a shell script to create a file in $USER /class/batch directory. Follow the Instructions • Input a page profile to yourself, copy it into other existing file • Start printing file at certain line • Print all the difference between two file, copy the two files at $USER/CSC/2007 directory	CO2,
14	Write shell script for- • Showing the count of users logged in • Printing Column list of files in your home directory. • Listing your job with below normal priority • Continue running your job after logging out	CO2

15	Write a shell script to change date format. Show the time taken in execution of this script	CO2
16	Write a shell script to print file names in directory showing date of creation & serial no. of file.	CO2
17	Write a shell script to count lines, words & characters in its input. (do not use wc)	CO2
18	Write a shell script to print end of a Glossary file in reverse order using array	CO2
19	Write a shell script to check whether Ram logged in, continue checking further after every 30 seconds till success	CO2,CO3
20	Write a shell script to compute GCD & LCM of two numbers.	CO2
21	Write a shell script to find whether a given number is prime	CO2
22	**Project:** Develop a script that scans a network and displays information about connected devices, such as IP addresses, MAC addresses, and open ports. You can use tools like Nmap to assist in the scanning process..	CO1, CO2,CO4
23	**Project:** Create a simple text-based game using Bash scripting. For example, you could develop a trivia game or a guessing game where the user must guess a word or a number.	
24	**Projects:** Develop a script that automates the process of backing up important files or directories. The script can compress and archive the files, and then copy them to a specified backup location.	

Defined Course Outcomes

COs	
CO 1	Familiarity with Linux Environment: Students should become comfortable with the Linux command line interface, understand basic commands, and navigate the file system
CO 2	Bash Scripting Skills: Students should acquire proficiency in writing Bash scripts to automate tasks and perform complex operations on files, directories, and system resources
CO 3	Command Execution and Output Manipulation: Students should learn how to execute commands and manipulate their output using filters, redirection, and pipelines.
CO 4	Conditional Statements and Loops: Students should be able to use conditional statements (if-else) and loop structures (for, while) in Bash scripts for control flow and repetitive tasks.

Department:	Department of Computer Science and Engineering		
Course Name: Introduction to Ethical Hacking	Course Code	L-T-P	Credits
	ENSP312	4-0-0	4
Type of Course:	Minor		
Pre-requisite(s), if any:			

Brief Syllabus:

The Certified Ethical Hacker (CEH) program is the gold standard of information security training programs. EC-Council's flagship certification allows you to master hacking technologies. You will need to understand hacking and become a hacker, but an ethical one! The accredited course provides the advanced hacking tools and techniques used by hackers and information security professionals alike to break into organizations. As we say, "To beat a hacker, you need to think like a hacker". This course will immerse you into the hacker mindset so you will be able to understand attacks and exploits to defend against future attacks. The security mindset in any organization must not be limited to the silos of a certain vendor, technologies, or pieces of equipment. This ethical hacking course puts you in the driver's seat of a hands-on environment with a systematic process. Here, you will be exposed to an entirely different way of achieving optimal information security posture in your prospective organization, by hacking it! You will scan, test, hack and secure your own systems while uncovering the ways to approach your target and succeed at breaking in every time! After taking this course, you will fully understand the five phases of ethical hacking: Reconnaissance, Gaining Access, Enumeration, Maintaining Access, and covering your tracks.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Ethical Hacking, Footprinting and Reconnaissance, Scanning Networks and Enumeration	No. of hours:

Content Summary: Information Security Overview, Hacking Methodologies and Frameworks, Hacking Concepts, Ethical Hacking Concepts, Information Security Controls, Information Security Laws and Standards, Footprinting Concepts, Footprinting through Search Engines, Footprinting through Web Services,

Footprinting through Social Networking Sites, Website Footprinting, Email Footprinting, Whois Footprinting, DNS Footprinting, Network Footprinting, Footprinting through Social Engineering, Footprinting Tools, Footprinting Countermeasures, Network Scanning Concepts, Scanning Tools, Host Discovery, Port and Service Discovery, OS Discovery (Banner Grabbing/OS Fingerprinting), Scanning Beyond IDS and Firewall, Network Scanning Countermeasures, Enumeration Concepts, NetBIOS Enumeration, SNMP Enumeration, LDAP Enumeration, NTP and NFS Enumeration, SMTP and DNS Enumeration, Other Enumeration Techniques, Enumeration Countermeasures.		
Unit Number: 2	**Title: Vulnerability Analysis, System Hacking, Malware Threats, and Sniffing**	**No. of hours:**
Content Summary: Vulnerability Assessment Concepts, Vulnerability Classification and Assessment Types, Vulnerability Assessment Tools, Vulnerability Assessment Reports, Gaining Access, Escalating Privileges, Maintaining Access, Clearing Logs, Malware Concepts, APT Concepts, Trojan Concepts, Virus and Worm Concepts, Fileless Malware Concepts, Malware Analysis, Malware Countermeasures, Anti-Malware Software, Sniffing Concepts, Sniffing Technique: MAC Attacks, Sniffing Technique: DHCP Attacks, Sniffing Technique: ARP Poisoning, Sniffing Technique: Spoofing Attacks, Sniffing Technique: DNS Poisoning, Sniffing Tools, Sniffing Countermeasures.		
Unit Number: 3	**Title: Social Engineering, Denial of Service, Session Hijacking, Evading IDS, Firewalls and Honeypots**	**No. of hours:**
Content Summary: Social Engineering Concepts, Social Engineering Techniques, Insider Threats, Impersonation on Social Networking Sites, Identity Theft, Social Engineering Countermeasures, DoS/DDoS Concepts, Botnets, DoS/DDoS Attack Techniques, DDoS Case Study, DoS/DDoS Attack Countermeasures, Session Hijacking Concepts, Application-Level Session Hijacking, Network-Level Session Hijacking, Session Hijacking Tools, Session Hijacking Countermeasures, IDS, IPS, Firewall and Honeypot Concepts, IDS, IPS, Firewall and Honeypot Solutions, Evading IDS, Evading Firewalls, Evading NAC and Endpoint Security, IDS/Firewall Evading Tools, Detecting Honeypots, IDS/Firewall Evasion Countermeasures.		
Unit Number: 4	**Title: Hacking Webservers, Hacking Web Applications, SQL Injection and Hacking Wireless Networks**	**No. of hours:**
Content Summary: Web Server Concepts, Web Server Attacks, Web Server Attack Methodology, Web Server Attack Countermeasures, Patch Management, Web Application Concepts, Web Application Threats, Web Application Hacking Methodology, Web API, Webhooks, and Web Shell, Web Application Security,		

SQL Injection Concepts, Types of SQL Injection, SQL Injection Methodology, SQL Injection Tools, Evasion Techniques, SQL Injection Countermeasures, Wireless Concepts, Wireless Encryption, Wireless Threats, Wireless Hacking Methodology, Wireless Hacking Tools, Bluetooth Hacking, Wireless Attack Countermeasures, Wireless Security Tools.

Unit Number: 5	**Title: Hacking Mobile Platforms, IoT and OT Hacking, Cloud Computing and Cryptography**	**No. of hours:**

Content Summary: Mobile Platform Attack Vectors, Hacking Android OS, Hacking iOS, Mobile Device Management, Mobile Security Guidelines and Tools, IoT Hacking, OT Hacking, Cloud Computing Concepts, Container Technology, Serverless Computing, Cloud Computing Threats, Cloud Hacking, Cloud Security, Cryptography Concepts, Encryption Algorithms, Cryptography Tools, Public Key Infrastructure (PKI), Email Encryption, Disk Encryption, Cryptanalysis, Cryptography Attack Countermeasures.

***Self-Learning Components:**

Coursera:

"IBM Cybersecurity Analyst Professional Certificate": This program covers various cybersecurity topics, including ethical hacking, and is offered by IBM.

"Introduction to Cyber Security Specialization": Offered by NYU, this specialization covers essential cybersecurity concepts, including ethical hacking.

Please Note:

At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books:

Certified Ethical Hacker (CEH) v12

Define Course Outcomes (CO)

COs	Statements
CO1	Students will be able to assess the ethical and legal requirements of security assessment and penetration testing and determine a strategy to comply with these requirements.
CO2	Students will be able to analyze different phases of hacking and recommend a strategy to use ethical hacking for assessing the security of various components of an information system.
CO3	Students will be able to compare and contrast different hacking techniques and analyze the legal implications of hacking.
CO4	Students will be able to examine different vulnerabilities, threats, and attacks to information systems and recommend the countermeasures.
CO5	Students will be able to analyze cryptography algorithms and encryption techniques and design the implementation strategies for securing information.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 43. Knowledge 44. Understand 45. Apply 46. Analyze 47. Evaluate 48. Create	Affective levels(A) 36. Receiving 37. Responding 38. Valuing 39. Organizing 40. Characterizing	Psychomotor levels(P) 36. Imitation 37. Manipulation 38. Precision 39. Articulation 40. Improving
CO1	C2		P1
CO2	C3		P2
CO3	C3		P3
CO4	C1		-
CO5	C1		P1

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	2	1	2	2	2	2	3
CO2	3	2	3	2	2	2	2	3	3	3	3	3
CO3	3	3	3	2	2	2	2	3	3	3	3	3
CO4	2	2	1	3	2	2	2	2	3	2	3	3
CO5	2	-	-	-	2	2	2	2	3	2	3	3

Justification for mapping must be relevant

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	2	2	1	2
CO2	3	2	2	2
CO3	2	3	3	1
CO4	2	3	2	3
CO5	2	2	1	2

Department:	**Department of Computer Science and Engineering**		
Course Name: **Introduction to Ethical Hacking**	**Course Code**	**L-T-P**	**Credits**
	ENSP362	0-0-2	1
Type of Course:	Minor		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	The objective is to extract information about the target organization that includes, but is not limited to: Organization Information: Employee details, addresses, and contact details, partner details, weblinks, web technologies, patents, trademarks, etc. Network Information: Domains, sub-domains, network blocks, network topologies, trusted routers, firewalls, IP addresses of the reachable systems, the Whois record, DNS records, and other related information.System Information: Operating systems, web server OSes, location of web servers, user accounts and passwords, etc.
CO 1	The objective is to monitor a target system remotely and perform other tasks that include but are not limited to: Bypassing access controls to gain access to the system (such as password cracking and vulnerability exploitation, Acquiring the rights of another user or an admin (privilege escalation), Creating and maintaining remote access to the system (executing applications such as trojans, spyware, backdoors, and keyloggers), Hiding malicious activities and data theft (executing applications such as Rootkits, steganography, etc.), Hiding the evidence of compromise.
CO 2	The objective is to use social engineering and related techniques to: Sniff user/employee credentials such as employee IDs, names, and email addresses. Obtain employees' basic personal details and organizational information. Obtain usernames and passwords, perform phishing & Detect phishing.

CO 3	The objective is to evade the IDS and Firewall, and other tasks that include, but are not limited to: Detect intrusion attempts, detect malicious network traffic, detect intruders and their attack weapon & evade firewalls using various evasion techniques.
CO 4	The objective is to protect the target wireless network from unauthorized access. To perform various tasks that include, but are not limited to: Discover Wi-Fi networks, capture and analyze wireless traffic, Crack WEP, WPA, and WPA2 Wi-Fi networks.
CO 5	The objective is to perform IoT and OT platform hacking and other tasks that include but are not limited to: Performing IoT and OT device footprinting, Capturing and analyzing traffic between IoT devices.
CO 6	The objective is to use encryption to conceal data and perform other tasks that include but is not limited to: Generate hashes and checksum files, Calculate the encrypted value of the selected file, use encrypting/decrypting techniques, perform file and data encryption, create self-signed certificates, perform email encryption, perform disk encryption & perform cryptanalysis.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Perform Footprinting Through Search Engines	CO2
2	Perform Footprinting Through Social Networking Sites	CO2
3	Perform Footprinting using Various Footprinting Tools	CO2
4	Scan beyond IDS and Firewall	CO1
5	Perform Network Scanning using Various Scanning Tools	CO2
6	Perform SNMP Enumeration	CO2
7	Perform RPC, SMB, and FTP Enumeration	CO2
8	Perform Enumeration using Various Enumeration Tools	CO3
9	Perform Vulnerability Research with Vulnerability Scoring Systems and Databases	CO3

10	Gain Access to the System	CO1
11	Perform Privilege Escalation to Gain Higher Privileges	CO2
12	Gain Access to the Target System using Trojans	CO2
13	Perform Dynamic Malware Analysis	CO3
14	Perform Network Sniffing using Various Sniffing Tools	CO3
15	Perform Social Engineering using Various Techniques	CO3
16	Detect and Protect Against DoS and DDoS Attacks	CO2
17	Perform Session Hijacking	CO2
18	Evade Firewalls using Various Evasion Techniques	CO1
19	Perform a Web Server Attack	CO2
20	Perform Web Application Attacks	CO2
21	Detect Web Application Vulnerabilities using Various Web Application Security Tools	CO4
22	Detect SQL Injection Vulnerabilities using Various SQL Injection Detection Tools	CO2
23	Perform Wireless Traffic Analysis	CO2
24	Perform Wireless Attacks	CO2
25	Hack Android Devices	CO1
26	Secure Android Devices using Various Android Security Tools	CO2
27	Perform Footprinting using Various Footprinting Techniques	CO2
28	Capture and Analyze IoT Device Traffic	CO2
29	Perform S3 Bucket Enumeration using Various S3 Bucket Enumeration Tools	CO2
30	Encrypt the Information using Various Cryptography Tools	CO2

Department:	**Department of Computer Science and Engineering**		
Course Name: **Competitive Programming Lab**	**Course Code**	**L-T-P**	**Credits**
	SEC036	0-0-4	2
Type of Course:	Skill Enhancement Course (SEC)		
Pre-requisite(s), if any: None			
Brief Syllabus: Introduction to Competitive Coding, Data Structures and Algorithms, Time and Space Complexity Analysis, Problem Solving Techniques, Advanced Data Structures, Coding Paradigms, Online Judges and Contest Platforms, Tips and Tricks for Competitive Coding, Mock Contests and Practice Sessions, Self-Learning Components			

Course Outcomes

CO1	Proficiency in Algorithms and Data Structures: Demonstrate proficiency in implementing and analyzing various algorithms and data structures commonly used in competitive programming.
CO2	Efficient Problem Solving: Develop the ability to analyze problem statements, design efficient algorithms, and write optimized code to solve competitive programming problems within time and memory constraints.
CO3	Algorithmic Thinking: Cultivate algorithmic thinking and problem-solving skills by identifying patterns, applying appropriate algorithms, and selecting optimal data structures for a given problem.
CO4	Code Optimization and Complexity Analysis: Apply strategies to optimize code and improve time and space complexity of solutions, considering factors such as algorithm selection, data structure usage, and efficient coding techniques.

CO5	Competitive Programming Skills: Gain familiarity with different online competitive programming platforms, participate in coding competitions, and develop strong problem-solving and critical thinking skills in a competitive programming environment.

Table of Contents

6	Coding Paradigms • Introduction to different coding paradigms: procedural programming, object-oriented programming, and functional programming. • Understanding the benefits and drawbacks of each paradigm in competitive coding.	CO5
7	Online Judges and Contest Platforms • Familiarization with popular online judge platforms like Codeforces, Topcoder, and LeetCode. • Practice solving problems from online contests and participating in coding competitions. List of suggested links to coding platforms ▪ Codeforces: https://codeforces.com/ ▪ Topcoder: https://www.topcoder.com/ ▪ AtCoder: https://atcoder.jp/ ▪ LeetCode: https://leetcode.com/ ▪ HackerRank: https://www.hackerrank.com/ ▪ CodeChef: https://www.codechef.com/ ▪ HackerEarth: https://www.hackerearth.com/ ▪ Project Euler: https://projecteuler.net/ ▪ UVa Online Judge: https://onlinejudge.org/ ▪ SPOJ (Sphere Online Judge): https://www.spoj.com/ ▪ Google Code Jam: https://codingcompetitions.withgoogle.com/codejam ▪ Kick Start by Google: https://codingcompetitions.withgoogle.com/kickstart ▪ ACM ICPC Live Archive: https://icpcarchive.ecs.baylor.edu/ ▪ A2 Online Judge: https://a2oj.com/ ▪ CodeSignal: https://codesignal.com/	CO5
8	Tips and Tricks for Competitive Coding • Learning effective coding techniques, shortcut methods, and best practices for competitive coding. • Developing strategies to optimize code, manage time, and improve problem-solving speed.	CO5
	Mock Contests and Practice Sessions • Conducting mock contests and practice sessions to simulate real coding competitions.	CO5

9	• Solving a wide range of problems to enhance coding skills and adaptability to different problem types.	
10	**Self-Learning Component:** List of Suggested Competitive programming Courses: ▪ Competitive Programmer's Core Skills" by Coursera: This course covers fundamental algorithms and data structures used in competitive programming. Link: https://www.coursera.org/learn/competitive-programming-core-skills ▪ "Algorithms and Data Structures" by MIT OpenCourseWare: This course teaches essential algorithms and data structures for competitive programming. Link: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-006-introduction-to-algorithms-fall-2011/ ▪ "Data Structures and Algorithms" by GeeksforGeeks: This course covers various data structures and algorithms commonly used in competitive programming. Link: https://practice.geeksforgeeks.org/courses/dsa-self-paced ▪ "Introduction to Competitive Programming" by NPTEL: This course introduces the basics of competitive programming and covers algorithms and problem-solving techniques. Link: https://onlinecourses.nptel.ac.in/noc21_cs07/ ▪ "Competitive Programming" by HackerRank: This course provides in-depth coverage of algorithms and data structures with hands-on coding exercises. Link: https://www.hackerrank.com/domains/tutorials/10-days-of-statistics ▪ "Advanced Data Structures and Algorithms" by Udemy: This course dives deeper into advanced data structures and algorithms for competitive programming. Link: https://www.udemy.com/course/advanced-data-structures-and-algorithms-in-java/ ▪ "Mastering Data Structures and Algorithms using C and C++" by Udemy: This course covers data structures and algorithms with a focus on problem-solving for coding interviews and competitive programming. Link: https://www.udemy.com/course/datastructurescncpp/ ▪ "Competitive Programming" by Coding Ninjas: This course provides comprehensive training in competitive programming, covering algorithms, data structures, and problem-solving techniques. Link:	CO5

	https://www.codingninjas.com/courses/online-competitive-programming-course ▪ "Algorithmic Toolbox" by Coursera: This course from the University of California San Diego covers algorithmic techniques and data structures for competitive programming. Link: https://www.coursera.org/learn/algorithmic-toolbox ▪ "Competitive Programming - From Beginner to Expert" by Udemy: This course offers a complete guide to competitive programming, starting from the basics and progressing to advanced topics. Link: https://www.udemy.com/course/competitive-programming-from-beginner-to-expert/ ▪ Competitive Programming Essentials, Master Algorithms 2022 (Udemy) https://www.udemy.com/course/competitive-programming-algorithms-coding-minutes/ ▪ The Bible of Competitive Programming & Coding Interviews **All students must complete one online course from the suggested programs*	

List of popular Competitive Programming Competitions:

1. ACM International Collegiate Programming Contest (ICPC): This is one of the most prestigious programming competitions for college students. Teams compete in solving a set of challenging algorithmic problems within a time limit. Website
2. Google Code Jam: Organized by Google, this annual coding competition challenges participants to solve algorithmic problems. It consists of multiple online rounds leading to a final onsite competition. Website
3. Facebook Hacker Cup: This annual coding competition by Facebook features multiple online rounds and an onsite final round. Participants solve algorithmic problems for a chance to win prizes. Website
4. Topcoder Open: Topcoder hosts this annual programming competition featuring algorithmic and design challenges. Participants compete for cash prizes and a chance to be recognized by industry experts. Website

5. International Olympiad in Informatics (IOI): IOI is an annual international programming competition for high school students. Participants solve algorithmic problems in a contest format. Website
6. AtCoder Grand Contest: AtCoder hosts this regular contest series featuring algorithmic programming challenges. Participants can compete individually or as a team. Website
7. Codeforces: Codeforces is a popular competitive programming platform that hosts regular contests. Participants compete in solving algorithmic problems and earn ratings based on their performance. Website
8. LeetCode Weekly Contests: LeetCode organizes weekly contests where participants can solve algorithmic problems and compete for rankings. Website
9. HackerRank Contests: HackerRank hosts various contests and challenges covering a wide range of programming topics. Participants can compete individually or as part of a team. Website
10. Kaggle Competitions: Kaggle is a platform for data science competitions, where participants solve real-world problems using machine learning and data analysis techniques. Website

All students must participate in some competitions

Suggested Books

1. "Competitive Programming 3" by Steven Halim and Felix Halim: This book is a comprehensive guide to competitive programming, covering algorithms, data structures, problem-solving techniques, and contest strategies. It includes numerous examples, explanations, and practice problems. Book Link
2. "Algorithms" by Robert Sedgewick and Kevin Wayne: This book provides a thorough introduction to algorithms, including sorting, searching, graph algorithms, and dynamic programming. It includes detailed explanations, visualizations, and implementation examples. Book Link
3. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein: Known as "CLRS," this book is a classic reference for algorithms. It covers a wide range of algorithms, data structures, and algorithm design techniques. Book Link
4. "Programming Challenges" by Steven S. Skiena and Miguel A. Revilla: This book presents a collection of programming problems from various competitions and online judges. It provides problem-solving techniques, algorithmic approaches, and example solutions. Book Link

5. "The Art of Computer Programming" by Donald E. Knuth: This multi-volume series is considered a classic in computer science. It covers various algorithms, data structures, and mathematical techniques in great detail. Book Link
6. "Cracking the Coding Interview" by Gayle Laakmann McDowell: Although not specifically focused on competitive programming, this book is a popular resource for coding interview preparation. It covers essential data structures, algorithms, and problem-solving techniques. Book Link
7. "Programming Pearls" by Jon Bentley: This book presents a collection of programming challenges and discusses techniques for solving them efficiently. It emphasizes problem-solving skills and algorithmic thinking. Book Link

Web References

- https://www.geeksforgeeks.org/competitive-programming-a-complete-guide/
- https://www.geeksforgeeks.org/must-do-coding-questions-for-companies-like-amazon-microsoft-adobe/
- https://www.udemy.com/course/competitive-programming
- https://github.com/smv1999/CompetitiveProgrammingQuestionBank
- https://github.com/parikshit223933/Coding-Ninjas-Competitive-Programming
- https://www.hackerearth.com/getstarted-competitive-programming/
- https://www.csestack.org/competitive-coding-questions/

List of Suggested Experiments in Lab Sessions

Questions on Arrays
1. Maximum Subarray Sum: Given an array of integers, find the contiguous subarray with the largest sum.
2. Two Sum: Given an array of integers and a target value, find two numbers in the array that add up to the target.
3. Rotate Array: Rotate an array of n elements to the right by k steps.
4. Merge Intervals: Given a collection of intervals, merge overlapping intervals.
5. Majority Element: Find the majority element in an array. The majority element appears more than n/2 times, where n is the size of the array.
6. Trapping Rain Water: Given an array representing the heights of bars, calculate the amount of water that can be trapped between the bars.
7. Next Permutation: Implement the next permutation algorithm to find the lexicographically next greater permutation of an array of integers.
8. Subarray with Given Sum: Given an unsorted array of non-negative integers and a target sum, find a subarray that adds up to the target sum.
9. Product of Array Except Self: Given an array of n integers, return an array output such that each element at index i of the output array is the product of all the elements in the original array except the one at i.
10. Minimum Size Subarray Sum: Given an array of positive integers and a target sum, find the minimum length of a contiguous subarray whose sum is greater than or equal to the target sum.
Questions on Recursion
1. Factorial: Write a recursive function to calculate the factorial of a given number.
2. Fibonacci Series: Write a recursive function to generate the nth term of the Fibonacci series.
3. Power of a Number: Write a recursive function to calculate the power of a given number.
4. Sum of Digits: Write a recursive function to find the sum of digits of a given number.

5. Palindrome Check: Write a recursive function to check whether a given string is a palindrome or not.
6. Tower of Hanoi: Solve the Tower of Hanoi problem using recursion.
7. Binary Search: Implement a recursive binary search algorithm to find an element in a sorted array.
8. Permutations: Write a recursive function to generate all permutations of a given string.
9. Subset Sum: Given an array of integers and a target sum, write a recursive function to check if there exists a subset that sums up to the target.
10. Combination Sum: Given an array of integers and a target sum, write a recursive function to find all possible combinations that sum up to the target.

Questions on Stacks & Queues:

1. Balanced Parentheses: Given a string of parentheses, write a function to determine if the parentheses are balanced using a stack.
2. Reverse a String: Write a function to reverse a string using a stack.
3. Evaluate Postfix Expression: Given a postfix expression, write a function to evaluate it using a stack.
4. Next Greater Element: Given an array, find the next greater element for each element in the array using a stack.
5. Largest Rectangle in Histogram: Given a histogram represented by an array of bar heights, find the largest rectangle that can be formed in the histogram using a stack.
6. Implement Stack using Queues: Implement a stack data structure using queues.
7. Implement Queue using Stacks: Implement a queue data structure using stacks.
8. Sliding Window Maximum: Given an array and an integer k, find the maximum element in each sliding window of size k using a queue.
9. Print Binary Tree in Level Order: Given a binary tree, print its elements in level order using a queue.
10. Implement Recent Counter: Design a data structure that counts the number of recent requests within a certain time range using a queue.

Questions on Linked Lists

1. Reverse a Linked List: Write a function to reverse a singly linked list.
2. Detect Cycle in a Linked List: Write a function to detect if a linked list contains a cycle.
3. Find the Middle of a Linked List: Write a function to find the middle node of a linked list.
4. Merge Two Sorted Lists: Given two sorted linked lists, write a function to merge them into a single sorted linked list.
5. Remove Nth Node from End of List: Given a linked list, remove the nth node from the end of the list and return its head.
6. Intersection of Two Linked Lists: Given two linked lists, write a function to find the intersection point if it exists.
7. Palindrome Linked List: Given a singly linked list, determine if it is a palindrome.
8. Remove Duplicates from Sorted List: Given a sorted linked list, remove duplicates from it.
9. Add Two Numbers as Linked Lists: Given two linked lists representing two numbers, write a function to add them and return the resulting linked list.
10. Flatten a Multilevel Linked List: Given a linked list with a special structure, flatten it into a single-level linked list.

Questions on Trees

1. Binary Tree Traversals: Implement different tree traversal algorithms such as in-order, pre-order, and post-order traversal.
2. Maximum Depth of Binary Tree: Find the maximum depth or height of a binary tree.
3. Validate Binary Search Tree: Given a binary tree, check if it is a valid binary search tree.
4. Lowest Common Ancestor of Two Nodes: Find the lowest common ancestor of two nodes in a binary tree.
5. Diameter of Binary Tree: Find the diameter of a binary tree, which is the longest path between any two nodes.
6. Binary Tree Level Order Traversal: Traverse a binary tree in level order and return the nodes in each level.
7. Symmetric Tree: Check if a binary tree is symmetric, meaning it is a mirror image of itself.

8. Serialize and Deserialize Binary Tree: Design algorithms to serialize and deserialize a binary tree.
9. Count Complete Tree Nodes: Count the number of nodes in a complete binary tree.
10. Construct Binary Tree from Preorder and Inorder Traversal: Given the preorder and inorder traversal of a binary tree, construct the tree.

Questions on Graphs

- Shortest path: Find the shortest path between two vertices in a graph. This can be solved using Dijkstra's algorithm or Bellman-Ford's algorithm.
- Maximum flow: Find the maximum flow from one vertex to another in a graph. This can be solved using the Ford-Fulkerson algorithm or the Dinic algorithm.
- Minimum spanning tree: Find the minimum spanning tree of a graph. This can be solved using Prim's algorithm or Kruskal's algorithm.
- Topological sorting: Find a topological ordering of a graph. This can be solved using Kahn's algorithm.
- Strongly connected components: Find the strongly connected components of a graph. This can be solved using Tarjan's algorithm.
- Bipartite matching: Find a maximum bipartite matching in a graph. This can be solved using the Hungarian algorithm.
- Traveling salesman problem: Find the shortest tour that visits all the vertices in a graph. This is an NP-hard problem, but there are approximation algorithms that can be used to find a good solution.

Time & Space Complexity

1. Time Complexity Analysis: Analyze the time complexity of a given algorithm or piece of code.
2. Space Complexity Analysis: Analyze the space complexity of a given algorithm or piece of code.
3. Big O Notation: Given a function or algorithm, determine its big O notation in terms of time or space complexity.
4. Best/Worst/Average Case Complexity: Analyze the best, worst, and average-case time or space complexity of an algorithm.

5. Sorting Algorithms: Implement and analyze the time complexity of various sorting algorithms such as Bubble Sort, Insertion Sort, Merge Sort, Quick Sort, and Heap Sort.
6. Searching Algorithms: Implement and analyze the time complexity of various searching algorithms such as Linear Search, Binary Search, and Hashing.
7. Dynamic Programming: Solve dynamic programming problems and analyze their time and space complexity.
8. Recursion vs. Iteration: Compare and analyze the time and space complexity of recursive and iterative solutions for a given problem.
9. Complexity Trade-offs: Analyze and compare the time and space complexity trade-offs of different algorithms for the same problem.
10. Space-Optimized Data Structures: Implement and analyze space-optimized data structures such as Bit Arrays, Bloom Filters, or Space-Efficient Hash Tables.

Questions on Divide & Conquer Strategy

1. Binary Search: Implement a recursive binary search algorithm to find an element in a sorted array.
2. Merge Sort: Implement the Merge Sort algorithm to sort an array of integers.
3. Quick Sort: Implement the Quick Sort algorithm to sort an array of integers.
4. Count Inversions: Given an array of integers, find the number of inversions present using the Divide and Conquer approach.
5. Closest Pair of Points: Given a set of points in a 2D plane, find the pair of points with the smallest distance between them using the Divide and Conquer technique.
6. Maximum Subarray Sum: Given an array of integers, find the maximum sum of a subarray using the Divide and Conquer approach.
7. Matrix Multiplication: Implement a Divide and Conquer algorithm to multiply two matrices efficiently.
8. Finding Majority Element: Given an array of integers, find the majority element (appearing more than n/2 times) using the Divide and Conquer technique.
9. Finding Kth Smallest Element: Given an array of integers, find the kth smallest element using the Divide and Conquer approach.
10. Closest Pair Sum: Given two sorted arrays and a target value, find the pair of elements (one from each array) with the closest sum to the target using the Divide and Conquer technique.

Questions on Dynamic Programming

1. Fibonacci Series: Implement the Fibonacci series using dynamic programming to efficiently calculate the nth term.
2. Longest Common Subsequence: Given two strings, find the length of the longest common subsequence using dynamic programming.
3. Knapsack Problem: Given a set of items with weights and values, determine the maximum value that can be obtained by selecting a subset of items within a weight limit using dynamic programming.
4. Coin Change Problem: Given a set of coin denominations and a target value, find the minimum number of coins needed to make the target value using dynamic programming.
5. Rod Cutting Problem: Given a rod of a certain length and a price list for different rod lengths, find the maximum value that can be obtained by cutting and selling the rod using dynamic programming.
6. Edit Distance: Given two strings, find the minimum number of operations (insertion, deletion, and substitution) required to convert one string into another using dynamic programming.
7. Maximum Subarray Sum: Given an array of integers, find the maximum sum of a subarray using dynamic programming.
8. Longest Increasing Subsequence: Given an array of integers, find the length of the longest increasing subsequence using dynamic programming.
9. Matrix Chain Multiplication: Given a sequence of matrices, find the minimum number of scalar multiplications needed to multiply them using dynamic programming.
10. Subset Sum Problem: Given a set of integers and a target sum, determine if there exists a subset that sums up to the target using dynamic programming.

Questions on Greedy Programming

1. Fractional Knapsack Problem: Given a set of items with weights and values, determine the maximum value that can be obtained by selecting fractions of items within a weight limit using a greedy algorithm.
2. Activity Selection Problem: Given a set of activities with start and finish times, select the maximum number of activities that can be performed without overlapping using a greedy algorithm.

3. Minimum Spanning Tree: Given a weighted graph, find the minimum spanning tree using Kruskal's or Prim's algorithm, which are both based on greedy approaches.
4. Huffman Coding: Given a set of characters and their frequencies, construct a binary code that minimizes the total encoded length using a greedy algorithm.
5. Coin Change Problem: Given a set of coin denominations and a target value, find the minimum number of coins needed to make the target value using a greedy algorithm.
6. Job Scheduling Problem: Given a set of jobs with their deadlines and profits, schedule the jobs to maximize the total profit using a greedy algorithm.
7. Interval Scheduling Problem: Given a set of intervals, select the maximum number of non-overlapping intervals using a greedy algorithm.
8. Dijkstra's Algorithm: Given a weighted graph, find the shortest path from a source vertex to all other vertices using Dijkstra's algorithm, which is based on a greedy approach.
9. Egyptian Fraction: Given a fraction, represent it as a sum of unique unit fractions using a greedy algorithm.
10. Car Fueling Problem: Given the total distance to be covered, the capacity of the fuel tank, and a list of distances between fuel stations, determine the minimum number of refuelings needed to reach the destination using a greedy algorithm.

Questions on String Matching

1. Naive String Matching: Implement the naive string matching algorithm to find all occurrences of a pattern in a text.
2. Knuth-Morris-Pratt (KMP) Algorithm: Implement the KMP algorithm to efficiently find all occurrences of a pattern in a text.
3. Rabin-Karp Algorithm: Implement the Rabin-Karp algorithm to efficiently find all occurrences of a pattern in a text using hashing.
4. Longest Common Substring: Given two strings, find the longest common substring using dynamic programming or other efficient algorithms.
5. Longest Common Prefix: Given an array of strings, find the longest common prefix using a suitable algorithm.
6. Regular Expression Matching: Implement a regular expression matching algorithm to determine if a string matches a given pattern.
7. Anagrams: Given a list of strings, find all pairs of strings that are anagrams of each other.

8. Palindromic Substrings: Given a string, find all palindromic substrings using a suitable algorithm.
9. Boyer-Moore Algorithm: Implement the Boyer-Moore algorithm to efficiently find all occurrences of a pattern in a text.
10. Subsequence Matching: Given two strings, determine if one string is a subsequence of the other.
Questions on Advanced Data Structures
1. Trie: Implement a Trie data structure and solve problems such as word search, autocomplete, or finding the longest common prefix.
2. Segment Tree: Implement a Segment Tree data structure and solve problems such as range sum queries, range minimum/maximum queries, or range updates.
3. Fenwick Tree (Binary Indexed Tree): Implement a Fenwick Tree data structure and solve problems such as prefix sum queries or range updates.
4. Disjoint Set Union (DSU) / Union-Find: Implement a DSU data structure and solve problems such as connected components, cycle detection, or Kruskal's algorithm for finding the minimum spanning tree.
5. Treap: Implement a Treap (a balanced binary search tree with randomized priorities) and solve problems such as maintaining the median of a dynamic set of numbers or solving range queries on a set of intervals.
6. Suffix Array: Implement a Suffix Array data structure and solve problems such as finding the longest common substring, finding the lexicographically smallest substring, or pattern matching.
7. LCA (Lowest Common Ancestor): Implement an LCA data structure and solve problems such as finding the lowest common ancestor of two nodes in a tree or solving distance-related queries on a tree.
8. K-D Tree: Implement a K-D Tree data structure and solve problems such as nearest neighbor search or range search in a multi-dimensional space.
9. AVL Tree or Red-Black Tree: Implement a balanced binary search tree (either AVL Tree or Red-Black Tree) and solve problems such as maintaining a sorted dynamic set or solving range queries.
10. B+ Tree: Implement a B+ Tree data structure and solve problems such as indexing or range queries on a large dataset.

References to Interview Questions

- https://www.simplilearn.com/coding-interview-questions-article
- https://www.csestack.org/competitive-coding-questions/
- https://www.geeksforgeeks.org/a-competitive-programmers-interview/
- https://www.geeksforgeeks.org/must-do-coding-questions-for-companies-like-amazon-microsoft-adobe/
- https://unstop.com/blog/competitive-coding-questions-with-solutions
- https://unstop.com/blog/competitive-coding-questions-with-solutions

Department Elective-I (Cyber Security)

Department:	**Department of Computer Science and Engineering**		
Course Name: Secure Coding & Vulnerabilities	**Course Code**	**L-T-P**	**Credits**
	ENSP301	4-0-0	4
Type of Course:	Minor (Department Elective I)		
Pre-requisite(s), if any:			

Brief Syllabus:

Secure Coding and Vulnerabilities is a comprehensive course that focuses on understanding and mitigating application security threats and attacks. The course covers various aspects such as security requirements gathering, secure application design and architecture, and secure coding practices for input validation, authentication, cryptography, session management, and error handling. Students will learn about common application vulnerabilities and the potential consequences of security breaches. They will also gain knowledge and skills in static and dynamic application security testing methods, as well as secure deployment and maintenance practices. The course aims to equip students with the necessary tools and techniques to develop robust and secure applications while adhering to best practices in the field of application security.

UNIT WISE DETAILS

Unit Number: 1	**Title: Introduction to coding and Security**	**No. of hours: 12**

Content Summary:

Introduction-security concepts-CIA Triad, Viruses, Trojans, and Worms, threat, vulnerability, risk, attack. Coding Standards: Dirty Code and Dirty Compiler, Dynamic Memory Management functions, Common memory management Errors (Initialization Errors, Forget to Check Return Values, accessing already freed memory, Freeing the same memory multiple times, Forget to free the allocated memory), Integer Security – Introduction to integer types: Integer Data Types, data type conversions, Integer vulnerabilities and mitigation strategies

Unit Number: 2	**Title: Secure Application Design and Architecture**	**No. of hours: 8**

Content Summary:

Security requirements gathering and analysis, Secure software development life cycle (SSDLC) , Security issues while writing SRS, Design phase security, Development Phase, Test Phase, Maintenance Phase, Writing Secure Code – Best Practices SD3 (Secure by design, default and deployment), Security principles and Secure Product Development Timeline.

Unit Number: 3	Title: Secure Coding Practices and Vulnerabilities	No. of hours: 8

Content Summary:
Input validation Techniques-whitelist validation, regular expressions, authentication and authorization, Cryptography, buffer overflows, Session management and protection against session-related attacks, Secure error handling and logging practices, SQL Injection Techniques and Remedies, Race conditions

Unit Number: 4	Title: Application Security Testing and Deployment	No. of hours: 12

Content Summary:
Security code overview, Secure software installation. The Role of the Security Tester, Building the Security Test Plan. Testing HTTP-Based Applications, Testing File-Based Applications, Testing Clients with Rogue Servers, Static and Dynamic Application Security Testing (SAST & DAST), Secure Deployment and Maintenance, Patch management and software updates, Vulnerability scanning and penetration testing.

***Self-Learning Components**: **mention 4-5 topics for students in bullet points**
Please Note:

1. Code Review Tools: Students can explore open-source code review tools such as SonarQube, ESLint, or FindBugs to understand how these tools can help identify security vulnerabilities in code.
2. Security Frameworks such as OWASP (Open Web Application Security Project) and their associated resources.
3. Secure Development Tools: Students can explore tools like Burp Suite, ZAP (Zed Attack Proxy), or WebInspect to understand how these tools can be used for dynamic application security testing (DAST) and penetration testing.
4. Secure Coding in Web Applications: Students can dive deeper into web application security topics, such as Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), or security measures like Content Security Policy (CSP) and HTTP security headers.

Reference Books:

- Writing Secure Code, Michael Howard and David LeBlanc,Microsoft Press, 2nd Edition, 2004
- Buffer Overflow Attacks: Detect, Exploit, Prevent by Jason Deckard ,Syngress,1st Edition, 2005
- Threat Modeling, Frank Swiderski and Window Snyder,Microsoft Professional, 1st Edition ,2004
- Secure Coding: Principles and Practices by Mark G. Graff, Kenneth R. van Wyk, Publisher(s): O'Reilly Media, Inc., 2003
- The Software Vulnerability Guide (Programming Series) by H. Thompson (Author), Scott G. Chase, 2005

Reference Links:

- **"Secure Coding Practices" on Udemy - Offered by The App Brewery.**

Link: https://www.udemy.com/course/secure-coding-practices/

- "**Secure Coding: Preventing Software Vulnerabilities" on Pluralsight - Offered by Pluralsight**. Link: Secure Coding: Preventing Software Vulnerabilities
- "**Software Security" on edX - Offered by University of Maryland, College Park**. Link: Software Security
- Identifying Security Vulnerabilities in C/C++Programming | Coursera
- Principles of Secure Coding | Coursera

- Identifying Security Vulnerabilities | Coursera

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** different types of application security threats and their potential impact.
CO2	**Apply** secure design principles and architectures to develop robust and secure applications.
CO3	**Implement** secure coding practices for input validation, authentication, cryptography, session management, and error handling.
CO4	**Conduct** static and dynamic application security testing to identify vulnerabilities and implement secure deployment and maintenance practices.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels©	Affective levels(A)	Psychomotor levels(P)
	1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C2	A2	P2
CO2	C3	A3	P3
CO3	C3	A3	P3
CO4	C4	A4	P4

CO-PO Mapping

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	2	1	2	2	2	2	3
CO2	3	2	3	2	2	2	2	3	3	3	3	3
CO3	3	3	3	2	2	2	2	3	3	3	3	3
CO4	2	2	1	3	2	2	2	2	3	2	3	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

CO-PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	2	1
CO2	3	2	2	2	2
CO3	2	3	3	1	1
CO4	2	3	2	3	2

Relevance of the Syllabus to various indicators

Unit I	**Introduction to coding and Security**
Local	-
Regional	-
National	-
Global	Enhancing cybersecurity capabilities and promoting secure software development.
Employability	-
Entrepreneurship	-
Skill Development	Developing coding skills with a focus on security.
Professional Ethics	Develop applications that prioritize data security and user privacy.
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Secure Application Design and Architecture**
Local	Applying security requirements and following secure software development life cycle (SSDLC) practices aligns with local needs to protect sensitive data and ensure secure application design.
Regional	-
National	-
Global	Promotes global standards in application security, fostering a global culture of secure software development.
Employability	Proficiency in secure application design and adherence to security principles enhances students' employability in organizations seeking professionals with secure development skills
Entrepreneurship	-
Skill Development	Enhances students' skills in secure software design, architecture, and implementation, preparing them to tackle application security challenges.
Professional Ethics	Ethical considerations of data privacy and security, fostering responsible development practices.
Gender	-
Human Values	-

Environment & Sustainability	-
Unit III	**Secure Coding Practices and Vulnerabilities**
Local	Understanding input validation techniques, cryptography, and secure error handling directly addresses local needs for developing secure applications and mitigating common vulnerabilities.
Regional	-
National	Addressing vulnerabilities such as SQL injection and race conditions through secure coding practices aligns with national objectives of securing critical applications and preventing cyber attacks.
Global	Knowledge of secure coding practices and vulnerability mitigation strategies helps establish global standards for secure software development and promotes a secure digital environment worldwide.
Employability	-
Entrepreneurship	-
Skill Development	Hones students' skills in secure coding, vulnerability identification, and remediation, enhancing their technical capabilities in application security.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Application Security Testing and Deployment**
Local	-
Regional	-
National	-
Global	Understanding static and dynamic application security testing methods and secure deployment practices promotes global standards for secure software deployment and mitigating application vulnerabilities.
Employability	Expertise in application security testing and secure deployment enhances students' employability in roles focused on ensuring application security and secure software deployment.
Entrepreneurship	-
Skill Development	Develops students' skills in application security testing, penetration testing, and secure deployment, equipping them with practical expertise in securing applications.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG-4,9,16

NEP 2020	Skill development, employability, and entrepreneurship
POE/4th IR	Emphasizes the importance of cybersecurity in the digital era.

Department:	Department of Computer Science and Engineering		
Course Name: Secure Coding & Vulnerabilities Lab	Course Code	L-T-P	Credits
	ENSP351	0-0-2	1
Type of Course:	Minor		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	
CO 1	**Apply** Secure Coding Techniques for enhancing application security.
CO 2	**Analyze** and Evaluate Security Vulnerabilities
CO 3	**Evaluate** and Communicate Importance of Secure Coding by analyzing potential vulnerabilities
CO 4	**Design** and Implement Secure Applications using secure cryptographic libraries.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Write code to convert between different data types	CO1
2	Implement dynamic memory allocation and deallocation operations, and analyze potential errors and vulnerabilities.	CO2
3	Write code snippets with initialization errors, memory leaks, and double free issues, and use tools like Valgrind to detect and fix these errors.	CO2
4	Analyze a given code snippet with dirty code practices	CO2
5	Perform static code analysis on a sample codebase using a secure coding tool SonarQube	CO3
6	Conduct dynamic code analysis on a web application using OWASP	CO2
7	Configure the tool to intercept and analyze HTTP requests and responses.	CO2
8	Implement encryption algorithms (e.g., AES) using secure cryptographic libraries or frameworks.	CO4
9	Implement and test whitelist validation techniques to ensure secure input handling.	CO1
10	Develop a simple web application that requires user authentication.	CO4
11	Implement cryptographic functions for secure data protection	CO4
12	Implement input sanitization and validation techniques to prevent SQL injection attacks.	CO1

13	Conduct a security audit and penetration testing on a provided application to identify SQL injection vulnerabilities.	CO2
14	Identify common memory management errors such as forgetting to check return values or accessing already freed memory.	CO2
15	Write a sample code that requires input validation, such as user input or data from external sources.	CO1
16	Write a sample code that involves cryptographic operations, such as encryption or hashing.	CO4
17	Conduct security testing on an HTTP-based application to identify vulnerabilities and security weaknesses.	CO2
18	Set up a local or web-based application that operates over HTTP. Perform security testing using appropriate tools and techniques, such as vulnerability scanners and penetration testing	CO2
19	Perform security testing on a file-based application to assess its security posture and identify potential vulnerabilities.	CO2
20	Utilize appropriate tools and techniques to conduct static analysis on the application's source code to identify potential vulnerabilities	CO3
21	Identify and configure important HTTP security headers, such as Strict-Transport-Security (HSTS), X-Frame-Options, X-XSS-Protection, and X-Content-Type-Options.	CO1
22	Develop a sample web application that includes error handling and logging functionality.	CO4
23	Implement secure error handling techniques, such as displaying generic error messages to users and logging detailed errors only to authorized personnel.	CO4
24	Apply secure coding best practices, such as input validation, output encoding, proper error handling, and secure use of APIs and libraries.	CO1
25	Test the code for vulnerabilities and discuss the importance of writing secure code to prevent potential exploitation.	CO3

Projects

- Implement a secure software development lifecycle

http://www.owasp.org/index.php/Category:OWASP_CLASP_Project

- Establish secure coding standards

http://www.owasp.org/index.php/Category:OWASP_Guide_Project

- Build a re-usable object library

http://www.owasp.org/index.php/Category:OWASP_Enterprise_Security_API

- Verify the effectiveness of security controls

http://www.owasp.org/index.php/Category:OWASP_Application_Security_Verification_Standard_Project

- Establish secure outsourced development practices including defining security requirements and verification methodologies in both the request for proposal (RFP) and contract.

http://www.owasp.org/index.php/Category:OWASP_Legal_Project

Department:	**Department of Computer Science and Engineering**		
Course Name: **Cyber Crime Investigation & Digital Forensics**	**Course Code**	**L-T-P**	**Credits**
	ENSP303	4-0-0	4
Type of Course:	Minor (Department Elective I)		
Pre-requisite(s), if any:			
Brief Syllabus: Introduces the principles and practices of digital forensics including digital investigations, data and file recovery methods, and digital forensics analysis and invalidation. Topics include data acquisition, digital forensics tools, virtual machines, network, mobile devices and cloud forensics.			
UNIT WISE DETAILS			
Unit Number: 1	**Title: Title: Introduction**	**No. of hours: 8**	
Content Summary: Introduction to Digital Forensics, Definition and types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, introduction to internet crimes, hacking and cracking, credit card and ATM frauds, web technology, cryptography, emerging digital crimes and modules.			
Unit Number: 2	**Title: Types of Cyber Crimes**	**No. of hours: 10**	
Content Summary: Crimes targeting Computers: Unauthorized Access Packet Sniffing Malicious Codes including Trojans, Viruses, Logic Bombs, etc. Online based Cyber Crimes: Phishing and its variants Web Spoofing and E-mail Spoofing Cyber Stalking Web defacement Financial crimes, ATM and Card Crimes etc Spamming Commercial espionage and Commercial Extortion online Software and Hardware Piracy Money Laundering Fraud& Cheating Other Cyber Crimes.			

Unit Number: 3	Title: Investigation of Cyber Crimes	No. of hours: 12

Content Summary:

Investigation of malicious applications Agencies for investigation in India, their powers and their constitution as per Indian Laws Procedures followed by First Responders; Evidence Collection and Seizure Procedures of Digital mediums Securing the Scene, Documenting the Scene, Evidence Collection and Transportation Data Acquisition Data Analysis Reporting

Unit Number: 4	Title : Forensic Tools and Processing of Electronic Evidence	No. of hours: 10

Content Summary:

Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images, damaged SIM and data recovery, multimedia evidence, retrieving deleted data: desktops, laptops and mobiles, retrieving data from slack space, renamed file, ghosting, compressed files.

***Self-Learning Components:**

1. **Open-Source Digital Forensics Tools: Introduction to popular open-source digital forensics tools such as Autopsy, Sleuth Kit, and Volatility.**
2. **Exploring open-source threat intelligence platforms like MISP and AlienVault OTX.**
3. **Discussing the benefits of information sharing and collaborative efforts in combating cyber threats.**
4. **Digital Forensics and Cyber-Crime Investigation, https://www.udemy.com/course/digital-forensics-and-cyber-crime-investigation/**

Reference Books:

- Moore, Robert, (2011). Cybercrime, investigating high-technology computer crime(2nd Ed.). Elsevie
- C. Altheide& H. Carvey Digital Forensics with Open Source Tools, Syngress, 2011.
- Majid Yar, "Cybercrime and Society", SAGE Publications Ltd, Hardcover, 2nd Edition, 2013.

- Robert M Slade, "Software Forensics: Collecting Evidence from the Scene of a Digital Crime", Tata McGraw Hill, Paperback, 1st Edition, 2004.

Web references:

- https://www.coursera.org/learn/digital-forensics-concepts
- https://www.udemy.com/course/computer-forensics-and-digital-forensics-for-everyone/

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** the nature and classification of conventional and cyber-crimes.
CO2	**Analyze** and **identify** various types of cyber-crimes and their modes of operation.
CO3	**Evaluate** the impact of cyber-crimes on individuals, organizations, and society.
CO4	**Develop** an understanding of digital forensics and the investigative procedures used in cyber-crime cases.
CO5	**Apply** forensic tools and techniques to retrieve and analyze digital evidence.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 31. Knowledge 32. Understand 33. Apply 34. Analyze 35. Evaluate 36. Create	Affective levels(A) 26. Receiving 27. Responding 28. Valuing 29. Organizing 30. Characterizing	Psychomotor levels(P) 26. Imitation 27. Manipulation 28. Precision 29. Articulation 30. Improving
CO1	C2	A1	-
CO2	C3	-	-
CO3	C4	A2	-
CO4	C5	-	P5
CO5	C6	-	P2

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	1	-	2	2	-	2	2	1
CO2	-	3	3	-	3	2	-	2	3	-
CO3	-	1	3	-	3	2	2	3	3	-
CO4	2	2	2	3	3	3	2	2	2	-
CO5	-	2	2	3	3	3	-	2	2	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	1	2	1
CO3	2	1	3	2
CO4	2	2	2	3
CO5	3	1	2	2

Relevance of the Syllabus to various indicators

Unit I	Introduction
Local	The knowledge and understanding of cybercrime and computer crime can help local communities and law enforcement agencies address and prevent such crimes in their area.
Regional	Cybercrime is a regional concern, and understanding its types and emerging trends can help in regional collaboration for combating cyber threats.
National	Cybercrime is a significant concern at the national level. Developing expertise in digital forensics and cybercrime investigation can enhance national security and protect critical infrastructure.
Global	Cybercrime has a global impact, and knowledge in this area can contribute to international efforts in combating cyber threats and promoting cybersecurity.
Employability	The skills and knowledge gained in this unit can enhance employability in the field of cybersecurity, law enforcement, digital forensics, and related industries.
Entrepreneurship	-
Skill Development	Developing skills in digital forensics, evidence handling, and understanding emerging digital crimes, contributing to skill development in the field.
Professional Ethics	Studying cybercrime and computer crime can raise awareness of ethical issues related to information security, privacy, and responsible use of technology.
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Types of Cyber Crimes
Local	-
Regional	-

National	Cyber crimes pose significant challenges to national security and the economy. Understanding different types of cyber crimes allows governments and law enforcement agencies to develop robust policies, laws, and strategies to address cyber threats at the national level.
Global	Cyber crimes have a global reach and impact. By studying the types of cyber crimes, individuals and organizations can contribute to global efforts in promoting cybersecurity, sharing threat intelligence, and developing international frameworks to combat cyber threats.
Employability	Acquiring knowledge about various types of cybercrimes enhances employability in the field of cybersecurity.
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills in internet technologies and network protocols
Professional Ethics	Awareness of different types of cybercrimes raises ethical considerations surrounding privacy, data protection, and responsible use of technology.
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Investigation of Cyber Crimes
Local	-
Regional	Collaboration among regional investigation agencies can be improved through the knowledge of investigation procedures and digital evidence handling.
National	Investigating cyber crimes is a critical aspect of national security, and this unit's content can enhance the investigation capabilities of agencies at the national level.
Global	Aligns with global Cooperation and sharing of best practices in cybercrime investigation.

Employability	Proficiency in cybercrime investigation and evidence handling is in high demand, offering employment opportunities in the field of digital forensics and cybersecurity.
Entrepreneurship	Knowledge in cybercrime investigation can inspire entrepreneurs to develop innovative tools and services for digital forensics and incident response.
Skill Development	Developing skills in evidence collection, data analysis, and reporting, contributing to skill development in the field of cybercrime investigation.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Forensic Tools and Processing of Electronic Evidence
Local	The knowledge and skills gained in this unit are relevant at the local level as local law enforcement agencies and forensic professionals need to be equipped with the tools and techniques to effectively process electronic evidence in cybercrime investigations within their jurisdiction
Regional	-
National	Protecting national security and upholding the rule of law in the digital realm requires a strong capability in digital forensics. The knowledge and proficiency in forensic tools and processing of electronic evidence contribute to national efforts in preventing and investigating cybercrimes.
Global	Cybercrimes are a global concern, and international cooperation is vital in addressing them.
Employability	Proficiency in forensic tools and processing of electronic evidence enhances employability in the field of digital forensics and cybersecurity.

Entrepreneurship	Knowledge of forensic tools and techniques can inspire entrepreneurs to develop innovative solutions, tools, and services in the field of digital forensics.
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4,9,16
NEP 2020	Its aligns with the policy's objective of developing skills relevant to the current and future job market, particularly in the field of cyber security.
POE/4th IR	The Fourth Industrial Revolution by providing knowledge and skills necessary to combat cyber threats and protect digital assets in an increasingly interconnected and digital world

Department:	**Department of Computer Science and Engineering**		
Course Name: **Cyber Crime Investigation & Digital Forensics Lab**	**Course Code**	**L-T-P**	**Credits**
	ENSP353	0-0-2	1
Type of Course:	Minor (Department Elective I)		

Defined Course Outcomes

COs	
CO 1	Understand the fundamental concepts and principles of digital forensics and cybercrimes.
CO 2	Apply the knowledge of digital forensics techniques and procedures to collect, analyse, and preserve electronic evidence in various types of cybercrimes.
CO 3	Evaluate and utilize forensic tools and technologies for data acquisition, analysis, and recovery in the investigation of cybercrimes.
CO 4	Analyse and interpret digital evidence obtained from different sources, such as electronic media, internet crimes, malicious applications, and various forms of cybercrimes.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Experiment on collecting and preserving electronic media for forensic analysis.	CO 2
2	Experiment on searching and retrieving digital evidence from various storage devices.	CO 2
3	Experiment on handling and analyzing malicious codes, such as Trojans, viruses, and logic bombs.	CO 2
4	Experiment on investigating unauthorized access to computer systems.	CO 2
5	Experiment on packet sniffing and analyzing network traffic for evidence.	CO 2
6	Experiment on identifying and investigating phishing attacks and their variants.	CO 2
7	Experiment on detecting and investigating web spoofing and email spoofing incidents.	CO 2
8	Experiment on cyber stalking investigation techniques.	CO 2
9	Experiment on investigating web defacement incidents and identifying the perpetrators.	CO 2
10	Experiment on investigating financial crimes, including ATM and credit card frauds.	CO 2
11	Experiment on tracing and investigating spamming activities.	CO 2
12	Experiment on investigating cases related to software and hardware piracy.	CO 2
13	Experiment on tracing and investigating money laundering activities.	CO 2
14	Experiment on investigating fraud and cheating cases in the digital realm.	CO 2

15	Experiment on analyzing malicious applications and their impact on digital devices.	CO 4
16	Experiment on understanding the role and capabilities of investigation agencies in India.	CO 1
17	Experiment on following proper evidence collection and seizure procedures in digital investigations.	CO 2
18	Experiment on securing and documenting the crime scene in digital forensics.	CO 2
19	Experiment on acquiring and analyzing data from digital devices.	CO 3
20	Experiment on using forensic tools like EnCase and FTK for digital investigations.	CO 3
21	Experiment on countering anti-forensics techniques and retrieving hidden information.	CO 3
22	Experiment on recovering data from damaged SIM cards and other multimedia evidence.	CO 2
23	Experiment on recovering deleted data from desktops, laptops, and mobile devices.	CO 2
24	Experiment on analyzing data from slack space and renamed files.	CO 4
25	Experiment on forensic imaging, including ghosting and analysis of compressed files.	CO 3

Department:	Department of Computer Science and Engineering		
Course Name: AI in Cyber Security	Course Code	L-T-P	Credits
	ENSP305	4-0-0	4
Type of Course:	Minor (Department Elective I)		

Pre-requisite(s), if any: basic understanding of web development technologies such as HTML, CSS, and JavaScript. Additionally, students should have some familiarity with networking concepts, operating systems, and databases.

Brief Syllabus:

This syllabus covers essential topics in web application security, including injection attacks, authentication and access control, cryptography, testing, security standards, best practices, and risk management. It is divided into four units and may be completed in a semester-long course. Students will gain an understanding of common web application vulnerabilities and how to prevent and mitigate them. They will also learn about authentication and access control mechanisms, cryptography techniques, and web application security testing. Finally, students will explore best practices for secure web application development and incident response and disaster recovery planning.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to AI and Cyber Security	No. of hours: 4

Content Summary:

Overview of Artificial Intelligence and its applications in Cyber Security History and evolution of AI in cyber security, Understanding of the Cyber Security threats landscape, Familiarization with the latest trends and techniques of AI in Cyber Security, Basic principles of Machine Learning and Deep Learning in Cyber Security , Ethical considerations and challenges of using AI in cyber security.

Unit Number: 2	Title: Machine Learning Techniques for Cyber Security	No. of hours: 8

Content Summary:

An introduction to Machine Learning techniques, Supervised and unsupervised Machine Learning models in Cyber Security, Feature engineering and data

preparation for Machine Learning models, Case studies demonstrating the application of Machine Learning to Cyber Security problems.

Unit Number: 3	Title: Deep Learning Techniques for Cyber	No. of hours: 8

Content Summary:

Introduction to Deep Learning techniques ,Convolutional Neural Networks (CNNs) and their application in Cyber Security ,Recurrent Neural Networks (RNNs) and their application in Cyber Security ,GANs and their application in Cyber Security ,Case studies demonstrating the application of Deep Learning to Cyber Security problems.

Unit Number: 4	Title: AI for Cyber Security: Threat Detection and Prevention	No. of hours: 8

Content Summary:

Introduction to AI and its applications in threat detection and prevention ,Overview of different types of threats in cyber security and their characteristics ,Understanding the limitations of traditional threat detection and prevention methods ,Fundamentals of machine learning and deep learning for threat detection and prevention ,Supervised machine learning algorithms for threat detection, such as decision trees, support vector machines, and random forests ,Unsupervised machine learning algorithms for anomaly detection, such as clustering and outlier detection ,Deep learning techniques for threat detection, such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) ,Feature selection and feature engineering for machine learning in threat detection, Emerging trends and challenges in AI for threat detection and prevention, including adversarial machine learning, explainable AI, and privacy concerns.

***Self-Learning Components:**

1) **Anomaly Detection**
2) **Malware Detection**
3) **Adaptive Access Control**
4) **Network Traffic Analysis**

Reference Books:

1. Artificial Intelligence for Cybersecurity" by Bhaskar Sinha (Auerbach Publications)
2. Machine Learning and Security: Protecting Systems with Data and Algorithms" by Clarence Chio and David Freeman (O'Reilly Media)

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** Understand the concepts and applications of AI in the field of cyber security.
CO2	**Express** the ethical and legal considerations associated with the use of AI in cyber security.
CO3	**Determine** emerging trends and technologies in AI for cyber security, and their potential impact on the field.
CO4	**Identify** strategies for integrating AI-driven solutions into existing cyber security frameworks, policies, and practices.
CO5	**Articulate** critical thinking and problem-solving skills to address real-world cyber security challenges using AI techniques.
CO6	**Design** machine learning techniques for threat detection and prevention in cyber security, including supervised and unsupervised algorithms.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 37. Knowledge 38. Understand 39. Apply 40. Analyze 41. Evaluate 42. Create	Affective levels(A) 31. Receiving 32. Responding 33. Valuing 34. Organizing 35. Characterizing	Psychomotor levels(P) 31. Imitation 32. Manipulation 33. Precision 34. Articulation 35. Improving
CO1	C2	A1	P1
CO2	C3	A3	P2
CO3	C3	A3	P3
CO4	C1	A2	-
CO5	C2	A3	P5
CO6	C6	A4	-

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	2	-	-	1	1	1	1
CO2	3	2	3	2	2	1	1	1	1	2	1	2
CO3	3	3	3	3	3	2	2	1	2	1	2	1
CO4	2	2	3	3	3	1	-	-	1	2	1	1
CO5	3	2	3	3	3	2	-	1	2	1	1	1
CO6	3	3	2	3	3	2	1	1	2	1	1	1

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	3	3	3	2
CO3	3	3	3	3
CO4	3	3	3	2
CO5	3	3	3	3
CO6	3	3	3	2

Relevance of the Syllabus to various indicators

Unit I	**Introduction to AI and Cyber Security**
Local	Addresses local understanding of the Cyber Security and its impact on society
Regional	Addresses regional Cyber Security infrastructure requirements.
National	Contributes to national Cyber Security literacy and its impact to the nation.
Global	Aligns with global trends in Cyber Security technologies and network protocols
Employability	Develops skills in using Cyber Security and its tools for network protocols
Entrepreneurship	Build entrepreneurship
Skill Development	Develops basic knowledge and skills in Cyber Security technologies and network protocols
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Machine Learning Techniques for Cyber Security**
Local	Addresses local understanding of the Internet and its impact on society

Regional	-
National	Contributes to national digital literacy and internet connectivity strategies
Global	Aligns with global trends in internet technologies and network protocols
Employability	Develops skills in using Machine learning techniques and understanding network protocols
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills in Machine learning techniques technologies and network protocols
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Deep Learning Techniques for Cyber**
Local	Addresses local network security needs and practices
Regional	-
National	Contributes to national network security strategies and protocols
Global	Aligns with global trends in network security techniques and protocols
Employability	Develops skills in Deep learning techniques and network security techniques
Entrepreneurship	-
Skill Development	Develops knowledge and skills in Deep learning techniques and network security
Professional Ethics	-
Gender	-

Human Values	-
Environment & Sustainability	-
Unit IV	**AI for Cyber Security: Threat Detection and Prevention**
Local	Addresses local understanding of Threat Detection and Prevention. and implementation of internet-based services
Regional	-
National	Contributes to national digital communication strategies and multimedia applications
Global	Aligns with global trends in internet telephony, multimedia applications, and SEO
Employability	Develops skills in Threat Detection and Prevention.
Entrepreneurship	-
Skill Development	Develops knowledge and skills in Threat Detection and Prevention
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts of internet telephony, multimedia applications, and SEO

Department:	**Department of Computer Science and Engineering**		
Course Name: **AI in Cyber Security Lab**	**Course Code**	**L-T-P**	**Credits**
	ENSP355	0-0-2	1
Type of Course:	Minor (Department Elective I)		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	Comprehensive Understanding of AI in Cyber Security:
CO 1	Practical Experience with AI Tools and Techniques
CO 2	Enhanced Malware Detection and Classification Skills
CO 3	Critical Thinking and Problem-Solving Abilities
CO 4	Research and Innovation in AI Cyber Security

Lis of Experiment

Ex. No	Experiment Title	Mapped CO/COs
1	Malware detection: Develop an AI model to detect and classify different types of malware.	CO 2
2	Intrusion detection: Build an AI system to identify and alert on network intrusions and suspicious activities.	CO 1
3	Phishing detection: Train an AI algorithm to recognize and flag phishing emails or websites.	CO 1, CO 3
4	Vulnerability assessment: Use AI techniques to identify potential vulnerabilities in software or systems.	CO 1, CO 3
5	Botnet detection: Develop an AI model to detect and track botnet activities on a network.	CO 1

6	Password cracking: Build an AI system to analyze and crack weak passwords.	CO 1, CO 3
7	Network traffic analysis: Use AI algorithms to analyze network traffic and identify patterns or anomalies.	CO 1, CO 3
8	Behavioral authentication: Develop an AI model to authenticate users based on their behavioral patterns.	CO 1, CO 3
9	Anomaly detection: Train an AI system to detect anomalous behavior in user activities or system logs.	CO 1
10	Zero-day vulnerability detection: Use AI techniques to identify unknown or previously undiscovered vulnerabilities.	CO 1, CO 3
11	Social engineering detection: Build an AI system to recognize and alert on social engineering attempts.	CO 1, CO 3
12	Web application security: Develop an AI model to identify and mitigate web application vulnerabilities.	CO 3, CO 4
13	Data exfiltration detection: Train an AI algorithm to detect and prevent unauthorized data exfiltration attempts.	CO 3, CO 4
14	Ransomware detection: Use AI techniques to identify and block ransomware attacks in real-time.	CO 3, CO 4
15	Firewall optimization: Employ AI algorithms to optimize firewall rules and configurations for better security.	CO 3, CO 4
16	Network anomaly prediction: Build an AI system to predict network anomalies before they occur.	CO 1, CO 3
17	Security log analysis: Use AI techniques to automatically analyze and correlate security logs for identifying threats.	CO 3, CO 4
18	DDoS attack detection: Develop an AI model to detect and mitigate Distributed Denial of Service (DDoS) attacks.	CO 3, CO 4
19	Mobile application security: Train an AI algorithm to identify security vulnerabilities in mobile applications.	CO 3, CO 4
20	Network segmentation optimization: Employ AI techniques to optimize network segmentation for enhanced security.	CO 1, CO 3

21	Threat intelligence analysis: Use AI algorithms to analyze and extract insights from threat intelligence feeds.	CO 1, CO 3
22	Security incident response automation: Develop an AI system to automate and streamline security incident response processes.	CO 3, CO 4
23	Deepfake detection: Train an AI model to identify and flag manipulated or forged media content.	CO 1, CO 3
24	Network forensics: Use AI techniques to analyze network traffic and digital artifacts for forensic investigations.	CO 3, CO 4
25	Security policy compliance: Develop an AI system to assess and ensure compliance with security policies and regulations.	CO 3, CO 4

Department:	**Department of Computer Science and Engineering**		
Course Name: Social Media Security	**Course Code**	**L-T-P**	**Credits**
	ENSP307	4-0-0	4
Type of Course:	Minor (Department Elective I)		
Pre-requisite(s), if any:			

Brief Syllabus:

Social media has become an integral part of our lives, shaping our online behaviors and interactions in numerous ways. People join social media platforms to share information, connect with friends, and engage in online communities. While social media offers these advantages, it also brings forth concerns regarding privacy and security. The constant flow of personal information shared on these platforms makes individuals vulnerable to various risks. Therefore, it is crucial for all of us to understand and address the issues surrounding privacy and security in the realm of social media. By acquiring knowledge about these challenges, we can adopt safer practices and protect ourselves from potential threats while enjoying the benefits of social media platforms. Being aware and proactive about social media security empowers us to navigate the digital landscape responsibly and ensure our online safety.

UNIT WISE DETAILS

Unit Number: 1	**Title: Social Media Overview**	**No. of hours: 8**

Content Summary:

Introduction to Social media. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, challenges, opportunities, and pitfalls in online social networks, APIs, Collecting data from Online Social Media, Social Media Content Analysis - BoW Model, TF-IDF; Network Analysis - Node Centrality Measures, Degree Distribution, Average Path Length, Clustering Coefficient, Power Law; Synthetic Networks - Random Graphs, Preferential Attachment Model.

Unit Number: 2	**Title: Security Issues in Social Media**	**No. of hours: 11**

Content Summary:

Overview, Review of Machine Learning, The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviours, Anonymity in a networked world, Identity Theft - Profile Cloning, Social Phishing, Fake, Compromised, Sybil accounts and their behaviour, Spamming, Rumour or Misinformation, Cyberbullying, Collective Misbehaviours, Flagging and reporting of inappropriate content.

Unit Number: 3	Title: Privacy Issues in Social Media	No. of hours: 11

Content Summary:

Overview, Privacy Settings, PII Leakage, Identity vs Attribute Disclosure Attacks, Inference Attacks, De-anonymization Attacks, Privacy Metrics - k-anonymity, l-diversity, Personalization vs Privacy, Differential Privacy, Social Media and User Trust.

Unit Number: 4	Title: Social Media Security: Laws, Best Practices, and Case Studies	No. of hours: 10

Content Summary:

Laws regarding posting of inappropriate content, Best practices for the use of Social media, Content Moderation and Removal Policies, User Authentication and Access Control, Security Awareness and Education, Social media Case studies-Facebook, Twitter, Instagram, YouTube, LinkedIn, StackOverflow, GitHub, Quora, SnapChat, Reddit, FourSquare, Yelp.

***Self-Learning Components:**

1. Social Media Security 101 - Stop The Hackers!
2. Privacy and Security in Online Social Media
3. CompTIA Social Media Security

References:

1. https://www.udemy.com/course/social-media-security-101-stop-the-hackers/
2. https://onlinecourses.nptel.ac.in/noc20_cs31/preview
3. https://niccs.cisa.gov/education-training/catalog/certfirst/comptia-social-media-security

Please Note:

At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books:

6. Mastering Social Media Mining, Bonzanini Marco, Packt Publishing Limited
7. Mining the Social Web, Mikhail Klassen and Matthew A. Russell, O'Reilly Media, Inc
8. Social media mining: an introduction, Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu, Cambridge University Press
9. Social Media Security: Leveraging Social Networking While Mitigating Risk, Michael Cross, Syngress
10. Social Media and the Law: A Guidebook for Communication Students and Professionals, Daxton R. Stewart, Taylor & Francis Ltd
11. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.

Online References:

1. https://media.defense.gov/2021/Sep/16/2002855950/-1/-1/0/CSI_KEEPING_SAFE_ON_SOCIAL_MEDIA_20210806.PDF
2. https://www.technology.pitt.edu/security/best-practices-safe-social-networking
3. https://www.mdpi.com/1999-5903/10/12/114

Course Outcomes (CO)

COs	Statements
CO1	**Demonstrate an understanding** of the different types of social media platforms, their features, and their impact on communication, marketing, and society.
CO2	**Acquire knowledge and skills** in social media monitoring techniques, including data collection, analysis, and the use of relevant tools and technologies.
CO3	**Develop** the ability to analyze and evaluate viral content on social media, understand the factors contributing to its spread, and recognize its implications for marketing and online engagement.
CO4	**Identify and analyze** the challenges, opportunities, and pitfalls associated with social media marketing, and formulate strategies for effective audience targeting, engagement, and brand promotion.
CO5	**Develop** strategies to safeguard personal information, foster user trust, and mitigate associated risks.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels(C) 43. Knowledge 44. Understand 45. Apply 46. Analyze 47. Evaluate 48. Create	Affective levels(A) 36. Receiving 37. Responding 38. Valuing 39. Organizing 40. Characterizing	Psychomotor levels(P) 36. Imitation 37. Manipulation 38. Precision 39. Articulation 40. Improving
CO1	C2	A3	P1
C02	C2	A2	P2
CO3	C4	A5	-
CO4	C4	A3	P4
CO5	C6	A4	P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3		1		3						
CO2	2	3		1				2				
CO3		3		2			1		3			
CO4		3	3	2				2				2
CO5				1	2	2	3					2

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1			
CO2		2	1		
CO3			2	1	
CO4				2	1
CO5					3

Relevance of the Syllabus to various indicators

Unit I	Social Media Overview
Local	-
Regional	-
National	Provides essential knowledge and skills related to social media platforms, social media marketing, and data collection from online social media.
Global	Covers key aspects of social media platforms, social media marketing, and data analysis techniques that have global applicability
Employability	Highly valued in the job market.
Entrepreneurship	Explore entrepreneurial opportunities in the digital marketing and social media industry.
Skill Development	Enhances students' technical skills in understanding and utilizing social media effectively.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Security Issues in Social Media
Local	Addresses local indicators by covering security issues in social media.
Regional	-
National	Provides essential knowledge and skills related to security issues in social media, which are relevant at the national level for ensuring online safety.
Global	Covers key aspects of security issues in social media that have global relevance.

Employability	Highly valued in the job market, particularly in roles related to cybersecurity, digital risk management, and social media governance.
Entrepreneurship	Equips with knowledge of security issues in social media, allowing to identify entrepreneurial opportunities in developing innovative solutions for securing social media platforms.
Skill Development	Enhances technical skills in identifying, analyzing, and addressing security threats.
Professional Ethics	Indirectly promotes professional ethics by emphasizing the importance of protecting user privacy, preventing cyberbullying, and addressing collective misbehaviors in social media platforms.
Gender	-
Human Values	Indirectly supports human values by fostering a safe and inclusive online environment.
Environment & Sustainability	-
Unit III	Privacy Issues in Social Media
Local	Addresses local indicators by covering privacy issues in social media that are relevant to the local context.
Regional	-
National	Provides essential knowledge and skills related to privacy issues in social media, which are relevant at the national level for ensuring data protection and privacy rights.
Global	Covers key aspects of privacy issues in social media that have global relevance, such as identity and attribute disclosure attacks.
Employability	Highly valued in the job market, particularly in roles related to data privacy, information security, and compliance with privacy regulations.
Entrepreneurship	Equips with knowledge of privacy issues in social media, allowing them to identify entrepreneurial opportunities in developing privacy-enhancing solutions for social media platforms.
Skill Development	Enhances technical skills in privacy settings, data protection, and privacy metrics.

Professional Ethics	Indirectly promotes professional ethics by emphasizing the importance of respecting user privacy, protecting personal information, and ensuring transparency.
Gender	-
Human Values	Indirectly supports human values by fostering a culture of privacy and user trust in social media platforms. .
Environment & Sustainability	-
Unit IV	Social Media Security: Laws, Best Practices, and Case Studies
Local	Addresses local indicators by covering laws regarding posting of inappropriate content that are relevant to local jurisdictions and regulations.
Regional	Provides regional relevance by including case studies of popular social media platforms that are widely used in the regional context, such as Facebook, Twitter, Instagram, and LinkedIn.
National	Covering laws related to social media and best practices for the use of social media platforms
Global	Includes case studies of various global social media platforms.
Employability	Highly valued in roles related to social media management, digital marketing, content moderation, and information security..
Entrepreneurship	Equips with knowledge of social media security laws, best practices, and case studies, allowing them to identify entrepreneurial opportunities in providing social media security services
Skill Development	Enhances students' skills in content moderation, user authentication, access control, security awareness, and education.
Professional Ethics	Emphasizing the importance of adhering to social media laws.
Gender	-
Human Values	Indirectly supports human values by promoting responsible use of social media, ensuring user privacy and safety, and addressing ethical considerations.

Environment & Sustainability	-
SDG	-
NEP 2020	Digital literacy, Critical thinking, Ethical use of technology
POE/4th IR	Technological advancements, innovation, adaptability, digital fluency, problem-solving, collaboration, and lifelong learning.

Department:	**Department of Computer Science and Engineering**		
Course Name: Social Media Security Lab	**Course Code**	**L-T-P**	**Credits**
	ENSP357	0-0-2	1
Type of Course:	Minor (Department Elective I)		
Pre-requisite(s), if any:			

Course Outcomes (CO)

COs	Statements
CO1	**Understand** the risks and vulnerabilities associated with social media platforms.
CO2	**Understand** the social and ethical implications of social media security.
CO3	**Develop** practical skills to secure social media accounts and data.
CO4	**Analyze** and respond to social media security incidents.
CO5	**Evaluate** the effectiveness of social media security controls.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Exploring Different Social Media Platforms a. Research and analyze various social media platforms. b. Identify their key features, target audiences, and unique characteristics. c. Compare and contrast their usage, advantages, and challenges.	CO1, CO2, CO5
2	Monitoring Social Media Trends a. Use social media monitoring tools to track popular hashtags and viral content. b. Analyze the patterns and trends in social media conversations. c. Identify the factors contributing to the popularity of certain content.	CO1, CO5
3	Social Media Marketing Analysis a. Study real-world social media marketing campaigns. b. Analyze their strategies, target audience engagement, and impact. c. Evaluate the challenges and opportunities in social media marketing.	CO2, CO3
4	Collecting and Analyzing Social Media Data a. Utilize APIs to collect data from online social media platforms. b. Perform content analysis using techniques like Bag-of-Words (BoW) model and TF-IDF. c. Extract insights and patterns from the collected data.	CO3
5	Social Network Analysis a. Perform network analysis on social media data. b. Calculate node centrality measures, degree distribution, average path length, and clustering coefficient. c. Identify key influencers and community structures within the social network.	CO3, CO5
6	Creating Synthetic Networks a. Generate random graphs and preferential attachment models to simulate social networks. b. Analyze the characteristics of the synthetic networks. c. Compare and contrast them with real-world social networks.	CO1, CO5
7	Profile Cloning and Identity Theft a. Study different types of identity theft in social media. b. Analyze profile cloning, social phishing, and compromised accounts.	CO1, CO2

	c. Understand the behavioral patterns and impacts of these attacks.	
8	Dealing with Spam and Misinformation a. Analyze the spread of spam and misinformation in social media. b. Identify techniques to detect and mitigate spamming activities. c. Evaluate the effectiveness of flagging and reporting mechanisms.	CO4
9	Privacy Settings Evaluation a. Evaluate the privacy settings of popular social media platforms. b. Assess the level of protection they provide for Personally Identifiable Information (PII). c. Propose recommendations for enhancing user privacy.	CO2, CO5
10	Privacy Attacks and Anonymity a. Study different privacy attacks in social media, such as inference attacks and de-anonymization attacks. b. Analyze the impact of identity disclosure and attribute disclosure attacks. c. Explore techniques like differential privacy for preserving user privacy.	CO2
11	Privacy Metrics Analysis a. Investigate privacy metrics like k-anonymity and l-diversity. b. Apply these metrics to analyze the privacy risks in social media datasets. c. Discuss the trade-offs between personalization and privacy in social media.	CO2
12	Understanding Social Media Laws and Regulations a. Study the laws and regulations related to social media usage. b. Analyze the legal implications of posting inappropriate content. c. Explore content moderation policies and user responsibilities.	CO2
13	User Authentication and Access Control a. Evaluate user authentication mechanisms in popular social media platforms. b. Analyze access control policies and user permissions. c. Discuss best practices for ensuring secure user authentication.	CO3
14	Security Awareness and Education a. Develop security awareness campaigns for social media users. b. Design educational materials to raise awareness about social media security risks.	CO2

	c. Evaluate the effectiveness of these campaigns through surveys or assessments.	
15	Case Study Analysis - Facebook a. Analyze the security and privacy practices of Facebook. b. Explore the challenges faced by Facebook in maintaining user data privacy. c. Discuss notable security incidents and their impact on user trust.	CO1, CO2, CO4
16	Case Study Analysis - Twitter a. Investigate the security measures implemented by Twitter. b. Analyze the response to cybersecurity incidents on the platform. c. Discuss the role of Twitter in addressing misinformation and cyberbullying.	CO1, CO2, CO4
17	Case Study Analysis - Instagram a. Analyze the privacy and security features of Instagram. b. Investigate the effectiveness of content moderation policies. c. Discuss the impact of influencer marketing and brand safety on Instagram.	CO1, CO2, CO4
18	Case Study Analysis - YouTube a. Evaluate the security controls and privacy settings of YouTube. b. Analyze the challenges of content moderation and copyright infringement. c. Discuss the role of YouTube in combating hate speech and harmful content.	CO1, CO2, CO4
19	Case Study Analysis - LinkedIn a. Study the security and privacy considerations on LinkedIn. b. Analyze the protection of professional user data and connections. c. Discuss the impact of LinkedIn in job search and professional networking.	CO1, CO2
20	Case Study Analysis - StackOverflow a. Investigate the security practices implemented on StackOverflow. b. Analyze the trust and reputation systems within the community. c. Discuss the role of StackOverflow in knowledge sharing and code collaboration.	CO1, CO2
21	Case Study Analysis - GitHub a. Analyze the security measures adopted by GitHub for source code repositories.	CO1, CO2

	b. Investigate the role of vulnerability reporting and code review processes. c. Discuss the importance of secure coding practices in open-source projects.	
22	Case Study Analysis - Quora a. Evaluate the privacy controls and content moderation on Quora. b. Analyze the impact of user-generated content and knowledge sharing. c. Discuss the challenges of maintaining a respectful and inclusive community.	CO1, CO2
23	Case Study Analysis - SnapChat a. Study the privacy and security features of SnapChat. b. Analyze the ephemeral messaging and privacy-by-design approach. c. Discuss the challenges of preventing data leaks and unauthorized access.	CO1, CO2
24	Case Study Analysis - Reddit a. Analyze the security and privacy considerations on Reddit. b. Investigate the moderation policies and community-driven content curation. c. Discuss the challenges of maintaining a balance between free speech and harmful content.	CO1, CO2

MINOR PROJECT-II

Department:	**Department of Computer Science and Engineering**		
Course Name: Minor Project-II	**Course Code**	**L-T-P**	**Credits**
	ENSI352	---	2
Type of Course:	Project		
Pre-requisite(s), if any: NA			

- Students expected to develop a basic project that demonstrates the application of learnings from studied subjects.
- Students are required to submit a hard copy of project file as per the template (Provided at the end of Handbook). File needs to be submitted in spiral bind.
- Project will be evaluated on the scale of 100 with following evaluation criteria.
  - Project idea & features (10)
  - Literature review (10)
  - Tools & Techniques employed (10)
  - Methodology (10)
  - Presentation of Results and its usefulness (20)
  - Implementation and its understandability (10)
  - Meetings & comments by guide (20)
  - Research paper (10)

File format for Minor project

1.	Abstract	Page No.
2.	Introduction (description of broad topic)	
3.	Motivation	
4.	Literature Review	
5.	Gap Analysis	
6.	Problem Statement	
7.	Objectives	
8.	Tools/platform used	
9.	Methodology	

10.	Experimental Setup	
11.	Evaluation Metrics	
12.	Results And Discussion	
13.	Conclusion & Future Work	
14.	References	
15.	Annexure I: Responsibility Chart	
16.	Annexure II: Screenshots of all the MS-Team Meetings with links (online)/ handwritten comments(offline) from guide	
17.	Annexure III Complete implementation code	
18.	Annexure IV Research Paper (Published/Submitted)	

Semester VII

Department:	**Department of Computer Science and Engineering**		
Course Name: EC Council Certified Ethical Hacker (CEH) Certification	**Course Code** SEC049	**L-T-P** 2-0-0	**Credits** 2
Type of Course:	SEC		
Pre-requisite(s), if any:			
Brief Syllabus: EC Council Certified Ethical Hacker (CEH) Certification [*Students are required to clear the EC Council certification]			

MINOR PROJECT-III

Department:	**Department of Computer Science and Engineering**		
Course Name: Minor Project-III	**Course Code**	**L-T-P**	**Credits**
	ENSI451	---	2
Type of Course:	Project		
Pre-requisite(s), if any: NA			

- Students expected to develop a basic project that demonstrates the application of learnings from studied subjects.
- Students are required to submit a hard copy of project file as per the template (Provided at the end of Handbook). File needs to be submitted in spiral bind.
- Project will be evaluated on the scale of 100 with following evaluation criteria.
  - Project idea & features (10)
  - Literature review (10)
  - Tools & Techniques employed (10)
  - Methodology (10)
  - Presentation of Results and its usefulness (20)
  - Implementation and its understandability (10)
  - Meetings & comments by guide (20)
  - Research paper (10)

File format for Minor project

1.	Abstract	Page No.
2.	Introduction (description of broad topic)	
3.	Motivation	
4.	Literature Review	
5.	Gap Analysis	
6.	Problem Statement	
7.	Objectives	
8.	Tools/platform used	
9.	Methodology	
10.	Experimental Setup	
11.	Evaluation Metrics	
12.	Results And Discussion	
13.	Conclusion & Future Work	
14.	References	
15.	Annexure I: Responsibility Chart	
16.	Annexure II: Screenshots of all the MS-Team Meetings with links (online)/ handwritten comments(offline) from guide	
17.	Annexure III Complete implementation code	
18.	Annexure IV Research Paper (Published/Submitted)	

Department Elective-II

Department:	**Department of Computer Science and Engineering**		
Course Name: Computational Services In The Cloud	**Course Code**	**L-T-P**	**Credits**
	ENSP401	4-0-0	4
Type of Course:	Department Elective-II (Minor)		
Pre-requisite(s), if any:			

Brief Syllabus:

This course covers evolutionary computing paradigms from multi-processor systems to Cloud, Edge, and Fog Computing. The course design follows cloud deployment models, service models, virtualization techniques and cloud architectural solutions. It also elaborates cloud compliances and security at fine-grained level by following a shared responsibility model. It reveals a design pattern to the students, enabling them to think through the process of designing and implementing cloud infrastructure and optimal IT solutions

Unit Number: 1	**Title: : Introduction to Cloud Computing**	**No. of hours: 11**

Content Summary:

Cloud Computing, Adoption of cloud-based IT resources, Service Models: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service(SaaS), Deployment models: Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Cloud Computing Characteristics, Challenges of cloud computing,Virtualization concept, Types of virtualizations, Demo of virtualization, Virtualization Merits, Role of virtualization in cloud computing, Virtualization Demerits, VMPlacement, VM Migration, VM Migration Demo, VM clustering, Design Issues in VM Clustering, Need of Dockers and Containers, Docker Eco-System, Hypervisor vs Docker.

Unit Number: 2	**Title: Microservices**	**No. of hours: 10**

Content Summary:

Microservices, Service-Oriented Architecture, REST API, IP Addressing, Subnetting, Supernetting, Designing of Virtual Private Cloud, Demo of VPC, VPC Peering,VPC Case Study, Cloud Storage, Serverless Computing, Cloud API Gateway, Cloud Databases, Resource Provisioning, Time shared and space shared, Efficient VMConsolidation on cloud server, Task/DAG Scheduling Algorithms, Min-Min, Max-Min, MET, B-level Demo, T-level Demo, Task-VM Mapping, Auto Scaling, Load Balancing.

Unit Number: 3	Title: Case Study	No. of hours: 08

Content Summary:

Case Study: Cloud Market analysis, Security and Compliances, Shared security model in IAAS/PAAS/SAAS, Shared technology issues, Data loss or leakage, Accountor service hijacking, Implementation of cloud security, Security Groups, Network Access Control Lists, Cloud databases, Parallel Query Execution with NoSQLDatabase, Big Data, Handling Big Data on Cloud Platform, Map- Reduce framework for large clusters using Hadoop, Design of data applications based on Map Reducein Apache Hadoop.

Unit Number: 4	Title: : Comparative study/analysis of public clouds	No. of hours: 09

Content Summary:

Comparative study/analysis of public clouds, Edge Computing, Fog Computing, Data Offloading, Cloud-Based DevOps Tools, Task Partitioning, Data Partitioning, Data Synchronization, Distributed File System, Data center, Ongoing Research Topics.

Self-Learning Component: - The students are expected to choose a topic in discussion with the industry expert and implement the concepts of cloud computing. The student should present the progress at the end of the semester.

Reference Books:

2. Lizhe Wang, Rajiv Ranjan, Jinjun Chen and Boualem Benatallah, Cloud Computing (1 ed.), CRC Press, 2017. ISBN 978-1351833097.
3. Judith S. Hurwitz and Daniel Kirsch, Cloud Computing For Dummies (2 ed.), Hoboken: John Wiley & Sons, 2020. ISBN 978-1119546658.
4. Prerna Sharma, Moolchand Sharma and Mohamed Elhoseny, Applications of Cloud Computing (1 ed.), CRC Press, 2020. ISBN 9780367904128.

Define Course Outcomes (CO)

COs	Statements
CO1	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.
CO2	Apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost.
CO3	Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.
CO4	Analyze various cloud programming models and apply them to solve problems on the cloud.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 49. Knowledge 50. Understand 51. Apply 52. Analyze 53. Evaluate 54. Create	Affective levels(A) 41. Receiving 42. Responding 43. Valuing 44. Organizing 45. Characterizing	Psychomotor levels(P) 41. Imitation 42. Manipulation 43. Precision 44. Articulation 45. Improving
CO1	C3	A3	P4
CO2	C3	A4	P2
CO3	C2	A2	P1
CO4	C4	A5	P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1				2	1	2	2	1
CO2	2	2	2	1			1	3		1	2	2
CO3	3	3	3		1	2		2	1		1	1
CO4	3	3	2	1		2		2	2		2	1

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	3
CO2	3	3	2	3
CO3	1	1	3	1
CO4	1	1	1	2

Relevance of the Syllabus to various indicators

Unit I	**Introduction to Design thinking**
Local	-
Regional	-
National	-
Global	It promotes international collaboration, data sharing, and connectivity, facilitating global trade, research, and innovation.
Employability	Proficiency in cloud computing technologies, service models, and deployment models enhances employability and career prospects.
Entrepreneurship	-
Skill Development	This includes skills in virtualization, cloud service models, deployment models, and containerization.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Case studies in Design thinking**
Local	-
Regional	-
National	-
Global	In the global context, microservices, service-oriented architecture, and cloud computing are essential technologies driving digital innovation and transformation. Global organizations heavily rely on these technologies to deliver scalable and resilient applications and services to a global user base.

Employability	Acquiring skills in microservices, service-oriented architecture, and cloud computing enhances employability prospects in the IT industry. Proficiency in these technologies is in high demand as organizations increasingly adopt cloud-based architectures and microservice-oriented approaches
Entrepreneurship	-
Skill Development	The course on microservices, service-oriented architecture, and cloud computing promotes skill development in areas such as cloud infrastructure design, API development, virtualization, storage management, and resource provisioning
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Design Frameworks**
Local	-
Regional	-
National	-
Global	It helps address global challenges such as data privacy, security breaches, and international data transfer regulations.
Employability	Knowledge of cloud market analysis, security, and compliance enhances employability in various roles, including cloud architects, cloud security specialists, and cloud consultants.
Entrepreneurship	-
Skill Development	Studying cloud market analysis, security, and compliance develops critical skills such as risk assessment, security implementation, and compliance management.
Professional Ethics	-
Gender	-
Human Values	-

Environment & Sustainability	-
Unit IV	**Innovation & Creativity**
Local	-
Regional	-
National	-
Global	Cloud computing is a global phenomenon, and a course on comparative study/analysis of public clouds and related topics provides students with a global perspective on cloud technologies.
Employability	Proficiency in cloud computing technologies and understanding the different deployment models, such as public clouds and edge computing, enhances employability prospects in the IT industry.
Entrepreneurship	-
Skill Development	A course on comparative study/analysis of public clouds and related topics enhances various skills such as research, critical analysis, problem-solving, and technical proficiency.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4, 9
NEP 2020	Integration of Emerging Technologies and Skill Development
POE/4th IR	The course on cloud computing aligns with the Fourth Industrial Revolution (IR 4.0) in the following ways: Advanced Infrastructure, Data Management and Analytics and Digital Transformation.

Department:	**Department of Computer Science and Engineering**		
Course Name: Computational Services In The Cloud Lab	**Course Code**	**L-T-P**	**Credits**
	ENSP451	0-0-2	1
Type of Course:	Minor		
Pre-requisite(s), if any:			

Proposed Lab Experiments

Defined Course Outcomes

COs	
CO 1	Apply the concept cloud computing to solve practical use cases.
CO 2	Analyzing different services in cloud computing
CO 3	Evaluate different available services provided by cloud vendors
CO 4	Design Cloud based application

List of Programs

Ex No	Experiment Title	Mapped CO/COs
1	Install Virtualbox / VMware Workstation with different flavours of linux or windows OS	CO1
2	Install a C compiler in the virtual machine created using virtual box and execute Simple Programs	CO1
3	Install Google App Engine. Create hello world app and other simple web applications using python/java.	CO1
4	Use GAE launcher to launch the web applications.	CO1
5	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.	CO2
6	Find a procedure to transfer the files from one virtual machine to another virtual machine	CO2
7	Find a procedure to launch virtual machine using trystack	CO2

	(Online Openstack Demo Version)	
8	Install Hadoop single node cluster and run simple applications like wordcount.	CO1
9	Deploy a simple web application using a Platform as a Service (PaaS) offering like AWS Elastic Beanstalk, Azure App Service, or Google App Engine	CO4
10	Create and manage databases using services like AWS RDS, Azure SQL Database, or Google Cloud SQL.	CO3
11	Containerize an application using Docker and create a container registry on a cloud platform.	CO3
12	Deploy and manage containers using container orchestration tools like AWS ECS, Azure Kubernetes Service (AKS), or Google Kubernetes Engine (GKE)	CO4
13	Develop and deploy a serverless function using AWS Lambda, Azure Functions, or Google Cloud Functions	CO4
14	Configure event triggers, access permissions, and monitoring for serverless functions	CO2
15	Utilize cloud-based data analytics tools like AWS Athena, Azure Data Lake Analytics, or Google BigQuery to query and analyze large datasets	CO2
16	Build and train machine learning models using cloud-based services like AWS SageMaker, Azure Machine Learning, or Google Cloud AutoML	CO2
17	Use infrastructure provisioning tools such as AWS CloudFormation, Azure Resource Manager, or Google Cloud Deployment Manager to define and deploy infrastructure components	CO1
18	Set up cloud monitoring and logging services like AWS CloudWatch, Azure Monitor, or Google Cloud Monitoring to track the performance and health of cloud resources	CO3
19	Implement access control policies and roles using AWS IAM, Azure Active Directory, or Google Cloud Identity and Access Management (IAM)	CO4
20	Enable encryption for data at rest and in transit using cloud security services	CO3
21	Explore cost optimization techniques like auto-scaling, spot instances, or reserved instances to optimize cloud resource usage and reduce costs	CO2

Department:	**Department of Computer Science and Engineering**		
Course Name: Microsoft Azure Cloud Fundamentals	**Course Code**	**L-T-P**	**Credits**
	ENSP403	4-0-0	4
Type of Course:	Departmental Elective-II (Minor)		
Pre-requisite(s), if any:			
Brief Syllabus: The Microsoft Azure Cloud Fundamentals course introduces the concepts of cloud computing and the Azure platform. It covers Azure services such as Virtual Machines, Storage, Networking, Identity, App Services, and Databases. The course focuses on security, monitoring, and management in Azure. Real-world case studies and hands-on labs enable practical application. The subject equips students to design trustworthy intrusion detection systems and enhances security in IoT networks using Azure.			
UNIT WISE DETAILS			
Unit Number: 1	**Title: Introduction to Cloud Computing**	**No. of hours: 12**	
Content Summary: Introduction to Cloud Computing and its Characteristics, Benefit, and Challenges of cloud computing. Cloud service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Cloud Deployment Models, for example, Public, private, hybrid, and community clouds. shared responsibility model. Identify appropriate use cases for each cloud model. Consumption-based model. Comparison of cloud pricing models.			
Unit Number: 2	**Title: Introduction to Microsoft Azure**	**No. of hours: 10**	
Content Summary: Microsoft Azure cloud platform and its significance in the industry, Azure regions, and availability zones for understanding global data center distribution. Introduction of various Azure services and solutions available for different scenarios.			
Unit Number: 3	**Title: Azure Virtual Machines (VMs) and Storage**	**No. of hours: 10**	

Content summary: Create and manage virtual machines using Azure. Different VM sizes and types based on performance requirements. VM scaling and load balancing for optimizing application performance. Azure storage services: Blob Storage, Table Storage, File Storage, and Disk Storage.

Unit Number: 4	Title: Azure Networking, Identity and Access Management	No. of hours: 12

Content Summary: creation and configuration of virtual networks and subnets in Azure. Azure Load Balancer for distributing incoming network traffic, VPN Azure Active Directory (Azure AD) for managing identities and authentication. Gateway for secure communication between on-premises networks, and Azure. Azure Active Directory (Azure AD) for managing identities and authentication. Database Services, Azure Storage Account for data storage and retrieval.

Reference Books:

1. **Microsoft Azure Essentials Fundamentals of Azure by Michael S. Collier and Robin E. Shahan**
2. **Mastering Microsoft Azure Infrastructure Services by John Savill**
3. **Azure for Architects by Ritesh Modi**

Text Books

Microsoft Azure For Dummie by Timothy L. Warner and Katrina Dow, and Michael Washam

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** Microsoft Azure concepts
CO2	**Express** proficiency in the handling of Azure services
CO3	**Determine** methods to create and manipulate virtual machines
CO4	**Identify** commonly used models to implement cloud network
CO5	**Articulate** Azure database services

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 49. Knowledge 50. Understand 51. Apply 52. Analyze 53. Evaluate 54. Create	Affective levels(A) 41. Receiving 42. Responding 43. Valuing 44. Organizing 45. Characterizing	Psychomotor levels(P) 41. Imitation 42. Manipulation 43. Precision 44. Articulation 45. Improving
CO1	C2		P1
CO2	C3		P2
CO3	C3		P4
CO4	C1		-
CO5	C1		P4

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	–	–	–	–	1	1	1	–	–	–	1
CO2	3	3	3	–	3	–	–	–	–	2	–	–
CO3	3	3	2	3	3	–	–	–	–	–	–	2
CO4	2	2	2	2	2	–	–	–	–	–	–	–
CO5	2	2	–	2	2	–	–	–	–	2	–	–

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	2	–	–	–
CO2	3	3	3	–
CO3	3	3	–	–
CO4	2	2	–	2
CO5	2	2	2	2

Relevance of the Syllabus to various indicators

Unit I	**Introduction to Cloud Computing**
Local	
Regional	
National	
Global	Develops skills in using cloud-based services
Employability	Develops skills in using cloud-based services
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills regarding Cloud concepts as well as in cloud computing, network management, and Azure services
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Introduction to Microsoft Azure**

Local	Understanding of Microsoft Azure services
Regional	-
National	-
Global	Aligns with global trends of Cloud
Employability	Develops cloud-based Knowledge for cloud architects
Entrepreneurship	-
Skill Development	Develops conceptual knowledge of Cloud computing
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Azure Virtual Machines (VMs) and Storage**
Local	
Regional	-
National	-
Global	Designing Virtual machines in Azure and storage management
Employability	Develops skills regarding the cloud security and cloud architecture
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Azure Networking, Identity, and Access Management**

Local	
Regional	-
National	-
Global	Access management of data
Employability	Develops skills in cloud security and network management
Entrepreneurship	-
Skill Development	Develops knowledge and skills in data storage and access management
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts of technology and coding

Department:	**Department of Computer Science and Engineering**		
Course Name: Microsoft Azure Cloud Fundamentals Lab	**Course Code**	**L-T-P**	**Credits**
	ENSP403	0-0-2	1
Type of Course:	Departmental Elective-II (Minor)		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	
CO 1	Acquire a practical understanding of cloud computing through hands-on lab experiments.
CO 2	Develop proficiency in using global data centers.
CO 3	Demonstrate the ability to create virtual machines and handle data storage
CO 4	Analyze and maintain the security and access management system.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Familiarize students with the lab environment, software, and tools.	CO1
2	Creating and Managing Virtual Machines with Virtual Box	CO1
3	Create and configure virtual machines running different operating systems (e.g., Windows and Linux).	CO2
4	Install and configure Next Cloud on a local server or cloud-based virtual machine.	CO2
5	Set up your (user) accounts and storage quotas.	CO2

6	Try to implement -Test file uploads, sharing, and collaboration features	CO1
7	Install pfSense as a virtual router/firewall.	CO2
8	Configure virtual networks, subnets, and VLANs	CO2
9	Network Setup with pf Sense: for Test routing, port forwarding, and firewall rules.	CO1
10	Identity and Access Management with Key Cloak: Explore user authentication methods, roles, and permissions.	CO3
11	Identity and Access Management with Key Cloak Configure single sign-on (SSO) for different applications.	CO3
12	Install Key Cloak as an identity provider on a virtual machine.	CO3
13	Install Azure CLI and PowerShell on your machines.	CO3
14	Configure single sign-on (SSO) for different applications.	CO3
15	Use Azure CLI and PowerShell to create and manage Azure resources (e.g., VMs, storage accounts).	CO3
16	Create a simple web app (e.g., using HTML/CSS/JS or a web framework).	CO3
17	Deploy the web app to Azure App Service using Azure portal or Azure CLI.	CO3
18	Test the app's accessibility and scalability	CO4
19	Create an Azure SQL Database instance.	CO4
20	Monitor security alerts and take remedial actions.	CO4

Department:	Department of Computer Science and Engineering		
Course Name: Storages and Databases on Cloud	**Course Code**	**L-T-P**	**Credits**
	ENSP405	4-0-0	4
Type of Course:	Departmental Elective-II (Minor)		
Pre-requisite(s), if any:			

Brief Syllabus:

The course on cloud databases and storage provides a comprehensive understanding of the principles, technologies, and best practices associated with storing and managing data in the cloud. The syllabus covers various topics, starting with an introduction to cloud computing and an exploration of different types of cloud storage and databases, including object storage, block storage, file storage, relational databases, NoSQL databases, and more. Students delve into popular cloud storage and database services, such as Amazon S3, Google Cloud Storage, and Azure Blob Storage gaining practical knowledge of their features, deployment options, scalability, and high availability. The curriculum also includes essential aspects like database design, data migration, security measures, backup and recovery strategies, performance optimization, and monitoring techniques. Real-world case studies provide insights into organizations utilizing cloud storage and databases effectively.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Storage on cloud	No. of hours: 4

Content Summary:

Introduction to Cloud Computing, Overview of cloud databases and cloud storages, types of cloud storages(Object, block and file), different types of cloud database management systems, Gartner Magic Quadrant for Cloud Database Management Systems, Advantages of Working with Cloud Databases, Considerations for Cloud Databases, Top Cloud Database, Factors that help in choosing the right cloud database, Challenges involved in using cloud storages and databases.

Unit Number: 2	Title: Data Integration, Migration, Security and performance on cloud	No. of hours: 8

Content Summary:

Techniques, tool, methods and considerations for migrating from premise database to cloud databases

Backup, Recovery, and Disaster Planning including automated backups, point-in-time recovery and replication

Performance Optimization and Monitoring including query optimization, indexing, caching, and monitoring tools

Scalability and High Availability: load balancing, replication, sharding, and auto-scaling, Cloud Data Warehousing

Unit Number: 3	Title: AWS Cloud Storage	No. of hours: 8

Content Summary:

Introduction to AWS cloud storage, AWS management console, AWS Storage Services, Uploading files and images , Creating a web server, Overview of Amazon S3, Storage Classes, EC2 Instance Storage, network file system Amazon Elastic Block Store, Amazon Elastic file system, Amazon Cloud Front.

Brief introduction to Google Cloud Storage, and Azure Blob Storage.

Unit Number: 4	Title: Case Study	No. of hours: 8

Content Summary: Case Studies and Real-world Examples of Netflix , Airbnb, Pinterest, spotify, coca-cola etc. Analyzing real-world use cases of organizations using cloud storage and databases, discussing architecture decisions, challenges, and lessons learned.

***Self-Learning Components:**

1) **E**xplore open-source projects related to cloud databases and storage. discover open-source projects from GitHub, learn from the codebase, and contribute to the development of cloud-based storage and database solutions. (https://github.com/topics/cloud-database)

2) Join the course : https://www.coursera.org/specializations/cloud-computing

2) Join Online Courses like

- https://www.udemy.com/topic/cloud-computing/
- https://www.coursera.org/courses?query=data%20storage

- https://www.mygreatlearning.com/academy/learn-for-free/courses/databases-and-files-systems-in-aws
- https://www.youtube.com/watch?v=EN4fEbcFZ_E
- https://www.codecademy.com/catalog/subject/cloud-computing
- https://www.simplilearn.com/tutorials/cloud-computing-tutorial

2) Read case studies of organizations that have successfully implemented cloud storage and database solutions.

- **Case Study of Delloite:** https://www2.deloitte.com/us/en/pages/consulting/articles/cloud-computing-case-studies.html
- **Case Study of Amazon:** https://aws.amazon.com/solutions/case-studies/amazon/

Learn about their challenges, architectural decisions, and best practices they adopted.

Reference Books:

1) "Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management" by Nitin Vengurlekar, 2013

2) "Cloud Database Development and Management" by Lee chao, 2013

3) "Advancing Cloud Database Systems and Capacity Planning with Dynamic Applications" by Narendra Kumar Kamila, 2017

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** & Recall the fundamental concepts and principles of cloud storage and databases. Interpret the security considerations and best practices for cloud storage and databases.
CO2	**Express** ideas and solutions for optimizing performance and improving efficiency in cloud storage and databases through indexing, caching, and query optimization techniques.

CO3	**Determine** the requirements of an application or system and determine the most suitable cloud storage and database solutions to meet those requirements.
CO4	**Identify** different types of cloud storage and database services available.
CO5	**Articulate** the best practices and considerations for designing scalable, reliable, and secure cloud storage and database architectures.
CO6	**Design** data storage architecture for cloud-based applications.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 55. Knowledge 56. Understand 57. Apply 58. Analyze 59. Evaluate 60. Create	Affective levels(A) 46. Receiving 47. Responding 48. Valuing 49. Organizing 50. Characterizing	Psychomotor levels(P) 46. Imitation 47. Manipulation 48. Precision 49. Articulation 50. Improving
CO1	C2		P1
CO2	C3		P2
CO3	C3		P3
CO4	C2		-
CO5	C3		P1

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	1	-	1	1	2	2	-	3
CO2	2	3	1	1	1	1	1	1	2	2	1	3
CO3	2	2	3	2	2	3	2	2	3	3	3	3
CO4	1	2	-	3	1	1	-	-	2	2	1	2
CO5	-	2	1	1	3	2	-	-	2	3	2	3
CO6	1	1	2	-	2	3	1	1	3	3	2	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	3
CO2	3	2	2	2
CO3	3	2	3	3
CO4	1	1	2	1
CO5	2	3	2	2
CO6	1	1	3	1

Relevance of the Syllabus to various indicators

Unit I	Introduction to cloud databases and storages
Local	local considerations may include factors like local network connectivity, data centre locations, and latency between local systems and cloud databases.
Regional	regional considerations can include regulatory compliance specific to a particular region, data sovereignty issues, and availability zones
National	national considerations such as national data protection laws and regulations, government policies related to cloud computing, and national cybersecurity guidelines that may impact the usage and storage of data in cloud databases.
Global	Aligns with global trends in internet technologies and network protocols accessibility of cloud databases and storage options

	across multiple regions, data replication and backup strategies for disaster recovery on a global scale
Employability	The unit syllabus may indirectly contribute to employability by introducing students to cloud computing concepts, cloud databases, and storage technologies
Entrepreneurship	-
Skill Development	The unit syllabus primarily focuses on developing skills related to cloud computing, cloud databases, and storage
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Data Integration, Migration, Security and performance on cloud
Local	local considerations may include factors like local network connectivity, data centre locations, and latency between local systems and cloud databases.
Regional	regional considerations can include regulatory compliance specific to a particular region, data sovereignty issues, and availability zones
National	national considerations such as national data protection laws and regulations, government policies related to cloud computing, and national cybersecurity guidelines that may impact the usage and storage of data in cloud databases.
Global	Aligns with global trends in internet technologies and network protocols accessibility of cloud databases and storage options across multiple regions, data replication and backup strategies for disaster recovery on a global scale
Employability	local considerations may include factors like local network connectivity, data centre locations, and latency between local systems and cloud databases.

Entrepreneurship	regional considerations can include regulatory compliance specific to a particular region, data sovereignty issues, and availability zones
Skill Development	national considerations such as national data protection laws and regulations, government policies related to cloud computing, and national cybersecurity guidelines that may impact the usage and storage of data in cloud databases.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	AWS Cloud Storage
Local	Primarily focuses on cloud storage technologies and their local implementation within the AWS ecosystem.
Regional	-
National	Contributes to national network security strategies and protocols
Global	AWS, Google Cloud, and Azure are global cloud service providers, enabling businesses worldwide to access their storage services and infrastructure.
Employability	Acquiring knowledge and skills in these cloud storage platforms enhances employability in the field of cloud computing and storage management.
Entrepreneurship	Knowledge of AWS, Google Cloud, and Azure storage services can empower entrepreneurs to build and scale their businesses by utilizing scalable and reliable cloud storage solutions for their applications and data.
Skill Development	The unit syllabus focuses on developing skills related to AWS cloud storage, including uploading files and images, creating a web server, utilizing different storage services
Professional Ethics	-

Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Case Studies
Local	Addresses local understanding and implementation of internet-based services
Regional	-
National	Contributes to national digital communication strategies and multimedia applications
Global	Aligns with global trends in internet telephony, multimedia applications, and SEO
Employability	Develops skills in internet telephony, multimedia applications, and SEO
Entrepreneurship	-
Skill Development	Develops knowledge and skills in internet telephony, multimedia applications, and SEO
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	It supports NEP's objective of enhancing the use of technology in education and research by providing students with knowledge and skills in cloud databases and storage, which are essential components of modern digital infrastructure
POE/4th IR	The course can incorporate discussions on ethical considerations in cloud databases and storage, addressing issues such as data privacy, security, and responsible data management.

Department:	**Department of Computer Science and Engineering**		
Course Name: Storages and Databases on Cloud Lab	**Course Code**	**L-T-P**	**Credits**
	ENSP455	0-0-2	1
Type of Course:	Departmental Elective-II (Minor)		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	Understand the principles and concepts of cloud storage and databases.
CO 1	Gain hands-on experience in using cloud storage services for data storage and retrieval.
CO 2	Implement backup and recovery strategies for cloud-based storage and databases.
CO 3	Optimize database performance in the cloud through indexing and query optimization techniques.
CO 4	Analyse real-world case studies to understand the challenges and solutions related to cloud storage and databases.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	**Create accounts and configure cloud storage services such as Amazon S3, Google Cloud Storage, or Azure Blob Storage:** Practice creating buckets/containers, uploading files, setting access permissions, and managing storage resources.	CO1, CO4, CO5
2	**Perform operations on object storage, including uploading, downloading, and deleting files:** Explore advanced features like versioning, lifecycle policies, and metadata management.	CO1, CO2, CO5
3	**Perform Block Storage Configuration:** Create and attach storage volumes to virtual machines, perform formatting and mounting, and understand snapshotting and resizing operations.	CO1, CO3, CO5
4	**File Storage Implementation:** Work with shared file systems such as Amazon EFS, Google Cloud Filestore, or Azure Files. They configure file shares, mount them on virtual machines, and explore features like file locking and access control.	CO1, CO4, CO5
5	**Database Provisioning and Management:** • learn to set up and configure cloud databases like Amazon RDS, Google Cloud SQL, or Azure Database Services • create database instances, manage security settings, and perform basic administration tasks such as backups and restores.	CO1, CO3, CO4, CO5
6	**Data Migration to the Cloud:** • Practice migrating databases from on-premises or other cloud providers to the selected cloud database service. • Explore different migration methods, tools, and validate the successful transfer of data	CO1, CO3, CO4, CO5

7	**Database Design and Schema Management:** • Work on designing and creating database schemas for various scenarios. • Implement tables, relationships, indexes, and constraints to support specific use cases and understand database modelling concepts.	CO1, CO3, CO5, CO6
8	**Data Security and Access Control:** Configure security measures for cloud databases, including setting up user accounts, managing roles and permissions, and implementing encryption techniques to protect data at rest and in transit	CO1, CO5
9	**Performance Tuning and Optimization:** Learn performance tuning techniques for cloud databases, including query optimization, index creation, caching strategies, and monitoring tools to identify and resolve performance bottlenecks	CO1, CO2, CO5
10	**High Availability and Scalability:** • Explore features like replication, automatic scaling, and load balancing to ensure high availability and scalability of databases in the cloud • Configure and test failover scenarios and evaluate the performance impact of scaling operations.	CO1, CO3, CO5
11	**Project** **Backup and Recovery Strategies:** • Practice implementing backup and recovery mechanisms for cloud databases • perform regular backups, schedule automated backups, and simulate recovery scenarios to restore databases to a consistent state.	CO1, CO5
12	**Project** **Cloud Data Warehousing:** • Gain hands-on experience with cloud data warehousing platforms like Amazon Redshift • load data, run complex queries, and analyze performance optimization techniques for data warehousing.	CO1, CO2, CO5, CO6
13	**Project**	CO1, CO2, CO6

	Design and implement an inventory management system that utilizes cloud storage for storing inventory data. Include features such as real-time inventory tracking, order management, and reporting capabilities.	
14	**Project** Build a document management system that leverages cloud storage for storing and organizing documents. Include features like full-text search, document tagging, and access control for secure document sharing.	CO1, CO2, CO5s

Department:	Department of Computer Science and Engineering		
Course Name: **APPLICATION DEVELOPMENT AND DEVOPS ON CLOUD**	**Course Code**	**L-T-P**	**Credits**
	ENSP407	4-0-0	4
Type of Course:	Minor (Department Elective III)		

Pre-requisite(s), if any: Nil

Brief Syllabus:

The syllabus aims to equip students with practical skills and theoretical knowledge to design, develop, and deploy applications in cloud environments while implementing DevOps practices to enhance software development, delivery, and operations on the cloud. It prepares them for a career in the dynamic and rapidly growing field of cloud computing and DevOps, where demand for skilled professionals is high due to the increasing adoption of cloud technologies in various industries.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Cloud Computing	No. of hours: 10

Content Summary:

Overview of Cloud Computing: Definition, Characteristics, Advantages, and Disadvantages.

Cloud Service Models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS).

Cloud Deployment Models: Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud.

Cloud Providers: Introduction to popular cloud service providers (e.g., AWS, Azure, Google Cloud).

Cloud Architecture: Understanding cloud components, virtualization, and multi-tenancy.

Introduction to DevOps: Principles, Practices, and Benefits.

Unit Number: 2	Title: Cloud-Based Application Development	No. of hours: 10

Content Summary:

Cloud Native Applications: Principles and architecture for building applications optimized for cloud environments.

Containerization: Docker and Kubernetes for application deployment, scaling, and management.

Microservices Architecture: Designing, developing, and deploying microservices-based applications.

Serverless Computing: Introduction to serverless architecture and Function as a Service (FaaS).

Application Security in the Cloud: Best practices for securing cloud-based applications.

Cloud-Based Databases: Database options and considerations in cloud environments.

Unit Number: 3	Title: DevOps Practices in Cloud	No. of hours: 10

Content Summary:

Continuous Integration (CI) and Continuous Deployment (CD) in Cloud: Setting up CI/CD pipelines.

Infrastructure as Code (IaC): Automating infrastructure provisioning using tools like Terraform and CloudFormation.

Configuration Management: Managing application configurations in a cloud-based environment.

Monitoring and Logging in Cloud: Tools and techniques for monitoring application performance and gathering logs.

Auto-scaling and Load Balancing: Scaling applications dynamically based on demand.

High Availability and Disaster Recovery: Designing and implementing resilient applications in the cloud.

Unit Number: 4	Title: Cloud-Based DevOps Tools and Best Practices	No. of hours: 10

Content Summary:

Cloud-Based Version Control: Using Git and other version control tools in cloud-based development.

Collaboration and Communication Tools: Utilizing cloud-based collaboration tools for distributed teams.

Cloud-Based Testing and Quality Assurance: Strategies for testing applications in cloud environments.

Cost Management in Cloud: Optimizing cloud resource usage and cost control.

Performance Optimization in Cloud: Techniques for improving application performance in cloud environments.

Case Studies and Real-World Projects: Analyzing successful cloud-based application development and DevOps projects.

***SELF-LEARNING COMPONENTS:**

- https://elearn.nptel.ac.in/shop/iit-workshops/completed/azure-devops-and-micro-services-azure-kubernetes-deployment-models/
- https://nptel.ac.in/courses/106105167

Please Note:

1)Students are supposed to learn the components on self-basis

2) At least 5-10 % syllabus will be asked in end term exams from self-learning components.

Reference Books:

1. Jez Humble and David Farley, Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation, Pearson Education, Inc., 2011.
2. Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 2013.
3. Arun Eapen, Docker on Amazon Web Services: Build, deploy, and manage your container applications at scale on AWS, Packt Publishing, 2017.
4. Sam Newman, Building Microservices: Designing Fine-Grained Systems, O'Reilly Media, Inc., 2015.
5. Mark Richards and Neal Ford, Fundamentals of Software Architecture: An Engineering Approach, O'Reilly Media, Inc., 2020.

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** the fundamental concepts and principles of cloud computing, including different cloud service models and deployment models. Gain insights into various cloud providers and their offerings to make informed decisions for application development and deployment.
CO2	**Acquire** practical knowledge and hands-on experience in developing cloud-native applications, utilizing containerization with Docker and orchestration using Kubernetes. Demonstrate proficiency in designing and implementing microservices-based architectures.
CO3	**Master** the principles and practices of DevOps in a cloud environment. Learn how to set up Continuous Integration (CI) and Continuous Deployment (CD) pipelines, automate infrastructure provisioning with Infrastructure as Code (IaC), and manage application configurations effectively.
CO4	**Develop** the skills to monitor, log, and optimize the performance of cloud-based applications. Explore auto-scaling and load balancing techniques to ensure high availability and disaster recovery strategies for resilient applications.
CO5	**Apply** cloud-based DevOps tools and best practices to collaborate effectively in distributed teams. Gain knowledge of cloud-based version control, testing, cost management, and performance optimization techniques to deliver efficient and cost-effective cloud solutions.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C2	-	P1
CO2	C3	-	P2
CO3	C3	-	P3
CO4	C1	-	-
CO5	C1	-	P1

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	2	1	-	3	3	-	1	3
CO2	3	3	2	-	3	-	-	-	-	-	-	3
CO3	3	3	2	2	3	1	-	-	-	-	-	3
CO4	-	3	2	2	3	-	-	-	-	-	1	3
CO5	-	3	2	3	2	-	-	-	-	-	-	3

Justification for mapping must be relevant.

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	-
CO2	2	1	-	-
CO3	2	-	-	1
CO4	-	-	1	-
CO5	2	1	-	1

Relevance of the Syllabus to various indicators

Unit I	Introduction
Local	Addresses local understanding of the Internet and its impact on society
Regional	Addresses regional internet connectivity and network infrastructure requirements
National	Contributes to national digital literacy and internet connectivity strategies
Global	Aligns with global trends in internet technologies and network protocols
Employability	Develops skills in using internet-based services and understanding network protocols
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills in internet technologies and network protocols
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	
Local	Addresses local understanding of the Internet and its impact on society
Regional	-
National	Contributes to national digital literacy and internet connectivity strategies

Global	Aligns with global trends in internet technologies and network protocols
Employability	Develops skills in using internet-based services and understanding network protocols
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills in internet technologies and network protocols
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	
Local	Addresses local network security needs and practices
Regional	-
National	Contributes to national network security strategies and protocols
Global	Aligns with global trends in network security techniques and protocols
Employability	Develops skills in network programming and network security techniques
Entrepreneurship	-
Skill Development	Develops knowledge and skills in client-server programming and network security
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

Unit IV	
Local	Addresses local understanding and implementation of internet-based services
Regional	-
National	Contributes to national digital communication strategies and multimedia applications
Global	Aligns with global trends in internet telephony, multimedia applications, and SEO
Employability	Develops skills in internet telephony, multimedia applications, and SEO
Entrepreneurship	-
Skill Development	Develops knowledge and skills in internet telephony, multimedia applications, and SEO
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts of internet telephony, multimedia applications, and SEO

Department:	**Department of Computer Science and Engineering**		
Course Name:	**Course Code**	**L-T-P**	**Credits**

APPLICATION DEVELOPMENT AND DEVOPS ON CLOUD LAB	**ENSP457**	0-0-2	1
Type of Course:	Minor (Department Elective III)		
Pre-requisite(s), if any: Nil			

Defined Course Outcomes

COs	**Course Outcomes (COs)**
CO 1	**Understand** the fundamental concepts of cloud computing, cloud service models, and cloud-based application development
CO 2	**Acquire** hands-on experience in deploying and managing applications on cloud platforms using various cloud services and tools
CO 3	**Implement** DevOps practices in cloud-based application development, including continuous integration, continuous deployment, and version control
CO 4	**Demonstrate** proficiency in using containerization (Docker and Kubernetes), Infrastructure as Code (IaC), and serverless computing for cloud-based application deployment and scaling
CO 5	**Develop** skills in application monitoring, logging, security, and performance optimization for cloud-based applications, and apply cost optimization strategies for cloud resources

Proposed Lab Experiments

Experiment No.	Experiment Title	Mapped COs
1	Setting up a cloud-based development environment	CO1
2	Deploying a web application on a cloud platform	CO1, CO2
3	Containerizing and deploying with Docker and Kubernetes	CO2, CO4
4	Implementing Continuous Integration (CI)	CO2, CO3
5	Implementing Infrastructure as Code (IaC)	CO2, CO4
6	Configuring auto-scaling for an application	CO2
7	Implementing high availability and disaster recovery	CO2
8	Building a serverless application	CO2, CO4
9	Implementing application monitoring and logging	CO2
10	Creating and managing a cloud-based database	CO2
11	Integrating third-party APIs with an application	CO2
12	Implementing security best practices	CO2
13	Managing application configurations	CO2
14	Performing load testing on an application	CO2
15	Migrating an application to the cloud	CO2
16	Implementing DevOps practices	CO3
17	Deploying a multi-tier application architecture	CO1, CO2
18	Integrating CI/CD pipeline with version control	CO2, CO3

19	Implementing blue-green deployment	CO3
20	Implementing Canary deployment	CO3
21	Performance optimization in cloud	CO2, CO4
22	Implementing feature flags	CO2, CO3
23	Implementing cost optimization strategies	CO2, CO5
24	Deploying a microservices-based application	CO2, CO4
25	Real-world project showcasing cloud-based development	CO1, CO2, CO3, CO4, CO5

1. **Exercise for Setting up a cloud-based development environment**: Exercise: Students set up an account with a cloud service provider (e.g., AWS, Azure) and create a virtual machine instance to host a basic web application.
2. **Project for Deploying a web application on a cloud platform**: Project: Students develop a simple web application and deploy it on a cloud platform using PaaS. They configure auto-scaling based on application demand and perform load testing to observe scaling behavior.
3. **Exercise for Containerizing and deploying with Docker and Kubernetes**: Exercise: Students containerize an existing application using Docker and deploy it on a Kubernetes cluster. They configure Kubernetes services, pods, and replicas for the application.
4. **Exercise for Implementing Continuous Integration (CI)**: Exercise: Students set up a CI/CD pipeline using a cloud-based CI/CD tool (e.g., Jenkins) to automatically build and test their application whenever code changes are pushed to the repository.
5. **Exercise for Implementing Infrastructure as Code (IaC)**: Exercise: Students use Terraform or CloudFormation to define and provision cloud resources for their application, such as virtual machines, storage, and networking.
6. **Project for Configuring auto-scaling for an application**: Project: Students design a scalable architecture for a multi-tier application and implement auto-scaling based on CPU utilization. They monitor application performance during auto-scaling events.
7. **Exercise for Implementing high availability and disaster recovery**: Exercise: Students configure a highly available architecture using load balancers and

multiple availability zones to ensure application resilience. They test disaster recovery scenarios.

8. **Project for Building a serverless application**: Project: Students develop a serverless application using FaaS. They implement serverless functions to handle specific application features and integrate them with event triggers.

9. **Exercise for Implementing application monitoring and logging**: Exercise: Students set up monitoring and logging solutions (e.g., CloudWatch, Stackdriver) for their applications to collect metrics, logs, and perform analysis.

10. **Project for Creating and managing a cloud-based database**: Project: Students design a database schema and implement a cloud-based database (e.g., Amazon RDS, Azure SQL Database). They perform data migration and backup strategies.

11. **Project for Integrating third-party APIs with an application**: Project: Students integrate a popular third-party API (e.g., Google Maps API, Twitter API) into their application to enhance its functionality and showcase real-time data retrieval.

12. **Exercise for Implementing security best practices**: Exercise: Students configure Identity and Access Management (IAM) roles and policies to enforce security for their cloud-based applications. They implement Network Security Groups and security groups to control traffic flow.

13. **Exercise for Managing application configurations**: Exercise: Students use cloud-native configuration management tools (e.g., AWS Systems Manager, Azure Configuration Management) to manage application configurations across multiple instances.

14. **Project for Performing load testing on an application**: Project: Students use load testing tools (e.g., JMeter, Gatling) to simulate high user loads on their cloud-based applications and analyze performance metrics under heavy traffic.

15. **Project for Migrating an application to the cloud**: Project: Students migrate an existing on-premises application to a cloud platform, considering factors like data transfer, application dependencies, and post-migration testing.

16. **Project for Implementing DevOps practices**: Project: Students collaborate in teams to develop a complete cloud-based application and implement DevOps practices, including version control, CI/CD, and automated testing.

17. **Exercise for Deploying a multi-tier application architecture**: Exercise: Students design and deploy a multi-tier application on the cloud, comprising frontend web servers, application servers, and database servers.

18. **Project for Integrating CI/CD pipeline with version control and issue tracking tools**: Project: Students set up integration between a CI/CD pipeline and

version control (e.g., Git) and issue tracking tools (e.g., Jira) for automated build and issue tracking.

19. **Exercise for Implementing blue-green deployment**: Exercise: Students implement blue-green deployment strategies to minimize downtime during application updates, allowing seamless rollback if issues arise.

20. **Exercise for Implementing Canary deployment**: Exercise: Students deploy a new feature of their application to a small subset of users using Canary deployment to gather feedback and monitor performance.

21. **Project for Performance optimization in the cloud**: Project: Students optimize the performance of their cloud-based application by tuning parameters, caching, and optimizing database queries for better response times.

22. **Project for Implementing feature flags**: Project: Students implement feature flags (feature toggles) in their application to enable/disable features dynamically and gradually release new functionalities.

23. **Project for Implementing cost optimization strategies**: Project: Students analyze the cost of their cloud resources and implement cost optimization techniques, such as using reserved instances and rightsizing resources.

24. **Project for Deploying a microservices-based application**: Project: Students design and deploy a microservices-based application architecture on the cloud, using containers and orchestrators like Kubernetes.

25. **Project for Real-world project showcasing cloud-based development**: Project: Students work on a real-world cloud-based development project, applying the concepts learned throughout the course to design, develop, deploy, and manage an application in the cloud.

Department Elective – III

Department:	**Department of Computer Science and Engineering**		
Course Name: **Mobile Application Development using iOS**	**Course Code**	**L-T-P**	**Credits**
	ENSP409	4-0-0	4
Type of Course:	Minor (Department Elective III)		

Pre-requisite(s), if any: Basics of Android

Brief Syllabus:

The objective of the course is to provide skills to develop applications for OS X and iOS. It includes introduction to development framework Xcode. Objective-C is used as programming language to develop the applications. Objective-C is the superset of the C programming language and provides object-oriented capabilities and a dynamic runtime. Objective-C inherits the syntax, primitive types, and flow control statements of C and adds syntax for defining classes and methods.

UNIT WISE DETAILS

Unit Number: 1	**Title: Introduction to IDE and SDK of iOS App Development**	**No. of hours: 10**

Content Summary:

Xcode-The SDK environment, Supporting tools, Advance settings. Development Technique, Fundamental of Object-Oriented Programming, The MVC architecture.

Unit Number: 2	**Title: Objective-C**	**No. of hours: 10**

Content Summary:

Introduction to Objective C, Primitive Data Types, Conditions, Loops, Functions, Arrays, Pointers, Structures, Classes, Objects, Foundation, Memory Management, Inheritance, Categories, Protocols, Predicates, Blocks, Multi-Threading.

Objects Send and Receive Messages concept, Use of Pointers to Keep Track of Objects, Methods - Return Values.

Unit Number: 3	Title: Encapsulating Data	No. of hours: 10

Content Summary:

Properties of Encapsulation of an Object's Values, Declare Public Properties for Exposed Data, Use Accessor Methods to Get or Set Property Values, Concept of Dot Syntax, Properties Are Backed by Instance Variables.

Dealing with Errors: Use NSError for Most Errors, Some Delegate Methods Alert You to Errors, Some Methods Pass Errors by Reference

Unit Number: 4	Title: Developing iOS Applications	No. of hours: 10

Content Summary:

iOS App Anatomy, Design Principles, Creating a Basic Hello World App with interface elements, UI View & Controller, UI Elements, Trigger Actions, Storyboard, Device Orientations, Using Gestures, Popovers and Modal Dialogs, Creating Universal Apps, Status Bar, Navigation Bar, Tab Bar, Content Views (e.g. Image view, Map View etc.), UI Table View and Table View Controller, Core Data, Test your App, Publishing your App.

***Self-Learning Components:**

2. XCode Documentation

References:

5. https://www.tutorialspoint.com/objective_c/objective_c_quick_guide.htm
6. https://www.coursera.org/learn/introduction-to-ios-mobile-application-development
7. https://www.geeksforgeeks.org/classes-objects-in-objective-c/

Please Note:

1)Students are supposed to learn the components on self-basis

2) At least 5-10 % syllabus will be asked in end term exams from self-learning components.

Textbook:

1. Effective objective C 2.0, Matt Galloway, Effective software development series, Scott Meyers.

Reference Books:

1. Programming in Objective-C (5th Edition) (Developer's Library) by Stephen G. Kochan.

2. iOS 6 Development Unleashed: Developing Mobile Applications for Apple iPhone, iPad, and iPod Touch by Robert McGovern

Online References:

8. https://developer.apple.com/library/archive/documentation/Cocoa/Conceptual/ProgrammingWithObjectiveC/Introduction/Introduction.html
9. https://www.digitalocean.com/community/tutorials/objective-c-hello-world-tutorial

Course Outcomes (CO)

COs	Statements
CO1	**Create** iPhone apps using Objective-C and Apple's new programming language, use industry tools and frameworks such as Cocoa, Xcode, UIKit, Git.
CO2	**Understand** and know how to use properly UIKit, asynchronous code, Core Image, NSURL Session and JSON Map Kit and Core Location, Auto Layout, Source Control, Core Data, Animation, and the app submission process.
CO3	Read and write programs based on Objective-C, also have a strong grasp of Objective-C objects
CO4	**Organize** their code professionally using objects and blocks, prototype several entries- level apps and try to publish on App store.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels(C) 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	C2	A1	P1
C02	C3	A4	P1

CO3	C5	A2	P2
CO4	C6	A1	P4

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	-	-	-	-	-	-	-	-	3
CO2	-	3	2	-	2	-	-	-	-	-	-	3
CO3	-	2	2	3	1	-	-	-	-	-	-	3
CO4	-	2	3	-	-		-	-	-	-	-	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	2		-	3
CO2	2	2	-	2
CO3	-	2	-	-
CO4	-	-	-	3

Relevance of the Syllabus to various indicators

Unit I	Introduction to IDE and SDK of iOS App Development
Local	-
Regional	-
National	-
Global	Xcode is the official IDE provided by Apple for iOS app development. It is available globally and widely used by developers worldwide. Xcode includes a suite of tools, such as

	Interface Builder, Instruments, and iOS Simulator, along with an extensive SDK for building iOS apps.
Employability	-
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Objective-C
Local	-
Regional	-
National	
Global	Objective C can be used globally with its syntax and syntactic rules
Employability	-
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Encapsulating Data

Local	In programming, "local" usually refers to variables, data, or methods that are confined to a specific scope, such as within a function or a block. Local variables are only accessible within the block or function where they are declared.
Regional	-
National	-
Global	
Employability	
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Developing iOS Applications
Local	-
Regional	-
National	"National" might represent initiatives or policies related to iOS app development adopted or regulated at the national level. For example, it could include national-level educational programs or government-supported initiatives promoting digital skills and app development.
Global	
Employability	-
Entrepreneurship	-
Skill Development	-

Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4, SDG 8, SDG 9
NEP 2020	Promoting universal access to education, holistic development, multidisciplinary approach, skill development, critical thinking, creativity, ICT integration, research and development, global competencies, and professional ethics.
POE/4th IR	Skill Development / Coding / Programming Software

Department:	Department of Computer Science and Engineering		
Course Name: Mobile Application Development using iOS Lab	Course Code	L-T-P	Credits
	ENSP459	0-0-2	1
Type of Course:	Departmental Elective III (Minor)		
Pre-requisite(s), if any: Basics of Android			

Defined Course Outcomes

COs	
CO 1	Create iPhone apps using Objective-C and Apple's new programming language, use industry tools and frameworks such as Cocoa, Xcode, UIKit, Git.
CO 2	Understand and know how to use properly UIKit, asynchronous code, Core Image, NSURL Session and JSON Map Kit and Core Location, Auto Layout, Source Control, Core Data, Animation, and the app submission process.
CO 3	Read and write programs based on Objective-C, also have a strong grasp of Objective-C objects
CO 4	Organize their code professionally using objects and blocks, prototype several entry- level apps and try to publish on App store.

Proposed Lab Experiments

Ex No	Experiment Title	Mapped CO/COs
1	Case Study of Objective-C language.	CO2
2	Case study of Windows and MAC systems	CO2
3	Case Study of XCode based on MAC Systems	CO2
4	Design an App for UISwitch based on Objective-C language	CO1
5	Design an App for UISlider based on Objective-C language	CO1

6	Design an App for UIStepper based on Objective-C language	CO1
7	Write a program for creating Story Boards	CO1
8	Design an App for UIAnimation based on Objective-C language	CO1
9	Create a Simple Calculator using Objective-C Language	CO1
10	Design an App for UIProgress Bar based on Objective-C language	CO1
11	Design an App for UIDatePicker Bar based on Objective-C language	CO1
12	Write an Objective-C program to print factorial of a given number	CO3
13	Write an Objective-C program to print Fibonacci series	CO3
14	Write an Objective-C program that displays the Phrase "Hello World"	CO3
15	Write an Objective-C program for displaying the value of variables	CO3
16	Write an Objective-C program for displaying the sum and subtraction of two variables	CO3
17	Write an Objective-C program for displaying the multiplication and division of the two variables	CO3
18	Write an Objective-C program that demonstrate control structure of Objective-C language	CO3
19	Create a Button using Objective-C	CO3
20	Write an Objective-C program to print the value of a variable inside a text, place it in parentheses, and insert a backslash just prior to the opening parenthesis	CO3
21	Write an Objective-C program to print Floyd's Triangle.	CO3
22	Write an Objective-C program to print palindrome of a number.	CO3
23	Write an Objective-C program to print pyramid.	CO3

24	Write an Objective-C program to find greatest number in between three numbers	CO3
25	Write an Objective-C program to check whether a number is even or odd.	CO3
26	Mini Project 1: Make an interactive project based on iOS App using Objective-C Language	CO4
27	Mini Project 2: Upload your iOS App in Apple AppStore and Publish it	CO4

Department:	Department of Computer Science and Engineering		
Course Name:	Course Code	L-T-P	Credits
DevOps & Automation	ENSP411	4-0-0	4
Type of Course:	Minor (Department Elective III)		

Pre-requisite(s), if any: Nil

Brief Syllabus:

Throughout the subject, students will engage in hands-on exercises and projects to gain practical experience with various DevOps tools and practices. By the end of the course, students will be well-equipped to embrace the DevOps culture and apply automation techniques to enhance software development, delivery, and operations processes.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to DevOps	No. of hours: 10

Content Summary:

Overview of DevOps: Definition, objectives, and benefits.

DevOps Principles: Collaboration, automation, continuous integration, continuous delivery, and continuous deployment.

DevOps Tools: Introduction to popular DevOps tools like Git, Jenkins, Docker, Kubernetes, and Ansible.

Version Control with Git: Branching, merging, and collaborative development using Git.

Continuous Integration (CI): Setting up CI pipelines with Jenkins for automated building and testing.

Continuous Delivery and Deployment: Implementing CD pipelines for deploying applications to various environments.

Unit Number: 2	Title: Containerization and Orchestration	No. of hours: 10

Content Summary:

Introduction to Containers: Docker and containerization concepts.

Container Management: Working with Docker containers, images, and registries.

Docker Compose: Managing multi-container applications.

Introduction to Kubernetes: Container orchestration and Kubernetes architecture.

Deploying Applications with Kubernetes: Deploying, scaling, and managing applications on Kubernetes.

Unit Number: 3	Title: Configuration Management and Infrastructure as Code (IaC)	No. of hours: 10

Content Summary:

Introduction to Configuration Management: Need for configuration management tools.

Managing Infrastructure with Ansible: Ansible architecture and playbooks for automated configuration management.

Infrastructure as Code (IaC) Concepts: Managing infrastructure using code, benefits of IaC.

IaC with Terraform: Infrastructure provisioning using Terraform and cloud service providers (e.g., AWS, Azure).

Unit Number: 4	Title: Monitoring, Logging, and Security in DevOps	No. of hours: 10

Content Summary:

Application Monitoring: Monitoring tools and techniques for tracking application performance and health.

Log Management: Centralized log collection, analysis, and visualization.

Security in DevOps: Implementing security best practices in CI/CD pipelines and containerized environments.

DevOps Culture and Collaboration: Encouraging collaboration between development and operations teams.

***SELF-LEARNING COMPONENTS:**

https://elearn.nptel.ac.in/shop/iit-workshops/completed/cicd-devops-automation-and-devsecops-automation/

Please Note:

1)Students are supposed to learn the components on self-basis

2) At least 5-10 % syllabus will be asked in end term exams from self-learning components.

Reference Books:

1. Jez Humble and David Farley, "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation," Pearson Education, Inc., 2011.
2. Nigel Poulton, "The Kubernetes Book," Independently published, 2018.
3. Sam Newman, "Building Microservices: Designing Fine-Grained Systems," O'Reilly Media, Inc., 2015.
4. Eberhard Wolff, "Microservices Patterns: With examples in Java," Manning Publications, 2018.
5. Yevgeniy Brikman, "Terraform: Up & Running: Writing Infrastructure as Code," O'Reilly Media, Inc., 2017.

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** the principles and benefits of DevOps, and its role in enhancing collaboration and efficiency between development and operations teams.
CO2	**Acquire** hands-on experience with popular DevOps tools such as Git, Jenkins, Docker, Kubernetes, and Ansible for implementing continuous integration, continuous delivery, and automated deployment processes.
CO3	**Demonstrate** proficiency in containerization and orchestration techniques using Docker and Kubernetes for efficient and scalable application deployment and management.

CO4	**Implement** configuration management and Infrastructure as Code (IaC) using Ansible and Terraform to automate the provisioning and management of infrastructure resources.
CO5	**Develop** skills in monitoring, logging, and security practices in the context of DevOps, ensuring application performance, resilience, and adherence to security best practices.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 1. Knowledge 2. Understand 3. Apply 4. Analyze 5. Evaluate 6. Create	Affective levels(A) 1. Receiving 2. Responding 3. Valuing 4. Organizing 5. Characterizing	Psychomotor levels(P) 1. Imitation 2. Manipulation 3. Precision 4. Articulation 5. Improving
CO1	-	-	P1
CO2	C2	-	P2
CO3	C3	L3	P3
CO4	C4	-	-
CO5	C5	L5	P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	3	-	3	-	-	-	3
CO2	3	3	-	3	3	-	-	3	-	-	-	3
CO3	3	3	2	2	3	2	2	3	-	-	-	3
CO4	-	3	2	3	3	-	2	3	2	-	-	3

CO5	-	3	2	3	-	-	3	3	-	-	-	3

Justification for mapping must be relevant.

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4
CO1	3	-	1	-
CO2	2	1	-	1
CO3	3	-	-	-
CO4	1	1	1	1
CO5	-	2	-	-

Relevance of the Syllabus to various indicators

Unit I	Introduction
Local	Addresses local understanding of the Internet and its impact on society
Regional	Addresses regional internet connectivity and network infrastructure requirements
National	Contributes to national digital literacy and internet connectivity strategies
Global	Aligns with global trends in internet technologies and network protocols
Employability	Develops skills in using internet-based services and understanding network protocols
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills in internet technologies and network protocols
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	
Local	Addresses local understanding of the Internet and its impact on society
Regional	-
National	Contributes to national digital literacy and internet connectivity strategies
Global	Aligns with global trends in internet technologies and network protocols

Employability	Develops skills in using internet-based services and understanding network protocols
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills in internet technologies and network protocols
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	
Local	Addresses local network security needs and practices
Regional	-
National	Contributes to national network security strategies and protocols
Global	Aligns with global trends in network security techniques and protocols
Employability	Develops skills in network programming and network security techniques
Entrepreneurship	-
Skill Development	Develops knowledge and skills in client-server programming and network security
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	

Local	Addresses local understanding and implementation of internet-based services
Regional	-
National	Contributes to national digital communication strategies and multimedia applications
Global	Aligns with global trends in internet telephony, multimedia applications, and SEO
Employability	Develops skills in internet telephony, multimedia applications, and SEO
Entrepreneurship	-
Skill Development	Develops knowledge and skills in internet telephony, multimedia applications, and SEO
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts of internet telephony, multimedia applications, and SEO

Department:	Department of Computer Science and Engineering		
Course Name: DevOps & Automation Lab	Course Code	L-T-P	Credits
	ENSP461	0-0-2	1
Type of Course:	Minor (Department Elective III)		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	Course Outcomes (COs)
CO 1	**Gain** hands-on experience in setting up version control using Git and performing collaborative software development with branching and merging techniques.
CO 2	**Acquire** practical knowledge in implementing continuous integration and continuous deployment (CI/CD) pipelines using Jenkins, automating the build, test, and deployment processes.
CO 3	**Develop** proficiency in containerization with Docker, including managing Docker containers and images, and deploying applications on Kubernetes for efficient and scalable orchestration.
CO 4	**Demonstrate** skills in infrastructure automation and configuration management using Ansible and Terraform to provision and manage cloud resources and application configurations.
CO 5	**Understand** and **apply** monitoring, logging, and security practices in DevOps, ensuring application performance, resilience, and adherence to security best practices throughout the software development lifecycle.

Proposed Lab Experiments

Ex. No.	Experiment Title	Mapped CO(s)
1	Setting up version control with Git	CO1
2	Implementing a basic Jenkins CI/CD pipeline	CO2
3	Automating application deployment with Jenkins	CO2
4	Containerizing an application using Docker	CO3
5	Managing Docker containers and images	CO3
6	Deploying applications with Kubernetes	CO3
7	Implementing Kubernetes deployment strategies	CO3
8	Continuous deployment with Kubernetes	CO3
9	Configuring infrastructure with Ansible	CO4
10	Automating application configuration with Ansible	CO4
11	Implementing Infrastructure as Code (IaC) with Terraform	CO4
12	Creating scalable and resilient infrastructure with Terraform	CO4
13	Monitoring application performance with Prometheus	CO5
14	Logging and centralized log management	CO5
15	Implementing security measures in CI/CD pipelines	CO5
16	Implementing feature flags for controlled feature rollout	CO5
17	Load testing and performance optimization	CO5
18	Automating application tests with Selenium	CO2, CO5
19	Integrating automated testing in CI/CD pipelines	CO2, CO5
20	Blue-green deployment for zero-downtime updates	CO3, CO5

21	Canary deployment for testing new features	CO3, CO5
22	Implementing GitOps for application deployments	CO3, CO5
23	Managing secrets and sensitive data securely	CO5
24	Disaster recovery planning and testing	CO5
25	Creating a DevOps project integrating multiple tools	CO1, CO2, CO3, CO4, CO5

1. **Setting up version control with Git**: Exercise: Initialize a Git repository, create branches, perform commits, and push changes to a remote repository. Project: Collaboratively work on a project using branching and merging techniques in Git.
2. **Implementing a basic Jenkins CI/CD pipeline**: Exercise: Set up a simple Jenkins pipeline to build and test a sample application from version control. Project: Develop a complete CI/CD pipeline that includes code building, automated testing, and deployment to a staging environment.
3. **Automating application deployment with Jenkins**: Exercise: Configure Jenkins to automatically deploy the application to a test server upon successful build. Project: Implement a full-fledged CD pipeline with Jenkins, including deployment to production after successful testing.
4. **Containerizing an application using Docker**: Exercise: Dockerize a basic application and run it in a container. Project: Containerize a multi-service application with Docker Compose for easier deployment.
5. **Managing Docker containers and images**: Exercise: Explore Docker commands to manage containers and images, such as starting, stopping, and cleaning up. Project: Implement a container registry and manage images for different application versions.
6. **Deploying applications with Kubernetes**: Exercise: Set up a Kubernetes cluster and deploy a basic application using YAML manifests. Project: Deploy a microservices-based application with Kubernetes, configuring services and network policies.
7. **Implementing Kubernetes deployment strategies**: Exercise: Implement rolling updates and rollbacks in Kubernetes. Project: Use Kubernetes deployment strategies like blue-green and canary deployments for a real-world application.

8. **Continuous deployment with Kubernetes**: Exercise: Set up a Jenkins pipeline for continuous deployment to Kubernetes. Project: Create an end-to-end automated CD pipeline with Jenkins and Kubernetes.

9. **Configuring infrastructure with Ansible**: Exercise: Use Ansible to provision and configure virtual machines. Project: Create a playbook to configure a complete development environment for an application.

10. **Automating application configuration with Ansible**: Exercise: Create Ansible playbooks to automate application-specific configurations. Project: Implement dynamic inventory and use Ansible roles for better code organization.

11. **Implementing Infrastructure as Code (IaC) with Terraform**: Exercise: Set up a basic Terraform configuration to create cloud resources. Project: Use Terraform to define infrastructure for a scalable and fault-tolerant application.

12. **Creating scalable and resilient infrastructure with Terraform**: Exercise: Implement auto-scaling and load balancing in Terraform. Project: Design a Terraform template for a highly available architecture using multiple availability zones.

13. **Monitoring application performance with Prometheus**: Exercise: Set up Prometheus for monitoring application metrics. Project: Create custom Prometheus metrics and use Grafana for visualization and alerting.

14. **Logging and centralized log management**: Exercise: Configure centralized log collection using tools like Fluentd or Logstash. Project: Set up ELK (Elasticsearch, Logstash, and Kibana) stack for efficient log analysis.

15. **Implementing security measures in CI/CD pipelines**: Exercise: Use Jenkins plugins to implement security checks in CI/CD pipelines. Project: Implement security scanning tools like SonarQube and integrate them into the pipeline.

16. **Implementing feature flags for controlled feature rollout**: Exercise: Add feature flags to a sample application to enable/disable specific features. Project: Implement a feature flag service for a real-world application and manage feature rollout.

17. **Load testing and performance optimization**: Exercise: Use load testing tools to evaluate application performance under heavy traffic. Project: Analyze performance bottlenecks and optimize the application for scalability.

18. **Automating application tests with Selenium**: Exercise: Use Selenium WebDriver for automating browser-based tests. Project: Develop an automated testing suite covering multiple application features.

19. **Integrating automated testing in CI/CD pipelines**: Exercise: Integrate automated tests into the Jenkins CI/CD pipeline. Project: Implement a complete testing strategy, including unit, integration, and end-to-end tests.

20. **Blue-green deployment for zero-downtime updates**: Exercise: Perform blue-green deployment for a sample application update. Project: Set up a blue-green deployment strategy for a production application.

21. **Canary deployment for testing new features**: Exercise: Implement canary deployment for a specific application feature. Project: Use canary deployment to gradually release new features to a subset of users.

22. **Implementing GitOps for application deployments**: Exercise: Use GitOps principles to manage Kubernetes manifests with Git. Project: Implement a GitOps workflow for application deployment and configuration management.

23. **Managing secrets and sensitive data securely**: Exercise: Utilize Kubernetes secrets or HashiCorp Vault to manage sensitive data. Project: Set up a secure secret management system for a production environment.

24. **Disaster recovery planning and testing**: Exercise: Design a disaster recovery plan for a sample application. Project: Test the disaster recovery plan and validate its effectiveness.

25. **Creating a DevOps project integrating multiple tools**: Exercise: Choose and integrate various DevOps tools into a sample project. Project: Create an end-to-end DevOps project showcasing the integration of tools and best practices.

Department:	Department of Computer Science and Engineering		
Course Name: .NET Framework	Course Code	L-T-P	Credits
	ENSP413	4-0-0	4
Type of Course:	Minor (Department Elective III)		
Pre-requisite(s), if any:			

Brief Syllabus:

The ".NET Framework" syllabus covers introduction and components of .NET, programming languages, Visual Studio, OOP, exception handling, memory management, Windows Forms/WPF, ASP.NET, web services, .NET Core, Entity Framework, and WCF. Emphasis on practical application and development skills for building robust and secure applications.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to .NET Framework	No. of hours: 8

Content Summary:

Overview of .NET Framework ,Introduction to the .NET platform, Evolution and history of .NET Framework, Key components and architecture of .NET Framework, Common Language Runtime (CLR) and Just-In-Time (JIT) compilation, Common Intermediate Language (CIL) and Intermediate Language (IL), Programming Languages in .NET (C# as the primary language for .NET development & Visual Basic .NET) ,Introduction to Visual Studio IDE, Installation and configuration of .NET Framework and Visual Studio, NuGet package manager and third-party libraries

Unit Number: 2	Title: .NET Framework Fundamentals	No. of hours: 8

Object-Oriented Programming (OOP) in .NET, Classes, objects, and inheritance, Exception Handling and Debugging, Debugging techniques and tools in Visual Studio, Logging and error reporting in .NET applications, Memory Management and Garbage

Collection, Automatic memory management in .NET, Garbage collection concepts and algorithms, Finalizers and the Dispose pattern, Performance considerations and best practices

Unit Number: 3	Title: Building Applications with .NET Framework	No. of hours: 12

Windows Forms and WPF Applications, Introduction to Windows Forms and Windows Presentation Foundation (WPF), Designing user interfaces using WinForms/WPF controls, Event-driven programming and event handling, Data binding and data access in WinForms/WPF applications, ASP.NET Web Development, Data access and validation in ASP.NET applications, Web Services and RESTful APIs, Creating and consuming web services in .NET, Authentication and security considerations in web services.

Unit Number: 4	Title: Advanced Topics in .NET Framework	No. of hours: 12

Content Summary:

.NET Core and Cross-Platform Development, Introduction to .NET Core and its advantages, Building cross-platform applications with .NET Core, Deploying and hosting .NET Core applications, Entity Framework and Database Connectivity, Overview of Entity Framework and Object-Relational Mapping (ORM), Creating and manipulating databases with Entity Framework, Querying data using LINQ (Language Integrated Query), Handling database migrations and versioning, Windows Communication Foundation (WCF), Introduction to WCF and service-oriented architecture (SOA), Creating and consuming WCF services, Message exchange patterns and bindings in WCF, Security and reliability in WCF applications

***Self-Learning Components:**

1. **Online Tutorials and Documentation: Direct students to the official Microsoft documentation for .NET Framework, which provides comprehensive guides and resources. Microsoft .NET Documentation**
2. **Hands-on Coding Exercises: Assign coding exercises from platforms like LeetCode or HackerRank that focus on implementing concepts of .NET Framework. LeetCode HackerRank**
3. **Project-Based Learning: Encourage students to work on small projects using different aspects of the .NET Framework. Provide examples of project ideas and resources like GitHub repositories for inspiration. GitHub**

**students will demonstrate the self-learning components through classroom presentations*
Reference/Text Books: 1. **"Mastering C# and .NET Framework" by Jayantha Dhanapala** 2. **"Pro C# and .NET Framework" by Andrew Troelsen** 3. **".NET Framework Programming with C#" by G. Shankar** 4. **".NET Programming: Concepts and Practice" by Atul Kumar**

Define Course Outcomes (CO)

COs	Statements
CO1	Knowledge: Understanding the fundamental concepts and components of the .NET Framework.
CO 2	Application: Applying knowledge to design and develop applications using Windows Forms, WPF, and ASP.NET.
CO 3	Analysis: Analyzing performance considerations and troubleshooting errors in the .NET Framework.
CO 4	Synthesis: Integrating advanced topics like .NET Core, Entity Framework, and WCF for cross-platform development and service creation.
CO 5	Evaluation: Assessing security, reliability, scalability, and performance of applications developed using the .NET Framework.

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels© 61. Knowledge 62. Understand 63. Apply 64. Analyze 65. Evaluate 66. Create	Affective levels(A) 51. Receiving 52. Responding 53. Valuing 54. Organizing 55. Characterizing	Psychomotor levels(P) 51. Imitation 52. Manipulation 53. Precision 54. Articulation 55. Improving
CO1	C1	A1	P1
C02	C3	A2	P2
CO3	C2	A3	P3
CO4	-	-	-
CO5	C5	-	P5

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Relevance of the Syllabus to various indicators

Unit I	**Introduction to .NET Framework**
Local	
Regional	
National	Understanding the evolution and history of the .NET Framework provides context specific to the national software development landscape.
Global	
Employability	Understanding the .NET Framework provides valuable skills and knowledge sought by employers in the software development industry.
Entrepreneurship	Understanding the .NET platform can support the development of innovative software products and services.
Skill Development	Studying the .NET Framework helps develop technical skills in application development and programming.
Professional Ethics	Familiarity with the .NET Framework enables professionals to adhere to ethical practices while developing software applications.
Gender	
Human Values	-
Environment & Sustainability	-
Unit II	**NET Framework Fundamentals**
Local	Understanding OOP in .NET can have local relevance in terms of specific programming practices and patterns adopted within the local software development community.
Regional	-
National	Understanding classes, objects, and inheritance in the .NET Framework is relevant at all levels of software development.
Global	Aligns with global trends in internet technologies and network protocols

Employability	Knowledge of classes, objects, and inheritance enhances employability in the software development field.
Entrepreneurship	Knowledge of OOP in .NET supports the development of innovative software products and services by entrepreneurs.
Skill Development	Learning about classes, objects, and inheritance improves technical skills required
Professional Ethics	
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Building Applications with .NET Framework**
Local	Understanding Windows Forms and WPF applications is relevant at a local level as it involves designing user interfaces and developing desktop applications specific to the local context.
Regional	Understanding Windows Forms and WPF applications is relevant at a regional level as these frameworks are commonly used in software development within a specific region.
National	Introduction to Windows Forms and WPF is important at a national level as these frameworks serve as the foundation for developing various types of applications used nationwide.
Global	Introduction to Windows Forms and WPF is important globally as these frameworks are fundamental to developing user interfaces and applications used on a global scale.
Employability	Understanding the basics of Windows Forms and WPF is crucial for employability in software development roles. Proficiency in these frameworks demonstrates competence and versatility, making individuals more desirable to potential employers.
Entrepreneurship	Knowledge of Windows Forms and WPF applications enables entrepreneurs to create innovative software products and services, driving business growth and success.

Skill Development	Understanding Windows Forms and WPF applications enhances technical skills in software development, enabling individuals to design and develop user-friendly and visually appealing applications.
Professional Ethics	Familiarity with Windows Forms and WPF applications ensures adherence to ethical standards in software development, including data privacy, accessibility, and industry best practices for usability and security.
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Advanced Topics in .NET Framework**
Local	the content on .NET Core, Entity Framework, and Windows Communication Foundation (WCF) has local relevance as it addresses the specific development and database connectivity needs within the local context.
Regional	-
National	The content on .NET Core, Entity Framework, and Windows Communication Foundation (WCF) is nationally relevant as it addresses specific development and database connectivity needs within the country, considering national requirements and technologies.
Global	addresses development and database connectivity needs on a global scale, considering international requirements and technologies.
Employability	Content equips individuals with the skills and knowledge necessary for software development roles. Proficiency in these technologies enhances employability prospects and opens up opportunities in the job market.
Entrepreneurship	Understanding these technologies enables entrepreneurs to create and scale their own software ventures.

Skill Development	Learning and applying these technologies contribute to the development of practical skills that are in demand in the industry, improving professional capabilities and career prospects
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 9, SDG 4, and SDG 8,
NEP 2020	-
POE/4th IR	the content on .NET Core, Entity Framework, and Windows Communication Foundation (WCF) addresses professional ethics and aligns with the demands and innovations of the Fourth Industrial Revolution (4IR).

Department:	**Department of Computer Science and Engineering**		
Course Name: **.NET Framework Lab**	**Course Code**	**L-T-P**	**Credits**
	ENSP463	4-0-0	4
Type of Course:	Minor (Department Elective III)		
Pre-requisite(s), if any:			

Defined Course Outcomes

COs	
CO 1	Knowledge and Understanding: Gain a thorough understanding of the core concepts and components of the .NET Framework.
CO 2	Application and Problem Solving: Apply .NET Framework knowledge to design and develop applications, solving programming problems effectively.
CO 3	Analyze and troubleshoot .NET applications, using debugging techniques and optimizing performance.
CO 4	Integrate advanced .NET topics like .NET Core, Entity Framework, and WCF to create cross-platform applications, work with databases, and build services.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
1	Installing and setting up the .NET Framework, Visual Studio IDE, and NuGet package manager	CO1
2	Creating a basic console application in C# or Visual Basic.NET and running it in Visual Studio.	CO1
3	Write a program to display "Hello World" using C#.	CO2
4	Create a Windows Forms application to design a simple calculator.	CO2
5	Develop a console application to perform basic arithmetic operations	CO2
6	Create a class hierarchy to represent different types of vehicles.	CO2
7	Implement inheritance and polymorphism concepts in a C# program.	CO2
8	Design a Windows Forms application to manage student records.	CO3
9	Create a WPF application to build a simple photo gallery.	CO3
10	Develop a web application to display and manage a list of books using ASP.NET..	CO3
11	Implement form validation and data access in an ASP.NET application.	CO3
12	Build a RESTful API using ASP.NET Web API to perform CRUD operations on a database.	CO3
13	Create a client application to consume a web service and display the retrieved data.	CO2
14	Implement a cross-platform application using .NET Core.	CO3
15	Develop a database-driven application using Entity Framework for data manipulation.	CO3

16	Design and implement a WCF service to provide secure communication between client and server.	CO4
17	Connect a .NET application to a database using ADO.NET and retrieve data.	CO3
18	Use LINQ (Language Integrated Query) to perform data querying and manipulation operations.	CO3
19	Deploy a .NET application to a web server or a cloud platform.	CO4
20	Configure and manage the hosting environment for a .NET application.	CO4
21	Use debugging techniques and tools in Visual Studio to identify and fix bugs in a program.	CO2
22	Create a program to demonstrate the automatic memory management feature in .NET.	CO4
23	Implement a program to analyze and optimize memory usage in a .NET application.	CO2
24	Develop a WCF service to perform CRUD operations on a database.	CO4
25	Design a client application to consume the WCF service and display the retrieved data.	CO4

Department:	Department of Computer Science and Engineering		
Course Name: New-Age programming languages (GO, F#, Clojure, Kotlin)	**Course Code**	**L-T-P**	**Credits**
	ENSP415	4-0-0	4
Type of Course:	Department Elective - III (Full Stack Development)		
Pre-requisite(s), if any:			

Brief Syllabus:

New-Age programming languages (GO, F#, Clojure, Kotlin) provides an introduction to the concepts and applications of modern programming languages. It explore the features and benefits of GO, F#, Clojure, and Kotlin, and develop practical skills in programming using these languages. The course will cover language syntax, data types, control structures, functional programming concepts, concurrency, and integration with other technologies.

UNIT WISE DETAILS

Unit Number: 1	Title: GO programming Language	No. of hours: 10

Content Summary:

Overview of GO, F#, Clojure, and Kotlin, Comparison with traditional programming languages, Installation and setup of development environment, Introduction to GO syntax and data types, Control structures, Functions and packages in GO, Arrays, slices, and maps in GO, Structs and custom data types, Pointers and memory management, Concurrency and parallelism in GO, Error Handling, Concurrent Programming in GO, Advanced GO Concepts- Function closures and anonymous functions, Reflection and type introspection, Testing and benchmarking in GO, Writing concurrent and parallel programs.

Unit Number: 2	Title: F# Programming Language	No. of hours: 10

Content Summary:

Introduction to F# syntax and functional programming concepts, Data Types, Variables, Operators, Decision Making, Loops, Functions, Strings, Options, Immutable data types and pattern matching, Higher-order functions and currying, Asynchronous and parallel programming in F#, Object-Oriented Programming with F#, Database access with F#, Querying and manipulating data using F#, Integration with relational and NoSQL databases

Unit Number: 3	Title: Introduction to Clojure Programming	No. of hours: 10

Content Summary:

Overview of Clojure and its features, Setting up the development environment, Basic syntax and data structures in Clojure, Functional Programming in Clojure, Immutable data and pure functions, Higher-order functions and recursion, Collections and sequence operations in Clojure, Destructuring and pattern matching, Macros and metaprogramming in Clojure, Concurrency models in Clojure, Asynchronous programming with core.async, Parallel programming with reducers and pmap, Interacting with Java libraries and APIs, Java interoperability in Clojure, Working with Java collections and objects, Web Development with Clojure, Building web applications using Clojure and Ring, Database access and persistence in Clojure, Error Handling and Testing: Exception handling and error management in Clojure, Testing strategies and frameworks in Clojure, Data Manipulation and Transformation: Data manipulation with Clojure's sequence functions, Data transformation with transducers, Data-driven development with data literals and data readers

Unit Number: 4	Title: Introduction to Kotlin Programming	No. of hours: 10

Content Summary:

Overview of Kotlin and its advantages, Setting up the development environment, Basic syntax and data types in Kotlin, Conditional statements and loops, Function declarations and parameters, Lambda expressions and higher-order functions, Object-Oriented Programming in Kotlin: Classes, objects, and inheritance, Properties and access modifiers, Interfaces and abstract classes, Understanding nullable and non-nullable types, Safe calls and the Elvis operator, Type inference and smart casting, Collections and Functional Programming: Working with lists, sets, and maps in Kotlin, Collection operations and transformations, Introduction to functional programming concepts in Kotlin, Creating extension functions in Kotlin, Using DSLs for domain-specific problems, Builder pattern and DSL implementation.

***Self-Learning Components:**

3. Web programming with GO
4. F# for Data Science and Machine Learning:
5. Metaprogramming and DSLs in Clojure:
6. Android App Development with Kotlin:

References:

1. Building Modern Web Applications with Go (Golang) by Udemy
2. https://www.jetbrains.com/academy/
3. https://www.classcentral.com/subject/f-sharp
4. https://www.classcentral.com/subject/clojure

Please Note:

At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books:

12. The Go Programming Language, Alan A. A. Donovan and Brian W. Kernighan, Addison-Wesley Professional.
13. An Introduction to Programming in Go, Caleb Doxsey, CreateSpace Independent Publishing.
14. Real-World Functional Programming: With Examples in F# and C#, Tomas Petricek and Jon Skeet, Manning.
15. Programming F# 3.0: A Comprehensive Guide for Writing Simple Code to Solve Complex Problems, Chris Smith, O'Reilly Media.
16. Getting Clojure: Build Your Functional Skills One Idea at a Time, Russ Olsen, O'Reilly.
17. The Joy of Clojure, Michael Fogus and Chris Houser, Manning Publication.
18. Atomic Kotlin, Bruce Eckel and Svetlana Isakova, Mindview LLC.
19. Kotlin in Action, Dmitry Jemerov and Svetlana Isakova, Manning Publication.

Online References:

1. https://gobyexample.com/ [
2. https://golang.org/doc/
3. https://www.youtube.com/playlist?list=PLlxmoA0rQ-LwgK1JsnMsakYNACYGa1cjR
4. https://kotlinlang.org/docs/home.html
5. https://docs.microsoft.com/en-us/dotnet/fsharp/
6. https://www.udemy.com/course/learning-functional-programming-with-f/
7. https://clojure.org/guides/getting_started

Course Outcomes (CO)

COs	Statements
CO1	**Understand** the fundamental principles and paradigms of modern programming languages, including functional programming, object-oriented programming, and concurrent programming.
CO2	**Develop** proficiency in using the syntax, data structures, and control flow constructs of each language (GO, F#, Clojure, and Kotlin) to solve programming problems.
CO3	**Explore** the unique features and strengths of each language, such as Go's focus on concurrency, F#'s functional programming capabilities, Clojure's emphasis on immutability and simplicity, and Kotlin's interoperability with existing Java code.
CO4	**Apply** the languages' respective development tools, such as Go's gofmt and go vet, F#'s F# Interactive (FSI), Clojure's Leiningen or Boot, and Kotlin's integrated development environment (IDE) support, to improve code quality and productivity.
CO5	**Design and implement** projects that integrate multiple programming languages, using appropriate inter-language communication mechanisms and libraries (e.g., Go and Kotlin interacting via REST APIs, F# and Clojure communicating via message queue

COs Mapping with Levels of Bloom's taxonomy

CO	Cognitive levels(C) 67. Knowledge 68. Understand 69. Apply 70. Analyze 71. Evaluate 72. Create	Affective levels(A) 56. Receiving 57. Responding 58. Valuing 59. Organizing 60. Characterizing	Psychomotor levels(P) 56. Imitation 57. Manipulation 58. Precision 59. Articulation 60. Improving
CO1	C2	A1	-
C02	C3	A2	P2
CO3	C2	A3	-
CO4	C3	A4	P3
CO5	C6	-	P4

CO-PO Mapping

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2			2					2		
CO2	2	2			2					2		
CO3	2	2		3								3
CO4					3					3		2
CO5						2				2		

1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4
CO1	3			3
CO2	3	2		
CO3		2		3
CO4		2		3
CO5		2	2	2

Relevance of the Syllabus to various indicators

Unit I	Introduction to New-Age Programming Languages and GO programming Language
Local	-
Regional	-
National	Provides essential knowledge and skills related to modern programming languages like GO, F#, Clojure, and Kotlin, which are widely used in national software development projects and initiatives.
Global	Relevant in the global software development community, as these languages and concepts have international adoption and usage.
Employability	Highly valued in the job market, as these languages are used in various industries and offer opportunities for software development roles.
Entrepreneurship	Equips students with knowledge of modern programming languages and advanced concepts, enabling them to explore entrepreneurial opportunities in software development and innovation using these languages.
Skill Development	Enhances students' technical skills in software development, making them more competent in the field of computer science.
Professional Ethics	While not directly related to professional ethics, the syllabus indirectly promotes ethical practices by emphasizing the importance of error handling, writing efficient and concurrent programs, and following best practices in software development.
Gender	-
Human Values	Indirectly supports human values by fostering the development of software solutions that are efficient, maintainable, and user-friendly, aligning with values such as accessibility, usability, and user-centric design.
Environment & Sustainability	-
Unit II	F# Programming Language

Local	-
Regional	-
National	Provides essential knowledge and skills which are relevant at the national level for software development, data analysis, and database management projects.
Global	As a globally recognized programming language used in various industries and research domains.
Employability	Highly valued in the job market, as these skills are sought after by companies and organizations involved in software development, data analysis, and database management.
Entrepreneurship	Equips with knowledge that allows to explore entrepreneurial opportunities in software development, data-centric applications, and database-driven solutions.
Skill Development	Enhances technical skills in programming, functional programming paradigms, and data manipulation, making them more competent in the field of computer science.
Professional Ethics	Indirectly promotes ethical practices by emphasizing good programming practices, data integrity, and security considerations
Gender	-
Human Values	Indirectly supports human values by fostering the development of software solutions that are efficient, maintainable, and user-friendly, aligning with values such as accessibility, usability, and user-centric design.
Environment & Sustainability	-
Unit III	Introduction to Clojure Programming
Local	-
Regional	-
National	Provides essential knowledge and skills which are relevant at the national level for software development, web application development, and data-driven solutions.

Global	As a globally recognized programming language used in various industries and research domains.
Employability	Language is highly valued in the job market. The skills are sought after by companies and organizations involved in software development, web application development, and data analysis.
Entrepreneurship	Explores entrepreneurial opportunities in software development, web application startups, and data-centric solutions
Skill Development	Enhances technical skills, making more competent in the field of computer science
Professional Ethics	Indirectly promotes ethical practices by emphasizing good programming practices, data integrity, and security considerations.
Gender	-
Human Values	Indirectly supports human values by fostering the development of software solutions that are efficient, maintainable, and user-friendly, aligning with values such as accessibility, usability, and user-centric design. .
Environment & Sustainability	-
Unit IV	Introduction to Kotlin Programming
Local	-
Regional	-
National	Provides essential knowledge relevant at the national level for software development, mobile app development, and general-purpose programming.
Global	Language has global applicability.
Employability	Highly valued in the job market. These skills are sought after by companies and organizations involved in software development, mobile app development, and DSL-based solutions.
Entrepreneurship	Explore entrepreneurial opportunities in software development, mobile app startups, and domain-specific language development

Skill Development	Make more competent in the field.
Professional Ethics	Indirectly promotes ethical practices by emphasizing good programming practices, code readability, and modularity.
Gender	-
Human Values	Indirectly by fostering the development of software solutions efficient, maintainable, and user-friendly.
Environment & Sustainability	-
SDG	SDG 4, SDG 8, SDG 9
NEP 2020	Quality education, equity, critical thinking, digital literacy, skill development.
POE/4th IR	Technological advancements, digital transformation, and future-ready skills.

Department:	Department of Computer Science and Engineering		
New Age Programming languages Lab	**Course Code**	**L-T-P**	**Credits**
	ENSP465	0-0-2	1
Type of Course:	Department Elective-III (Full Stack Development)		
Pre-requisite(s), if any:			

Course Outcomes (CO)

COs	Statements
CO1	**Understand** the fundamental principles and paradigms of modern programming languages
CO2	**Develop** proficiency in using the syntax, data structures, and control flow constructs of each language
CO3	**Explore** the unique features and strengths of each language, such as Go's focus on concurrency, F#'s functional programming capabilities, Clojure's emphasis on immutability and simplicity, and Kotlin's interoperability with existing Java code.
CO4	**Apply** the languages' respective development tools and best practices.
CO5	**Design and implement** projects that utilize the strengths of each language to tackle complex problems or tasks.

Proposed Lab Experiments

Ex. No	Experiment Title	Mapped CO/COs
	Practicals on GO Programming Language	
1	Write a program that takes user input and performs basic calculations (e.g., addition, subtraction, multiplication) using different data types like integers and floats. Use control structures like if statements and loops to handle different scenarios and validate user input.	CO2
2	Create a package that contains multiple functions to perform common tasks, such as string manipulation or mathematical operations. Use these functions in a separate program to demonstrate their functionality and reusability.	CO1
3	Implement a program that stores a collection of elements using arrays. Perform operations like adding, removing, or updating elements	CO2
4	Define a struct Person with the following members: name, age, job and salary. Create methods associated with the struct to read data in structure and print data.	CO4
5	Develop a program that utilizes pointers to modify and manipulate data in memory. Explore concepts like referencing, dereferencing, and memory allocation/deallocation.	CO2
6	Write a program that demonstrates the use of Go routines and channels to achieve concurrent execution of tasks.	CO3
7	Create a program that handles various error scenarios and provides appropriate error messages or responses. Write unit tests for critical functions and verify their correctness using Go's testing package.	CO5
8	**Mini Project**: Task Manager Application in Go Create a task manager application using the Go programming language. The application should allow users to manage their tasks by adding, updating, and deleting tasks. The tasks should have attributes such as title, description, due date, and status (e.g., "in progress", "completed").	CO5

Practicals on F# Programming Language			
9	a.	WAP to read marks of 4subjects and calculate the Percentage of student and find the result according to given conditions 60>=1st Division 60<&& 50>= 2nd Division 50<&& 40>=3rd Division 40<=fail.	CO2
	b.	WAP to accept an integer and check whether it is prime or not.	
10	a.	Write a function that takes a string as input and returns the reverse of the string. Also check if a given string is a palindrome	CO2
	b.	Create a function that takes a string as input and performs the following transformations: i. If the string contains only alphabetic characters, convert it to uppercase. ii. If the string contains only numeric characters, convert it to an integer and double its value. iii. If the string contains a mix of alphabetic and numeric characters, return it as is.	
	c.	Design a function that validates an email address based on specific rules, such as the presence of an '@' symbol and a valid domain name. Use pattern matching to check if the input string matches the expected email format.	
12		Implement a program that performs various operations on lists using higher-order functions (define a list of integers or strings). Write pure functions that demonstrate the map, filter, reduce/fold operations.	CO1
13		Implement a program that performs multiple I/O-bound or computationally intensive tasks concurrently using F#'s asynchronous workflows and parallel programming constructs.	CO3
14		Create a program that demonstrates the object-oriented programming (OOP) capabilities of F#. Define classes, objects, and inheritance hierarchies using F#'s OOP syntax.	CO3
15		Create a program that demonstrates the following tasks:	CO4

	i. Establish a connection to both the relational and NoSQL databases using appropriate database drivers or libraries. ii. Perform basic CRUD operations (Create, Read, Update, Delete) on the databases.	
16	**Mini Project**: Employee Management System Create an Employee Management System using the F# programming language and a relational database. The system should allow users to perform CRUD (Create, Read, Update, Delete) operations on employee records stored in the database. It should provide functionality to add new employees, retrieve employee information, update employee details, and delete employee records.	CO5
	Practicals on Clojure Programming Language	
17	Write a program that demonstrates the basic syntax and data structures in Clojure, such as lists, vectors, maps, and sets.	CO1
18	Write functions that manipulate and transform sequences using operations such as map, filter, reduce, and take.	CO2
19	Implement a program that showcases asynchronous programming using the core.async library.	CO3
20	Write code that calls Java methods, creates Java objects, and works with Java collections and objects from Clojure.	CO4
21	Develop a web application using Clojure and the Ring library. Set up routes, handle HTTP requests and responses, and render dynamic content.	CO5
22	Write functions that interact with the database, perform CRUD operations, and handle transactions.	CO5
23	Implement error handling mechanisms, such as exception handling and error management, in Clojure.	CO4
24	**Mini Project**: Blogging Platform with Clojure Create a Blogging Platform using the Clojure programming language. The platform should allow users to create and publish blog posts, manage user accounts, and provide functionality for reading and commenting on blog posts. It	CO5

	should utilize a relational database for data storage and retrieval.		
Practicals on Kotlin Programming Language			
25	19	WAP for print following o/p Hello Kotlin!!!	CO2
	20	WAP to take employee's basic salary, dept_code and experience. Calculate bonus according to following criteria i. dept_code = 101 && exp <= 2 bonus = 3% ii. dept_code = 102 && exp <= 4 bonus = 5% iii. dept_code = 103 && exp <= 7 bonus = 8%	
	21	WAP to accept an integer and display average of digit.	
26	Write a program in Kotlin that demonstrates various aspects of function declarations, parameters, and higher-order functions. a. Implement a function that takes two integer parameters and returns their sum. b. Create a function that has default parameter values for an optional third parameter, which is a string representing a greeting. If no greeting is provided, the function should use a default greeting. c. Explore named parameters by creating a function that takes multiple parameters and demonstrate how to call the function by specifying the parameter names explicitly. d. Implement a variable-length argument function that takes a variable number of integers and calculates their average. e. Utilize a higher-order function by creating a function that accepts a lambda expression as a parameter. The lambda should take an integer parameter and return the square of that integer.		CO2
27	WAP to create a class Student with data members' rollno, student name, course and percentage and member functions to accept and display the details of student. a. Implement properties, methods, and constructors in classes. b. Explore access modifiers and visibility scopes in Kotlin.		CO1
28	Implement a program that demonstrates the declaration and usage of nullable and non-nullable variables. Utilize safe calls (?.) and the Elvis operator (?:) to handle nullable values and provide alternative values or perform fallback actions.		CO3

29	WAP to implement various collections like lists, sets, and maps in Kotlin and perform common operations on them. Use collection functions and transformations such as map, filter, and reduce to manipulate data.	CO2
30	Implement a DSL for a domain-specific problem, showcasing Kotlin's expressive syntax and extension functions.	CO5
31	Implement a program that demonstrates the creation and usage of extension functions in Kotlin(Choose a specific class or data type, such as String). For example, you can create an extension function that counts the number of vowels in a string or reverses the string.	CO3
32	**Mini Project**: Quiz App Build a quiz application that presents users with multiple-choice questions on various topics. Users can select their answers, and the app provides instant feedback on correctness. Keep track of the user's score and display the result at the end of the quiz. Include features like a timer, score calculation, and a database of questions.	CO5