SCHOOL OF ENGINEERING

AND

TECHNOLOGY

B. Tech (Computer Science & Engineering) with Specialization in UI/UX

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

The field of Computer Science & Engineering is at the forefront of technological advancements, shaping the world we live in today. It encompasses a diverse range of disciplines, including computer systems, algorithms, software development, networking, artificial intelligence, and more. As technology continues to revolutionize every aspect of our lives, the demand for skilled computer scientists and engineers is ever-increasing.

Our B. Tech Computer Science & Engineering with Specialization in UI/UX program is designed to provide students with a comprehensive understanding of the foundational principles and practical skills needed to excel in this dynamic field. Over the course of four years, students will delve into subjects such as programming languages, data structures, operating systems, database management, computer architecture, and software engineering.

At our institution, we emphasize a hands-on approach to learning, combining theoretical knowledge with practical application. Students will have the opportunity to work on real-world projects, engage in laboratory experiments, and participate in internships to gain valuable industry experience. We believe that this experiential learning will not only strengthen technical proficiency but also foster critical thinking, problem-solving abilities, and teamwork skills.

Furthermore, our curriculum is designed to keep pace with the rapidly evolving nature of the computer science and engineering field. We strive to incorporate the latest trends and emerging technologies, ensuring that our graduates are equipped with the knowledge and adaptability necessary to thrive in a competitive industry.

As technology continues to reshape our world, computer scientists and engineers have a pivotal role to play in driving innovation and creating solutions to complex challenges. Our B. Tech Computer Science & Engineering with Specialization in UI/UX program aims to nurture and empower the next generation of professionals who will shape the future of technology.

We are committed to providing a supportive and inclusive learning environment, where students can explore their passions, develop their skills, and unlock their full potential. Through dedicated faculty, state-of-the-art infrastructure, and a vibrant community, we strive to create an enriching educational experience that prepares students for successful careers in the field of Computer Science & Engineering.

We invite aspiring students to embark on this exciting journey with us, as together, we explore the limitless possibilities of computer science and engineering and make a positive impact on the world.

Objectives of the program

1. Develop a strong foundation: The primary objective of our B. Tech Computer Science & Engineering with Specialization in UI/UX program is to provide students with a solid foundation in the fundamental principles of computer science and engineering. Through comprehensive coursework, students will gain a deep understanding of programming languages, data structures, algorithms, computer architecture, and software development methodologies.

2. Foster technical competence: We aim to equip students with the necessary technical skills to excel in the field of computer science and engineering. By offering a rigorous curriculum and hands-on learning experiences, students will develop proficiency in designing, implementing, and analyzing complex computer systems, networks, and software applications.

3. Encourage problem-solving abilities: Problem-solving lies at the heart of computer science and engineering. Our program aims to nurture students' analytical and critical thinking skills, enabling them to identify and solve complex problems using innovative approaches and cutting-edge technologies. Through projects, case studies, and practical assignments, students will learn to apply their knowledge to real-world scenarios.

4. Promote interdisciplinary collaboration: In today's interconnected world, computer science and engineering often intersect with other disciplines. Our program encourages interdisciplinary collaboration, enabling students to explore areas such as artificial intelligence, data science, cybersecurity, robotics, and more. This fosters a holistic approach to problem-solving and prepares students for multidisciplinary projects and industry demands.

5. Cultivate creativity and innovation: We believe that creativity and innovation are essential for driving technological advancements. Our program encourages students to think creatively, explore new ideas, and develop innovative solutions to address emerging challenges in the field. Through research-oriented projects and exposure to the latest industry trends, students are encouraged to push the boundaries of what is possible.

6. Instill professional ethics and social responsibility: As future computer science and engineering professionals, students have a responsibility to uphold ethical

standards and consider the societal impact of their work. Our program emphasizes the importance of ethical conduct, privacy, security, and responsible use of technology. Students will be encouraged to explore the ethical implications of their decisions and develop a sense of social responsibility.

7. Foster lifelong learning: Given the ever-evolving nature of computer science and engineering, our program aims to instill a passion for lifelong learning. We encourage students to stay abreast of the latest advancements, trends, and technologies through continuous professional development. By cultivating a love for learning, students will be well-prepared to adapt to the dynamic and evolving landscape of their chosen field.

Career Avenues

Diverse career avenues available to graduates of the B. Tech Computer Science & Engineering with Specialization in UI/UX program are as follows:

1. Software Development: Graduates can pursue careers as software developers, working on designing, coding, testing, and maintaining software applications and systems. They can specialize in areas such as web development, mobile app development, game development, or enterprise software development.

2. Systems Analyst: A systems analyst analyzes an organization's computer systems and procedures to improve efficiency and effectiveness. They work on designing and implementing new systems, conducting feasibility studies, and identifying areas for improvement in existing systems.

3. Data Scientist: With the increasing volume of data in various industries, data scientists are in high demand. They utilize their skills in data analysis, statistics, and machine learning to extract insights from large datasets, make data-driven decisions, and develop predictive models.

4. Artificial Intelligence Engineer: As AI technology continues to advance, there is a growing demand for professionals skilled in developing AI algorithms and systems. AI engineers work on creating intelligent machines, developing natural language processing systems, computer vision applications, and other AI-driven solutions.

5. Cybersecurity Analyst: In an era of heightened cybersecurity threats, organizations require experts who can protect their systems and data. Cybersecurity analysts identify vulnerabilities, implement security measures, conduct risk assessments, and respond to security incidents to safeguard computer systems and networks.

6. Network Engineer: Network engineers are responsible for designing, implementing, and maintaining computer networks within organizations. They ensure network reliability, security, and performance, and troubleshoot network issues to ensure smooth operations.

7. IT Project Manager: IT project managers oversee the planning, execution, and delivery of technology projects within organizations. They manage project teams, coordinate resources, track progress, and ensure projects are completed within budget and on time.

8. Database Administrator: Database administrators manage and maintain databases, ensuring data integrity, security, and performance. They design database structures, implement backup and recovery procedures, and optimize database systems for efficient data storage and retrieval.

9. Software Quality Assurance Engineer: QA engineers are responsible for ensuring the quality and reliability of software applications. They develop and execute test plans, identify and report bugs and issues, and work closely with development teams to improve software quality.

10. Research and Development: Graduates can pursue careers in research and development, working on innovative projects, exploring new technologies, and pushing the boundaries of computer science and engineering. This can involve academic research, industry research labs, or research and development departments within companies.

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.

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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 Outcome (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 - Develop knowledge and abilities in the area of Computer Science and Engineering and create a foundation of lifelong learning to facilitate progressive careers in industry and in pursuit of higher studies.

PEO2 - To provide our students with the technical and analytical abilities they need to create creative solutions to challenging real-world issues using both current and emerging technology.

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 - Acquire a comprehensive understanding of the fundamental principles, theories, and practices in Computer Science and Engineering, enabling graduates to apply their knowledge effectively in various professional settings.

PSO2 - Demonstrate proficiency in utilizing current and emerging technologies to analyze and solve complex real-world problems in the field of Computer Science and Engineering. Graduates should be capable of developing innovative solutions and adapting to technological advancements.

PSO3 - Develop strong communication and interpersonal skills, including the ability to collaborate effectively in multidisciplinary teams, present technical information clearly, and engage in professional discussions. Graduates should also demonstrate leadership qualities and be able to assume responsibilities in their chosen field.

PSO4 - Cultivate a sense of ethics, social responsibility, and awareness of current concerns in the field of Computer Science and Engineering. Graduates should understand the importance of ethical practices, sustainable development, and contribute positively to their workplace, society, and the nation.

Program Highlights

- Professionally qualified, competent, and committed teaching faculty.
- Industry enabled curriculum and training from industry experts.
- 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 programs, value-added courses besides core curriculum.
- Effective career counselling, guidance and mentoring program to excel in professional and personal spheres of life.
- Special programs 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 AI, Machine Learning & Data Science

Program Scheme

Semester I

SN	Category	Course Code	Course Title	L	T	P	C
1	Major	ENMA101	Engineering Calculus	3	1	-	4
2	Minor	ENSP105	Introduction to UX Design	4	-	-	4
3	Major	ENPH101/ENCH101	Engineering Physics / Engineering Chemistry	3	1	-	4
4	Major	ENCS101	Fundamentals of Computer programming	4	-	-	4
5	Major	ENPH151/ENCH151	Engineering Physics Lab/ Engineering Chemistry lab	-	-	2	1
6	SEC	SEC003	Engineering Drawing & Workshop Lab	-	-	4	2
7	Major	ENCS151	Fundamentals of Computer Programming Lab	-	-	2	1
8	VAC I		Environmental Studies & Disaster Management(Online Moodle)	2	-	-	2
TOTAL				16	2	8	**22**

Semester II

SN	Category	Course Code	Course Title	L	T	P	C
1	Major	ENMA102	Linear Algebra and Ordinary Differential Equations	3	1	-	4
2	Minor	ENSP160	Empathy and Understanding Problems Lab	-	-	4	2
3	Major	ENCH101/ENPH 101	Engineering Chemistry / Engineering Physics	3	1	-	4
4	Major	ENEE101	Basics of Electrical & Electronics Engineering	4	-	-	4
5	Major	ENCH151/ENPH 151	Engineering Chemistry Lab / Engineering Physics lab	-	-	2	1
6	VAC II		Extension Activities(community engagement service)	2	-	-	2
7	Major	ENEE151	Basics of Electrical & Electronics Engineering Lab	-	-	2	1
8	Open Elective		Open Elective-I	3	-	-	3
TOTAL				15	2	8	**21**

Semester III

SN	Category	Course Code	Course Title	L	T	P	C
1	Minor	ENSP203	User Research	4	-	-	4
2	Major	ENCS203	Discrete Mathematics	3	1	-	4
3	Major	ENCS205	Data Structures	4	-	-	4
4	VAC		VAC III	2	-	-	2
5	Minor	ENSP255	User Research Lab	-	-	2	1
6	Major	ENCS253	Data Structures Lab	-	-	2	1
7	AEC	AEC011	Life Skills for Professionals-I	3	-	-	3
8	INT	ENSI251	Summer Internship / Project-I	-	-	-	2
9	Open Elective		Open Elective-II	3	-	-	3
10	SEC	SEC043	Technology in Experience Design	2	-		2
TOTAL				21	1	4	**26**

Semester IV

SN	Category	Course Code	Course Title	L	T	P	C
1	Minor	ENSP210	Introduction to UI Design	4	-	-	4
2	SEC	SEC044	Information Architecture	2	-	-	2
3	Major	ENCS202	Analysis and Design of Algorithms	3	1	-	4
4	Major	ENCS204	Database Management Systems	3	1	-	4
5	AEC	AEC012	Life Skills for Professionals-II	3	-	-	3
6	Major	ENCS254	Database Management Systems Lab	-	-	2	1
7	Major	ENCS256	Analysis and Design of Algorithms Lab	-	-	2	1
8	Open Elective		Open Elective-III	3	-	-	3
9	VAC		VAC IV	2	-	-	2
10	Minor	ENSP260	UI Design Lab	-	-	2	1
11	Project	ENSI252	Minor Project-I	-	-	-	2
TOTAL				20	2	6	**27**

Semester V

SN	Category	Course Code	Course Title	L	T	P	C
1	Major	ENCS301	Theory of Computation	3	1	-	4
2	Major	ENCS303	Operating Systems	4	-	-	4
3	Major	ENCS351	Operating System Lab	-	-	2	1
4	INT	ENSI351	Summer Internship/ Project-II	-	-	-	2
5	AEC	AEC013	Life Skills for Professionals-III	3	-	-	3
6	Minor	ENSP351	Design Thinking	4	-	-	4
7	Minor	ENSP365	Design Thinking Lab	-	-	2	1
8	SEC	SEC045	Introduction to Interaction Design	2	-	-	2
9	Minor	ENSP317	Usability Testing	4	-	-	4
TOTAL				20	1	4	**25**

Semester VI

SN	Category	Course Code	Course Title	L	T	P	C
1	Major	ENCS302	Computer Organization & Architecture	3	1	-	4
2	Major	ENCS304	Computer Networks	4	-	-	4
3	Major		Web Development with HTML/CSS/Java Script/Python	4	-	-	4
4	Major	ENCS352	Computer Networks Lab	-	-	2	1
5	Minor	ENSP368	Visual Design Tools Lab	-	-	4	2
6	Major	ENCS358	Web Development Lab	-	-	2	1
7	Minor		Department Elective -I	4	-	-	4
8	Minor		Department Elective -I Lab	-	-	2	1
9	Project	ENSI352	Minor Project-II	-	-	-	2
TOTAL				15	1	10	**23**

			Department Elective –I (UI-UX)					
(i)	Minor	ENSP318	Wireframing & Prototyping	4	-	-	4	Imagine XP
	Minor	ENSP370	Wireframing & Prototyping Lab	-	-	2	1	Imagine XP
(ii)	Minor	ENSP320	Metaverse & its Applications	4	-	-	4	
	Minor	ENSP372	Metaverse Lab	-	-	2	1	
(iii)	Minor	ENSP322	Introduction to Virtual Reality and Augmented Reality	4	-	-	4	
	Minor	ENSP374	Virtual Reality and Augmented Reality Lab	-	-	2	1	

Semester VII

SN	Category	Course Code	Course Title	L	T	P	C
1	Minor		Department Elective-II	4	-	-	4
2	Minor		Department Elective-III	4	-	-	4
3	SEC		Portfolio Development & Review	2	-	-	2
4	Project	ENSI451	Minor Project-III	-	-	-	2
TOTAL				10	0	0	**12**
OR							
	INT	ENSI453	Professional Internship from Industry	-	-	-	**12**

			Department Elective - II					
1	Minor	ENSP425	UX Design for Futuristic Technologies - HMI	4	-	-	4	Imagin XP
2	Minor	ENSP427	Introduction to Computer Vision	4	-	-	4	
3	Minor	ENSP429	Graphics Design	4	-	-	4	

			Department Elective - III					
1	Minor	ENSP431	Design Thinking for Product Management	4	-	-	4	Imagin XP
2	Minor	ENSP433	Adobe Photoshop	4	-	-	4	
3	Minor	ENSP435	Introduction to Figma	4	-	-	4	

Semester VIII

SN	Category	Course Code	Course Title	L	T	P	C
1	PROJ	ENSI452	Industrial Project/R&D Project/Start-up Project	-	-	-	12
TOTAL							12

Total Credits: 168

Categorization of Courses

Credit

Category	Credit
Major	88
Minor	20
Industrial Project/R&D Project/Start-up…	12
AEC	9
Open Elective	9
VAC	8
SEC	8
Minor Project	6
Summer Internship	4
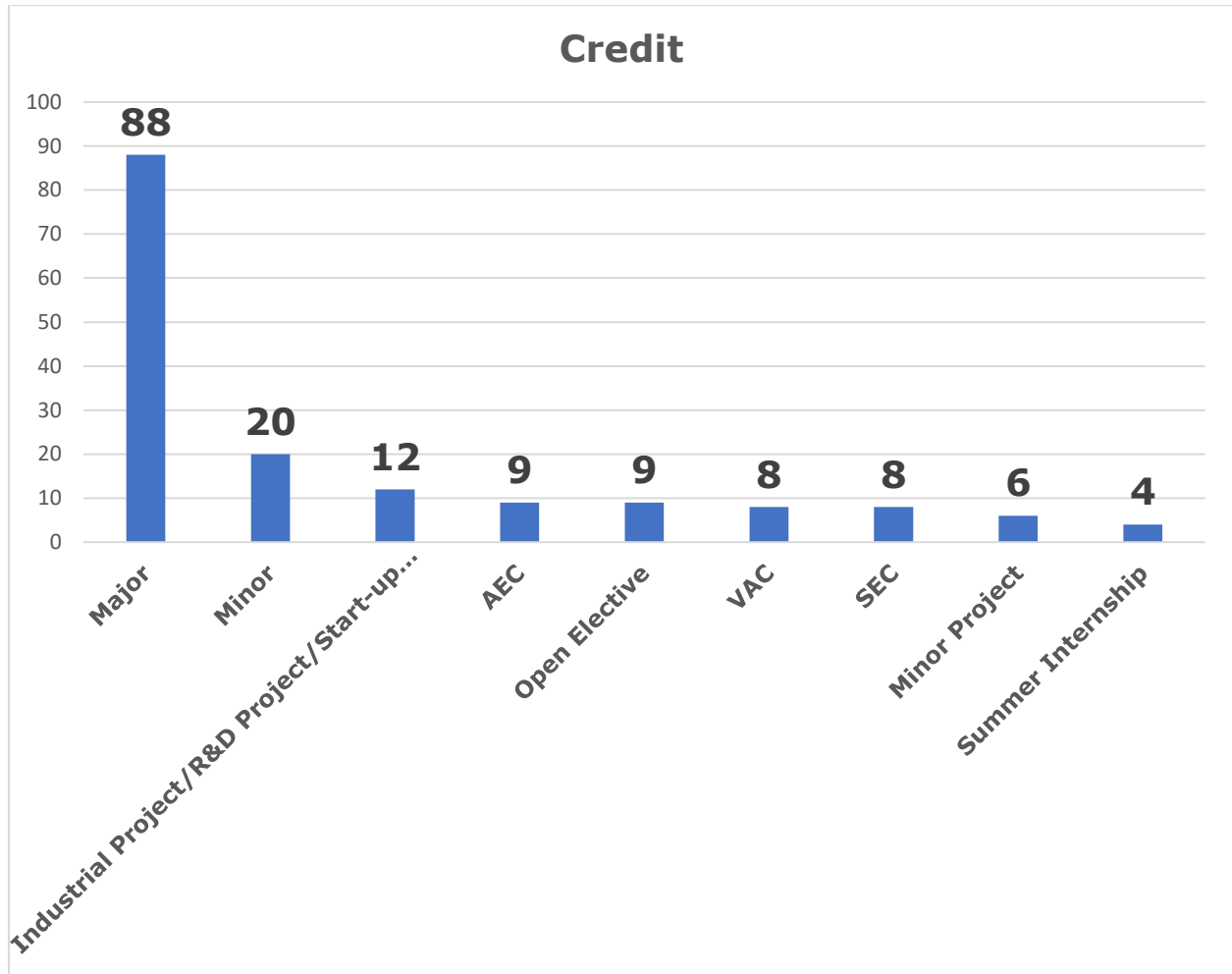
Syllabus

Semester: 1

ENGINEERING CALCULUS

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): 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 applications.

*Self-Learning Components:

https://onlinecourses.nptel.ac.in/noc22_ma75/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. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

Reference Books: -

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.

Other useful resource(s):

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

Define Course Outcomes (CO)

COs	Statements
CO 1	To **apply** the knowledge of differential calculus in the field of engineering.
CO 2	To **deal** with functions of several variables that are essential in optimizing the results of real life problems.

CO 3	Multiple integral tools to deal with engineering problems involving centre of gravity, volume etc.
CO 4	To **deal** with vector calculus that is required in different branches of Engineering to graduate engineers.
CO 5	Geometrical approach to the mean value theorems and their **application** to the mathematical problems
CO 6	**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.

COURSE Syllabus

Introduction to UX design

Department:	Department of Computer Science and Engineering		
Course Name: Introduction to UX design	**Course Code**	**L-T-P**	**Credits**
	ENSP105	4-0-0	4
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus:

To understand the concept of UX design and how it has evolved. Able to understand UX design process and methodology. Able to understand how UX industry work. To know the job, roles and responsibilities in UX industry. To understand the importance of UX in digitalization and different types of industries.

UNIT WISE DETAILS

Unit Number: 1	Title: Evolution of UX Design	No. of hours: 6

Content Summary:

Understand the evolution of UX design as an industry practice and learning about UX industry experts, Design around us, Job roles and responsibilities in the UX industry

Unit Number: 2	Title: Process & Methodologies	No. of hours: 6

Content Summary:

Understanding UX design processes and methodologies – user centred design, 5S model,

Unit Number: 3	Title: Tools & Technology in UX Design	No. of hours: 9

Content Summary:

Tools, prototype, Industry standards, Technology, NFC, Chatbot, Siri

Unit Number: 4	Multiple domains & trends in UX Design	No. of hours: 9

Content Summary:

UX industry trends in various sectors

Unit Number: 5	Title: Project	No. of hours: 30

Content Summary:

Project on UX design process and industry trends

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. Designing for Digital Age: How to create human-centered products and services - Kim Goodwin
2. Sketching the User experiences - Bill Buxton
3. The design of everyday things - Don Norman
4. The elements of user experience - Jesse James Garrett
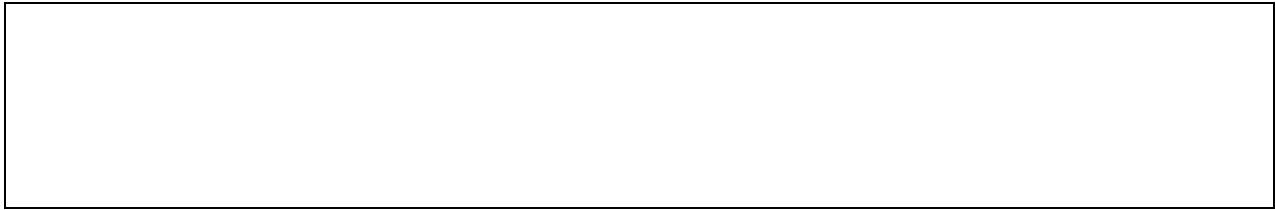
Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** the concept of UX design and how it has evolved
CO2	**Define** and recognize the importance of UX in digitalization and different types of industries.
CO3	**Examine** UX design process and methodology.
CO4	**Evaluate** and understand how UX industry works.
CO5	**Examine** the job, roles and responsibilities in UX industry.

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	P5
C02	C1	A3	P1
CO3	C4	A2	P4
CO4	C5	A5	P5
CO5	C4	A5	P3

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

1=weakly mapped

2= moderately mapped

3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	2	1	-	-	-
CO2	2	3	1	-	-	-
CO3	2	1	2	-	-	-
CO4	1	1	1	1	2	-
CO5	-	-	-	1	2	3

Relevance of the Syllabus to various indicators

Unit I	Introduction
Local	Addresses local understanding of UX and its impact on society
Regional	Addresses regional level concerns through UX and understand the needs
National	Contribution to national level in terms of Customer experience
Global	Aligns with global trends in UI & UX
Employability	Develops understanding of UX in a broader perspective
Entrepreneurship	Helps in establishing the roots of the business through UX
Skill Development	-

Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	Understanding how UX has impacted thought process which triggers need of being more sustainable
Unit II	The Process & Methodologies
Local	Addresses local understanding of the process & methodologies of UX
Regional	Addresses and understands the regional level process & methodologies of UX
National	Contributes to new processes at national level
Global	Aligns with global trends in terms of process & methodologies of UX
Employability	Develops basic knowledge of UX methodologies
Entrepreneurship	Prepare students of the industry by helping them understand different processes
Skill Development	Develops skills of methodologies used in UX
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	Understanding each process helps in achieving the target of sustainable future
Unit III	Tools & Technology in UX design

Local	Addresses local tools & technology used in UX design
Regional	Addresses and understands the regional level tools used in UX design
National	Contributes and understands the techniques used at national level
Global	Aligns with different trends & technologies used at global level
Employability	Develops skills in network programming and network security techniques
Entrepreneurship	Understanding technologies for better entrepreneurship
Skill Development	Develops knowledge and skills in tools & techniques
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Multiple domains & trends in UX Design
Local	Addresses local understanding of trends in UX Design
Regional	Addresses and understands the regional level trends of UX design
National	Contributes by understanding national level trends in UX
Global	Aligns with global trends of UX design and multiple domains
Employability	Helps in coping within industry by knowing different trends

Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

ENGINEERING PHYSICS

Department:	Department of Computer Science and Engineering		
Course Name: **Engineering Physics**	**Course Code** ENPH101	**L–T–P** 4-0-0	**Credits** 4
Type of Course:	Major		

Pre-requisite(s), if any: Integration/Differentiation

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

UNIT WISE DETAILS

Unit Number: 1	Title: Laser and Fibre Optics	No. of hours: 10

Content Summary:

Laser: Introduction, principle of Laser, stimulated and spontaneous emission, He-Ne Laser, Ruby Laser, Application of Lasers.

Fibre Optics: Introduction, numerical aperture, step index and graded index fibres, attenuation & dispersion mechanism in optical fibers (Qualitative only), application of optical fibres, optical communication (block diagram only)

Unit Number: 2	Title: Electrodynamics	No. of hours: 10

Content Summary:

Maxwell's equations, Derivation of wave equation for plane electromagnetic wave, Velocity of Electromagnetic waves, electromagnetic energy density, Poynting vector. Poynting theorem, wave equation in dielectric & conducting media.

Unit Number: 3	Title: Polarization	No. of hours: 10

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© 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	-	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	-	-	-	-	-	-	-	-	-	-

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	Laser and Fibre Optics
Local	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Regional	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
National	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Global	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Employability	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Entrepreneurship	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Skill Development	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Professional Ethics	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers

Gender	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Human Values	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Environment & Sustainability	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Unit II	**Electrodynamics**
Local	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Regional	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
National	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Global	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Employability	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Entrepreneurship	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as

	starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Skill Development	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Professional Ethics	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Gender	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Human Values	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Environment & Sustainability	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Unit III	**Polarization**
Local	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Regional	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
National	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as

	starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Global	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Employability	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Entrepreneurship	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Skill Development	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Professional Ethics	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Gender	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Human Values	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Environment & Sustainability	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers

Unit IV	New Engineering Materials
Local	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Regional	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
National	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Global	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Employability	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Entrepreneurship	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Skill Development	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Professional Ethics	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Gender	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as

	starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Human Values	Understanding the principles and applications of lasers and optical fibers can inspire entrepreneurial opportunities, such as starting a business in laser technology, laser manufacturing, or developing innovative applications for optical fibers
Environment & Sustainability	NA
SDG	SDG 4
NEP 2020	-
POE/4th IR	-

ENGINEERING PHYSICS LAB

Department:	Department of Computer Science and Engineering		
Course Name: **Engineering Physics Lab**	**Course Code**	**L–T–P**	**Credits**
	ENPH151	0-0-2	1
Type of Course:	Major		
Pre-requisite(s), if any: Integration/Differentiation			

Proposed Lab Experiments

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

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

ENGINEERING DRAWING & WORKSHOP LAB

Department:	Department of Mechanical Engineering		
Course Name: **Engineering Drawing and Workshop Lab**	**Course Code**	**L-T-P**	**Credits**
	SEC033	0-0-4	2
Type of Course:	SEC		
Pre-requisite(s), if any:			

Proposed Lab Experiments

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.

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

FUNDAMENTALS OF COMPUTER PROGRAMMING

Department:	Department of Computer Science and Engineering		
Course Name: **Fundamentals of Computer Programming**	**Course Code** **ENCS101**	**L–T–P** 4-0-0	**Credits** 4
Type of Course:	Major Course		
Pre-requisite(s), if any: None			
Brief Syllabus: Fundamentals of Computer Science, Python Introduction, Data Types, Operators, Python data Structures, Conditional Statements, Loops in Python, Functions, OPPS Concepts, basics of Data Pre-processing, Classification and Visualization in Python			
UNIT WISE DETAILS			
Unit Number: 1	**Title: Introduction to Computer Fundamentals**	**No. of hours: 8**	
Content Summary: Introduction to Computers and Computing, Von Neumann architecture, Central Processing Unit (CPU): ALU, control unit, registers, Memory: primary and secondary storage, cache memory, virtual memory, Input/output devices: keyboard, mouse, monitor, printer, etc., Introduction to operating systems Types of operating systems: batch processing, time-sharing, distributed, real-time, etc., Binary, decimal, and hexadecimal number systems, Bits, bytes, and data representation, Character encoding: ASCII, Unicode, Storage devices: hard disks, solid-state drives, optical storage, Introduction to algorithms and complexity analysis, Introduction to software development life cycle (SDLC)			

Overview of computer security, Types of threats: viruses, malware, phishing Ethical considerations in computer use		
Unit Number: 2	**Title: Introduction to Python programming & its Environment**	**No. of hours: 8**
Content Summary: Python Features, Local Environment Setup, Installing Python, Setting up PATH, Python Syntax, Keywords, Understanding Variables, Data Types: Scalar Types, Sequence Type, Mapping Type, Set Types, Mutable Types: List, Dictionary, Set, Immutable Types: Numbers, String, tuple, Operators: Arithmetic, Assignment, Comparison, Logical, Identity, Membership, Bitwise, Basic of String, Manipulating strings, Modify Strings, String Concatenation, Format – Strings, Escape Characters, Inbuilt method of Strings, Basic of Regular Expressions		
Unit Number: 3	**Title: Condition and Control Structures, Functions and Recursion**	**No. of hours: 8**
Content Summary: Condition: If, If. Else and nested if, Loops: For, while loops, Nested loops, Enumerate, Break, Continue Statement. Sequence and Iterable Objects, Randomization Function calls, type conversion and coercion, math functions, adding new function, parameters and argument, recursion and its use, Recursive Fibonacci, Tower of Hanoi, Lambda Functions and Anonymous Functions in Python		
Unit Number: 4	**Title: Objects and Classes**	**No. of hours: 8**
Content Summary: Basics of Object-Oriented Programming, Creating Class and Object, Constructors in Python – Parameterized and Non-parameterized, Inheritance in Python, In built class methods and attributes, Multi-Level and Multiple Inheritance, Method Overriding and Data Abstraction, Encapsulation and Polymorphism.		
Unit Number: 5	**Title: Data Pre-processing, Classification and Visualization in Python**	**No. of hours: 8**

Content Summary:

Data Preprocessing: Data cleaning - Missing Values Noisy Data, Data Cleaning as a Process, Data Integration, Data Reduction, Data transformation and Data Discretization.

Data visualization: Introduction to Matplotlib & Seaborn Libraries, basic plotting, various charts

Mini Project: Students to work on good size dataset, apply data preprocessing and cleaning, write data retrieval queries, apply various data exploration & visualization techniques.

*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.

*Students will demonstrate the self-learning components through classroom presentations

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:

TEXTBOOKS:

1. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India

Reference Books

1. R. Nageswara Rao, "Core Python Programming", Dreamtech

2. Wesley J. Chun. "Core Python Programming, Second Edition", Prentice Hall

3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley

Web References

https://www.tutorjoes.in/python_programming_tutorial/

https://www.udemy.com/course/100-days-of-code/

https://favtutor.com/blog-details/7-Python-Projects-For-Beginners

https://github.com/NaviRocker/100-days-of-python

https://hackr.io/blog/python-projects

Define Course Outcomes (CO)

COs	Statements
CO1	Acquire an **understanding** of Computer fundamental concepts and Python programming language features, working environment
CO2	**Demonstrate** proficiency in Python syntax and effectively utilize keywords in programming.
CO3	**Analyze** and **solve** programming problems that require the use of conditional statements and looping structures
CO4	**Apply** the concepts of functions, recursion & OOPS in problem solving
CO5	Be able to **implement & demonstrate** the concepts of data Pre-processing and data visualization techniques on real datasets.
CO6	**Involve** in self-Learning & be **able to develop** mini-projects in python

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	C1	-	P1
CO2	C1	-	P1, P2
C03	C2	-	P3
CO4	C3	-	P3
CO5	C6	-	P3
CO6	C6	-	P3

CO-PO Mapping

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

Relevance of the Syllabus to various indicators

Unit I	Mapping
Local	All topics in the syllabus are relevant at the local level as they provide a foundational understanding of computer fundamentals & programming.
Regional	All topics in the syllabus can be applicable at the regional level, where individuals and organizations in a specific region utilize Python for various purposes.
National	All topics in the syllabus can be applicable at the national level, as Python is widely used across different industries and sectors.
Global	All topics in the syllabus can be applicable at the global level, as Python is a popular programming language used worldwide.
Employability	All topics in the syllabus, especially Python features, syntax, data types, and string manipulation, contribute to enhancing employability as Python is widely used in the job market.
Entrepreneurship	Understanding Python features, syntax, and data types can be beneficial for entrepreneurs who want to develop software solutions or build web applications.
Skill Development	All topics in the syllabus contribute to skill development in Python programming, including understanding variables, data types, operators, and string manipulation.
Professional Ethics	Professional ethics are not directly addressed in the syllabus topics but are important for ethical behaviour in any professional field.
Gender	NA
Human Values	Human values are not directly addressed in the syllabus topics but can be integrated into the teaching and learning process to emphasize the importance of ethical and responsible programming practices.

Environment & Sustainability	NA
Unit II	
Local	All topics are relevant at local level as programming problems of local nature can be solved using conditional & looping constructs in problem solving
Regional	All topics are relevant at regional level as programming problems of regional level may utilize conditional & looping constructs in problem solving
National	All topics are relevant at National level as programming problems of national level may utilize conditional & looping constructs in problem solving
Global	All topics are relevant at global level as programming problems of global level may utilize conditional & looping constructs in problem solving
Employability	Conditional & Looping structures are very useful programming tools in problem solving questions during placement drives
Entrepreneurship	Conditional & Looping structures are very useful programming tools in problem solving, any startup involving programming concepts will be useful.
Skill Development	Conditional & Looping structures are very useful programming tools in problem solving and thus skill development.
Professional Ethics	Writing programming codes/solutions will always use conditional & looping structures. There are well defined professional ethics for writing codes.
Gender	NA
Human Values	Any computational solution created with applications for humankind will always involve these programming constructs.

Environment & Sustainability	All computational solutions mapped with environment & sustainability will somehow involve these constructs at the backend.
Unit III	
Local	All topics are relevant at local level as programming solutions at local nature can always use concepts of functions & recursions in problem solving
Regional	All topics are relevant at regional level as programming solutions at regional nature can always use concepts of functions & recursions in problem solving
National	All topics are relevant at national level as programming solutions at national level can always use concepts of functions & recursions in problem solving
Global	All topics are relevant at global level as programming solutions at global nature can always use concepts of functions & recursions in problem solving
Employability	Topics are quite relevant for placements
Entrepreneurship	Working Knowledge of topics can be a advantage for entrepreneurs
Skill Development	Topics can be quite useful for skill development on Programming
Professional Ethics	Writing codes involving functions can be related to coding ethics
Gender	NA
Human Values	NA
Environment & Sustainability	Related applications may be mapped with environment and sustainability
Unit IV	
Local	Solutions involving Descriptive analytics using data visualization techniques can have a local reference.

Regional	Regional reference is possible
National	National reference is possible
Global	Global aspect is also possible
Employability	Skills attained for developing applications using pandas, data visualizations have direct mapping with employability
Entrepreneurship	Mapping of this aspect is also possible. Startup problems can be using these learning aspects
Skill Development	Topics can be quite useful for skill development on descriptive analytics
Professional Ethics	descriptive analytics is related to presenting thoughts & values in ethical manner
Gender	NA
Human Values	NA
Environment & Sustainability	Applications/problem handling based on environment & sustainability issues
SDG	All SDG goals can be touched upon through development /problem solving of related issues
NEP 2020	All indicators of NEP 2020 can be touched upon through development /problem solving of related issues
POE/4th IR	All indicators of POE & 4th IR can be touched upon through development /problem solving of related issues
UNIT V	
Local	Data Cleaning (Missing Values, Noisy Data): These techniques are applicable at the local level to improve the quality of data for local applications and analysis. Data Integration: This process can be used to combine and integrate locally collected data from multiple sources for analysis and decision-making.

Regional	Data Reduction: By reducing the dimensionality or size of the data, regional organizations can efficiently process and analyze data within their specific context.
National	Data Transformation and Data Discretization: These techniques can be applied to national datasets to transform and discretize the data for further analysis and decision-making. Mini Project: The mini project, which involves data preprocessing, exploration, and visualization, can be conducted using national datasets to address relevant national-level issues or challenges.
Global	Data Cleaning as a Process: Data cleaning is a crucial step in ensuring the quality and reliability of global datasets that are used for international research, collaborations, and decision-making
Employability	Data preprocessing, cleaning, and visualization skills are highly valuable in various industries and sectors, enhancing employability prospects.
Entrepreneurship	Data preprocessing and visualization skills are essential for entrepreneurs to gain insights from data, make data-driven decisions, and develop innovative solutions.
Skill Development	The syllabus provides an opportunity for students to develop skills in data preprocessing, data cleaning, data integration, and data visualization, which are in high demand in the current job market.
Professional Ethics	The syllabus includes aspects of data cleaning and integration, which contribute to maintaining data integrity and upholding professional ethics in data analysis and decision-making processes.
Gender	The syllabus does not specifically address gender-related aspects.
Human Values	The syllabus indirectly promotes human values by emphasizing the importance of data quality, integrity, and accuracy in decision-making processes.

Environment & Sustainability	The syllabus does not directly address environmental or sustainability aspects.
SDG	The syllabus can indirectly contribute to various SDGs, such as SDG 4 (Quality Education) by providing students with essential data processing and analysis skills.
NEP 2020	The syllabus aligns with the objectives of NEP 2020 by focusing on the development of practical skills, project-based learning, and application of data analysis techniques.
POE/4th IR	The syllabus aligns with the demands of the fourth industrial revolution by equipping students with data preprocessing, cleaning, and visualization skills that are essential for data-driven decision-making and automation.

FUNDAMENTALS OF COMPUTER PROGRAMMING LAB

Department:	Department of Computer Science and Engineering		
Course Name:	**Course Code**	**L–T–P**	**Credits**
Fundamentals of Computer Programming lab	**ENCS151**	0-0-2	1
Type of Course:	Major		

Defined Course Outcomes

CO1	**Demonstrate** the problem-solving skills using variables, basic data types, python data structures, operators, conditional statements, looping structures, functions etc.
CO 2	**Solve** real world problems involving the concepts based on OOPS
CO 3	**Solve** Real world problems using pandas, data visualization libraries in python
CO 4	**Work** on real world data sets and develop mini projects in python

Proposed Lab Experiments

S. N	Experiment	Mapped COs
1	Working with variables, operators in Python to manage inputs	CO1
2	understanding datatypes & formatting commands	CO1
3	Control Flow & Loops in Python	CO1
4	Python Data Types- List & Tuples	CO1
5	Python Data Types- Dictionary, Sets	CO1
6	Python Functions and Recursion	CO1
7	Python Object Oriented Programming: Class and Constructor	CO2
8	Python Object Oriented Programming: Inheritance, Methods Method Overriding and Data Abstraction, Encapsulation and Polymorphism	CO2
9	Handling data in Python	CO3
10	Data Visualization with various python packages	CO3
11	Mini Projects (Suggested): Project 1: Interactive Basic Calculator: Create a calculator that accepts two numbers and an operator (+,-,/,*,&,<,>,// etc) using keyboard. Depending on operator, calculator must calculate the appropriate answer. Project 2: Create a formatted student marksheet. Refer to your marksheet format. Project 3: Guess the Number game. Project 4: Dice Rolling Simulator Project 5: **Rock, Paper, Scissors Game**	CO4

| | Project 6: Contact Management System:
 Project 7: Sudoku Solver
 Project 8: Bank Account Management System:
 Project 9: Student Management System
 Project 10: Library Management System:
 Project 11: Employee Payroll System:
 Projects 12: Contact Management System with Inheritance:
 Project 13: Banking System with Multiple Inheritance:
 Project 14: School Management System with Multi-Level Inheritance: | |

Session 1: Working with variables, operators in Python to manage inputs

- Rules for creating variables in Python
- Comments
- Handling user inputs from keyboard using 'input' command and printing on console
- Multiple assignment
- Basics of how memory is allocated to variables in python.
- Mathematical Operators in Python: Arithmetic, Logical, shift, identity, membership, bitwise

Exercises:

1. Your first program: Say Hello
2. Calculate the multiplication and sum of tw[=o numbers
3. Print the sum of the current number and the previous number
    4. Exercise on python operators & input command
    5. Create a BMI calculator with Python

Project 1: Interactive Basic Calculator: Create a calculator that accepts two numbers and an operator (+,-,/,*,&,<,>,// etc) using keyboard. Depending on operator, calculator must calculate the appropriate answer

Session 2: understanding datatypes & formatting commands

- Python Primitive Data Types
- Type Error, Type Checking and Type Conversion
- Number Manipulation and Strings in Python
- Formatting numbers & strings
- Random number generation in python
-

Exercises:

1. Exercise on primitive data types
2. Exercise on number & string manipulation
3. Exercise on Type Error, Type Checking and Type Conversion
4. Exercise on random number generation in python
5. Convert Decimal number to octal using print() output formatting
6. Display float number with 2 decimal places using print()
7. Accept any three string from one input() call
8. Format variables using a string.format() method.

Project 2: Create a formatted student marksheet. Refer to your marksheet format

Session 3 & 4 : Control Flow & Loops in Python

- Control Flow with if / else and Conditional Operators
- Nested if statements and elif statements
- Multiple If Statements in Succession
- Loops in python,
- Concept of break, continue, pass statement

Exercises:

1. program which asks the user for a number. If number is even print 'Even', else print 'Odd'.
2. Program to print the largest of the three numbers
3. Program that accepts marks of a student & calculates his percentage & grade. Make suitable assumptions
4. program to print counting from 1 to 10
5. program which prints all the divisors of a number.
6. program to check if input number is a prime number
7. Write a program to print all the numbers between 1000 and 2000 which are divisible by 7 but are not a multiple of 5.
8. program to find greatest common divisor (GCD) or highest common factor (HCF) of given two numbers.
9. Write a program to calculate factorial of a number.
10. program to print multiplication table of a given number
11. Count the total number of digits in a number
12. Display numbers from -10 to -1 using for loop
13. Use else block to display a message "Done" after successful execution of for loop
14. Program to display all prime numbers within a range
15. Display all Armstrong numbers in a given range
16. Display Fibonacci series up to 10 terms
17. Calculate the cube of all numbers from 1 to a given number
18. Find the sum of the series upto n terms

19. Print the following pattern

1

1 2

1 2 3

1 2 3 4

1 2 3 4 5

20. program to use for loop to print the following reverse number pattern

5 4 3 2 1

4 3 2 1

3 2 1

2 1

1

21. Write a program to print the following start pattern using the for loop

*

* *

* * *

* * * *

* * * * *

* * * *

* * *

* *

*

22. [Interactive Coding Exercise] Leap Year

23. [Interactive Coding Exercise] Pizza Order Practice

Project 3: Guess the Number game

Create a program in which the system will choose a random number between any ranges defined, and then the user is given a hint to guess the number. Every time the user guesses the number wrongly, he is given another clue leading him toward the answer. The clue can be of any type like smaller, greater, multiples, dividers, etc.

Project 4: Dice Rolling Simulator

- As the name of the program suggests, this project will be imitating a rolling dice. This python project will generate a random number each time the dice is rolled and also the user can repeat this program as long as he wants. The program is projected in such a way that when the user rolls a die, the program will generate a random number between 1 and 6.

- The program will use the in-build function to generate the random number for rolling dice. It will also ask the user if they wish to roll the dice again.

Session 5: Python Data Types- List & Tuples

- list operations and manipulations
- list & tuple functions
- list slicing
- list comprehension
- Tuples
- List VS Tuples
- List & Tuple methods
- Uses of List & Tuples

Exercises:

1. Reverse a list in Python
2. Concatenate two lists index-wise
3. Turn every item of a list into its square
4. Concatenate two lists in the following order
5. Iterate both lists simultaneously
6. Remove empty strings from the list of strings
7. Add new item to list after a specified item
8. Extend nested list by adding the sublist
9. Replace list's item with new value if found
10. Remove all occurrences of a specific item from a list.
11. Python program to get the smallest number from a list

12. Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings
13. Implement the concept of stacks & queues with lists
14. Write a Python program to remove duplicates from a list
15. Write a Python program to clone or copy a list
16. program to find the list of words that are longer than n from a given list of words
17. Program that get two lists as input and check if they have at least one common member
18. program to print a specified list after removing the 0th, 4th and 5th elements. (enumerate)
19. program to print the numbers of a specified list after removing even numbers from it
20. program to shuffle and print a specified list (shuffle)
21. program to generate all permutations of a list in Python. (itertools)
22. program to convert a list of characters into a string
23. program to find the index of an item in a specified list
24. Python program to add a list to the second list
25. program to check whether two lists are circularly identical
26. program to find the second smallest number in a list
27. program to get unique values from a list
28. program to get the frequency of the elements in a list.
29. Create a list by concatenating a given list which range goes from 1 to n
30. Program to find common items from two lists
31. Program to Extract elements with Frequency greater than K
32. program to check if the list contains three consecutive common numbers in Python
33. program to Replace all Characters of a List Except the given character
34. Program to Prefix frequency in string List
35. program to reverse All Strings in String List
36. Program to Swap elements in String list
37. Program to Retain records with N occurrences of K
38. Program to Remove Consecutive K element records
39. Copy specific elements from one tuple to a new tuple
40. Check if all items in the tuple are the same
41. Create acronyms using Python
42. Python program to find tuples which have all elements divisible by K from a list of tuples
43. Python program to find Tuples with positive elements in List of tuples
44. Python – Count tuples occurrence in list of tuples
45. Python – Removing duplicates from tuple
46. Python – Remove duplicate lists in tuples (Preserving Order)

47. Python – Cross Pairing in Tuple List
48. Python – Consecutive Kth column Difference in Tuple List
49. Python – Kth Column Product in Tuple List
50. Python – Flatten tuple of List to tuple

Project 5: Rock, Paper, Scissors Game

- We have always played rock, and paper scissors game with our playmates. But what if your playmate is not available? Then you can play rock, paper, scissors along with your computer that is designed by you. It is one of the most fun python project ideas for beginners to build their skills.

- **In this program, we will use a random function for generating the random output by the computer side. The user will make the first move and then the program makes one.** Then a function will check the validity of the move. At last, we will display the result and ask the user to play again or not.

Session 6: Python Data Types- Dictionary, Sets

- Create a dictionary
- Add Elements to a Python Dictionary
- Accessing Elements from Dictionary
- Removing elements from Dictionary
- Python Dictionary Methods
- Create a Set in Python
- Duplicate Items in a Set
- Add and Update Set Items in Python
- Add, update items
- Remove an Element from a Set
- Built-in Functions with Set

Exercises

- program to check whether a given key exists in a dictionary or not.
- program to iterate over dictionary items using for loop.
- program to print only keys & values of a dictionary.
- program in python to map 2 lists into a dictionary.
- program to remove a set of keys.
- program to sort dictionary by values (Ascending/ Descending).
- program to concatenate two dictionaries to create one.

- program to sum all the values of a dictionary.
- program to get the maximum and minimum value of dictionary.
- program to check if a dictionary is empty or not.
- program to sort dictionary values in python.
- program to check whether a key exists in the dictionary or not.
- program in python to map keys to dictionary.
- program in Python to remove repetitive items from a list.

Session 7: Python Functions and Recursion

- Learn Syntax for function calls in Python.
- Call built-in functions and user-defined functions.
- Understand the return value of a function call.
- Explicit type conversion using functions like int (), float (), str ().
- Implicit type coercion in Python operations.
- Exploring the math module in Python.
- Commonly used math functions like sqrt (), sin (), cos (), etc.
- Defining and implementing user-defined functions in Python.
- Syntax for function definition, including the function name, parameters, and return statement.
- Understanding the concept of recursion.
- Recursive function calls and their relationship with the call stack.
- Identifying base cases and recursive cases in recursive functions.
- Implementing a recursive function to calculate the Fibonacci sequence.
- Understanding the mathematical definition of the Fibonacci sequence.
- Analyzing the efficiency and limitations of the recursive solution.
- Implementing a recursive function to solve the Tower of Hanoi puzzle.
- Understanding lambda functions as anonymous functions in Python.
- Using lambda functions in conjunction with built-in functions like map (), filter (), and reduce ().

Exercises

Exercise 1: Function Calls and Type Conversion:

- Write a program that takes user input of two numbers, performs addition, and displays the result.
- Implement error handling to handle cases where non-numeric input is provided.

Exercise 2: Math Functions:

- Create a program that calculates the area of a circle using the math module's functions.

▪ Prompt the user for the radius and display the calculated area.
Exercise 3: Adding New Function:
▪ Write a program that converts temperature from Celsius to Fahrenheit and vice versa. ▪ Implement two separate functions for the conversion formulas and test them.
Exercise 4: Parameters and Arguments:
▪ Create a program that calculates the total cost of a meal, including tax and tip. ▪ Define a function that takes the cost of the meal, tax percentage, and tip percentage as arguments.
Exercise 5: Recursion and Fibonacci:
▪ Write a program that calculates the Fibonacci sequence up to a given term using recursion. ▪ Prompt the user for the desired term and display the Fibonacci sequence.
Exercise 6: Tower of Hanoi:
▪ Implement a program that solves the Tower of Hanoi puzzle using recursion. ▪ Prompt the user for the number of disks and display the steps required to solve the puzzle.
Exercise 7: Lambda Functions and Anonymous Functions:
▪ Write a program that uses lambda functions to perform basic arithmetic operations. ▪ Prompt the user for two numbers and allow them to choose the operation to perform.
Project 6: Contact Management System:
• Create a contact management system that allows users to add, search, update, and delete contacts. • Implement the functionalities using functions for each operation. • Provide options for sorting and displaying contacts using different criteria, such as name or date added.
Project 7: Sudoku Solver:
• Develop a program that can solve Sudoku puzzles using recursion. • Write a recursive function to fill in the empty cells of the puzzle one by one, checking for valid entries at each step. • Allow users to input the unsolved puzzle and display the solved result.
Session 8: Python Object Oriented Programming: Class and Constructor

- Understanding the fundamental concepts of OOP, such as objects, classes, encapsulation, inheritance, and polymorphism.
- Differentiating between procedural programming and OOP.
- Defining classes in Python to create blueprints for objects.
- Introducing constructors as special methods in classes.
- Implementing a non-parameterized constructor using the __init__ method.
- Implementing a parameterized constructor to initialize attributes with user-provided values.
- Defining class attributes that are shared among all instances of a class.
- Understand and implement Class Methods and Static Methods
- Implementing inheritance by defining a subclass that inherits attributes and methods from a superclass.
- Defining method overriding to provide a different implementation of a method in a subclass.
- Understanding polymorphism as the ability of objects to take on multiple forms.

Exercises

Exercise 1: Class and Object Creation

- Create a class called **Student** that represents a student's information.
- Define attributes such as name, age, and grade for the **Student** class.
- Instantiate multiple objects of the **Student** class and set their attributes.
- Display the information of each student object.

Exercise 2: Non-parameterized Constructor

- Create a class called **Rectangle** that represents a rectangle.
- Define attributes for the length and width of the rectangle.
- Implement a non-parameterized constructor in the **Rectangle** class to initialize the attributes with default values.
- Instantiate a **Rectangle** object and display its dimensions.

Exercise 3: Parameterized Constructor

- Extend the **Rectangle** class with a parameterized constructor.
- Modify the parameterized constructor to accept length and width values as parameters and initialize the attributes accordingly.
- Instantiate a **Rectangle** object by providing length and width values through the constructor.
- Display the dimensions of the rectangle object.

Exercise 4: Bank Account Class

- Create a class called **BankAccount** that represents a bank account.

- Define attributes such as account number, account holder name, and balance.
- Implement a parameterized constructor to initialize the attributes.
- Include methods to deposit and withdraw funds from the bank account.
- Instantiate a **BankAccount** object and perform deposit and withdrawal operations.
- Display the updated balance after each transaction.

Exercise 5: Employee Class

- Create a class called **Employee** to represent an employee's information.
- Define attributes such as employee ID, name, and salary.
- Implement a parameterized constructor to initialize the attributes.
- Include a method to display the employee's details.
- Instantiate multiple **Employee** objects and display their information.

Exercise 6: Vehicle Class Hierarchy

- Create a base class called **Vehicle** with attributes such as make, model, and year.
- Define a parameterized constructor in the **Vehicle** class to initialize the attributes.
- Create derived classes like **Car**, **Motorcycle**, and **Truck** that inherit from the **Vehicle** class.
- Implement constructors in the derived classes to initialize additional attributes specific to each type of vehicle.
- Instantiate objects of each derived class and display their details.

Students to do any of the following mini project

Project 8: Bank Account Management System:

- Create a bank account class with attributes such as account number, account holder name, and balance.
- Implement methods to deposit, withdraw, and display the account details.
- Use constructors to initialize the account attributes and handle different types of accounts (e.g., savings, checking).

Project 9: Student Management System:

- Develop a student class with attributes like student ID, name, and grades.
- Implement methods to calculate the average grade, display student information, and add new grades.
- Use constructors to initialize student attributes and handle student objects with different sets of grades.

Project 10: Library Management System:

- Create classes for books, authors, and library members.

- Implement methods to add books, search for books by author or title, and manage library member details.
- Use constructors to initialize book and member attributes and handle multiple book copies.

Project 11: Employee Payroll System:

- Develop an employee class with attributes like employee ID, name, salary, and designation.
- Implement methods to calculate monthly salary, display employee details, and handle promotions.
- Use constructors to initialize employee attributes and handle different employee designations.

Session 9: Python Object Oriented Programming: Inheritance, Methods Method Overriding and Data Abstraction, Encapsulation and Polymorphism.

- Understanding the fundamental concepts of OOP, such as objects, classes, encapsulation, inheritance, and polymorphism.
- Differentiating between procedural programming and OOP.
- Defining classes in Python to create blueprints for objects.
- Introducing constructors as special methods in classes.
- Implementing a non-parameterized constructor using the __init__ method.
- Implementing a parameterized constructor to initialize attributes with user-provided values.
- Defining class attributes that are shared among all instances of a class.
- Understand and implement Class Methods and Static Methods
- Implementing inheritance by defining a subclass that inherits attributes and methods from a superclass.
- Defining method overriding to provide a different implementation of a method in a subclass.
- Understanding polymorphism as the ability of objects to take on multiple forms.

Exercises

Exercise 5: Class Attributes and Methods:

- Create a class that represents a car. Include class attributes such as the number of wheels and class methods to calculate the average speed of all cars created.
- Write a program to instantiate multiple car objects and access their class attributes and methods.

Exercise 5: Parameterized Constructors:

- Build a class called "Rectangle" that has attributes for length and width.

- Implement a parameterized constructor that takes the length and width as arguments and initializes the attributes.
- Write a program to create multiple rectangle objects with different dimensions and display their properties.

Exercise 5: Multi-Level Inheritance:

- Create a base class called "Animal" with attributes and methods common to all animals.
- Derive a subclass called "Mammal" from the "Animal" class with additional attributes and methods specific to mammals.
- Further derive a subclass called "Dog" from the "Mammal" class with specific attributes and methods for dogs.
- Write a program to instantiate a dog object, access its inherited attributes and methods, and invoke the dog-specific ones.

Exercise 5: Multiple Inheritance:

- Define a base class called "Shape" with attributes and methods related to shapes.
- Create two subclasses, "Circle" and "Rectangle," that inherit from the "Shape" class.
- Implement another class called "Shape3D" that represents 3D shapes and inherits from both the "Circle" and "Rectangle" classes.
- Write a program to instantiate a 3D shape object, access attributes and methods from the multiple inherited classes, and display their properties.

Exercise 5: Method Overriding:

- Create a base class called "Vehicle" with a method called "start" that prints "Vehicle started."
- Derive a subclass called "Car" from the "Vehicle" class and override the "start" method to print "Car started."
- Derive another subclass called "Motorcycle" from the "Vehicle" class and override the "start" method to print "Motorcycle started."
- Write a program to instantiate a car and a motorcycle object and invoke their respective "start" methods.

Exercise 5: Polymorphism:

- Define a base class called "Shape" with a method called "area" that returns the area of a shape.
- Create subclasses, such as "Rectangle," "Circle," and "Triangle," that inherit from the "Shape" class and implement their own "area" methods.
- Write a program to instantiate objects of different shapes, invoke their "area" methods, and display the calculated areas.

Projects 12: Contact Management System with Inheritance:

- Build a contact management system that allows users to add, search, update, and delete contacts.
- Create a base class called "Contact" with common attributes and methods.
- Implement subclasses like "PersonContact" and "OrganizationContact" that inherit from the base class and add specific attributes and methods.
- Employee Management System with Class Methods:

- Develop an employee management system that stores and manages employee information.
- Use class methods to implement functionalities such as calculating average salary, finding the highest-paid employee, and displaying employee statistics.

Project 13: Banking System with Multiple Inheritance:

- Create a banking system that models different types of bank accounts, including savings accounts, checking accounts, and credit card accounts.
- Implement multiple inheritance by creating a base class called "BankAccount" and subclasses for each specific account type.
- Use the appropriate attributes and methods from both the base class and the subclasses to handle account transactions and balance management.

Project 14: School Management System with Multi-Level Inheritance:

- Develop a school management system that handles student, teacher, and administrative tasks.
- Implement multi-level inheritance with a base class called "Person" and subclasses like "Student," "Teacher," and "Administrator" inheriting from it.
- Define specific attributes and methods for each subclass, such as calculating student grades, managing teacher schedules, and handling administrative tasks.

Session 10: Handling data in Python

- Text file handling
- What is Python Pandas?
- Pandas Series
- Basic Operations on Series
- Pandas DataFrame
- Basic Operations on DataFrames
- Extracting data from RDBMS using SQLite

Exercises:

- Read the data in different formats like csv,excel,text file etc
- Apply data cleaning activities
- Apply queries on data to fetch relevant data using various sample data sources

- Apply join operations on multiple data sources to extract data
- Extracting data from data in RDBMS using SQLite library

Project: https://github.com/jvns/pandas-cookbook

Session 11: Data Visualization with various python packages

Learn to create various types of visualization charts with following libraries

- Matplotlib
- Seaborn
- Bokeh
- Plotly

Exercises:

1.draw a line using given axis values with suitable label in the x axis , y axis and a title.

2.draw line charts of the financial data of Alphabet Inc. between October 3, 2016 to   October   7,   2016.
 Sample Financial data (fdata.csv):

Date, Open, High, Low, Close
 10-03-16,774.25,776.065002,769.5,772.559998
 10-04-16,776.030029,778.710022,772.890015,776.429993
 10-05-16,779.309998,782.070007,775.650024,776.469971
 10-06-16,779,780.47998,775.539978,776.859985
 10-07-16,779.659973,779.659973,770.75,775.080017

3. display the grid and draw line charts of the closing value of Alphabet Inc. between October 3, 2016 to October 7, 2016. Customized the grid lines with linestyle -, width .5. and color blue.
Date, Close
 03-10-16,772.559998
 04-10-16,776.429993
 05-10-16,776.469971
 06-10-16,776.859985
 07-10-16,775.080017

4. display the grid and draw line charts of the closing value of Alphabet Inc. between October 3, 2016, to October 7, 2016. Customized the grid lines with rendering with a larger grid (major grid) and a smaller grid (minor grid).Turn on the grid but turn off ticks

5. Write a Python program to create multiple plots.

Consider following data in csv format:

Exercise 1: Read Total profit of all months and show it using a line plot

Exercise 2: Get total profit of all months and show line plot with the following Style properties

Exercise 3: Read all product sales data and show it using a multiline plot

Exercise 4: Read toothpaste sales data of each month and show it using a scatter plot

Exercise 5: Read face cream and facewash product sales data and show it using the bar chart

Exercise 6: Read sales data of bathing soap of all months and show it using a bar chart. Save this plot to your hard disk

Exercise 7: Read the total profit of each month and show it using the histogram to see the most common profit ranges

Exercise 8: Calculate total sale data for last year for each product and show it using a Pie chart

Exercise 9: Read Bathing soap facewash of all months and display it using the Subplot

Exercise 10: Read all product sales data and show it using the stack plot

Project: https://github.com/CICIFLY/Data-Analytics-Projects

Self-Learning Components

- Students are required to demonstrate their self

- learning components by developing a mini project

List of Suggested projects for students

Project: Random password generator

Create a program that takes a number and generate a random password length of that number.

Topics: random module, joining strings, taking input

Hint: *Create a string with all characters, then take random characters from it and concatenate each char to make a big string.*

Project: Tic-Tac-Toe

- We all have interesting memories of playing tic-tac-toe with our friends, don't we? This is the most fun and interesting game to play anywhere, all you need is a pen and paper.

- create a 3x3 grid just like the traditional method. Then we will ask the user to put 'X' at any of the grid and respond accordingly by placing 'O' in the remaining places. Also, we will try to put 'O' in the program to create the vertical, horizontal, or diagonal lines as because whoever does that first will win the game and the message will be displayed.

Project: Number Guessing

The number-guessing game is a simple game where one player thinks of a number and the other player tries to guess the number. The player who is thinking of the number will provide hints to the other player, such as whether the guess is too high or too low, to help them narrow down the possibilities and eventually guess the correct number.

Project: Password Strength Checker

A password strength generator is a program that helps users create strong and secure passwords. **This type of program typically uses algorithms to evaluate the strength of a given password and provide feedback to the**

user on how to improve it. The program may also be able to generate a strong password for the user automatically.

Strong passwords are important for protecting online accounts from hackers and other malicious actors. A good password should be at least 8 characters long and include a mix of uppercase and lowercase letters, numbers, and special characters. Using a password strength generator can help ensure that your password is strong and secure.

Project: Hangman Game

- It is always fun to build a game using python programming. This project involves the same. Hangman Game or more like a "guess the word" game is the best program for good interactive learning.

- Here, the user will have to guess an alphabet to complete a word, and also each user will have a limited number of chances to guess a letter. The programmer can create the preorganized list of words to be finished and then include a specific function to check whether the user has guessed the correct letter if yes then include that letter to word for finishing the default word and if the guesswork is not true then reducing the count of chances to guess further.

- While developing this python project you will learn the core concepts like variables, characters, strings, lists, conditional statements, loops, and functions. Also, the concept of the counter variable is used to limit the number of guesses.

Project: Password Strength Checker

- A password strength generator is a program that helps users create strong and secure passwords. **This type of program typically uses algorithms to evaluate the strength of a given password and provide feedback to the user on how to improve it.** The program may also be able to generate a strong password for the user automatically.

- Strong passwords are important for protecting online accounts from hackers and other malicious actors. A good password should be at least 8 characters long and include a mix of uppercase and lowercase letters, numbers, and special characters. Using a password strength generator can help ensure that your password is strong and secure.

Project: Mad Libs Generator
Mad Libs is a word game where players supply words to fill in blanks in a story or sentence, typically with funny or amusing results. A Mad Libs generator is a tool that can be used to automatically create Mad Libs stories. To use a Mad Libs generator, the user typically inputs various types of words, such as nouns, verbs, and adjectives, and the generator will use these words to fill in the blanks in a pre-written story or sentence. The resulting Mad Libs story will often be humorous and nonsensical.

Project: Snake Game
The snake game is a classic arcade game where the player controls a snake that moves around the screen, trying to eat food while avoiding obstacles and its own tail. The snake grows in length each time it eats food, making it more difficult to navigate and maneuver. The objective of the game is to score as many points as possible by eating as much food as possible without crashing into an obstacle or the snake's own tail.

Project: Calculator Application:
- Build a calculator application that supports basic mathematical operations using functions.   - Implement error handling for invalid input and division by zero.   - Enhance the calculator by adding more advanced operations such as exponentiation and square root using math functions.

Project: Recursive File Search:
- Write a program that recursively searches a directory and its subdirectories for files with a specific extension.   - Implement the recursive file search using a function that calls itself.   - Allow the user to input the directory path and extension to search for.

Project: Recursive Drawing:
- Create a program that uses recursion to draw geometric patterns.   - Write functions to draw shapes such as squares, circles, and triangles, with varying sizes and positions.   - Implement recursion to generate more complex patterns by recursively calling the drawing functions.

Project: Text Adventure Game:
- Design and build a text-based adventure game using functions for different game actions and interactions.   - Implement recursion to allow for nested scenarios or choices within the game.   - Include multiple storylines, character interactions, and branching paths based on user decisions.

Project: Recursive Image Processing:
- Develop a program that applies recursive algorithms for image processing tasks, such as blurring or edge detection.   - Implement recursive functions to traverse the image pixels and modify their values based on neighboring pixels.   - Allow users to input an image file and display the processed result.
Project: Maze Solver:
- Build a program that solves a maze using recursion.   - Create a function that recursively explores the possible paths in the maze until the exit is found.   - Visualize the maze solving process by displaying the steps taken to navigate through the maze.

References

https://www.tutorjoes.in/python_programming_tutorial/

https://www.udemy.com/course/100-days-of-code/

https://favtutor.com/blog-details/7-Python-Projects-For-Beginners

https://github.com/NaviRocker/100-days-of-python

https://hackr.io/blog/python-projects

LINEAR ALGEBRA AND ORDINARY DIFFERENTIAL EQUATIONS

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

Pre-requisite(s): 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 Components:

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

Please Note:

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

Reference Books:

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

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

Define Course Outcomes (CO)

COs	Statements
CO 1	**Identify** and **analyze** the properties of various types of matrices, such as symmetric, skew-symmetric, Hermitian, skew Hermitian, unitary, and orthogonal matrices.
CO 2	**Analyze** quadratic forms and apply eigenvalues and eigenvectors in practical situations.
CO 3	**Define** and **comprehend** vector spaces, subspaces, linear independence, and basis.
CO 4	**Determine** the dimension of vector spaces and compute row space, column space, and null space of matrices.
CO 5	**Solve** first-order linear, separable, exact, and homogeneous differential equations.

CO 6	**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	-

Empathy & Understanding problems LAB

Department:	Department of Computer Science and Engineering		
Course Name: Empathy & Understanding problems LAB	**Course Code**	**L-T-P**	**Credits**
	ENSP160	0-0-4	2
Type of Course:	Minor		
Pre-requisite(s), if any:			

Brief Syllabus:

To understand the concept of empathy and empathizing with users effectively. Discern the facts after dully analyzing the information received from the user. To learn how to define the problem on the basis of facts. To grasp various empathy techniques and tools. To practice various tools to comprehend root cause of the problem leading to correct definition.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Empathy	No. of hours: 3

Content Summary:

What is Empathy, Learn how to understand users & their problems, techniques to empathize with users and identify key user problems.

Unit Number: 2	Title: Analysing facts from Empathy to dig deeper	No. of hours: 3

Content Summary:

Learn how to gain insights from empathy and define problems statements

Unit Number: 3	Title: Empathy Tools & Techniques	No. of hours: 3

Content Summary:

Empathy tools – techniques for getting empathy insights through interviews

Unit Number: 4	**Application of Empathy in design**	No. of hours: 3

Content Summary:

Empathy maps, emotional mapping, observation, field study with actual users

Unit Number: 5	Title: Project	No. of hours: 18

Content Summary:

Project submissions empathy mapping

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. Empathy: Why it matters, how to get it - Roman Kizanie
2. The Art of Empathy: A complete Guide to life's most essential skill - Karla McLaren

Define Course Outcomes (CO)

COs	Statements
CO1	**Define** empathy and empathize with users effectively.
CO2	**Examine** and discern the facts after dully analyzing the information received from the user.
CO3	**Recognize** and learn how to define the problem based on facts.
CO4	**Define** various empathy techniques and tools.
CO5	**Design** and apply various tools to comprehend root cause of the problem leading to correct definition.

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	C3	A2	P4
C02	C2	A1	P1
CO3	C1	A3	P3
CO4	C1	A2	P1
CO5	C3	A2	P5

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	-	1	-	-	-
CO2	2	3	3	2	2	2
CO3	2	2	2	1	1	1
CO4	3	-	2	-	-	-
CO5	3	3	2	1	-	1

Relevance of the Syllabus to various indicators

Unit I	Introduction to Empathy
Local	Addresses understanding users' needs within the society
Regional	Addresses problems at regional level
National	Contribution by understanding problems & needs of users at national level
Global	Aligns with global problems & needs

Employability	-
Entrepreneurship	Helps in establishing the roots of the business through understanding their needs
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Analyzing facts from Empathy to dig deeper
Local	Addresses local needs and gather insights
Regional	Addresses and understands the regional level issues and their daily routine
National	Contributes to problem solving at national level
Global	Aligns with global level issues & concerns of the users
Employability	Develops empathising skills required for industry
Entrepreneurship	Helps in building stronger insights for entrepreneurship
Skill Development	Develops empathising skills
Professional Ethics	Learning more about being empathetic with users
Gender	-
Human Values	-

Environment & Sustainability	-
Unit III	Empathy tools & techniques
Local	Addresses local tools & technology used in research
Regional	Addresses and understands the regional level tools & techniques for getting empathy insights
National	Contributes and understands the techniques used at national level
Global	Aligns with different trends & techniques used at global level
Employability	Develops skills by learning different techniques of primary research
Entrepreneurship	Understanding techniques for better interview methods
Skill Development	Develops knowledge and skills in tools & techniques
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Application of Empathy in Design
Local	Addresses local understanding by learning different applications of empathising with user
Regional	Addresses and understands the regional level applications

National	Contributes by understanding national level applications used
Global	Aligns with global level applications used for understanding users
Employability	Helps in learning tools and applications required for industry projects
Entrepreneurship	-
Skill Development	Learning different application techniques helps in enhancing skills
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

ENGINEERING CHEMISTRY

Department:	Department of Computer Science and Engineering		
Course Name: ENGINEERING CHEMISTRY	Course Code	L–T–P	Credits
	ENCH101	4-0-0	4
Type of Course:	Major		

Pre-requisite(s), if any:

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: 10
Content Summary: Introduction, water analysis: i. Hardness-determination by EDTA method-numerical problems, ii. Alkalinity-determination by double indicator method-numerical problems, iii. Determination of dissolved oxygen by Winkler's method and iv. Determination of chemical oxygen demand - numerical problems. Boiler scales formation and ill effects, prevention of scales by external method (hot lime-soda process). Desalination by electrodialysis.		

Unit Number: 2	Title: Chemical Fuels	No. of hours: 10
Content Summary: Chemical fuels Introduction, classification with examples, calorific value-classification (HCV & LCV), determination of calorific value of solid and liquid fuels using Bomb calorimeter-		

numerical problems. Petroleum cracking -fluidized bed catalytic 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. Solar energy- Photo voltaic cells- definition, working and importance of PV cells. Production of solar grade silicon by chemical vapor deposition.

Unit Number: 3	Title: Battery Technology	No. of hours: 10

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: Zn-Ag_2O, Ni-Cd, Zn-air 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. Construction, working and applications of solid oxide fuel cell.

Unit Number: 4	Title: Polymer	No. of hours: 10

Content Summary:

Basic concepts of polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna S, Buna-N, Neoprene, Nylon-6, nylon-6,6 and Terylene). General methods of synthesis of organometallic compounds (Grignard reagent) and their applications.

*Self-Learning Components:

https://onlinecourses.nptel.ac.in/noc21_cy49/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:

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.

Define Course Outcomes (CO)

Cos	Statements
CO1	**Understand** the basic concept of batteries & fuel cells and their applications.
CO2	**Express** proficiency to apply semiconductor photochemistry in energy harnessing and optical sensors.
CO3	**Determine** various methods to enhance the quantity & quality of gasoline.
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
CO2	C3	-	P5
CO3	C2	-	-
CO4	C3	-	P3
CO5	C6	-	P4

CO-PO Mapping

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

ENGINEERING CHEMISTRY LAB

Department:	Department of Computer Science and Engineering		
Course Name: **ENGINEERING CHEMISTRY LAB**	**Course Code** **ENCH151**	**L-T-P** 0-0-2	**Credits** 1
Type of Course:	Major		

Proposed Lab Experiments

Defined Course Outcomes

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.

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	Calibration of pH meter and determination of pH of a solution	CO1, CO5
9	Determination of chloride content in water sample.	CO1, CO3 CO5, CO6
10	Estimation dissolved oxygen (DO) content in the given water sample by Winkler's method.	CO1, CO3,CO5
11	Determination of iron content in the given solution by Mohr's method.	CO1, CO3, CO5
12	Determination of rate constant of hydrolysis of esters.	CO3, CO5
13	To determine the Iron content in the given salt by using external indicator	CO1, CO3, CO5
14	To determine the iron concentration in the given water sample by Spectrophotometer using potassium thiocyanate as colour developing agent.	CO2, CO3, CO5

15	Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution	CO2, CO3, CO5
16	Determination of molar absorptivity of a compound ($KMnO_4$ or any water soluble food colorant).	CO2, CO3, CO5
17	Preparation of a nickel complex $[Ni(NH_3)_6]Cl_2$ and estimation of nickel by complexometric titration.	CO4, CO5, CO6
18	Synthsis of drug like Aspirin, Paracetamol etc.	CO4, CO5, CO6

BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING

Department:	Department of Electrical & Electronics Engineering		
Course Name:	**Course Code**	**L-T-P**	**Credits**
Basics of Electrical & Electronics Engineering	**ENEE101**	4-0-0	4
Type of Course:	Major		
Pre-requisite(s), if any: NA			

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 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: 10

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: 10

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: 10

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.

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	PSO4
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	-	-
C02	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

BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB

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 Course		

Proposed Lab Experiments

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.

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

Semester: 3

Department:	Department of Computer Science and Engineering		
Course Name:	**Course Code**	**L–T–P**	**Credits**
User Research		4-0-0	4
Type of Course:	Programme Core / Programme Elective /Open Elective		
Pre-requisite(s), if any:			

Brief Syllabus:

Be able to understand the importance of User research, Understanding the different user research methodologies. Able to grasp hands-on experience of tools for user research. Understanding cognitive psychology and user behavior. Performing a user research with users on a chosen problem.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to User Research	No. of hours: 6
Content Summary:		

Introduction to User Research and its Importance, Understanding User interactions

Unit Number: 2	Title: User Research Methodologies	No. of hours: 12
Content Summary:		

Planning for a User Research User Segment, defining persona for research & recruiting users, Preparing a Questionnaire for user research, Focus group discussion

- do and don'ts, Online surveys - tools, do and don'ts, Analysis Interview Tips & Techniques

Unit Number: 3	Title: Hands on Practice of Methodologies	No. of hours: 15

Content Summary:

Preparing and Conducting Stakeholder workshop, Preparing questionnaire for Interviews, and Online surveys

Unit Number: 4	Tools of Empathy and Analysis	No. of hours: 15

Content Summary:

Tools of empathy like Persona, Empathy Map and User Journey Map, Documenting Qualitative Research, Documenting Quantitative Research

Unit Number: 5	Title: Project Work	No. of hours: 12

Content Summary:

Project work on User research

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. UX Research- by Brad Nunnally (Author), David Farkas (Author)
2. The UX Research Methodology Guidebook- User testing free ebook

3. Modern UX research in action: 10 research stories- User testing free ebook

4. Observing the User Experience: A Practitioner's Guide to User Research- by Mike Kuniavsky

Unit II	User Research Methodologies
Local	Addresses local needs and gather insights
Regional	Addresses and understands the regional level issues and their daily routine through surveys and interviews
National	Conducting user research methodologies at national level
Global	Aligns with global level research methods
Employability	Develops understanding of user research methods for industry
Entrepreneurship	Helps in building stronger insights for entrepreneurship
Skill Development	Develops understanding of different research methodologies
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Field study : Hands on practice of methodologies
Local	Addresses local stakeholders research

Regional	Addresses and understands the regional level research with stakeholder mapping
National	Contributes and understands the methodologies used at national level
Global	Aligns with different techniques used at global level
Employability	Develops skills by hands on practice for different methodologies
Entrepreneurship	Helps in establishing business by hands on practice
Skill Development	Develops knowledge and skills by practicing techniques
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Tools of Empathy & Analysis
Local	Addresses local understanding by applying different tools of empathy
Regional	Addresses and understands the regional level tools of Empathy
National	Contributes by understanding national level tools of Empathy mapping
Global	Aligns with global level research methods & tools
Employability	Helps in learning tools of empathising
Entrepreneurship	-

Skill Development	Learning different tools of empathy mapping and qualitative & quantitative research methods
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

Semester -III

DISCRETE MATHEMATICS

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	**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:

Topics (with book references):

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.(Introduction to Graph Theory" by Richard J. Trudeau)
3. Combinatorial Optimization & Error Detection & correction using The Pigeonhole Principle ("Combinatorial Optimization: Algorithms and Complexity" by Christos H. Papadimitriou and Kenneth Steiglitz)
4. Scheduling and Task Prioritization, using Partial ordering. ("Introduction to Scheduling" by Yves Robert and Frederic Vivien)
5. Rules based system and Algorithm design using conditional statements. (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. Mathematics For Computer Science, https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/
3. Introduction to Discrete Mathematics for Computer Science Specialization, https://www.coursera.org/specializations/discrete-mathematics
4. Discrete Math Series : Propositional Logic masterclass https://www.udemy.com/course/discretemathematics/
5. Master Discrete Mathematics: Sets, Math Logic, and More: https://www.udemy.com/course/master-discrete-mathematics/
6. Master Math by Coding in Python: https://www.udemy.com/course/math-with-python/
7. Discrete Mathematics for Computer Science in C, Java, Python: https://www.udemy.com/course/discrete-mathematics-and-its-applications/
8. Discrete Mathematics - Complete Course: https://www.udemy.com/course/discrete-mathematics-complete-course/
9. Discrete Optimization: https://www.coursera.org/learn/discrete-optimization
10. 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)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 of Discrete Mathematics:

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.

E-Books of Discrete Mathematics (with Links):

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/discmath-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

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

Relevance of the Syllabus to various indicators

Unit I	Introduction
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
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

DATA STRUCTURES

Department:	Department of Computer Science and Engineering		
Course Name: **Data Structure**	**Course Code**	**L–T–P**	**Credits**
	ENCS205	4-0-0	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: 10

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: 10

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: 10

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: 10

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:

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**

   - "Algorithms, Part I" by Robert Sedgewick and Kevin Wayne (available on Coursera)
   - "Algorithms, Part II" by Robert Sedgewick and Kevin Wayne (available on Coursera)

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. 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.

Define 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
C02	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

Justification for mapping must be relevant

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

CO-PSO Mapping

PSO	PSO1	PSO2	PSO3	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

DATA STRUCTURES LAB

Department:	Department of Computer Science and Engineering		
Course Name: Data Structure lab	Course Code	L–T–P	Credits
	ENCS253	0-0-2	1
Type of Course:	Major		
Pre-requisite(s), if any: Basics of Computer Programming			

Proposed Lab Experiments

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

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	CO2

		b) Inserting a new node in the middle c) Deleting a node from the end	
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 c) Deleting an existing node from BST		CO3
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

	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.	
	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.	
	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.	

User Research

Department:	Department of Computer Science and Engineering		
Course Name: **User Research**	**Course Code**	**L–T–P**	**Credits**
	ENSP203	4-0-0	4
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus:
Be able to understand the importance of User research, Understanding the different user research methodologies. Able to grasp hands-on experience of tools for user research. Understanding cognitive psychology and user behavior. Performing a user research with users on a chosen problem.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to User Research	No. of hours: 6
Content Summary: Introduction to User Research and its Importance, Understanding User interactions		

Unit Number: 2	Title: User Research Methodologies	No. of hours: 12
Content Summary: Planning for a User Research User Segment, defining persona for research & recruiting users, Preparing a Questionnaire for user research, Focus group discussion		

- do and don'ts, Online surveys - tools, do and don'ts, Analysis Interview Tips & Techniques

Unit Number: 3	Title: **Hands on Practice of Methodologies**	**No. of hours: 15**

Content Summary:

Preparing and Conducting Stakeholder workshop, Preparing questionnaire for Interviews, and Online surveys

Unit Number: 4	**Tools of Empathy and Analysis**	**No. of hours: 15**

Content Summary:

Tools of empathy like Persona, Empathy Map and User Journey Map, Documenting Qualitative Research, Documenting Quantitative Research

Unit Number: 5	Title: **Project Work**	**No. of hours: 12**

Content Summary:

Project work on User research

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

5. UX Research- by Brad Nunnally (Author), David Farkas (Author)

6. The UX Research Methodology Guidebook- User testing free ebook

7. Modern UX research in action: 10 research stories- User testing free ebook

8. Observing the User Experience: A Practitioner's Guide to User Research- by Mike Kuniavsky

Define Course Outcomes (CO)

COs	Statements
CO1	**Define** the importance of user research.
CO2	**Explore** and understand the different user research methodologies.
CO3	**Evaluate** and apply hands-on experience of tools for user research.
CO4	**Recognize** cognitive psychology and user behavior.
CO5	**Define** and perform user research with users on a chosen problem.

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
C02	C2	A3	P3
CO3	C3	A2	P4
CO4	C4	A5	P4
CO5	C3	A2	P5

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	2	-	-	-	-	1
CO2	3	1	1	1	-	1
CO3	1	3	1	-	-	-
CO4	3	-	1	2	-	1
CO5	1	3	1	2	1	2

Relevance of the Syllabus to various indicators

Unit I	Introduction to User Research
Local	Addresses understanding users' needs within the society
Regional	Addresses needs by conducting user research at regional level
National	Contribution by understanding problems & needs of users at national level
Global	Aligns with User behaviour at global level
Employability	-
Entrepreneurship	Helps in establishing the roots of the business through understanding their users

Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	User Research Methodologies
Local	Addresses local needs and gather insights
Regional	Addresses and understands the regional level issues and their daily routine through surveys and interviews
National	Conducting user research methodologies at national level
Global	Aligns with global level research methods
Employability	Develops understanding of user research methods for industry
Entrepreneurship	Helps in building stronger insights for entrepreneurship
Skill Development	Develops understanding of different research methodologies
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

Unit III	Field study : Hands on practice of methodologies
Local	Addresses local stakeholders research
Regional	Addresses and understands the regional level research with stakeholder mapping
National	Contributes and understands the methodologies used at national level
Global	Aligns with different techniques used at global level
Employability	Develops skills by hands on practice for different methodologies
Entrepreneurship	Helps in establishing business by hands on practice
Skill Development	Develops knowledge and skills by practicing techniques
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Tools of Empathy & Analysis
Local	Addresses local understanding by applying different tools of empathy
Regional	Addresses and understands the regional level tools of Empathy
National	Contributes by understanding national level tools of Empathy mapping
Global	Aligns with global level research methods & tools

Employability	Helps in learning tools of empathising
Entrepreneurship	-
Skill Development	Learning different tools of empathy mapping and qualitative & quantitative research methods
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

User Research Lab

Department:	Department of Computer Science and Engineering		

Course Name:	Course Code		L-T-P	Credits
User Research Lab	ENSP255		0-0-2	1

Type of Course:	Minor

Pre-requisite(s), if any:

Brief Syllabus:

The phenomenon of user research is learnt through hands on training. Exploring different user research methodologies ensuring appropriate solution. The tools for user research becomes familiar. Introduction to basic cognitive psychology and user behaviour. Field experience on user researching through a pre-selected problem.

UNIT WISE DETAILS

Unit Number: 1	Title: Qualitative Research	No. of hours: 3

Content Summary:

Qualitative Research Project implementing Qualitative Research Strategy

Unit Number: 2	Title: Quantitative Research	No. of hours: 3

Content Summary:

Quantitative Research Project implementing Quantitative Research Strategy

Unit Number: 3	Title: Mental Model	No. of hours: 3
Content Summary: Behavioral Psychology, Human Factor Design, use of empathy mapping and customer journey mapping to understand user needs		
Unit Number: 4	**Research Planning**	No. of hours: 6
Content Summary: Detailed approach into the implementation of user research tools through workshops		

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. Observing the User Experience: A Practitioner's Guide to User Research- by Mike Kuniavsky
2. UX Research- by Brad Nunnally and David Farkas

Define Course Outcomes (CO)

COs	Statements
CO1	**Conduct** user research through hands-on training.
CO2	**Define** different user research methodologies ensuring appropriate solution.
CO3	**Evaluate**, learn and apply field experience on user researching through a pre-selected problem.
CO4	**Design** and apply qualitative and qualitative and quantitative tools and techniques in design process.
CO5	**Propose** solutions based on qualitative and quantitative research.

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	A2	P1
C02	C2	A1	P1
CO3	C5	A2	P3

CO4	C4	A3	P4
CO5	C3	A2	P5

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant
1=weakly mapped
  2= moderately mapped
  3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6

CO1	2	3	1	1	-	1
CO2	1	3	2	1	-	-
CO3	1	3	1	1	1	1
CO4	1	3	-	1	1	1
CO5	1	2	-	1	1	1

Relevance of the Syllabus to various indicators

Unit I	Qualitative Research
Local	Addresses the understanding Qualitative research
Regional	Addresses implementation of research methods at regional level
National	Contribution and understanding of Qualitative research at National level
Global	Understanding the implementation of research method project at global level
Employability	Helps in getting opportunities by Qualitative research methods
Entrepreneurship	Helps in establishing the roots of the business research methods
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	Enhancing professional ethics through communication while conducting research methods
Gender	-

Human Values	-
Environment & Sustainability	-
Unit II	Quantitative Research
Local	Addresses the understanding Quantitative research
Regional	Addresses implementation of research methods at regional level
National	Contribution and understanding of Quantitative research at National level
Global	Understanding the implementation of research method project at global level
Employability	Helps in getting opportunities by Quantitative research methods
Entrepreneurship	Helps in establishing the roots of the business research methods
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	Enhancing professional ethics through communication while conducting research methods
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Mental Models
Local	Addresses the understanding of user needs through empathy mapping and customer journey mapping

Regional	Addresses customer needs through empathy mapping at regional level
National	Contribution and understanding of Behavioral Psychology, Human Factor Design at National level
Global	Understanding the Behavioral Psychology, Human Factor Design at global level
Employability	Helps in getting opportunities by understanding different mental models
Entrepreneurship	Helps in establishing the roots of the business through empathy mapping and customer journey mapping
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Research Planning
Local	Addresses understanding of implementation of user research tools through workshops
Regional	Addresses the regional level understanding of user research tools
National	Application of user research tools through workshops at National level
Global	Aligns with global level user research tools
Employability	Develops deeper understanding of user research tools

Entrepreneurship	Helps in building stronger hold in research methods
Skill Development	Develops and enhances skills required for the course
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

Technology in Experience Design

Department:	Department of Computer Science and Engineering		
Course Name: **Technology in Experience Design**	**Course Code**	**L-T-P**	**Credits**
	SEC043	2-0-0	2
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus:

Get to know futuristic technologies and their implementation in design. Able to comprehend technology constraints on design. To Understand technology for digital experience and product ecosystems. Research project in design using latest technology.

UNIT WISE DETAILS

Unit Number: 1	Title: Technology for Experience Design	No. of hours: 9

Content Summary:

Understanding technology for digital experience and product ecosystems – form factors, operating systems, wifi, Bluetooth, sensors and other hardware components.

Unit Number: 2	Title: Technological feasibility & viability	No. of hours: 6

Content Summary:

Understanding technological feasibility and viability. Technology constraints on design.

Unit Number: 3	Title: Futuristic Technologies	No. of hours: 9

Content Summary:

Learning about futuristic technologies and their implementation in design, Wearable medical devices

Unit Number: 4	Futuristic Technologies continued	No. of hours: 6

Content Summary:

Details of Internet of Things, Augmented reality and virtual reality, ATM, KIOSK

Unit Number: 5	Research Project	No. of hours: 45

Content Summary:

Research project on upcoming technologies and defining product ecosystems and constraints of key technologies

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. Emotions, technology and design - Sharon Y. Tettegah
2. Augmented Reality: Principles and Practice - Dieter Schmalstieg
3. Augmented Reality: An emerging technologies guide - Gregory Kipper and Joseph Rampolla

Define Course Outcomes (CO)

COs	Statements
CO1	Define futuristic technologies and their implementation in design.
CO2	Recognize and comprehend technology constraints on design.
CO3	Evaluate and understand technology for digital experience and product ecosystems.
CO4	Analyze and apply insights in design project.
CO5	Design and use the latest technology in any existing or new product ecosystem.

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	A1	P1
C02	C2	A3	P3
CO3	C3	A2	P2
CO4	C3	A2	P1
CO5	C3	A2	P3

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

  1=weakly mapped
  2= moderately mapped

3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	-	1	2	2	3
CO2	-	3	3	1	-	-
CO3	2	-	-	3	2	1
CO4	-	1	-	-	-	2
CO5	1	-	2	1	1	-

Relevance of the Syllabus to various indicators

Unit I	Technology for digital experience
Local	Addresses local understanding of the digital Technology
Regional	Addresses the regional understanding of technology for digital experience
National	Contributes to national product eco system for digital experience
Global	Aligns with global technology for digital experience
Employability	Develops skills required to implement and develop technology for digital experience
Entrepreneurship	Promote Entrepreneurship in innovating various technologies for digital experience
Skill Development	Develops basic knowledge and skills used for digital experience
Professional Ethics	-
Gender	-
Human Values	-

Environment & Sustainability	-
Unit II	**Technological feasibility and viability**
Local	Addresses local understanding of technology feasibility and viability
Regional	Address the technology feasibility and viability at regional level
National	Contributes to national Technological feasibility and viability
Global	Aligns with global trends technological feasibility
Employability	Develops skills used to understand and implement technological feasibility and viability
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills required to understand the fundamental of technological feasibility
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Futuristic Technologies**
Local	Addresses local understanding of the futuristic Technologies
Regional	Addresses to futuristic Technologies at regional level

National	Contributes to national implementation of futuristic Technologies
Global	Aligns with global trends in various technologies
Employability	Develops skills in using and implementing futuristic Technologies
Entrepreneurship	Enhances the Entrepreneurship by developing and innovating the various futuristic Technologies
Skill Development	Develops basic knowledge and skills to understand and implement futuristic Technologies
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Futuristic Technologies Continued**
Local	Addresses local understanding and implementation IoT , AR VR and ATM & KIOSK
Regional	Addresses understanding of IoT , AR VR and ATM & KIOSK at regional Level
National	Implementing the futuristic technologies at national level which includes IoT , AR VR and ATM & KIOSK at regional Level
Global	Aligns with global trends in futuristic technologies
Employability	Develops skills in futuristic technologies
Entrepreneurship	Enhances the Entrepreneurship by developing and innovating the various futuristic Technologies

Skill Development	Develops knowledge and skills in implementing futuristic Technologies which includes IoT , AR VR and ATM & KIOSK at regional Level
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-

LIFE SKILLS FOR PROFESSIONALS-I

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: 6

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: 6

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: 6

Content Summary:

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

Unit Number: 4	Title: Number system	No. of hours: 6

Content Summary:

Factor, LCM & HCF, Simplification, Mixture, Average, Ratio, and Partnership.

Unit Number: 5	Title: Time Management	No. of hours: 6

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© 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	C3	-	-
C02	C2	-	-

CO3	C2	-	P4
CO4	C6	-	-
CO5	C6	-	P5

CO-PO Mapping

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

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

Semester: 4

Introduction to UI Design

Department:	Department of Computer Science and Engineering		
Course Name: **Introduction to UI Design**	**Course Code**	**L-T-P**	**Credits**
	ENSP210	4-0-0	4
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus: Learning UI design guidelines for different platforms and operating systems. Understanding the principles and fundamentals of UI Design. To be able to learn and get hands on Iconography & typography for interface design. To fundamentals of screen design based on design guidelines and Cross platform screen design. To master with the practical training in UI design for digital screens.

UNIT WISE DETAILS

Unit Number: 1	Title: Basic elements of UI Design	No. of hours: 6

Content Summary: Introduction to basic elements of visual design – detailed study of color, color wheel, visual hierarchy, legibility and readability, grid, layout

Unit Number: 2	Title: Typography	No. of hours: 9

Content Summary:

What is typography, Typefaces history and study, Types of fonts - serif
and non-serif, Font anatomy, Importance of Typography in modern age
UI design, Usage of type for print vs digital, Latest Trends in Typography

Unit Number: 3	Title: Iconography	No. of hours: 9

Content Summary:

What is iconography, visualization of icons, industry standards and
specifications for iconography, designing for various form factors,
trends in iconography, User perception about iconography

Unit Number: 4	Introduction to Visual Tools	No. of hours: 6

Content Summary:

Introduction to visual design tools including lab session on elements of visual design
and tools

Unit Number: 5	Project Work	No. of hours: 30

Content Summary:

Project work in tools & elements of visual design

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. Graphic Design The New Basics - Ellen Lupton and Jennifer Cole Phillips
2. The Visual Miscellaneous - David Mc Candless

Define Course Outcomes (CO)

COs	Statements
CO1	**Learning** UI design guidelines for different platforms and operating systems.
CO2	**Understanding** the principles and fundamentals of UI Design.
CO3	**Learn** and get hands experience with iconography & typography for interface design.
CO4	**Learn** fundamentals of screen design based on design guidelines and cross-platform screen design.
CO5	**Translate** ideas and concepts into meaningful interactions through UI.

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
C02	C2	A1	P1
CO3	C3	A2	P3
CO4	C1	A1	P5
CO5	C4	A2	P5

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant
1=weakly mapped
   2= moderately mapped

3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	2	1	2	1	1	-
CO2	3	1	1	1	1	-
CO3	2	1	1	-	2	-
CO4	2	1	2	1	1	-
CO5	1	2	2	1	1	-

Relevance of the Syllabus to various indicators

Unit I	Basic elements of UI design
Local	Addresses the understanding basic elements of Visual design
Regional	Addresses implementation of UI design at regional level
National	Contribution and understanding of User Interface design elements at National level

Global	Understanding the detailed study of color, color wheel, visual hierarchy, legibility and readability, grid, layout at global level
Employability	-
Entrepreneurship	Helps in establishing the visual understanding of design
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Typography
Local	Addresses the understanding of Typefaces history
Regional	Addresses importance of Typography in modern age UI design
National	Contribution and understanding of Typography at National level
Global	Understanding the latest Trends in Typography at global level
Employability	Helps in getting opportunities by deep understanding of UI design elements
Entrepreneurship	Helps in building the core development team
Skill Development	Enhances skills of an individual required in this area

Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Iconography**
Local	Addresses the understanding of iconography, visualization of icons, industry standards and specifications for iconography
Regional	Addresses Iconography designing for various form factors
National	Understanding and creating perception about Iconography at National level
Global	Understanding the trends of Iconography at global level
Employability	Helps in getting opportunities by understanding visualization concepts
Entrepreneurship	Helps in establishing the roots of the business Iconography concepts
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

Unit IV	Introduction to Visual tools
Local	Addresses understanding of visual design tools
Regional	Addresses the regional level understanding of tools used in visual design
National	Application of visual design tools through lab experiments at National level
Global	Aligns with global level visual design tools
Employability	Develops deeper understanding of visual design tools
Entrepreneurship	Helps in building stronger hold on elements of Visual design
Skill Development	Develops and enhances skills required for the course
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

UI Design Lab

Department:	Department of Computer Science and Engineering		
Course Name: **UI Design Lab**	**Course Code** ENSP260	**L-T-P** 0-0-2	**Credits** 1
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus:
Advance UI interface designing. Cross platform interface design and responsive design. UI concept and design guidelines. UI design documentation and design delivery documentation. Understanding how UI/UX work in different sectors together.

UNIT WISE DETAILS		
Unit Number: 1	**Title: UI & Responsive design**	**No. of hours: 3**

Content Summary:

Advance UI design, Creation of cross platform interface design and responsive design

Unit Number: 2	**Title: UI design concept**	**No. of hours: 3**

Content Summary:

UI Concept, design guidelines and tools, Introduction to UI design concept and guidelines and Zeppelin

Unit Number: 3	**Title: UI design documentation**	**No. of hours: 3**

Content Summary:

UI design documentation, the process of UI design documentation and design delivery documentation

Unit Number: 4	Practical Project	No. of hours: 6
Content Summary: Practical Project, Hands on training through Project on interface designing		
*Self-Learning Components: mention 4-5 topics for students in bullet points **Please Note:** **1)Students are supposed to learn the components on self-basis** **2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class** **3) At least 5-10 % syllabus will be asked in end term exams from self-learning components**		
Reference Books: 1. 100 things every designer needs to know about people - Susan Weinschenk 2. Don't make me think - Steve Krug 3. The UX Book - Rex Hartson and Pardha Pyla		

Define Course Outcomes (CO)

COs	Statements
CO1	**Assess** the visual hierarchy, typography, colour schemes, and layout in UI designs to optimize user experience.

CO2	**Formulate** informed judgments and recommendations for improving UI designs based on user feedback.
CO3	**Design** comprehensive UI design strategies that integrate user research, prototyping, and user testing.
CO4	**Design** innovative and visually compelling UI solutions for complex user interfaces.
CO5	**Compile** UI design documentation and design delivery documentation.

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
C02	C4	A2	P4
CO3	C6	A4	P3
CO4	C6	A5	P5
CO5	C4	A2	P1

CO-PO Mapping

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

CO2	2	2	-	2	2	-	-	-	-	-	1	1
CO3	1	1	3	1	3	-	-	-	-	-	-	2
CO4	1	-	3	2	3	-	-	1	-	-	1	1
CO5	1	-	2	2	3	-	-	1	-	-	-	-

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant
1=weakly mapped
  2= moderately mapped
  3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	2	-	2	-	2	1
CO2	2	3	1	-	1	1
CO3	1	3	2	-	1	1
CO4	2	3	2	-	1	-
CO5	1	2	1	-	-	-

Relevance of the Syllabus to various indicators

Unit I	UI & Responsive design
Local	Addresses the understanding advance UI design lab
Regional	Addresses implementation of cross platform interface design
National	Contribution and understanding of responsive design at National level
Global	Understanding the creation of cross platform interface design at global level
Employability	Helps in strong job prospects as UI is base for all digital design
Entrepreneurship	Helps in establishing the understanding of UI & Responsive design
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	UI design concept
Local	Addresses the understanding of UI concept
Regional	Addresses importance design guidelines & tools of UI lab
National	Contribution and understanding of UI design concept

Global	Understanding the Zeppelin concept at global level
Employability	Helps in getting opportunities by deep understanding of hands on experience
Entrepreneurship	Helps in building the core basics
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	UI design documentation
Local	Addresses the understanding of UI design documentation
Regional	Addresses need of documentation at regional level
National	Understanding and creating design delivery documentation
Global	Understanding the process of UI design documentation at global level
Employability	Helps in getting opportunities by building better UI design
Entrepreneurship	-
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-

Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Practical project**
Local	Addresses different projects of UI
Regional	Addresses the regional level understanding by hands on training
National	Application of project at National level
Global	Aligns with global level projects of UI
Employability	Develops deeper understanding of UI
Entrepreneurship	Helps in building stronger hold on interfaces
Skill Development	Develops and enhances skills required for the course
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

COs	Statements
CO1	Learn to generate new web page with HTML CSS.

CO2	Define the methods applying CSS to the HTML web page.
CO3	Exposure to develop a static web page.
CO4	Design website with HTML and CSS
CO5	Evaluate the use od various types of cascading style sheets

Ex. No	Experiment Title	Mapped CO/COs
1	Write a HTML program for the demonstration of Lists. a. Unordered List b. Ordered List c. Definition List d. Nested List	CO1, CO2, CO3, CO4, CO5
2	Write a HTML program for demonstrating Hyperlinks. a. Navigation from one page to another. b. Navigation within the page	CO2
3	Write a HTML program for time-table using tables.	CO4
4	Write a HTML program to develop a static Home Page using frames.	CO3
5	Write a HTML program to develop a static Registration Form.	CO5
6	Write a HTML program to develop a static Login Page	CO1
7	Write a HTML program to develop a static Web Page for Catalog.	CO3
8	Write a HTML program to develop a static Web Page for Shopping Cart.	CO4
9	Write HTML for demonstration of cascading stylesheets. a. Embedded stylesheets. b. External stylesheets. c. Inline styles.	CO5

Information Architecture

Department:	Department of Computer Science and Engineering		
Course Name: **Information Architecture**	**Course Code** SEC044	**L-T-P** 2-0-0	**Credits** 2
Type of Course:	SEC		
Pre-requisite(s), if any:			

Brief Syllabus:

Understanding Information architecture. Tools and techniques of Information architecture. Hands on using excel as a tool for card sorting. Creating IA for different industries. Learning types and structures and structures of IA.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Information Architecture	No. of hours: 3

Content Summary:

What is Information architecture, Structure, hierarchy and types of Information architecture, Principles and steps of Information Architecture

Unit Number: 2	Title: Tools & Techniques of Information Architecture	No. of hours: 6

Content Summary:

Learning affinity mapping, Card sorting, Analysis of Information architecture, Using excel as a tool for card sorting, Activity based.

Unit Number: 3	Title: Tools & Techniques	No. of hours: 6

Content Summary:

Learning affinity mapping, Card sorting, Analysis of Information architecture, Using excel as a tool for card sorting, Activity based.

Unit Number: 4	Project	No. of hours:15

Content Summary:

Project submission implemented with Information architecture on any Industry

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. A Practical Guide to Information Architecture- by Donna Spencer

2. Mental Models: Aligning Design Strategy with Human Behavior - by Indi Young

3. Information Architecture for the World Wide Web: Designing Large- Scale Web Sites – by Peter Morville, Louis Rosenfeld

Define Course Outcomes (CO)

COs	Statements
CO1	**Define** the concept of information architecture.
CO2	**Evaluate** tools and techniques of Information architecture.
CO3	**Perform** hands-on exercises for card sorting.
CO4	**Examine** IA for different digital products.
CO5	**Design** and learn different types and structures of IA.

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

	C5	A2	P4
C02			
CO3	C3	A4	P3
CO4	C4	A3	P3
CO5	C2	A2	P4

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant
1=weakly mapped
2= moderately mapped
3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	-	1	-	1	-
CO2	-	3	1	2	2	1
CO3	1	2	2	1	-	-
CO4	1	2	3	1	2	1
CO5	2	2	3	1	1	-

Relevance of the Syllabus to various indicators

Unit I	Introduction to Information Architecture
Local	Addresses the understanding Information Architecture
Regional	Addresses implementation of structure, hierarchy and types of Information architecture
National	Contribution and understanding of types of Information architecture at National level
Global	Understanding the principles of Information architecture at global level
Employability	Helps in strong job prospects by learning definite skills
Entrepreneurship	Helps in establishing the understanding of Information architecture required in the industry
Skill Development	Enhances skills of an individual required in this area

Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Tools & Techniques of Information Architecture**
Local	Addresses the tools & techniques of Information Architecture
Regional	Addresses importance of learning affinity mapping, Card sorting
National	Contribution and understanding of card sorting techniques
Global	Understanding and Analysing Information architecture techniques at global level
Employability	Helps in getting opportunities by deep understanding of hands on experience
Entrepreneurship	Helps in building the core basics
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

Unit III	Designing Information Architecture for business strategy and exploring gaps
Local	Addresses the understanding of Information Architecture for business strategy
Regional	Addresses need of strategizing at regional level
National	Understanding and creating Information Architecture for enterprise to meet its organizational goals using a tree structure
Global	Understanding the process of making the case using the site mapping and content inventory and audit at global level
Employability	Helps in getting opportunities by building better UI design
Entrepreneurship	-
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Practical project
Local	Addresses different projects of Information Architecture

Regional	Addresses the regional level understanding by hands on training
National	Application of project at National level
Global	Aligns with global level projects of Information Architecture
Employability	Develops deeper understanding of Information Architecture
Entrepreneurship	Helps in building stronger hold on interfaces
Skill Development	Develops and enhances skills required for the course
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

ANALYSIS AND DESIGN OF ALGORITHMS

Department:	Department of Computer Science and Engineering		
Course Name: **Analysis and Design of Algorithms**	**Course Code** **ENCS202**	**L-T-P** 4-0-0	**Credits** 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: 10**

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: 10**

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: 10**

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: 10**

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:

https://onlinecourses.nptel.ac.in/noc19_cs47/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

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.

Define 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
C02	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	-	-	-	-	-	-	2
CO3	-	-	3	-	-	-	-	-	-	-	-	3
CO4	-	-	-	-	2	-	-	-	2	-	-	3
CO5	-	-	-	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	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	
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	
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	
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	-

ANALYSIS AND DESIGN OF ALGORITHMS LAB

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

Proposed Lab Experiments

Defined Course Outcomes

COs	
CO 1	**Analyze** the time and space complexities of algorithms and evaluate their performance
CO 2	**Apply** algorithmic problem-solving strategies to solve complex computational problems
CO 3	**Design** and develop innovative algorithms for solving complex computational problems.
CO 4	**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	To implement Bellman Ford's Algorithm.	CO2
12	To implement Depth First Search and Breadth First Search Algorithm.	CO2
13	To implement Naïve String-matching Algorithm.	CO3
14	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	Compute the transitive closure of a given directed graph using Warshall's algorithm	CO3
18	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

DATABASE MANAGEMENT SYSTEMS

Department:	Department of Computer Science and Engineering		
Course Name: **Database Management System**	Course Code **ENCS204**	L-T-P 4-0-0	Credits 4
Type of Course:	Major		

Pre-requisite(s), if any: **Nil**

Brief Syllabus:

Introduction to database, Database modelling languages, E-R modelling, Transaction Processing, Database security.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction	No. of hours: 12

Content Summary:

Introduction to DBMS: Database system architecture: Data Abstraction, Data Independence, 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.

Unit Number: 2	Title: Relational Query Languages	No. of hours: 8

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, Query optimization algorithms. Open source and Commercial DBMS - MYSQL, ORACLE,

DB2, SQL server. Relational database design: Database anomalies, Domain and data dependency, Armstrong's axioms, Normal forms (1NF,2NF, 3NF, Boyce/Codd Normal, 4NF), Dependency preservation, Lossless design.

Unit Number: 3	Title: Transaction Processing	No. of hours: 12

Content Summary:

Storage strategies: File Organization, Indices, B-tree and B+ trees, hashing, Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, multi-version and optimistic Concurrency Control schemes, Database recovery.

Unit Number: 4	Title: Database Security	No. of hours: 8

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection. Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

*SELF-LEARNING COMPONENTS:

https://onlinecourses.nptel.ac.in/noc22_cs91/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:

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.

Define Course Outcomes (CO)

COs	Statements
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.	
CO 1	**Summarize** the concepts of database objects; enforce integrity constraints on a database using RDBMS.
CO 2	**Use** Structured Query Language (SQL) for database manipulation
CO 3	**Understand** basic database storage structures and access techniques
CO 4	**Analyze** and **implement** transaction processing, concurrency control and database recovery protocols in databases.

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	-

CO-PSO Mapping

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

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	-	-
C02	C2	-	-
CO3	C3	A4	P4
CO4	C5	-	P5

Relevance of the Syllabus to various indicators

Unit I	**Introduction**
Local	Understanding the fundamentals of DBMS can aid in solving local data management challenges.
Regional	Understanding DBMS architecture can be applied to regional projects or research in data management fields.
National	DBMS plays a significant role in various national data management systems and applications.
Global	DBMS is fundamental to global data management practices and technologies.

Employability	Knowledge of DBMS enhances employability in various technical and IT professions.
Entrepreneurship	Knowledge of DBMS can inspire entrepreneurial opportunities in IT-based ventures.
Skill Development	Learning DBMS develops analytical and problem-solving skills for data management tasks.
Professional Ethics	Applying DBMS principles with integrity ensures ethical practices in data handling.
Gender	DBMS education is equally important for individuals of all genders pursuing IT careers.
Human Values	Applying DBMS with ethical considerations contributes to responsible data management.
Environment & Sustainability	-
Unit II	**Relational Query Languages**
Local	Understanding relational query languages can aid in solving local data retrieval challenges.
Regional	Understanding relational query languages can be applied to regional projects or research in data management.
National	Relational query languages are widely used in various national data management systems and applications.
Global	Relational query languages are fundamental to global data retrieval and processing practices.
Employability	Knowledge of relational query languages enhances employability in IT and database-related professions.
Entrepreneurship	Knowledge of relational query languages can inspire entrepreneurial opportunities in IT-based ventures.
Skill Development	Learning relational query languages develops analytical and query optimization skills.

Professional Ethics	Applying relational query languages with integrity ensures ethical data retrieval and manipulation.
Gender	Relational query languages education is equally important for individuals of all genders pursuing IT careers.
Human Values	Applying relational query languages with ethical considerations promotes user privacy and data security.
Environment & Sustainability	-
Unit III	**Transaction Processing**
Local	Understanding transaction processing aids in managing local data operations and concurrency control.
Regional	Understanding transaction processing can be applied to regional data management systems and applications.
National	Transaction processing is crucial for various national data-intensive applications and systems.
Global	Transaction processing is fundamental to global data management and processing practices.
Employability	Knowledge of transaction processing enhances employability in IT and database management professions.
Entrepreneurship	Knowledge of transaction processing can inspire entrepreneurial opportunities in data management ventures.
Skill Development	Learning transaction processing develops skills in data concurrency control and recovery mechanisms.
Professional Ethics	Applying transaction processing with integrity ensures data consistency and reliability.
Gender	Transaction processing education is equally important for individuals of all genders pursuing IT careers.
Human Values	Applying transaction processing with ethical considerations maintains data integrity and security.
Environment & Sustainability	-
Unit IV	**Database Security**

Local	Understanding database security aids in protecting local data from unauthorized access and attacks.
Regional	Understanding database security can be applied to regional data management systems and applications.
National	Database security is essential for safeguarding national data and information systems.
Global	Database security is fundamental to global data protection and privacy practices.
Employability	Knowledge of database security enhances employability in IT security and data protection professions.
Entrepreneurship	Knowledge of database security can inspire entrepreneurial opportunities in cybersecurity ventures.
Skill Development	Learning database security develops skills in access control and intrusion detection.
Professional Ethics	Applying database security with integrity ensures ethical data protection and privacy.
Gender	Database security education is equally important for individuals of all genders pursuing IT security careers.
Human Values	Applying database security with ethical considerations promotes data confidentiality and integrity.
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-
POE/4th IR	-

DATABASE MANAGEMENT SYSTEMS LAB

Department:	Department of Computer Science and Engineering		
Course Name:	**Course Code**	L-T-P	Credits
Database Management System Lab	**ENCS254**	0-0-2	1
Type of Course:	Major		

Proposed Lab Experiments

Defined Course Outcomes

COs	
CO 1	**Acquire** fundamental knowledge of relational database concepts, SQL, and database design principles through hands-on experiments.
CO 2	**Develop** proficiency in writing and executing SQL queries for data manipulation, retrieval, filtering, sorting, and grouping.
CO 3	**Gain** practical experience in implementing advanced SQL concepts such as joins, subqueries, aggregate functions, and constraints for complex data operations.
CO 4	**Demonstrate** the ability to design and normalize database schemas to minimize data redundancy and ensure data integrity.

CO 5	Apply theoretical concepts learned in the course to real-world scenarios, such as database connectivity in application development, indexing for query optimization, and implementing triggers and stored procedures for automation and data management.

Ex. No.	Experiment Title	Mapped CO/COs
1	Introduction to SQL: Write SQL queries to create, modify, and delete tables and understand basic SQL commands.	CO1, CO2
2	Data Manipulation with SQL: Perform various data manipulation operations like insertion, deletion, and updating records.	CO2, CO3
3	Retrieving Data using SELECT: Practice using SELECT statements to retrieve data from single and multiple tables.	CO2, CO3
4	Filtering Data with WHERE: Use the WHERE clause to filter data based on specific conditions.	CO2, CO3
5	Sorting and Grouping Data: Sort and group query results using ORDER BY and GROUP BY clauses.	CO2, CO3
6	Working with Joins: Perform inner, left, right, and full joins on multiple tables.	CO2, CO3
7	Subqueries: Use subqueries to solve complex queries and understand their role in SQL.	CO2, CO3
8	Aggregate Functions: Apply aggregate functions like SUM, AVG, COUNT, MAX, and MIN on data.	CO2, CO3
9	Constraints in SQL: Implement various constraints like NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, and CHECK.	CO2, CO3, CO4
10	Normalization: Normalize a given set of tables to reduce data redundancy and ensure data integrity.	CO4

11	Creating Views: Create and manage views to simplify complex queries and enhance security.	CO2, CO3
12	Indexing: Understand the concept of indexing and create indexes on tables to improve query performance.	CO2, CO3, CO4
13	Triggers: Design and implement triggers to automate certain actions on table events.	CO2, CO3, CO5
14	Stored Procedures: Create stored procedures to execute a set of SQL statements as a single unit.	CO2, CO3, CO5
15	Transactions and Concurrency Control: Implement transactions and handle concurrent access to the database.	CO2, CO3, CO5
16	Data Backup and Recovery: Perform data backup and restore operations to safeguard against data loss.	CO5
17	Database Connectivity: Develop a simple database application using programming languages like Java or Python.	CO5
18	Relational Algebra Operations: Perform relational algebra operations like Union, Intersection, and Difference.	CO2, CO3
19	Nested Relational Model: Practice querying and manipulation on nested relational data.	CO2, CO3
20	Entity-Relationship Diagrams (ERD): Design an ERD to represent the database schema for a given scenario.	CO4
21	Index Selection and Tuning: Analyze query performance and select appropriate indexes for optimization.	CO2, CO3, CO4
22	Schema Evolution: Modify the database schema to incorporate changes in requirements.	CO4
23	Triggers for Auditing: Implement triggers for auditing purposes to track changes in data.	CO5

24	Data Replication: Set up and test database replication for data redundancy and fault tolerance.	CO5
25	Distributed Databases: Understand distributed databases and perform data distribution and integration exercises.	CO5

1. **Introduction to SQL** Exercise: Write SQL queries to create a simple database schema for a library management system. Project: Design and implement a relational database for an online shopping platform.

2. **Data Manipulation with SQL** Exercise: Perform insertion, deletion, and update operations on sample data in a given database. Project: Create a student registration system and write SQL queries to manage student data.

3. **Retrieving Data using SELECT** Exercise: Write SELECT queries to retrieve specific fields from a table and explore data filtering. Project: Develop a database for a hotel and use SELECT queries to extract room availability and pricing details.

4. **Filtering Data with WHERE** Exercise: Practice using the WHERE clause to filter data based on specific conditions (e.g., age, date). Project: Create a database for a movie rental service and use WHERE to retrieve movies of a particular genre.

5. **Sorting and Grouping Data** Exercise: Use ORDER BY to sort query results and GROUP BY to group data based on a common attribute. Project: Develop a database for an inventory system and use sorting and grouping to analyze product sales.

6. **Working with Joins** Exercise: Perform different types of joins to combine data from multiple related tables. Project: Create a database for an e-commerce website and use joins to fetch customer orders with product details.

7. **Subqueries** Exercise: Use subqueries to find specific data from complex queries in a given database. Project: Develop a database for a school and use subqueries to determine students' grades in a subject.

8. **Aggregate Functions** Exercise: Apply aggregate functions (e.g., SUM, AVG, COUNT) to analyze data in a table. Project: Create a database for a

financial institution and use aggregate functions to calculate account balances.

9. **Constraints in SQL** Exercise: Implement various constraints (e.g., PRIMARY KEY, FOREIGN KEY) on table attributes. Project: Design a database for a customer management system and apply constraints to ensure data integrity.

10. **Normalization** Exercise: Normalize a set of sample tables to third normal form (3NF) to minimize data redundancy. Project: Create a database for a music streaming platform and ensure proper normalization of the schema.

11. **Creating Views** Exercise: Create views to simplify complex queries and restrict access to certain data. Project: Develop a database for a medical clinic and use views to provide a simplified patient information dashboard.

12. **Indexing** Exercise: Add indexes to specific attributes of a table to enhance query performance. Project: Design a database for an online book store and optimize query response time with appropriate indexing.

13. **Triggers** Exercise: Design triggers to enforce data integrity rules and automate actions on data changes. Project: Create a database for a reservation system and implement triggers for automatic seat allocation.

14. **Stored Procedures** Exercise: Write and execute stored procedures to perform specific tasks in a database. Project: Develop a database for a university and use stored procedures to calculate student GPA.

15. **Transactions and Concurrency Control** Exercise: Implement transactions and handle concurrent access to maintain data consistency. Project: Design a database for a banking system and implement transaction management for fund transfers.

16. **Data Backup and Recovery** Exercise: Perform data backup and restoration operations to safeguard against data loss. Project: Create a database for an HR management system and implement regular data backups.

17. **Database Connectivity** Exercise: Develop a simple database application using JDBC or any appropriate ORM tool. Project: Build a database-backed web application for an online shopping platform using Django or Flask.

18. **Relational Algebra Operations** Exercise: Practice relational algebra operations like Union, Intersection, and Difference. Project: Create a

database for a movie database and perform relational algebra to find common movies between actors.

19. **Nested Relational Model** Exercise: Query and manipulate nested relational data in a given database. Project: Design a database for a social networking platform and explore nested data structures for user profiles.

20. **Entity-Relationship Diagrams (ERD)** Exercise: Draw an ERD for a given database scenario with appropriate relationships. Project: Model a database for a real estate agency and create an ERD to represent property listings and client interactions.

21. **Index Selection and Tuning** Exercise: Analyze query performance and select appropriate indexes for optimization. Project: Optimize a database for an e-commerce platform and improve query speed using appropriate indexing techniques.

22. **Schema Evolution** Exercise: Modify the database schema to incorporate changes in requirements. Project: Extend a database for a customer relationship management system and handle schema evolution for new features.

23. **Triggers for Auditing** Exercise: Design triggers for auditing purposes to track changes in data. Project: Implement auditing features in a database for an employee attendance system using triggers.

24. **Data Replication** Exercise: Set up data replication for fault tolerance and redundancy in a distributed database. Project: Implement data replication for a hospital management system to ensure data availability across multiple servers.

25. **Distributed Databases** Exercise: Understand distributed databases and perform data distribution and integration exercises. Project: Design and implement a distributed database for a geographically dispersed organization with multiple locations.

LIFE SKILLS FOR PROFESSIONALS-II

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: 6

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: 6

Content Summary: Time & Work, Time & Distance, Train, Boat & Stream, Permutation & combination, Probability

Unit Number: 3	Title: Arithmetic	No. of hours: 6

Content Summary: Inequalities, Log, progression, Mensuration, BODMAS

Unit Number: 4	Title: Presentation Skills	No. of hours: 6

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: 6

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 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** 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© 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	-	-
C02	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

Semester: 5

THEORY OF COMPUTATION

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: NA

Brief Syllabus:

This course provides a formal connection between algorithmic problem solving and the theory of languages and automata and develops 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: 10

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: 10

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© 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	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	-	-	-	-	-	-	-	-	-	3
CO2	2	2		-	-	-	-	-	-	-	-	3
CO3	2	3	3	3	-	-	3	-	-	-	-	2
CO4	3	3	3	3	-	-	3	3	3	-	-	2
CO5	1	-	-	2	3	-	1	-	-	-	-	3
CO6	-	-	-	-	-	3	-	-	-	-	-	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	1
CO2	3	2	2	2
CO3	3	3	2	2
CO4	2	3	2	3

CO5	3	3	2	3
CO6	2	1	-	-

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.

OPERATING SYSTEMS

Department:	Department of Computer Science and Engineering		
Course Name: **OPERATING SYSTEMS**	**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:

The 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: 10

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: 10

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.

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. 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©	Affective levels(A0	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	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

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	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.

OPERATING SYSTEM LAB

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

Proposed Lab Experiments

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 Experiments

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

Design Thinking

Department:	Department of Computer Science and Engineering		
Course Name: **Design Thinking**	**Course Code** ENSP315	**L-T-P** 4-0-0	**Credits** 4
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus:

Get to know what design thinking and wicked problem is. To learn to generate new ideas. To grasp the methods of the design thinking 5d process. To comprehend and effectively use the tools and techniques to solve wicked problems. To apprehend the application of design thinking with case studies.

UNIT WISE DETAILS

Unit Number: 1	Title: **Introduction to Design Thinking**	No. of hours: 6

Content Summary:

Learning the meaning of design thinking and how it has evolved to solve wicked problems around the world, four pillars of wicked problems

Unit Number: 2	Title: **Design Philosophies**	No. of hours: 12

Content Summary:

What is User Centered Design? User-Centered Design Process, UCD is an Iterative Process, UCD Considers the Whole User Experience, Investment in UCD Pays off, Benefits of UCD and UX, UCD Waterfall process map

Unit Number: 3	Title: Case Studies in Design Thinking	No. of hours: 9

Content Summary:

Getting to know the real-world applications and success stories of different industries

Unit Number: 4	Design Framework	No. of hours: 15

Content Summary:

AARRR framework, Customer Experience Index (CX Index), Google's HEART framework, Social Impact Metrics, IDEO, Standford

Unit Number: 5	Project	No. of hours: 18

Content Summary:

Project on Design thinking

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. Gamestorming: A Playbook for Innovators, Rulebreakers, and Changemakers- by Dave Gray, Sunni Brown, James Macanufo
2. Sprint- Jake Knapp

3. Change by Design - Tim Brown

Define Course Outcomes (CO)

COs	Statements
CO1	Learn to generate new ideas.
CO2	Define the methods of the design thinking 5D process.
CO3	Exposure to the tools and techniques of solving wicked problems.
CO4	Design and apply the method of design thinking with case studies.
CO5	Evaluate and explore what design thinking and wicked problems are.

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	C3	A1	P1

	C3	A2	P1
C02			
CO3	C2	A2	P2
CO4	C3	A3	P3
CO5	C3	A1	P2

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	-	-	2	2	3
CO2	-	3	3	-	-	-

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

Relevance of the Syllabus to various indicators

Unit I	**Introduction to Design Thinking**
Local	Addresses local understanding of the Design thinking and its impact on society
Regional	Addresses to solve the wicked problems of society
National	Contributes to national solution to the wicked problems around the world
Global	Aligns with global trends in Design Thinking
Employability	Develops skills in using solving the problems using the four pillar of the wicked problems
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills Design thinking
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Design Philosophies**
Local	Addresses local understanding of the Design philosophy
Regional	-

National	Contributes to national Design literacy
Global	Aligns with global trends in Design philosophy
Employability	Develops skills in using design process followed by designers
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills Design philosophy
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Case Studies in Design Thinking**
Local	Addresses local understanding of the Design thinking and its impact on society
Regional	Addresses to solve the wicked problems of society
National	Contributes to national solution to the wicked problems around the world
Global	Aligns with global trends in Design Thinking
Employability	Develops skills in using solving the problems using the four pillar of the wicked problems
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills Design thinking

Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Design Framework**
Local	Addresses local understanding and implementation of AARRR framework, CX Index and Google's HEART framework
Regional	-
National	-
Global	Aligns with global trends in framework
Employability	Develops skills in designing framework
Entrepreneurship	-
Skill Development	Develops knowledge and skills in implementing various framework
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-

Design Thinking Lab

Department:	Department of Computer Science and Engineering		
Course Name:	**Course Code**	**L-T-P**	**Credits**
Design Thinking Lab	ENSP365	0-0-2	1
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus:
Deep dive into complex wicked problems to solve them through strategies. To be able to understand the various ways in which innovative products can be built, To be able to follow the 5d process from scratch. Understanding in the way of business advantages.

UNIT WISE DETAILS

Unit Number: 1	Title: Advance Tools in Design Thinking	No. of hours: 3

Content Summary:
Learning tools like value proposition mapping and canvas, Feature mapping and ROI mapping

Unit Number: 2	Title: Business Advantage of Design Thinking	No. of hours: 3

Content Summary:
Case studies and aspects of design thinking on business of various sectors, Design Management, Product lockdown

Unit Number: 3	Title: Practicising Product lockdown	No. of hours: 3
Content Summary: UI design documentation, design delivery documentation		
Unit Number: 4	**Strategic Design Thinking**	**No. of hours: 6**
Content Summary: Project based: Strategic Product design (prototypes) and making wearable devices with UX in it		

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. Design Thinking Workshop: The 12 Indispensable Elements for a Design Thinking Workshop- by Pauline Tonhauser

2. Sprint- by Jake Knapp

COs	Statements
CO1	Learn to generate new ideas.
CO2	Define the methods of the design thinking 5D process.
CO3	Exposure to the tools and techniques of solving wicked problems.
CO4	Design and apply the method of design thinking with case studies.
CO5	Evaluate and explore what design thinking and wicked problems are.

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	C3	A1	P1
C02	C3	A2	P1
CO3	C2	A2	P2
CO4	C3	A3	P3
CO5	C3	A1	P2

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

1=weakly mapped

2= moderately mapped

3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	-	-	2	2	3
CO2	-	3	3	-	-	-
CO3	2	-	-	3	1	1
CO4	-	1	-	-	-	2
CO5	-	-	2	1	-	-

Relevance of the Syllabus to various indicators

Unit I	**Advance Tools in Design Thinking**
Local	Addresses local understanding of the Design thinking Tools and its impact on society

Regional	Addresses to the advance tools in Design Thinking
National	Contributes to national advancement in design thinking tools
Global	Aligns with global trends in Design Thinking Tools
Employability	Develops skills in using solving the problems using Advance tools in design thinking
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills Design thinking
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Business Advantage of Design Thinking**
Local	Addresses local business advantage of Design thinking
Regional	Addresses regional business advantage of Design thinking
National	Contributes to national business advantage of Design thinking
Global	Aligns with global trends of Design thinking with business perspective
Employability	Develops skills in using design process followed by designers
Entrepreneurship	-

Skill Development	Develops basic knowledge and skills Design Thinking
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Practicing Product lockdown**
Local	Addresses local practicing of product lockdown
Regional	Addresses regional practicing of Design documentation
National	Contributes to national practicing of product lockdown
Global	Aligns with global trends design documentation
Employability	Develops skills in practicing design documentation in product lockdown
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills in design documentation
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Strategic Design Thinking**

Local	Addresses local understanding of strategic design thinking
Regional	Addresses regional understanding of making wearable devices
National	Addresses national understanding of making wearable devices
Global	Aligns with global trends in strategic design thinking
Employability	Develops skills in making wearable devices
Entrepreneurship	-
Skill Development	Develops knowledge and skills in implementing Strategic design thinking
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-

Introduction to Interaction Design

Department:	Department of Computer Science and Engineering		
Course Name:	Course Code	L-T-P	Credits
	SEC045	2-0-0	2

Introduction to Interaction Design			
Type of Course:	SEC		

Pre-requisite(s), if any:

Brief Syllabus:

Learning the Importance and scope of Interaction design, User centered design. Design of interactive products Methods of interaction design Tools for interaction design. Get to know futuristic technologies and their implementation in design.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Interaction Design	No. of hours: 3
Content Summary: Understanding scope and history of interaction in design, case studies		
Unit Number: 2	Title: User Centered Design	No. of hours: 6
Content Summary: What is User Centered Design? User-Centered Design Process, UCD is an Iterative Process, UCD Considers the Whole User Experience, Investment in UCD Pays off, Benefits of UCD and UX, UCD Waterfall process map		
Unit Number: 3	Title: Design of Interactive products	No. of hours: 6

Content Summary:		
Ergonomics (Physical, cognitive and organizational)		

Unit Number: 4	**Methods of Interaction Design**	**No. of hours: 3**

Content Summary:		
Learning the different methods which includes tools and techniques of interaction design, Understanding micro-interactions		

Unit Number: 5	**Project**	**No. of hours: 12**

Content Summary:

Project on Ergonomics

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. About Face 3: The Essentials of Interaction Design- by Robert Reimann,Alan Cooper, David Cronin (Author)

2. Designing Interactions (The MIT Press)- by Bill Moggridge

Define Course Outcomes (CO)

COs	Statements
CO1	**Recognize** the importance and scope of Interaction design, not just for user interfaces, but also for physical products.
CO2	**Explain** the relationship between principles of input and feedback.
CO3	**Demonstrate** proficiency in using relevant software tools and technologies to develop interactive designs.
CO4	**Critically** evaluate the strengths and weaknesses of different user interfaces based on interaction design.
CO5	**Apply** the principles of interaction design to create prototypes and wireframes for digital interfaces.

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	A1	P1
C02	C4	A2	P1
CO3	C1	A2	P3
CO4	C4	A5	P4
CO5	C3	A4	P5

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant
1=weakly mapped
  2= moderately mapped
  3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	-	2	1	2	-
CO2	1	1	1	-	1	1
CO3	1	3	-	-	1	1
CO4	1	3	2	-	1	-
CO5	2	2	1	-	2	1

Relevance of the Syllabus to various indicators

Unit I	Introduction to Interaction design
Local	Addresses the understanding of Interaction design
Regional	Addresses implementation of Interaction design at regional level
National	Contribution and understanding of scope and history of interaction in design at National level
Global	Understanding the detailed history of Interaction design at global level
Employability	-
Entrepreneurship	Helps in establishing the understanding of Interface design
Skill Development	Enhances skills of an individual required in this area

Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	User centered design
Local	Addresses the understanding of User-Centered Design Process
Regional	Addresses importance of UCD as an Iterative Process
National	Contribution and understanding of UCD as Whole User Experience at National level
Global	Understanding the benefits of UCD and UX at global level
Employability	Helps in getting opportunities by deep understanding of Interaction design
Entrepreneurship	Helps in building the core development team
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Design of Interactive products

Local	Addresses the understanding of Interactive products
Regional	Addresses Ergonomics (Physical, cognitive and organizational)
National	Understanding and creating Interfaces at National level
Global	Understanding the role of Ergonomics at global level
Employability	Helps in getting opportunities by building better products
Entrepreneurship	Helps in establishing good ergonomically products
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Methods of Interaction Design
Local	Addresses different methods of Interaction design
Regional	Addresses the regional level understanding of tools and techniques of interaction design
National	Application of Micro interactions at National level
Global	Aligns with global level Interaction design tools
Employability	Develops deeper understanding of Interaction design tools
Entrepreneurship	Helps in building stronger hold on micro interactions

Skill Development	Develops and enhances skills required for the course
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

Usability Testing

Department:	Department of Computer Science and Engineering		
Course Name: **Usability Testing**	**Course Code** ENSP317	**L-T-P** 4-0-0	**Credits** 4
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus:
Learn the process of conducting usability tests Learning steps for digital products. Learning Preparations for usability testing Understanding Usability testing methodologies. To able to Conduct the Usability testing and document it

UNIT WISE DETAILS

Unit Number: 1	Title: Process of Usability Testing	No. of hours: 6

Content Summary:

What is Usability testing, Types of testing, Learning the steps to test different types of products/service/methods- planning, executing, information gathering and documentation, case studies

Unit Number: 2	Title: Usability testing for Digital products	No. of hours: 6

Content Summary:

Learn how to create questionnaires, test cases and test moderation. Preparing for the testing of products, Understanding people's psychology and Behavior

Unit Number: 3	Title: Tools & Techniques of Usability Testing	No. of hours: 9

Content Summary:

Usability testing methodologies – task based user testing, A/B testing, lab based user testing, remote user testing, moderated & un-moderated user testing

Unit Number: 4	Project Work	No. of hours: 39

Content Summary:

Project work on Usability Testing- students will pick up a real-life digital application and conduct end- to-end usability testing on the product and submit a report for evaluation.

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests - by Jeffrey Rubin, Dana Chisnell ,

2. The complete guide to user testing websites, apps, and prototypes- User testing free ebook

Define Course Outcomes (CO)

COs	Statements
CO1	Define and analyze and critique the design of interactive products
CO2	Recognize understand the concept of micro-interactions in detail products
CO3	Define what the procedure for analysing findings from a usability test
CO4	Interpret and implement various tools and techniques of Usability testing
CO5	Design and execute the process to conduct end-to-end usability testing on real life digital products

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	C3	A1	P1
C02	C3	A2	P3
CO3	C2	A3	P2
CO4	C1	A1	P3

CO5	C3	A2	P3

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	2	2	1	2	3
CO2	1	3	3	2	1	-
CO3	2	-	1	3	-	1
CO4	-	2	-	-	2	2
CO5	2	1	2	1	1	2

Relevance of the Syllabus to various indicators

Unit I	**Introduction to micro-interactions**
Local	Addresses invoking of emotions by four triggers of micro interactions
Regional	Addresses invoking of emotions by four triggers of micro interactions at regional level
National	Contributes to invoking of emotions by four triggers of micro interactions
Global	Aligns with four triggers of micro interactions for invoking emotions
Employability	-
Entrepreneurship	-
Skill Development	Develops basic skill to invoke emotions
Professional Ethics	-
Gender	-
Human Values	Enhances human values to express emotions
Environment & Sustainability	-
Unit II	**Rapid prototyping techniques**
Local	Addresses local understanding to use the tools of rapid prototyping
Regional	Address the regional understanding of usage of tools and techniques of rapid prototyping
National	-
Global	Aligns with global trends of rapid prototyping

Employability	Develops skills used to understand and use tools and techniques of rapid prototyping
Entrepreneurship	To enhance the entrepreneurship by innovating various tools of rapid prototyping techniques
Skill Development	Develops basic knowledge and skills required to develop Tools and methods of rapid prototyping for idea generation Crazy 8, Scamper, 6 thinking hat
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Multi-Screen Interaction design**
Local	Addresses local use multi screen interaction design
Regional	Addresses to service design case studies at regional level like health care
National	Contributes to national level service design case designs
Global	Aligns with global trends service designs
Employability	Develops skills in multi screen Interaction design
Entrepreneurship	Enhances the Entrepreneurship by giving job opportunity to talents who have the skill of Multi screen interaction design
Skill Development	Develops basic knowledge and skillset for service design case studies like health care /ATM
Professional Ethics	-

Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Designing for futuristic technologies**
Local	Addresses local understanding of Designing for futuristic technologies
Regional	Addresses understanding regional level about gesture control
National	Implementing the designing interactions for futuristic technologies
Global	Aligns with global trends in designing for futuristic technologies
Employability	Develops skills in projects based on sound/voice and gesture control
Entrepreneurship	Enhances the Entrepreneurship by developing skills on gesture control
Skill Development	Develops knowledge and skills in designing futuristic technologies
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-

Unit V	**Emotional Design**
Local	Addresses local understanding of emotional design
Regional	Addresses understanding of emotional design at reginal level
National	Implementing the emotional case study at national level
Global	Aligns with global trends in Emotional Design
Employability	-
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	Determines the various emotion of various people in the society and help them in healing and sharing their emotions
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-

LIFE SKILLS FOR PROFESSIONALS-III

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: 6

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

Unit Number: 2	Title: Logical Reasoning	No. of hours: 6

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

Unit Number: 3	Title: Logical & Non-verbal reasoning	No. of hours: 6

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

Unit Number: 4	Title: Understanding Stress	No. of hours: 6

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: 6

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©	Affective levels(A)	Psychomotor levels(P)
	1. Knowledge	1. Receiving	1. Imitation
	2. Understand	2. Responding	2. Manipulation
	3. Apply	3. Valuing	3. Precision
	4. Analyze	4. Organizing	4. Articulation
	5. Evaluate	5. Characterizing	5. Improving
	6. Create		

CO1	C2	-	-
C02	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

SOFTWARE ENGINEERING

Department:	Department of Computer Science and Engineering		
Course Name: Software Engineering	Course Code	L–T–P	Credits
	ENCS305	4-0-0	4
Type of Course:	Major		
Pre-requisite(s), if any:			

Brief Syllabus:

Importance of Software Engineering, Software Development Lifecycle and its models, Agile vs. Plan Based development, Development of Software Documents, Version Control system using GitHub and Eclipse IDE, Requirements Engineering technique, Development of UML Diagrams, Software Architecture and Design patterns, Software Testing- Black Box and White Box, Developing Test cases using Equivalence and Boundary value partitioning techniques, Test Driven Development with Junit in Eclipse, Software Refactoring.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Software Engineering	No. of hours: 10

Content Summary:

Importance of Software Engineering, Discipline of Software Engineering; Eclipse Introduction, Overview, and Demo; Lifecycle models: Requirements Engineering, Design and Implementation, Maintenance, Software Process Model Introduction, Waterfall Process, Spiral Process, Evolutionary Prototyping Process, Agile Process, Choosing a Model, Lifecycle Documents.

Unit Number: 2	Title: Engineering Requirements	No. of hours: 10

Content Summary:

Requirements Engineering: General RE Definition, Functional and Non-functional Requirements, User and System Requirements, Modelling Requirements, Analyzing Requirements, Requirements Prioritization, Requirements Engineering Process and steps; Creating SRS and performing requirements inspections. Engineering standards in building, testing, operation and maintenance of the computer and software systems. Requirements analysis using DFD, ER Diagrams, Requirement documentation, Nature of SRS, Characteristics & organization of SRS.

Unit Number: 3	Title: Software Metrics and UML	No. of hours: 10

Content Summary:

Software Metrics: Size Metrics like LOC, Token Count, Function Count, Design Metrics, Data Structure Metrics, Information Flow Metrics. Cost Estimation Models: COCOMO, COCOMO-II.

Object Orientation Introduction, UML Structural Diagrams: Class Diagrams, Component Diagram, UML Structural Diagram: Deployment Diagram. UML creation tips; UML Behavioural Diagram: Use Case, Use Case Diagram: Creation Tips, UML Behavioural Diagrams: Sequence, UML Behavioural Diagrams: State Transition Diagram. UML creation tips; Software Architecture: What is Software Architecture? Advantages and use of architectural models. Architectural patterns. Designing architectural patterns. Design Patterns: Patterns Catalogue, Pattern Format, Factory Method Pattern, Strategy Pattern, Choosing a Pattern, Negative Design Patterns.

Unit Number: 4	Title: Software Testing and Maintenance	No. of hours: 10

Content Summary:

Testing: Black Box Testing Failure, Fault and Error, Verification Approaches, Pros and Cons of Approaches, Testing Introduction, Testing Granularity Levels, Alpha and Beta Testing, Black-Box Testing, Systematic Functional Testing Approach; Test Data Selection, Equivalence Partitioning and Boundary Value Analysis, Create and Evaluate Test Case Specifications, Generate Test Cases from Test Case Specifications. White-Box Testing: Coverage Criteria Intro, Statement Coverage, Control Flow Graphs, Test Criteria, MC/DC Coverage.

Software Maintenance: Management of Maintenance, Maintenance Process, Maintenance Models, Regression Testing, Reverse Engineering, Software Re-engineering.

*SELF-LEARNING COMPONENTS:

https://onlinecourses.nptel.ac.in/noc20_cs68/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:

a) R. Pressman, Software Engineering A Practitioner's Approach (8 ed.), McGraw Hill International, 2019. ISBN 978-1259253157.

b) Sommerville, Software Engineering (10 ed.), Person Publications Publishing Company, 2017. ISBN 978-9332582699.

c) K. K. Aggarwal & Yogesh Singh, "Software Engineering", New Age International.

d) W.S. Jawadekar, "Software Engineering – Principles and Practices", McGraw Hill.

Define Course Outcomes (CO)

COs	Statements
CO1	Demonstrate understanding of Software Engineering as an iterative and systematic process.
CO2	Recall the lifecycle models of software engineering.

CO3	Design the software development process to complement technical understanding of software products.
CO4	Analyze requirements using modeling techniques such as DFD and ER diagrams.
CO5	Generate test case specifications and test cases from given 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	C2	A2	P2
CO2	C1	A1	P3
CO3	C4	A4	P4
CO4	C5	A4	P5
CO5	C6	A5	P5

CO-PO Mapping

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

Relevance of the Syllabus to various indicators

Unit I	Introduction to Software Engineering
Local	Can help students understand the local software industry and its specific challenges.
Regional	Can provide insights into the regional software development practices and challenges.
National	Address the broader context of software engineering within a country, including its impact on the economy and society

Global	Explore the global nature of software development and its impact on various industries and sectors worldwide.
Employability	Provide students with a foundational understanding of software engineering concepts and practices, which are valuable skills in the job market.
Entrepreneurship	Provide insights into the software industry, its challenges, and potential opportunities for innovation and business ventures.
Skill Development	Introduce fundamental concepts and techniques used in software engineering.
Professional Ethics	Consideration of ethical issues in software development, such as privacy, security, and responsible use of technology.
Gender	-
Human Values	Impact of software on individuals, societies, and ethical considerations related to human well-being.
Environment & Sustainability	-
Unit II	**Engineering Requirements**
Local	Help in assessing the complexity and quality of software developed within the local context.
Regional	Provide insights into the software development practices and trends within a specific region.
National	contribute to evaluating software quality and productivity within a country's software industry.

Global	Provide standardized measures for assessing software complexity and quality, regardless of the geographical location.
Employability	Commonly used in software development organizations to measure productivity, quality, and project estimation.
Entrepreneurship	Evaluating the feasibility, cost estimation, and risks associated with software development projects.
Skill Development	By enhancing the ability to measure, analyze, and improve software quality and productivity.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Software Metrics and UML**
Local	Standardized techniques can be employed by local software development teams.
Regional	Provide a common language and methodology for software development, facilitating collaboration and communication among regional software development teams.
National	Provide a standardized framework for software development, promoting consistency and interoperability among national software projects.
Global	Widely adopted internationally, allowing for effective communication and collaboration among software development teams across different countries.
Employability	Commonly used in industry, and proficiency in these techniques is valued by employers.
Entrepreneurship	Aiding entrepreneurs in planning, designing, and communicating their software ideas.

Skill Development	Enhancing students' proficiency in software modeling and design.
Professional Ethics	Address the importance of developing reliable software and adhering to quality standards in the software engineering profession.
Gender	-
Human Values	-
Environment & Sustainability	Development of reliable software that reduces wastage, energy consumption, and potential negative environmental impacts.
Unit IV	**Software Testing and Maintenance**
Local	Provide practical knowledge and techniques for testing software developed within the local context.
Regional	Address common testing challenges and practices in software development within the region.
National	Provide essential knowledge and skills required for testing software developed within the country.
Global	Testing is an integral part of software development across different countries and industries worldwide.
Employability	As software testing skills are in high demand by employers seeking quality assurance in software development projects.
Entrepreneurship	Provide knowledge and techniques for ensuring the quality and reliability of software products developed by entrepreneurs.
Skill Development	Introduce essential concepts, methodologies, and tools used in software testing.
Professional Ethics	Addressing ethical considerations in software testing, such as ensuring impartiality, confidentiality, and integrity in the testing process.
Gender	-

Human Values	-
Environment & Sustainability	-
SDG	SDG 4,8,9
NEP 2020	-
POE/4th IR	Emphasizes the responsible and ethical development and deployment of the systems.

Semester: 6

COMPUTER ORGANIZATION & ARCHITECTURE

Department:	Department of Computer Science and Engineering		
Course Name: **Computer Organization & Architecture**	**Course Code**	**L–T–P**	**Credits**
	ENCS302	3-1-0	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

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.

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/

Textbook:

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) 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
CO5	C4	A2	P3

CO-PO Mapping

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

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.

COMPUTER NETWORKS

Department:	Department of Computer Science and Engineering		
Course Name: **Computer Networks**	**Course Code** ENCS304	**L–T–P** 4-0-0	**Credits** 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: 10

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: 10

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: 10

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: 10

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)

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 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©	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	C1	-	-
C02	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	3	-	-	2	-	-	-	-	-	1	3
CO2	-	2	3	-	2	-	-	-	-	-	2	3
CO3	-	3	2	3	1	-	-	-	-	-	2	3
CO4	-	1	2	3	2	-	-	-	-	-	1	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	2	-	-	-
CO2	3	2	-	-
CO3	2	-	2	-
CO4	1	1	-	-
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	

COMPUTER NETWORKS LAB

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

Proposed Lab Experiments

Defined Course Outcomes

COs	
CO 1	**Understand** the fundamental concepts of computer networks, including network devices, IP addressing, VLANs, and routing protocols, through hands-on experimentation and network configuration.
CO 2	**Develop** practical skills in setting up and configuring computer networks, including wired and wireless networks, and troubleshoot basic connectivity issues using network commands and tools.
CO 3	**Acquire** proficiency in configuring advanced network features such as VLANs, inter-VLAN routing, static routing, and Network Address Translation (NAT) to design complex network architectures.
CO 4	**Design** and **implement** error detection and correction mechanisms using Hamming Codes and CRC for 7/8 bits ASCII codes to ensure data integrity over a network.

Ex. No	Experiment Title	Mapped CO/COs
1	Create a simple network with multiple PCs, switches, and routers.	CO 1
2	Assign IP addresses to devices and configure basic connectivity.	CO 1, CO 2
3	Test connectivity between PCs using ping and trace routes.	CO 2
4	Configure VLANs on switches and assign ports to specific VLANs.	CO 2, CO 3
5	Enable inter-VLAN routing using a router or Layer 3 switch.	CO 3
6	Test connectivity between PCs in different VLANs.	CO 3
7	Set up a network with multiple routers.	CO 1, CO 3
8	Configure static routes on routers to enable communication between networks.	CO 3, CO 4
9	Verify routing tables and test connectivity between networks.	CO 4
10	Set up a network with a private IP address space.	CO 4
11	Configure NAT on a router to enable translation between private and public IP addresses.	CO 4
12	Test connectivity between devices on the private network and the Internet.	CO 4
13	Create a wireless network using access points and wireless clients.	CO 1, CO 2
14	Simulate network issues such as connectivity problems, routing errors, or misconfigurations.	CO 2, CO 3
15	Design and implement a network traffic monitoring.	CO 3

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.	CO 1
17	Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes.	CO 4
18	Write a program for error detection and correction for 7/8 bits ASCII codes using CRC.	CO 4
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.	CO 4
20	Design and deploy TCP based Multithreaded HTTP client server for accessing student activity data in the institute.	CO 3, CO 4
21	Design and deploy TCP based Multithreaded FTP client server to share institute level notices.	CO 3, CO 4
22	Design and deploy TCP based Multithreaded Chat client server for your class.	CO 3, CO 4
23	Design and deploy UDP based Multithreaded Chat client server for your class.	CO 3, CO 4
24	Examining real-world network deployments.	CO 3, CO 4
25	Case studies of network failures and their resolutions.	CO 2, CO 3, CO 4

Web Development with HTML/CSS/Java Script/Python

Department:	Department of Computer Science and Engineering		
Course Name: Web Development with HTML/CSS/Java Script/Python	Course Code	L-T-P	Credits
		4-0-0	4
Type of Course:	Major		

Pre-requisite(s), if any: Basic computer skills and familiarity with HTML and CSS are recommended pre-requisites for this syllabus.

Brief Syllabus:

The syllabus for "Web Designing Using HTML, CSS, JavaScript, and PHP" covers the essential elements of web design and development. It starts with an introduction to HTML, teaching students about the structure of HTML documents, tags, and text formatting. CSS is then introduced, covering selectors, styling text and backgrounds, and working with colors and fonts.The course progresses to JavaScript, where students learn about variables, data types, conditional statements, loops, functions, and events. They also gain knowledge of DOM manipulation, allowing them to interact with HTML elements dynamically.The next unit focuses on PHP, teaching students server-side scripting. They learn about PHP syntax, variables, handling forms and user input, working with files and directories, and integrating databases using MySQL.The final unit involves a web design project. Students plan and design a website, implementing their skills in HTML, CSS, JavaScript, and PHP. They learn about integrating front-end and back-end development, testing, debugging, and deploying the project to a hosting server.Overall, this syllabus equips students with the necessary skills to create visually appealing and interactive websites using HTML, CSS, JavaScript, and PHP.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to HTML (HyperTextMarkup Language) and CSS	No. of hours: 4
Content Summary:		
Introduction to HTML (Hypertext Markup Language), Basic structure of HTML documents HTML tags and elements ,Text formatting and links ,Images, Introduction to CSS (Cascading Style Sheets), Internal, External and Embedded CSS, selectors Styling text and backgrounds Working with colors and fonts.		
Unit Number: 2	Title: Advanced HTML and CSS	No. of hours: 8
Content Summary:		
HTML forms and input elements ,HTML tables, CSS layout techniques ,Box model and positioning Responsive design principles ,CSS transitions and animations ,Working with media (images, audio, and video).		
Unit Number: 3	Title: JavaScript Fundamentals	No. of hours: 8

Content Summary:
Introduction to JavaScript, JavaScript variables and data types, Java operators, Conditional statements and loops ,JS Functions and events ,JavaScript Arrays, DOM , Data Validation using JS, Accessing and modifying HTML elements.

Unit Number: 4	Title: Dynamic Web Development with PHP	No. of hours: 8

Content Summary:
Introduction to server-side scripting ,PHP syntax and variables ,PHP data types, Working with forms and user input ,Handling files and directories ,Working with databases (MySQL) ,Database connections and queries ,Inserting, updating, and retrieving data.

Unit Number: 5	Title: Web Design Project	No. of hours: 8

Content Summary:
Planning and designing a web project, Implementing the project using HTML, CSS, JavaScript, and PHP, Integrating front-end and back-end development ,Testing and debugging ,Deploying the web project to a hosting server.

*Self-Learning Components:
1. **Codecademy Web Development Skill Path: https://www.codecademy.com/learn/paths/web-development**
2. **FreeCodeCamp Responsive Web Design Certification: https://www.freecodecamp.org/learn/responsive-web-design/**
3. **Codecademy Web Development Skill Path: https://www.codecademy.com/learn/paths/web-development**
4. **FreeCodeCamp Responsive Web Design Certification: https://www.freecodecamp.org/learn/responsive-web-design/**

Reference Books:
1. **JavaScript and JQuery: Interactive Front-End Web Development" by Jon Duckett**
2.

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand: Demonstrate** a clear understanding of the fundamental concepts and principles of web designing using HTML, CSS, JavaScript, and PHP.
CO2	**Express**: Express ideas and concepts effectively through the implementation of HTML, CSS, JavaScript, and PHP in web design projects.
CO3	**Determine** Determine appropriate strategies and techniques to solve web design problems using HTML, CSS, JavaScript, and PHP.

CO4	**Identify**: Identify and analyze the different components and elements required for effective web design, including HTML structure, CSS styles, JavaScript functions, and PHP scripts.
CO5	**Articulate**: Articulate the purpose, functionality, and interaction of various web design elements, including HTML tags, CSS selectors, JavaScript events, and PHP database operations.
CO6	**Design**: Design and develop visually appealing and responsive web pages using HTML, CSS, JavaScript, and PHP, considering user experience and accessibility.

COsMapping 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
C02	C3	A3	P2
CO3	C3	A3	P3
CO4	C4	A2	-
CO5	C5	A3	P5
CO6	C6	A4	-

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

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	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 HTML (HyperTextMarkup Language) and CSS
Local	The syllabus's relevance to the local context can be seen in the application of HTML, CSS, JavaScript, and PHP to create websites that cater to the needs and preferences of the local community.
Regional	The regional relevance lies in the ability to design websites that reflect the cultural, linguistic, and regional characteristics of the target audience.
National	The syllabus aligns with national objectives by equipping students with the skills to contribute to the digital

	economy and participate in the development of the national web ecosystem.
Global	The global relevance is evident as web designing using HTML, CSS, JavaScript, and PHP is a globally recognized skill set that can be applied to create websites and web applications for a global audience.
Employability	The syllabus enhances employability by providing students with practical skills in web designing, which are in high demand in the job market, both locally and globally.
Entrepreneurship	Students can leverage their web designing skills to start their own web design businesses, contributing to the entrepreneurial ecosystem.
Skill Development	The syllabus focuses on developing technical skills in HTML, CSS, JavaScript, and PHP, enhancing students' proficiency in web designing.
Professional Ethics	The syllabus may touch upon ethical considerations such as respecting intellectual property rights, ensuring user privacy, and adhering to professional standards in web design.
Gender	The syllabus is gender-neutral and can be pursued by individuals of all genders, promoting inclusivity in the field of web designing.
Human Values	-
Environment & Sustainability	The syllabus may not directly address environmental aspects, but students can incorporate sustainable design practices, such as optimizing website performance and minimizing resource consumption.
Unit II	**Advanced HTML and CSS**
Local	The syllabus's relevance to the local context can be seen in the application of HTML, CSS to create websites that cater to the needs and preferences of the local community.
Regional	The regional relevance lies in the ability to design websites that reflect the cultural, linguistic, and regional characteristics of the target audience.
National	The syllabus aligns with national objectives by equipping students with the skills to contribute to the digital economy and participate in the development of the national web ecosystem.
Global	The global relevance is evident as web designing using HTML, CSS, JavaScript, and PHP is a globally recognized

	skill set that can be applied to create websites and web applications for a global audience.
Employability	The syllabus enhances employability by providing students with practical skills in web designing, which are in high demand in the job market, both locally and globally.
Entrepreneurship	Students can leverage their web designing skills to start their own web design businesses, contributing to the entrepreneurial ecosystem.
Skill Development	The syllabus focuses on developing technical skills in HTML, CSS, JavaScript, and PHP, enhancing students' proficiency in web designing.
Professional Ethics	The syllabus may touch upon ethical considerations such as respecting intellectual property rights, ensuring user privacy, and adhering to professional standards in web design.
Gender	-
Human Values	-
Environment &Sustainability	The syllabus may not directly address environmental aspects, but students can incorporate sustainable design practices, such as optimizing website performance and minimizing resource consumption.
Unit III	**JavaScript Fundamentals**
Local	The syllabus's relevance to the local context can be seen in the application JavaScript to create websites that cater to the needs and preferences of the local community.
Regional	The regional relevance lies in the ability to design websites that reflect the cultural, linguistic, and regional characteristics of the target audience.
National	The syllabus aligns with national objectives by equipping students with the skills to contribute to the digital economy and participate in the development of the national web ecosystem.
Global	The global relevance is evident as web designing using HTML, CSS, JavaScript, and PHP is a globally recognized skill set that can be applied to create websites and web applications for a global audience.
Employability	The syllabus enhances employability by providing students with practical skills in web designing, which are in high demand in the job market, both locally and globally.

Entrepreneurship	Students can leverage their web designing skills to start their own web design businesses, contributing to the entrepreneurial ecosystem.
Skill Development	The syllabus focuses on developing technical skills in HTML, CSS, JavaScript, and PHP, enhancing students' proficiency in web designing.
Professional Ethics	The syllabus may touch upon ethical considerations such as respecting intellectual property rights, ensuring user privacy, and adhering to professional standards in web design.
Gender	-
Human Values	-
Environment & Sustainability	The syllabus may not directly address environmental aspects, but students can incorporate sustainable design practices, such as optimizing website performance and minimizing resource consumption.
Unit IV	**Dynamic Web Development with PHP**
Local	The syllabus's relevance to the local context can be seen in the application of PHP to create websites that cater to the needs and preferences of the local community
Regional	The regional relevance lies in the ability to design websites that reflect the cultural, linguistic, and regional characteristics of the target audience.
National	The syllabus aligns with national objectives by equipping students with the skills to contribute to the digital economy and participate in the development of the national web ecosystem.
Global	The global relevance is evident as web designing using HTML, CSS, JavaScript, and PHP is a globally recognized skill set that can be applied to create websites and web applications for a global audience.
Employability	The syllabus enhances employability by providing students with practical skills in web designing, which are in high demand in the job market, both locally and globally.
Entrepreneurship	Students can leverage their web designing skills to start their own web design businesses, contributing to the entrepreneurial ecosystem.
Skill Development	The syllabus focuses on developing technical skills in HTML, CSS, JavaScript, and PHP, enhancing students' proficiency in web designing.
Professional Ethics	The syllabus may touch upon ethical considerations such as respecting intellectual property rights, ensuring user

	privacy, and adhering to professional standards in web design.
Gender	-
Human Values	-
Environment & Sustainability	The syllabus may not directly address environmental aspects, but students can incorporate sustainable design practices, such as optimizing website performance and minimizing resource consumption.
SDG	SDG 4
NEP 2020	-
POE/4th IR	Aligns with the concepts of internet telephony, multimedia applications, and SEO
Unit V	**Web Design Project**
Local	The syllabus's relevance to the local context can be seen in the application of HTML, CSS, JavaScript, and PHP to create websites that cater to the needs and preferences of the local community.
Regional	The regional relevance lies in the ability to design websites that reflect the cultural, linguistic, and regional characteristics of the target audience.
National	The syllabus aligns with national objectives by equipping students with the skills to contribute to the digital economy and participate in the development of the national web ecosystem.
Global	The global relevance is evident as web designing using HTML, CSS, JavaScript, and PHP is a globally recognized skill set that can be applied to create websites and web applications for a global audience.
Employability	The syllabus enhances employability by providing students with practical skills in web designing, which are in high demand in the job market, both locally and globally.
Entrepreneurship	Students can leverage their web designing skills to start their own web design businesses, contributing to the entrepreneurial ecosystem.
Skill Development	The syllabus focuses on developing technical skills in HTML, CSS, JavaScript, and PHP, enhancing students' proficiency in web designing.
Professional Ethics	The syllabus may touch upon ethical considerations such as respecting intellectual property rights, ensuring user privacy, and adhering to professional standards in web design.

Gender	
Human Values	
Environment & Sustainability	

Web Development Lab

Department:	Department of Computer Science and Engineering		
Course Name: Web Development Lab	Course Code	L-T-P	Credits
	ENCS358	4-0-0	4
Type of Course:	Major		
Pre-requisite(s), if any: Basic computer skills and familiarity with HTML and CSS are recommended pre-requisites for this syllabus.			

Proposed Lab Experiments

Defined Course Outcomes

COs	Proficiency in HTML, CSS, JavaScript, and PHP.
CO 1	Ability to Design and Implement Interactive Web Elements.
CO 2	Problem-solving and Critical Thinking Skills.
CO 3	Application of Web Development Concepts
CO 4	Effective Collaboration and Communication Skills.

Ex. No	Experiment Title	Mapped CO/COs
1	Creating a Basic HTML Page: Learn to create a simple HTML page with headings, paragraphs, and basic elements.	CO 2
2	CSS styling sheets: Create a web page to differentiate the use of internal, external and Embedded Styling sheets.	CO 1
3	Styling with CSS: Apply CSS styles to enhance the appearance of HTML elements, such as fonts, colors, and backgrounds.	CO 1
4	Designing a Web Page: Working with Frames.	CO 1
5	Designing a Web Page: Working with Images and Hyperlinks.	CO 1, CO 3
6	Create HTML table: Create a Table using HTML and CSS properties like border, outline, and margin.	CO 1, CO 3
7	Create Lists: Create a webpage using lists in HTML and CSS properties.	CO 1, CO 3

8	Responsive Web Design: Design a responsive webpage that adjusts its layout based on different screen sizes using media queries.	CO 1, CO 3
9	Image Gallery: Develop an image gallery using HTML and CSS, with features like thumbnails and light box effects.	CO 1
10	Create Form: Design a form in a web page using HTML & CSS properties.	CO 1, CO 3
11	Form Validation: Use JavaScript to validate form inputs, such as required fields, email format, and password strength.	CO 1, CO 3
12	Implementing data types, variables, expression, and operator in JavaScript.	CO 1, CO 3
13	Use of conditional statements & looping statements in Java Script.	CO 1
14	Write a JavaScript Program to check whether the given positive number is a multiple of 3.	CO 1, CO 3
15	JavaScript Operators: Write a JavaScript program to calculate multiplication and division of two numbers.	CO 3,CO 4
16	JavaScript Arrays: Write a JavaScript program to compute the sum of elements of given array of integers.	CO 3,CO 4
17	Dropdown Menus: Design dropdown menus using HTML, CSS, and JavaScript to provide a hierarchical navigation structure.	CO 1, CO 3
18	Introduction to PHP: Learn the basics of PHP and create a simple PHP script to display dynamic content on a webpage.	CO 3,CO 4
19	Database Connectivity: Connect PHP with a MySQL database to retrieve and display data on a webpage.	CO 3,CO 4
20	User Registration and Login System: Implement a user registration and login system using PHP and MySQL.	CO 3,CO 4
21	Addition Operations: Perform addition operations using PHP and MySQL to manage database records.	CO 3,CO 4
22	Retrieve/View Operations: Perform Retrieve/View Operations using PHP and MySQL to manage database records.	CO 1, CO 3
23	Delete Operation: Perform delete operations using PHP and MySQL to manage database records.	CO 3,CO 4
24	Update Operation: Perform update operations using PHP and MySQL to manage database records.	CO 3,CO 4
25	Content Management System (CMS): Build a simple CMS using PHP and MySQL to manage website content dynamically.	CO 3,CO 4
26	Website Deployment: Learn how to deploy a web project on a server, configure domain and hosting settings, and make the website live on the internet.	CO 3,CO 4

K.R. MANGALAM UNIVERSITY

Visual design Tools Lab

Department:	Department of Computer Science and Engineering		
Course Name: **Visual Design Tools Lab**	**Course Code** ENSP368	**L-T-P** 2-0-0	**Credits** 2
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus:
Be able to Design vector artwork. Able to prepare graphics for web and print. To implement useful keyboard shortcuts. Learn illustrator the way a professional would use it. Practice everything you learn during the course.

UNIT WISE DETAILS

Unit Number: 1	Title: Photoshop	No. of hours: 3

Content Summary:

Photoshop – Interface & Workspace, Modifying workspace, tools and layers, blending options

Unit Number: 2	Title: Photoshop continued	No. of hours: 3

Content Summary:

Photoshop – layer effect filters, Image editing and enhancing, mixing, layer masking, External Plug-ins

Unit Number: 3	Title: Illustrator	No. of hours: 3
Content Summary: Illustrator - Interface & Workspace, Modifying workspace, tools and layers, blending options		
Unit Number: 4	**Illustrator Continued**	No. of hours: 3
Content Summary: Illustrator – working with vectors, object libraries, layer effect filters, Image editing and enhancing, mixing, layer masking, drawing, External Plug-ins		
Unit Number: 5	Title: Project	No. of hours: 18
Content Summary: Lab work on visual design tools, Project on visual design tools		

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. The Adobe Photoshop CC Book for Digital Photographers - Scott Kelby
2. Adobe Illustrator CC Classroom in a Book (2017 release) - Brian Wood
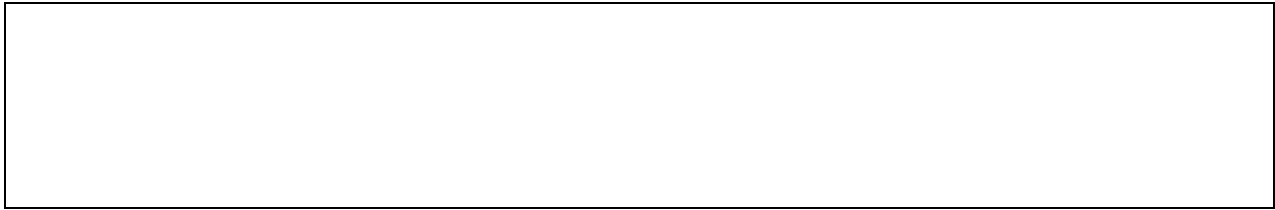
Define Course Outcomes (CO)

COs	Statements
CO1	**Define** and be able to design vector artwork.
CO2	**Examine** and be able to prepare graphics for web and print.
CO3	**Evaluate** and implement useful keyboard shortcuts.
CO4	**Learn** Adobe Illustrator the way a professional would use it.
CO5	**Sketch** and practice everything you learn during the course.

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
C02	C2	A2	P1
CO3	C5	A2	P3
CO4	C1	A1	P3
CO5	C6	A3	P5

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	2	2	2	-	2	-
CO2	2	2	2	-	1	-
CO3	3	2	2	2	2	1
CO4	3	3	2	1	1	-
CO5	2	2	2	1	1	-

Relevance of the Syllabus to various indicators

Unit I	Photoshop
Local	Addresses the understanding of the software
Regional	Addresses working of the software at regional level

National	Contribution and understanding of Photoshop at National level
Global	Understanding the usage of software at global level
Employability	Helps in getting opportunities by enhancing skills
Entrepreneurship	Helps in establishing the roots of the business through learning of software tools
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Photoshop continued
Local	Addresses understanding of Photoshop at advance level
Regional	Addresses the regional level understanding of Photoshop and tools
National	Application of software at National level
Global	Aligns with global level usage of Photoshop
Employability	Develops deeper understanding of the working of the tools
Entrepreneurship	Helps in building stronger hold for Photoshop
Skill Development	Develops and enhances skills required for the course

Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Illustrator
Local	Addresses the understanding of the software
Regional	Addresses working of the software at regional level
National	Contribution and understanding of Illustrator at National level
Global	Understanding the usage of software at global level
Employability	Helps in getting opportunities by enhancing skills
Entrepreneurship	Helps in establishing the roots of the business through learning of software tools
Skill Development	Enhances skills of an individual required in this area
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Illustrator continued
Local	Addresses understanding of Illustrator at advance level

Regional	Addresses the regional level understanding of Illustrator and tools
National	Application of software at National level
Global	Aligns with global level usage of Illustrator
Employability	Develops deeper understanding of the working of the tools
Entrepreneurship	Helps in building stronger hold for Illustrator
Skill Development	Develops and enhances skills required for the course
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-

Defined Course Outcomes

| COs 1 | To be able to master tools of illustration, interactions and 3D rendering/animations like Adobe Suite, Blender, Framer etc… |

Ex. No	Experiment Title	Mapped CO/COs
1	Redesign the style guide for headspace(app). Create 3 onboarding screens, a splash screen with a loader and 2 app screens (home page + one screen of your choice) on Figma.	CO1

2	Create a simple logo animation of your application using vector file from Illustrator - Should be under 6 seconds - Use vector to create your logo or photoshop shape layers - Logo should be designed keeping in mind It will be used for application.	CO1
3	Please pick any one of the below references (option 1, option 2 and option 3) and try to replicate all the elements of the selected scene and don't forget to add materials and lighting along with the proper composed camera view as well.	CO1

Department Elective I

Wireframing & Prototyping

Department:	Department of Computer Science and Engineering		
Course Name: **Wireframing & Prototyping**	**Course Code** ENSP318	**L-T-P** 4-0-0	**Credits** 4
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus: Practice to learn the tools required to design wireframes and prototypes. Design wireframes on paper and translate paper concepts into digital wireframes. Understand and practice the techniques involved in designing digital wireframes for UI Platforms. Understand and practice the techniques involved in designing digital wireframes for HMI and other digital screens. Understand and practice the techniques involved in creating digital prototypes. Tools to be taught – AxureRP, invision

UNIT WISE DETAILS

Unit Number: 1	Title: Basic guidelines of Wireframing	No. of hours: 6

Content Summary: Introduction to wireframes, understanding responsive design, primary, secondary and utility navigation, content, inline links, indexes, search

Unit Number: 2	Title: Designing wireframes on paper	No. of hours: 12

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Content Summary:

Header, footer, sidebar, navigation systems, use of whitespace, web fonts and typography

Unit Number: 3	Title: Designing wireframes on Axure/Invision	No. of hours: 12

Content Summary:

Creating visual mockups, whitespace to style a form, scrolling, introduction to clickable prototypes, introduction to Axure and Invision, importing and exporting assets, creating hotspots

Unit Number: 4	Designing digital wireframes for different UI platforms	No. of hours: 12

Content Summary:

Practical hands-on demonstration of paper-based wireframes and clickable prototypes using digital tools

Unit Number: 5	Practice & Project based	No. of hours: 18

Content Summary:

Designing for Web, Mobile Application, IOS, wearable

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. The Adobe Photoshop CC Book for Digital Photographers- by Scott Kelby

2. Adobe Illustrator CC Classroom in a Book (2017 release)- by Brian Wood

Define Course Outcomes (CO)

COs	Statements
CO1	Define the concepts of Innovation and Creativity
CO2	Recognize the of types of innovation, role of innovators and innovation settings in organizations
CO3	Define what Innovation management and its 4 pillars
CO4	Evaluate and implement innovation as a culture Innovation management tool in different industries
CO5	Design and formulate research study for executing innovation management to diversified businesses for enhancing user experience.

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	P1
C02	C3	A3	P3
CO3	C3	A2	P3
CO4	C2	A1	P2
CO5	C3	A3	P3

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3

- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

1=weakly mapped

2= moderately mapped

3=strongly mapped

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	1	1	2	2	3
CO2	2	3	3	1	1	-
CO3	1	-	1	3	-	1
CO4	-	2	-	-	2	1
CO5	2	-	2	1	1	2

Relevance of the Syllabus to various indicators

Unit I	Basics guidelines of Wireframing and Prototyping
Local	Addresses local understanding and guidelines of wireframing and Prototyping
Regional	-
National	Contributes to basic guidelines of wireframing and Prototyping nation wide
Global	Aligns with global technology of wireframing and Prototyping
Employability	Develops skills required to implement understanding responsive design, primary, secondary and utility navigation, content, inline links etc.
Entrepreneurship	Promote Entrepreneurship by implementing responsive design, primary, secondary and utility navigation, content, inline links and prototyping tools

Skill Development	Develops basic knowledge and skills used prototyping tools
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Designing wireframes on paper**
Local	Addresses local understanding of designing wireframes
Regional	Address the understand of how to design wireframes at regional level
National	-
Global	Aligns with global trends of designing wireframes on paper
Employability	Develops skills used to understand and implement wireframes and prototyping tools
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills required to understand and implement wireframes and prototyping tools
Professional Ethics	-
Gender	-
Human Values	-

Environment & Sustainability	-
Unit III	**Designing wireframes and prototypes on Figma and AdobeXD**
Local	Addresses local use of prototypes on Figma and AdobeXD
Regional	Addresses to design wireframes and using prototyping on Figma and AdobeXD
National	Contributes to national implementation wireframes and prototype
Global	Aligns with global trends of prototype on Figma and AdobeXD
Employability	Develops skills in using Figma and AdobeXD
Entrepreneurship	Enhances the Entrepreneurship by developing use cases by Figma and AdobeXD
Skill Development	Develops basic knowledge and skillset related to Figma and AdobeXD
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	**Designing digital wireframes for different UI platforms**
Local	Addresses local understanding of different UI platforms

Regional	Addresses understanding of different UI platforms at reginal level
National	Implementing the designing of digital wireframes for of different UI platforms
Global	Aligns with global trends in digital designing
Employability	Develops skills in digital designing
Entrepreneurship	Enhances the Entrepreneurship by designing digital wireframes for different UI Platforms
Skill Development	Develops knowledge and skills in designing digital wireframes for different UI Platforms
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-

Department Elective I Lab

Wireframing & Prototyping Lab

Department:	Department of Computer Science and Engineering		
Course Name: **Wireframing & Prototyping Lab** **Department Elective I Lab**	**Course Code**	**L–T–P**	**Credits**
	ENSP370	0-0-2	1
Type of Course:	Minor		
Pre-requisite(s), if any:			

Brief Syllabus:

Advance prototyping, Cross platform interface design and responsive design, concept and design guidelines. Design documentation and design delivery documentation, Understanding how UI/UX work in different sectors together.

UNIT WISE DETAILS

Unit Number: 1	Title: **Advance Prototyping**	No. of hours: 3
Content Summary: Creation of cross platform interface design and responsive design		

Unit Number: 2	Title: Concept, design guidelines & tools	No. of hours: 3

Content Summary:

Introduction to UI design concept and guidelines and Zeplin

Unit Number: 3	Title: Design documentation	No. of hours: 3

Content Summary:

The process of UI design documentation and design delivery documentation

Unit Number: 4	Practical Project	No. of hours: 6

Content Summary:

Hands on training through Project on interface designing

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. HTML5: Discover How To Create HTML 5 Web Pages With Ease (HTML5 CSS3 JavaScript)- by Shay Howe

2. Responsive Web Design with HTML5 and CSS3- by Ben Frain

Define Course Outcomes (CO)

COs	Statements
CO1	Define the concepts of Innovation and Creativity
CO2	Recognize the of types of innovation, role of innovators and innovation settings in organizations
CO3	Define what Innovation management and its 4 pillars
CO4	Evaluate and implement innovation as a culture Innovation management tool in different industries
CO5	Design and formulate research study for executing innovation management to diversified businesses for enhancing user experience.

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	P1
C02	C3	A3	P3

CO3	C3	A2	P3
CO4	C2	A1	P2
CO5	C3	A3	P3

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	1	1	2	2	3
CO2	2	3	3	1	1	-
CO3	1	-	1	3	-	1
CO4	-	2	-	-	2	1
CO5	2	-	2	1	1	2

Relevance of the Syllabus to various indicators

Unit I	**Advance Prototyping**
Local	Addresses local understanding and guidelines of advance Prototyping
Regional	-
National	Contributes to basic guidelines of advance Prototyping nation wide
Global	Aligns with global technology of wireframing and Prototyping
Employability	Develops skills required to implement understanding responsive design, primary, secondary and utility navigation, content, inline links etc.
Entrepreneurship	Promote Entrepreneurship by implementing responsive design and advance prototyping
Skill Development	Develops basic knowledge and skills used in advance prototyping tools
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	**Concept, design guidelines & tools**
Local	Addresses local understanding concept , design guidelines & tools.
Regional	Address the understand of how to conceptualize design and implement it on various tools

National	-
Global	Aligns with global trends of understanding concept , design guidelines & tools.
Employability	Develops skills used to understand guidelines and implement the concept on tools.
Entrepreneurship	-
Skill Development	Develops basic knowledge and skills required to understand and implement various tools related to design
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Design documentation**
Local	Addresses local use of design documentation
Regional	Addresses to design documentation at regional level
National	Contributes to national implementation of design documentation and delivery documentation.
Global	Aligns with global trends of design documentation and delivery documentation
Employability	Develops skills in design documentation and delivery documentation
Entrepreneurship	Enhances the Entrepreneurship by developing use cases of design documentation

Skill Development	Develops basic knowledge and skillset of delivery documentation
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-

Department Elective –I

Metaverse & its Applications

Department:	Department of Computer Science and Engineering		
Course Name: Metaverse & its Applications	Course Code	L-T-P	Credits
	ENSP320	4-0-0	4
Type of Course:	Minor		
Pre-requisite(s), if any:			

Brief Syllabus:
Metaverse is an online learning platform designed to help students learn cutting-edge technologies and develop web-enabled technology skills such as virtual reality, voice recognition, artificial intelligence, and more. It is an open-source learning platform created by the Silicon Valley-based company, Metaverse Technologies.
Metaverse courses provide students with an introduction to various emerging technologies and skills. Students can learn about various topics such as AI machine learning, virtual reality development, and augmented reality development. Through the use of Metaverse courses, students can gain in-depth knowledge about the various technologies and their applications.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Mataverse	No. of hours: 4

Content Summary:
Overview of the Metaverse concept, Evolution and history of the Metaverse, Characteristics and key features of the Metaverse, Comparison between Virtual Reality (VR), Augmented Reality (AR), and the Metaverse, The Metaverse vs. Web 3.0, Advantages and Challenges of the Metaverse, ,Opportunities in the development of Mataverse.

Unit Number: 2	Title: Technologies and Frameworks in the Metaverse	No. of hours: 8

Content Summary:
Types of the Metaverse, Devices to access the metaverse, Extended reality (XR) in the metaverse, Virtual Reality (VR) technologies and devices, Augmented Reality (AR) technologies and devices, Blockchain technology and its role in the Metaverse, Cryptocurrencies and digital assets in the Metaverse, Artificial Intelligence (AI) and Machine Learning (ML) in the Metaverse,

Unit Number: 3	Title: Applications of the Metaverse	No. of hours: 8

Content Summary:
Social interactions and virtual communities in the Metaverse, Gaming and entertainment in the Metaverse, Education and training in the Metaverse, Healthcare and telemedicine in the Metaverse, Business and commerce in the Metaverse, Art, creativity, and digital ownership in the Metaverse.

Unit Number: 4	Title: Building for the Metaverse	No. of hours: 8

Content Summary:
Design principles for Metaverse applications, User experience (UX) and user interface (UI) considerations in the Metaverse, Development frameworks and tools for creating Metaverse applications, Security and privacy considerations in the Metaverse, Future trends and possibilities in the Metaverse.

*Self-Learning Components:
1) Explore existing Metaverse platforms and applications (e.g., Decentraland, Roblox, Fortnite) and analyze their features
2) OpenXR: An open standard for accessing VR and AR devices, WebXR: A framework for creating VR and AR experiences using web technologies
3) Unity3D or Unreal Engine: Game development engines for creating Metaverse experiences
4) Read articles and research papers on the Metaverse and its applications

Reference Books:
- "The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything" by Robert Scoble and Shel Israel
- "Virtual Reality and Augmented Reality: Myths and Realities" by Mel Slater, Anthony Steed, and Yiorgos Chrysanthou
- "Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher
- "The Metaverse: A Scientific Journey through Virtual Reality, Artificial Intelligence, and the Internet of Things" by Angelica Maria Tactay and Thanh Thuy Vo

Reference Links:
- https://opensource.com/article/22/6/open-source-metaverse
- Metaverse 101 : Ultimate Metaverse Course For Beginners | Udemy

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** the concept, evolution, and key features of the Metaverse
CO2	**Identify** the technologies and frameworks used in the Metaverse

CO3	**Analyze** and assess the applications of the Metaverse in various domains
CO4	**Evaluate** the role and impact of different technologies in the Metaverse.
CO5	**Design** and create Metaverse applications by applying appropriate design principles

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	A3	P3
CO4	C4	A3	P3
CO5	C5	A3	P4

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	1	2
CO2	1	2	2	1	2	2	1	2	1	1	1	3
CO3	2	2	3	2	1	2	2	2	2	2	2	2
CO4	2	2	2	3	1	2	2	2	2	2	2	2
CO5	2	2	2	1	3	2	2	2	2	2	2	2

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3

- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

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

Relevance of the Syllabus to various indicators

Unit I	Introduction to Mataverse
Local	-
Regional	-
National	-
Global	The Metaverse has the potential to connect individuals globally, breaking down geographical barriers and enabling collaboration on a global scale.
Employability	-
Entrepreneurship	-
Skill Development	Knowledge related to virtual reality, augmented reality, and emerging technologies.
Professional Ethics	Students will explore ethical considerations related to the Metaverse, such as privacy, security, and responsible use of technology.
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Technologies and Frameworks in the Metaverse
Local	-
Regional	-
National	-

Global	Equips students with the knowledge and skills needed to participate in the global Metaverse ecosystem, facilitating international collaborations and knowledge exchange.
Employability	-
Entrepreneurship	Familiarity with the technologies such as virtual reality, augmented reality, blockchain, and artificial intelligence cultivates entrepreneurial skills by enabling students to identify and leverage technological advancements in the development of Metaverse applications.
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Applications of the Metaverse
Local	Understanding the potential applications of the Metaverse locally can inspire the creation of virtual communities, immersive education platforms, and innovative solutions tailored to local needs.
Regional	-
National	-
Global	Explores global applications of the Metaverse
Employability	Develops skills in network programming and network security techniques
Entrepreneurship	-
Skill Development	Equips students with specialized skills sought after by industries utilizing the Metaverse.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Building for the Metaverse
Local	-
Regional	-
National	-
Global	The ability to build robust and secure Metaverse applications positions students to contribute to the global

	Metaverse ecosystem, collaborating with international teams and organizations.
Employability	-
Entrepreneurship	-
Skill Development	Familiarity with development frameworks and tools specific to the Metaverse equips students with the technical skills required to create immersive and interactive experiences.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4,9
NEP 2020	Introducing students to emerging technologies, fostering interdisciplinary knowledge, and exploring the potential of the Metaverse in transforming education and various sectors.
POE/4th IR	The Metaverse represents a paradigm shift in how humans interact with digital information and environments, making it a key component of the 4th IR.

Department Elective –I Lab

Metaverse & its Applications Lab

Department:	Department of Computer Science and Engineering		
Course Name: Metaverse & its Applications Lab	Course Code	L-T-P	Credits
	ENSP372	4-0-0	4
Type of Course:	Minor		
Pre-requisite(s), if any:			

Proposed Lab Experiments

Defined Course Outcomes

COs	
CO 1	**Demonstrate** knowledge of Metaverse Technologies and Tools
CO 2	**Apply** technical Skills in Virtual and Augmented Reality Development
CO 3	**Analyze** and Evaluate Metaverse Applications
CO 4	**Design** and Create Immersive Experiences in the Metaverse

Ex. No	Experiment Title	Mapped CO/COs
1	Explore popular VR tools and environments such as Unity3D, Unreal Engine, or Google VR SDK.	CO1
2	Set up the development environment and familiarize yourself with the VR interface.	CO2
3	Design and create a simple VR environment using Unity3D or Unreal Engine.	CO2
4	Add objects, textures, and interactive elements to the environment.	CO2
5	Test the VR environment using a compatible VR headset.	CO2
6	Develop a simple VR game using Unity3D or Unreal Engine.	CO2
7	Create a VR simulation for training purposes, such as a virtual laboratory or a virtual driving simulator.	CO2
8	Develop a VR application for educational purposes, such as virtual classrooms, historical reconstructions, or language learning.	CO2

9	Develop an AR application that uses image recognition to overlay virtual content on recognized images.	CO2
10	Design and implement a VR application for therapeutic or rehabilitation purposes, such as phobia treatment or physical therapy.	CO2
11	Develop a web-based telemedicine application that enables remote patient-doctor consultations.	CO2
12	Design and develop a virtual store or marketplace within a 3D environment.	CO2
13	Create an AR game where virtual objects or characters are overlaid on the real-world environment.	CO2
14	Use Unity3D to create a VR environment, incorporating 3D models, textures, and interactive elements. Test the VR experience using Google Cardboard or other compatible VR headsets.	CO2
15	Develop an AR application using Unity3D and Vuforia. Use Vuforia's image recognition capabilities to overlay virtual content on recognized images or markers. Test the application on a mobile device with a camera.	CO4
16	Develop a simple blockchain-based application for the Metaverse using Ethereum and Solidity. Implement smart contracts to manage digital assets or ownership within the virtual environment.	CO4
17	Train an AI model using TensorFlow to recognize and classify objects within an AR or VR environment. Use the trained model to create interactive experiences or intelligent behaviors within the Metaverse.	CO2
18	Build an AR application focused on educational content. Develop interactive experiences that provide supplementary information or simulations related to specific subjects.	CO3
19	Create an AR simulation that incorporates physics-based interactions between virtual objects and the real world.	CO3
20	Implement an AR application that tracks and applies virtual effects or filters to the user's face in real-time. Use facial tracking libraries such as ARKit or ARCore to accomplish this.	CO4

21	Use open-source design tools like Figma or Sketch to create mockups and wireframes for a Metaverse application.	CO4
22	Use open-source security tools like OWASP ZAP or Burp Suite to perform security assessments and vulnerability scanning on a Metaverse application.	CO4
23	Develop a Metaverse application using an open-source platform like Decentraland or Mozilla Hubs	CO3
24	Conduct user experience testing sessions with participants to gather feedback on the application's usability, navigation, and overall user experience	CO3
25	Analyze the feedback and iterate on the design and functionality of the Metaverse application based on the user input.	CO3

Projects:

1. Virtual Classroom Platform:
Develop a virtual classroom platform in the Metaverse that provides an immersive and interactive learning environment. The platform should support features such as virtual classrooms, live video streaming, interactive whiteboards, and virtual student-teacher interactions.

2. AR-based Language Learning Application:
Create an augmented reality (AR) application for language learning. The application should use AR technology to overlay virtual language lessons, flashcards, and interactive exercises on real-world objects to enhance language learning immersion and engagement.

3. Virtual Art Gallery:
Design and develop a virtual art gallery in the Metaverse. The gallery should allow users to explore and view artwork from various artists, provide information about the pieces, and enable interactions such as virtual tours and social sharing of favorite artworks.

4. VR-based Physical Rehabilitation Application:
Build a virtual reality (VR) application for physical rehabilitation purposes. The application should provide guided exercises, gamified rehabilitation routines, and real-time feedback to assist patients in their recovery process. Incorporate interactive elements and progress tracking to make the experience engaging and motivating.

5. AR-powered Retail Experience:
Create an augmented reality (AR) application for retail that enhances the shopping experience. Develop features such as virtual try-on for clothing or accessories, product visualization in the real-world environment, and

personalized recommendations based on user preferences. The application should aim to provide a seamless and immersive retail experience.

Department Elective I

Introduction to Virtual Reality and Augmented Reality

Department:	Department of Computer Science and Engineering		
Course Name: Introduction to Virtual Reality and Augmented Reality	**Course Code**	**L-T-P**	**Credits**
	ENSP322	4-0-0	4
Type of Course:	Minor		
Pre-requisite(s), if any:			

Brief Syllabus:

To be able to have an understanding on futuristic technologies To be able to practice and implement technologies in new ideas. To be able to implement after understanding different platforms.

UNIT WISE DETAILS

Unit Number: 1	Title: Designing for AR	No. of hours: 15
Content Summary: What is augmented reality, Examples, Case studies on augmented reality, implementing augmented reality in different industry domains		
Unit Number: 2	Title: Designing for VR	No. of hours: 15
Content Summary: What is virtual reality, Examples, Case studies on virtual reality, implementing augmented reality in different industry domains		
Unit Number: 3	Title: Introduction to Internet of Things	No. of hours: 15
Content Summary: What is Internet of things, Examples, Case studies on IOT, Implementing IOT in different industry domains		
Unit Number: 4	**Project**	No. of hours: 15
Content Summary: Project based		

*Self-Learning Components: mention 4-5 topics for students in bullet points
Please Note:
1)Students are supposed to learn the components on self-basis
2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class
3) At least 5-10 % syllabus will be asked in end term exams from self-learning components

Reference Books:
1. Designing for Wearables: Effective UX for Current and Future Devices- by Scott Sullivan (Author)
2. Designing Bots: Creating Conversational Experiences- by Amir Shevat
3. Designing for Emerging Technologies: UX for Genomics, Robotics, and the Internet of Things- by Jonathan Follett

Define Course Outcomes (CO)

COs	Statements
CO1	Define and analyze the concept of augmented and virtual reality in depth with the help of different examples.
CO2	Recognize understand the process of implementing virtual and augmented reality through case studies
CO3	Define and interpret Internet of things (IOT) and its application in different industry domains
CO4	Demonstrate and implement various tools and techniques of Usability testing
CO5	Design and create futuristic technologies solutions for different industries utilizing varied

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	A1	P1
C02	C3	A2	P3
CO3	C2	A3	P2
CO4	C1	A1	P3
CO5	C3	A2	P3

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	2	1	2	1	2	2
CO2	3	3	3	2	1	3

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

Relevance of the Syllabus to various indicators

Unit I	Introduction to AR
Local	Addresses the concept of AR
Regional	Addresses the case studies of AR at regional level
National	Contributes to implementing AR in various industries
Global	Aligns with enhancement and recent developments in AR
Employability	Enhances employability by floating the projects based on oculus
Entrepreneurship	Enhances Entrepreneurship by doing the projects and case studies on AR
Skill Development	Develops basic skill to understand, learn and implement AR
Professional Ethics	-
Gender	-
Human Values	
Environment & Sustainability	-
Unit II	Designing for VR
Local	Addresses the concept of VR
Regional	Addresses the case studies of VR at regional level
National	Contributes to implementing VR in various industries
Global	Aligns with enhancement and recent developments in VR
Employability	Enhances employability by floating the projects based on oculus
Entrepreneurship	Enhances Entrepreneurship by doing the projects and case studies on VR
Skill Development	Develops basic skill to understand, learn and implement VR
Professional Ethics	-
Gender	-
Human Values	-

Environment & Sustainability	-
Unit III	**Introduction to Internet of things (IOT)**
Local	Addresses the concept of IoT
Regional	Addresses the case studies of IoT at regional level
National	Contributes to implementing IoT in various industries
Global	Aligns with enhancement and recent developments in IoT
Employability	Enhances employability by floating the projects based IoT case studies
Entrepreneurship	Enhances Entrepreneurship by doing the projects and case studies on IoT
Skill Development	Develops basic skill to understand, learn and implement IoT
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-

Semester-7

Portfolio Development & Review

Department:	Department of Computer Science and Engineering		
Course Name:	**Course Code**	**L-T-P**	**Credits**
Portfolio Development & Review	SEC046	2-0-0	2
Type of Course:	SEC		

Pre-requisite(s), if any:

Brief Syllabus:

To learn the importance of portfolio and creating a UX Portfolio for career and Internship recruitment. To prepare students for internship and placement recruitments. To boost students' confidence in applying for different roles in UX/UI in different companies. To ensure the right set of information reach the recruiters' to profile about the student, that brings the best out their skills and strengths.

UNIT WISE DETAILS

Unit Number: 1	Title: Designing portfolio & Resume	No. of hours: 6

Content Summary:

What is a Design Portfolio and Resume, its purpose in design industries, types and mediums of portfolio- web-based, slide deck, physical, portals and tools used to create a portfolio, portfolio as a medium of communication, scrutiny of projects into a mini portfolio case study

Unit Number: 2	Title: Creation of Portfolio	No. of hours: 6

Content Summary:

Documenting case studies in a portfolio, application of tools for visual design and interface design, creation of a portfolio, creating a beta version of portfolio and templates, Creating different types of resumes

Unit Number: 3	Title: Product Lifecycle Things	No. of hours: 18

Content Summary:

Building portfolios for different Design/UX roles- User Research, Design Thinking and Strategy, UI Design and Interaction Design, Usability Testing and Heuristic Evaluation, Understanding Roles and responsibilities and appropriate content generation

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. The Graphic Designer's guide to Portfolio Design- by Debbie Ross Myers

2. Infographics: The Power of Storytelling – by Jason Lankow

Define Course Outcomes (CO)

COs	Statements
CO1	Define and analyze the concept of designing the portfolio resume
CO2	Recognize understand the process of creation of portfolio
CO3	Define and interpret product life cycle things
CO4	Demonstrate and implement various tools and techniques of portfolio designing
CO5	Design and create futuristic technologies solutions for designing different portfolio on different design UX/Roles

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	C3	A1	P1
C02	C3	A2	P3
CO3	C2	A3	P2

CO4	C1	A1	P3
CO5	C3	A2	P3

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	2	1	2	1	2	2
CO2	3	3	3	2	1	3
CO3	2	-	1	3	-	1
CO4	-	2	-	-	2	-
CO5	2	1	2	1	1	2

Relevance of the Syllabus to various indicators

Unit I	Designing portfolio & Resume
Local	Addresses the concept of designing portfolio & resume
Regional	Addresses the purpose of designing portfolio in different industries
National	Contributes to implementing the designing portfolio and resume in various industries
Global	Aligns with enhancement and application of tools in visual design and interface design
Employability	Enhances employability by documenting case studies on portfolio designing
Entrepreneurship	Enhances Entrepreneurship by creating beta version of portfolio and template
Skill Development	Develops basic skill to understand , learn and application of tools in visual design and interface design
Professional Ethics	-
Gender	-
Human Values	
Environment & Sustainability	-
Unit II	Creation of Portfolio
Local	Addresses the concept of portfolio creation
Regional	Addresses the creation of portfolio as medium of communication
National	Contributes to implementing the creating portfolio and resume in various industries

Global	Aligns with enhancement and application of tools in visual design and interface design
Employability	Enhances employability by documenting case studies on portfolio creation
Entrepreneurship	Enhances Entrepreneurship by creating beta version of portfolio and template
Skill Development	Develops basic skill to understand , learn the application of tools in visual design and interface design
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Product Lifecycle Things**
Local	Addresses the concept of IoT
Regional	Addresses the case studies of IoT at regional level
National	Contributes to implementing IoT in various industries
Global	Aligns with enhancement and recent developments in IoT
Employability	Enhances employability by floating the projects based IoT case studies
Entrepreneurship	Enhances Entrepreneurship by doing the projects and case studies on IoT
Skill Development	Develops basic skill to understand , learn and implement IoT

Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-

Department Elective - II

UX Design for Futuristic Technologies

Department:	Department of Computer Science and Engineering		
Course Name: UX Design for Futuristic Technologies	Course Code	L-T-P	Credits
	ENSP425	4-0-0	4
Type of Course:	Minor		
Pre-requisite(s), if any:			

Brief Syllabus:

User Experience (UX) Design is the process design use to create products that provide meaningful and relevant experience to users. This involves the design of the entire process of acquiring and integrating the product, including aspects of branding, design, usability, and function. This course is rooted in better understanding users to solve their problems, with as little fuss and as much joy as possible. UX designers spend much of their time speaking to users, learning how they go about their lives, and creating the best possible experience that addresses their problems. The UX/UI Design of the application improves the user experience and customer satisfaction that ultimately helps increase the number of users of the specific application. The UI and UX Design help to win the consumers' confidence and make them use your application or website providing them what they are looking for

You'll learn the foundations of UX design and what distinguishes good from bad UX. You will also explore the UX design process; user research, designing your experience, using your goals and ideas to draw wireframes, and then building usable prototypes.

UNIT WISE DETAILS

Unit Number: 1	Title: Basic elements of UI design	No. of hours: 8

Content Summary:
Introduction to basic elements of visual design – detailed study of color, color wheel, visual hierarchy, legibility and readability, grid, layout

Unit Number: 2	Title: : Design Action Model and Principles of Design In UI	No. of hours: 12

Content Summary: 7 Stage model of action cycle for design tools, Unity, harmony and methods, balance and its types, hierarchy, Scale/proportion, dominance/emphasis, rhythm, similarity and contrast .

Unit Number: 3	Title: Typography & Iconography	No. of hours: 12

Content Summary:
What is typography, Typefaces history and study, Types of fonts - serif and non-serif, Font anatomy, Importance of Typography in modern age UI design, Usage of type for print vs digital, Latest Trends in Typography
What is iconography, visualization of icons, industry standards and specifications for iconography, designing for various form factors, trends in iconography, User perception about iconography

Unit Number: 4	Title: Introduction to Visual Tools	No. of hours: 8
Content Summary: Introduction to visual design tools including lab session on elements of visual design and tools.		
Unit Number: 5 Project work Project work in tools & elements of visual design		
*Self-Learning Components: mention 4-5 topics for students in bullet points **Please Note:** **1)Students are supposed to learn the components on self-basis** **2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class** **3) At least 5-10 % syllabus will be asked in end term exams from self-learning components**		
Reference Books: 1. Graphic Design The New Basics - Ellen Lupton and Jennifer Cole Phillips 2. The Visual Miscellaneous - David Mc Candless		

Define Course Outcomes (CO)

COs	Statements
CO1	Learning UI design guidelines for different platforms and operating systems
CO2	Understanding the principles and fundamentals of UI Design.
CO3	To be able to learn and get hands on Iconography & typography for interface design.
CO4	To fundamentals of screen design based on design guidelines and Cross platform screen design.
CO5	To master with the practical training in UI design for digital screens.

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		P2
CO3	C3		P3
CO4	C1		-
CO5	C1		P1

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need
to mention lower level

CO-PO Mapping

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

	1				1	3	1	1		2

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

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

Introduction to Computer Vision

Department:	Department of Computer Science and Engineering		
Course Name: Introduction to Computer Vision	**Course Code**	**L-T-P**	**Credits**
	ENSP427	4-0-0	4
Type of Course:	Minor		
Pre-requisite(s), if any: -			

Brief Syllabus:

The "Introduction to Computer Vision" course is designed to introduce students to the fundamental concepts and practical applications of computer vision. The course will cover topics related to image processing, camera models, geometric techniques, machine learning, and various computer vision applications. Students will gain hands-on experience through practical exercises and projects, implementing algorithms, and working with real-world datasets using popular computer vision libraries and machine learning frameworks. By the end of the course, students will have a strong foundation in computer vision principles and be able to apply their knowledge to solve real-world visual recognition and understanding problems.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction and Image Processing	No. of hours: 8

Content Summary:

Image Formation, Image Filtering, Edge Detection, Principal Component Analysis, Corner Detection, SIFT, Applications: Large Scale Image Search.

Practical Component:
- Implementing image filtering techniques using Python and OpenCV
- Applying edge detection algorithms to images
- Implementing Principal Component Analysis (PCA) for image compression
- Feature detection and extraction using corner detection and SIFT

Unit Number: 2	Title: Geometric Techniques and Camera Models	No. of hours: 8

Content Summary:

Image Transformations, Camera Projections, Camera Calibration, Depth from Stereo, Two-View Structure from Motion, Object Tracking.

Practical Component:
- Implementing image transformations (e.g., rotation, scaling) using OpenCV
- Camera calibration using chessboard pattern and OpenCV
- Depth estimation from stereo images using disparity mapping
- Object tracking using OpenCV's tracking APIs

Unit Number: 3	Title: Machine Learning for Computer Vision	No. of hours: 6

Content Summary:

Introduction to Machine Learning, Image Classification, Object Detection, Semantic Segmentation.

Practical Component:

- Training and evaluating image classifiers using popular machine learning frameworks (e.g., TensorFlow, PyTorch)
- Implementing object detection algorithms (e.g., Faster R-CNN, SSD)
- Semantic segmentation using deep learning models (e.g., U-Net, FCN)

Unit Number: 4	Title: Lighting, Shape, and Image Motion	No. of hours: 10

Content Summary:

Photometry, Lightness, Shape from Shading, Optical Flow, Introduction to Tracking, Parametric Models, Non-parametric Models, Tracking Considerations.

Practical Component:

- Implementing photometric stereo techniques for shape recovery
- Estimating optical flow using Lucas-Kanade or other methods
- Tracking objects in video sequences using various algorithms
- Implementing shape from shading algorithms for 3D reconstruction

Unit Number: 5	Title: Classification, Recognition, and Useful Methods	No. of hours: 8

Content Summary:

Introduction to Recognition, Classification: Generative Models, Classification: Discriminative Models, Action Recognition, Color Spaces and Segmentation, Binary Morphology, 3D Perception, The Retina, Vision in the Brain.

Practical Component:

- Implementing generative models for classification tasks (e.g., Naive Bayes, Gaussian Mixture Models)
- Training and evaluating discriminative models (e.g., Support Vector Machines, Neural Networks) for image classification.
- Implementing image segmentation algorithms using color spaces and morphological operations
- Simulating visual perception models and understanding their impact on computer vision tasks

*Self-Learning Components:

1. **Image Processing**:
    - Topics: Image formation, image filtering, edge detection, principal component analysis (PCA), corner detection, SIFT.
    - Online Resources:
        - OpenCV documentation and tutorials: https://docs.opencv.org/
        - Digital Image Processing textbook by Rafael C. Gonzalez and Richard E. Woods

- Coursera course: "Image and Video Processing: From Mars to Hollywood with a Stop at the Hospital" by Guillermo Sapiro

2. **Geometric Techniques and Camera Models**:
   - Topics: Image transformations, camera projections, camera calibration, depth from stereo, two-view structure from motion, object tracking.
   - Online Resources:
     - "Multiple View Geometry in Computer Vision" textbook by Richard Hartley and Andrew Zisserman
     - OpenCV documentation on camera calibration and stereo vision
     - YouTube tutorials on camera calibration and 3D reconstruction

3. **Machine Learning for Computer Vision**:
   - Topics: Introduction to machine learning, image classification, object detection, semantic segmentation.
   - Online Resources:
     - Stanford CS231n course on Convolutional Neural Networks for Visual Recognition: http://cs231n.stanford.edu/
     - "Deep Learning" textbook by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
     - PyTorch or TensorFlow official documentation and tutorials

4. **Lighting, Shape, and Image Motion**:
   - Topics: Photometry, lightness, shape from shading, optical flow, object tracking.
   - Online Resources:
     - "Computer Vision: Algorithms and Applications" textbook by Richard Szeliski
     - OpenCV documentation on optical flow and object tracking
     - YouTube tutorials on shape from shading and optical flow estimation

5. **Classification, Recognition, and Useful Methods**:
   - Topics: Introduction to recognition, generative and discriminative models for classification, action recognition, color spaces and segmentation.
   - Online Resources:
     - "Pattern Recognition and Machine Learning" textbook by Christopher M. Bishop
     - CVPR (Conference on Computer Vision and Pattern Recognition) papers on specific topics of interest
     - YouTube tutorials on color spaces, image segmentation, and action recognition

Reference Books:

1. "Computer Vision: Algorithms and Applications" by Richard Szeliski, Springer.
2. "Multiple View Geometry in Computer Vision" by Richard Hartley and Andrew Zisserman, Cambridge University Press.
3. "Digital Image Processing" by Rafael C. Gonzalez and Richard E. Woods, Pearson.
4. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press.
5. "Pattern Recognition and Machine Learning" by Christopher M. Bishop, Springer.

Define Course Outcomes (CO)

COs	Statements
CO1	**Recall** and explain fundamental concepts, principles, and techniques related to computer vision, such as image formation, camera models, and basic image processing methods.
CO2	**Apply** various computer vision algorithms and techniques to solve real-world visual recognition and understanding problems, including object detection, image classification, and image segmentation.
CO3	**Analyze** and evaluate different computer vision approaches, critically assess their strengths and limitations, and make informed decisions about selecting appropriate methods for specific applications.
CO4	**Synthesize** their knowledge of computer vision concepts and techniques to design and implement novel computer vision solutions for complex problems, demonstrating creativity and innovation.
CO5	**Evaluate** the performance and efficiency of computer vision algorithms, compare their results against established benchmarks, and propose improvements or optimizations based on quantitative assessments.

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	-	-	-
C02	C3	-	-
CO3	C4	A4	-
CO4	C4	A4	P4
CO5	C5	A5	P5

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need

to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

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	2	-	-
CO2	2	3	-	-
CO3	2	2	-	-
CO4	1	3	-	-
CO5	2	2	-	-

Relevance of the Syllabus to various indicators

Unit I	Introduction to Programming and Computation
Local	Relevant to local technology and data processing
Regional	Encourages local innovation and problem-solving

National	Contributes to building a strong national workforce in the technology sector by imparting essential computer vision knowledge
Global	Align with global relevance as computer vision is essential components of the global tech industry
Employability	Improved employability prospects in local, regional, national, and even global tech companies.
Entrepreneurship	-
Skill Development	Focuses on developing critical skills such as problem-solving, logical thinking, and algorithm design, which are essential for students' overall skill development.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit II	Python Basics and Control Structures
Local	Relevant to local and image processing
Regional	Relevant to regional and image processing
National	Contributes to building a strong national workforce in the technology sector by imparting essential computer vision knowledge
Global	Align with global relevance as computer vision is essential components of the global tech industry
Employability	Improved employability prospects in local, regional, national, and even global tech companies.
Entrepreneurship	-
Skill Development	Focuses on developing critical skills such as problem-solving, logical thinking, and algorithm design, which are essential for students' overall skill development.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	Data Structures and Abstraction
Local	Knowledge of data structures and abstraction principles is valuable for local businesses handling large datasets.

Regional	Focuses on developing critical skills such as problem-solving, logical thinking, and algorithm design.
National	-
Global	-
Employability	Improved employability prospects in local, regional, national, and even global tech companies.
Entrepreneurship	-
Skill Development	Focuses on developing critical skills such as problem-solving, logical thinking, and algorithm design, which are essential for students' overall skill development.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit IV	Program Development and Efficiency
Local	Knowledge of Program Development and Efficiency is valuable for local industries to optimize their computational resources for improved performance.
Regional	Focuses on developing critical skills such as problem-solving, logical thinking, and algorithm design, which are essential for students' overall skill development.
National	-
Global	-
Employability	Improved employability prospects in local, regional, national, and even global tech companies.
Entrepreneurship	-
Skill Development	Focuses on developing critical skills such as problem-solving, logical thinking, and algorithm design, which are essential for students' overall skill development.
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit V	Program Efficiency and Complexity Analysis
Local	Understanding program efficiency is vital for local industries to optimize their computational resources for improved performance.

Regional	It equips students with skills needed to tackle regional image processing challenges in various domains.
National	It equips students with skills needed to tackle at national image processing challenges in various domains.
Global	It equips students with skills needed to tackle at global image processing challenges in various domains.
Employability	-
Entrepreneurship	-
Skill Development	-
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	Aligns with the UN Sustainable Development Goal 4 (Quality Education) by imparting foundational computer science knowledge to students.
NEP 2020	The syllabus supports the National Education Policy 2020's emphasis on integrating technology and computational thinking in education.
POE/4th IR	The syllabus prepares students for the Fourth Industrial Revolution by providing them with essential programming and computational skills.

Department Elective – II

Graphics Design

Department:	Department of Computer Science and Engineering		
Course Name: Graphics Design	Course Code	L–T–P	Credits
	ENSP429	4-0-0	4

Type of Course:	Minor
Pre-requisite(s), if any:	

Brief Syllabus:

The Graphics Design syllabus provides students with a comprehensive understanding of the fundamental principles and techniques of graphic design. It begins with an introduction to the principles and concepts of graphic design, emphasizing their significance in various industries. Students learn about color theory, typography, and composition, and gain an overview of different graphic design tools and software commonly used in the field. The syllabus then focuses on graphic design software and tools, with a particular emphasis on industry-standard applications like Adobe Photoshop and Illustrator. Students gain proficiency in using these software programs, learning essential tools and techniques for image manipulation, enhancement, and the creation of vector-based designs and illustrations.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Graphics Design	No. of hours: 10

Content Summary:

Introduction to graphics design principles and concepts, Understanding the role of graphic design in various industries, Overview of graphic design tools and software, Fundamentals of color theory and typography, Introduction to layout and composition techniques.

Unit Number: 2	Title: Graphic Design Software and Tools	No. of hours: 10

Content Summary:

Introduction to graphic design software (e.g., Adobe Photoshop, Illustrator), Exploring the user interface and essential tools of graphic design software, Understanding layers, brushes, and other important features, Image manipulation and enhancement techniques, Creating vector-based designs and illustrations.

Unit Number: 3	Title: Design Principles and Techniques	No. of hours: 10

Content Summary:

Exploring advanced color theory and its application in design, Typography principles and advanced text formatting techniques, Creating effective compositions and layouts, Understanding design hierarchy and visual hierarchy, Using grids and guides for design alignment and balance.

Unit Number: 4	Title: Design Projects and Portfolio Development	No. of hours: 10

Content Summary:

Applying design principles and techniques in real-world projects, Creating graphics for digital and print media (e.g., logos, banners, posters), Developing a personal design style and brand identity, Reviewing and providing feedback on design projects, Building a portfolio of completed design works.

*Self-Learning Components:
1. Adobe Illustrator
2. Adobe Photoshop
3. Vector Graphics

Refences:
1. https://learning.adobe.com/certification.html
2. https://www.coursera.org/specializations/graphic-design
3. Online Learning Platforms like Udemy, LinkedIn Learning, and Skillshare offer a variety of graphic design courses that provide completion certificates.

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

Reference Books:
1. Graphic Design: The New Basics, Ellen Lupton and Jennifer Cole Phillips, Princeton Architectural Press
2. The Elements of Graphic Design, Alex W. White, Allworth
3. Adobe Illustrator Classroom in a Book, Brian Wood, Adobe Press
4. Adobe Photoshop Classroom in a Book, Andrew Faulkner and Conrad Chavez, Adobe Press

Online References
1. https://www.youtube.com/watch?v=3S7MaLzoA_E (All videos)
2. https://helpx.adobe.com/creative-cloud/tutorials-explore.html
3. https://www.youtube.com/c/TheFuturAcademy
4. https://edu.gcfglobal.org/en/beginning-graphic-design/?gclid=EAIaIQobChMIkf35uafm_wIVFj6WCh0GWwH1EAAYAiAAEgLNB_D_BwE#

Course Outcomes (CO)

COs	Statements
CO1	**Understand and apply** fundamental principles and concepts of graphic design, including color theory, typography, and composition, to create visually appealing and effective designs.
CO2	**Demonstrate** proficiency in using industry-standard graphic design software and tools, such as Adobe Photoshop and Illustrator, to manipulate images, create illustrations, and design graphics for various media.
CO3	**Apply** advanced design techniques, including the use of grids, guides, and visual hierarchy, to create well-structured and balanced design compositions.

CO4	**Develop** a personal design style and brand identity, showcasing creativity and innovation in design projects, and effectively communicate design ideas through visual elements and typography.
CO5	**Compile** a comprehensive portfolio of completed design works that showcases technical skills, understanding of design principles, and the ability to create professional-quality graphics for both digital and print media.

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	-	-
C02	C3	-	-
CO3	C3	-	-
CO4	C6	-	-
CO5	C5	-	-

CO-PO Mapping

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

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

CO-PSO Mapping

PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3

CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Relevance of the Syllabus to various indicators

Unit I	Introduction to Graphics Design
Local	Provides a foundation in graphics design principles and concepts that can be applied to local design projects and industries, catering to the specific needs and preferences of the local community.
Regional	The knowledge and skills gained from the syllabus can be applied to regional design practices and industries, addressing the design requirements and trends specific to the region.
National	Equips with fundamental graphics design skills that are applicable to the national design industry
Global	The syllabus have global relevance, allowing students to understand and participate in the global design community and contribute to international design projects.
Employability	Focuses on developing essential graphics design skills, enhancing students' employability in the design industry.
Entrepreneurship	Introduces the fundamentals of graphic design, providing them with the necessary knowledge and skills to pursue entrepreneurial ventures in the design field.
Skill Development	Offers opportunities to develop and refine their graphics design skills, including color theory, typography, layout, and composition, enabling them to enhance their design abilities and craftsmanship.
Professional Ethics	Incorporate discussions and considerations of professional ethics in the field of graphics design
Gender	Promote gender inclusivity and equality by encouraging diverse perspectives and representation in design projects, fostering an inclusive and equitable design environment.
Human Values	Incorporate discussions on the impact of graphic design on human values, such as cultural sensitivity, social responsibility, and the ethical use of design to promote positive societal values.

Environment & Sustainability	Integrate principles of sustainable design, highlighting the importance of environmentally conscious design practices, materials, and production processes.
Unit II	Graphic Design Software and Tools
Local	The syllabus familiarizes with industry-standard graphic design software, enabling them to meet the local design industry's software requirements.
Regional	Understanding graphic design software commonly used in the region allows to adapt to regional design practices.
National	Equips with the skills necessary to contribute to the national design industry and stay competitive in the job market.
Global	Knowledge of popular graphic design software provides with a global perspective, allowing them to participate in international design projects.
Employability	Highly valued in the design industry, enhancing employability and opening up job opportunities in various design roles.
Entrepreneurship	Enables to start their own design businesses or work as freelance designers, supporting their entrepreneurial aspirations.
Skill Development	focuses on developing practical skills in using graphic design software.
Professional Ethics	Emphasizing responsible use of graphic design software, respecting intellectual property rights, and ensuring ethical considerations in design projects.
Gender	Encouraging equal access and opportunities for all genders to learn and excel in using graphic design software, fostering a gender-balanced representation in the field.
Human Values	Used to promote human values such as diversity, inclusivity, social justice, and empathy, creating designs that resonate with the target audience.
Environment & Sustainability	Emphasizing the responsible use of resources, reducing environmental impact, and considering sustainability aspects in digital design processes.
Unit III	Design Principles and Techniques
Local	Understanding advanced color theory, typography principles, and design techniques specific to the local context allows to create designs that resonate with the local culture, preferences, and aesthetics.

Regional	Exploring design principles and techniques relevant to the regional design industry enables to adapt their designs to regional design trends and effectively communicate with regional clients.
National	Proficiency in advanced design principles and techniques positions as valuable contributors to the national design industry, promoting innovation and creativity in design projects across the country.
Global	Knowledge of advanced design principles and techniques provides with a global perspective on design
Employability	Advanced design principles and techniques enhances employability, making them desirable candidates for design-related roles in various industries and organizations.
Entrepreneurship	Advanced design principles and techniques empowers to establish their own design businesses, offering unique and innovative design solutions to clients.
Skill Development	Syllabus focuses on developing students' design skills by introducing advanced color theory, typography principles, and layout techniques.
Professional Ethics	Emphasizing ethical considerations in design choices, respecting intellectual property rights, and promoting ethical practices in design projects.
Gender	Fostering a diverse and inclusive design community.
Human Values	Promote human values such as empathy, social justice, and inclusivity, creating designs that positively impact individuals and society.
Environment & Sustainability	Encourages to consider environmental and sustainability aspects in their design choices, promoting responsible and eco-friendly design approaches.
Unit IV	Design Projects and Portfolio Development
Local	Engaging in design projects that cater to the local community's needs and preferences helps to create designs that are relevant and relatable to the local context.
Regional	Designing graphics for regional events, organizations, or businesses allows to contribute to the regional design landscape and showcase their understanding of regional design aesthetics.
National	Personal design style and brand identity enables to contribute to the national design industry
Global	Equips to compete in the global design market and showcase skills to clients and employers worldwide.

Employability	Enhance employability by demonstrating the ability to apply design principles and techniques effectively and showcasing creativity, versatility, and problem-solving skills.
Entrepreneurship	Developing a personal design style and brand identity prepares for entrepreneurial ventures, enabling them to establish own design businesses.
Skill Development	Helps to refine design skills, apply design principles effectively, and gain practical experience in creating graphics for various media.
Professional Ethics	Fostering a culture of constructive criticism, collaboration, and professional growth.
Gender	Ensuring inclusivity and equal recognition of diverse perspectives and voices in the design field.
Human Values	Promote human values such as empathy, cultural sensitivity, and social responsibility, creating designs that positively impact individuals and society.
Environment & Sustainability	Promotes environmental consciousness and responsible design choices, contributing to a more sustainable and eco-friendly design industry.
SDG	SDG4, SDG8, SDG9, SDG12, SDG17
NEP 2020	Digital literacy, Universal Access and Equity, Curriculum and Pedagogy Reforms, Holistic Development, Multidisciplinary and Vocational Education, Professional Development of Teachers.

Department Elective III

Design Thinking for Product Management

Department:	Department of Computer Science and Engineering		
	Course Code	L-T-P	Credits

Course Name: **Design Thinking for Product Management**	ENSP431	4-0-0	4
Type of Course:	Minor		

Pre-requisite(s), if any:

Brief Syllabus:

Understanding the cycle of product design. Be able to find and execute the technology required. Understanding the importance of product management. To be able to execute the cycle of product management.

UNIT WISE DETAILS

Unit Number: 1	**Title: Introduction to Product Lifecycle management**	**No. of hours: 3**

Content Summary:

What is augmented reality, Examples, Case studies on augmented reality, implementing augmented reality in different industry domains

Unit Number: 2	**Title: Product development platform**	**No. of hours: 9**

Content Summary:

PLM, Supply Chain Collaboration, ALM and QMS, Multi-Tenant Cloud-Based, PLM Software, How Arena Provided the All-In-One Product Development

Platform Apical Instruments Needed. Phases of product lifecycle and corresponding technologies.

Unit Number: 3	Title: Product Lifecycle Things	No. of hours: 9

Content Summary:

Rootstock Product Lifecycle Management Integration, Shared Product Information, How the Integration Works,

Unit Number: 4	Project	No. of hours: 39

Content Summary:

Project work on PLM

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

Please Note:

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

2)Mention open-source tools/ new concepts/technologies that students will be required to learn and present through presentations in class

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

Reference Books:

1. A Project Guide to UX Design: For user experience designers in the field or in the making- by Russ Unger, Carolyn Chandler
2. UX Lifecycle- by Val Head
3. Hooked: How to Build Habit-Forming Products- by Nir Eyal

Define Course Outcomes (CO)

COs	Statements
CO1	Define and understand Product Lifecycle and Product Lifecycle Management
CO2	Identify and understand identify the phases of Product lifecycle
CO3	Examine Product life cycle stages, Benefits, areas of PLM
CO4	Understand Phases of product lifecycle and corresponding technologies
CO5	Design the Product Life Cycle using numerous instruments of Product Development Platform

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	C3	A1	P1
C02	C3	A2	P3

CO3	C2	A3	P2
CO4	C3	A1	P3
CO5	C3	A2	P3

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

PO	PO1	PO2	PO3	PSO4	PSO5	PSO6
CO1	3	1	2	1	2	3
CO2	2	3	3	2	1	2
CO3	1	-	1	3	-	1
CO4	-	2	-	-	3	-
CO5	3	1	2	1	1	2

Relevance of the Syllabus to various indicators

Unit I	Introduction to Product Lifecycle management
Local	Addresses the concept of AR
Regional	Addresses the case studies of AR at regional level
National	Contributes to implementing AR in various industries
Global	Aligns with enhancement and recent developments in AR
Employability	Enhances employability by floating the projects based on oculus
Entrepreneurship	Enhances Entrepreneurship by doing the projects and case studies on AR
Skill Development	Develops basic skill to understand , learn and implement AR
Professional Ethics	-
Gender	-
Human Values	
Environment & Sustainability	-
Unit II	Product development platform
Local	Addresses the concept of supply chain collaboration ,ALM & QMS
Regional	Addresses the Phases of product life cycle and corresponding technologies
National	Contributes to implementing product life cycle and corresponding technologies various industries

Global	Aligns with enhancement and recent developments in corresponding technologies of product development platform.
Employability	Enhances employability by offering product development platform
Entrepreneurship	Enhances Entrepreneurship by doing the projects and case studies in corresponding technologies of product development platform.
Skill Development	Develops basic skill to understand, learn and implement product development platform
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
Unit III	**Product Lifecycle Things**
Local	Addresses the concept product lifecycle things
Regional	Addresses the case studies of shared product information
National	Contributes to implementing rootstock product life cycle management integration
Global	Aligns with enhancement and recent developments in product lifecycle things
Employability	Enhances employability by floating the projects based on implementing rootstock product life cycle management

Entrepreneurship	Enhances Entrepreneurship by doing the projects and case studies on product life cycle
Skill Development	Develops basic skill to understand , learn and implement product life cycle and how integration works
Professional Ethics	-
Gender	-
Human Values	-
Environment & Sustainability	-
SDG	SDG 4
NEP 2020	-

Department Elective - III

Adobe Photoshop

Department:	Department of Computer Science and Engineering		
Course Name: Adobe Photoshop	**Course Code**	**L–T–P**	**Credits**
	ENSP433	4-0-0	4
Type of Course:	Minor		
Pre-requisite(s), if any:			

Brief Syllabus:
This course enhance the ability to create accurate masks and image effects, retouch images, work with video files, automate repetitive tasks, and integrate with other Adobe applications.

UNIT WISE DETAILS

Unit Number: 1	Title: Introduction to Adobe Photoshop	No. of hours: 10

Content Summary:
Raster vs vector scanning, creating new image, saving files for print, saving files for web/screen, working for adobe bridge, introduction: using the tool, option bar and other panel, undoing actions, customizing the workspace, tools panel overview

Unit Number: 2	Title: Photo corrections	No. of hours: 10

Content Summary:
Strategy for retouching, resolution and image size, Adjusting the color in Camera Raw, Straightening and cropping the image in Photoshop, Replacing colors in an image, Adjusting saturation with the Sponge tool, Repairing areas with the Clone Stamp tool, Using the Spot Healing Brush tool, Using content-aware fill, Applying the Unsharp Mask filter.

Mini project: Use the Spot Healing Brush, Clone Stamp, or Content-Aware Fill to remove any unwanted elements or blemishes in the photos.

Unit Number: 3	Title: Working with Selections	No. of hours: 10

Content Summary:

About selecting and selection tools, Using the Quick Selection tool, Moving a selected area, Manipulating selections, Using the Magic Wand tool, Selecting with the lasso tools, Rotating a selection, Selecting with the Magnetic Lasso

tool, Cropping an image and erasing within a selection, Refining the edge of a selection.

Unit Number: 4	Title: Layer and channels	No. of hours: 10

Content Summary:
Layers, Using the Layers panel, Rearranging layers, Applying a gradient to a layer, Applying a layer style, Flattening and saving files. Working with masks and channels, Creating a mask, Refining a mask, Creating a quick mask, Manipulating an image with Puppet Warp, Working with channels.
Mini project: Create a documentation or presentation showcasing the original images, the layered composition, and a brief description of the layer and channel techniques applied.

*Self-Learning Components:
  * Text and Typography

Note: Students will give presentations or submit projects based on the self-learning components for evaluation.

Reference Books:
  1. Learn Adobe Photoshop from Scratch (Udemy)
  2. How to create high quality flyer in Adobe Photoshop (Coursera)

Define Course Outcomes (CO)

COs	Statements
CO1	Recall and identify the basic concepts, tools, and functionalities in Adobe Photoshop
CO2	Apply various photo correction techniques to enhance and modify images.
CO3	Analyze different selection tools in Adobe Photoshop, to make precise selections and manipulate selected areas.
CO4	Analyze and evaluate the usage of masks and channels for advanced image editing.

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	C1	A1	P1
C02	C2	A2	P2
CO3	C3	A4	P3
CO4	C4, C5	A5	P4

*Please Note:
Map only 1 or 2 Levels in each category. If a higher level is given, no need to mention lower level

CO-PO Mapping

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

Please Note:
- Refer to POs while mapping each CO.
- Mark " – " if not applicable
- If attainment of a CO is strongly mapped with a PO , Mark 3
- If attainment of a CO is moderately mapped with a PO , Mark 2
- If attainment of a CO is weakly mapped with a PO , Mark 1

Justification for mapping must be relevant

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

CO-PSO Mapping

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

Relevance of the Syllabus to various indicators

Unit I	Introduction to Adobe Photoshop
Local	The syllabus content is relevant at the local level as it provides foundational knowledge and skills in using Adobe Photoshop, which can be applied by individuals and businesses in the local community for various purposes such as image editing, graphic design, and print production.
Regional	The relevance at the regional level is similar to the local level. The skills and knowledge gained from the syllabus can be utilized by professionals and organizations in the region to meet their image editing and design needs. It contributes to the regional workforce's proficiency in digital media and graphic design.
National	At the national level, the syllabus is significant as it aligns with the broader goals of promoting digital literacy, fostering creativity, and enhancing the competitiveness of the national workforce in the digital media industry. It equips individuals with skills that are in demand in various sectors, including advertising, publishing, marketing, and media.
Global	In the global context, the syllabus remains relevant as Adobe Photoshop is a widely used software worldwide. The skills acquired through the syllabus enable individuals to collaborate, compete, and contribute in the global digital economy. The global relevance is further amplified by the extensive use of digital media in various industries across borders.
Employability	The syllabus enhances employability by equipping individuals with specific technical skills in Adobe Photoshop, which is a sought-after software in the creative industry. Proficiency in image editing and design using Photoshop can open up job opportunities in graphic design firms, advertising agencies, publishing

	houses, and other organizations that require visual content creation.
Entrepreneurship	The syllabus supports entrepreneurship by providing individuals with the necessary skills to start their own graphic design or digital media businesses. With knowledge of Adobe Photoshop and the ability to create and edit high-quality images, individuals can offer their services to clients, create digital products, or establish their own creative ventures.
Skill Development	The syllabus focuses on developing technical skills in using Adobe Photoshop, including understanding the interface, working with tools and panels, undoing actions, and customizing the workspace. These skills contribute to the overall skill development of individuals in the field of digital media and graphic design.
Professional Ethics	
Gender	
Human Values	The syllabus aligns with human values such as creativity, artistic expression, attention to detail, and the pursuit of excellence in visual communication. It encourages individuals to exercise their creativity, engage in critical thinking, and express themselves through digital media.
Environment & Sustainability	
Unit II	Photo Corrections
Local	The syllabus content is relevant at the local level as it provides individuals with skills and techniques for retouching and enhancing images using Adobe Photoshop. These skills can be applied by individuals and businesses in the local community for various purposes, such as improving the quality of photographs, creating visual content for local events or businesses, and enhancing digital media projects.
Regional	The relevance at the regional level is similar to the local level. The skills and knowledge gained from the syllabus can be utilized by professionals and organizations in the region to meet their image editing and retouching needs. It contributes to the regional workforce's proficiency in digital media, graphic design, and photography-related industries.

National	At the national level, the syllabus is significant as it aligns with the broader goals of promoting digital literacy, fostering creativity, and enhancing the competitiveness of the national workforce in various industries. Proficiency in image retouching and enhancement using Adobe Photoshop is valuable in sectors such as photography, advertising, graphic design, and e-commerce.
Global	In the global context, the syllabus remains relevant as Adobe Photoshop is a widely used software worldwide. The skills acquired through the syllabus enable individuals to compete and contribute in the global digital media and design industry. The demand for image retouching and enhancement skills is prevalent across borders, making the syllabus globally relevant.
Employability	The syllabus enhances employability by equipping individuals with specific technical skills in image retouching and enhancement using Adobe Photoshop. Proficiency in these skills can open up job opportunities in photography studios, design agencies, advertising firms, e-commerce companies, and other organizations that require high-quality visual content creation and editing.
Entrepreneurship	The syllabus supports entrepreneurship by providing individuals with the necessary skills to start their own photography, graphic design, or digital media businesses. With knowledge of image retouching and enhancement using Adobe Photoshop, individuals can offer specialized services, create visually appealing products, and establish their own creative ventures.
Skill Development	The syllabus focuses on developing technical skills in various aspects of image retouching and enhancement using Adobe Photoshop. These skills contribute to the overall skill development of individuals in the field of digital media, graphic design, photography, and related industries.
Professional Ethics	
Gender	
Human Values	The syllabus aligns with human values such as creativity, artistic expression, attention to detail, and the pursuit of excellence in visual communication. It encourages individuals to exercise their creativity,

	enhance visual aesthetics, and deliver high-quality visual content.
Environment & Sustainability	
Unit III	**Working with Selections**
Local	The syllabus content is relevant at the local level as it provides individuals with skills in selecting and manipulating image selections using Adobe Photoshop. These skills can be applied by individuals and businesses in the local community for various purposes, such as editing and retouching local photographs, creating visual content for local events or businesses, and enhancing digital media projects within the community.
Regional	The relevance at the regional level is similar to the local level. The skills and knowledge gained from the syllabus can be utilized by professionals and organizations in the region to meet their image editing and manipulation needs. It contributes to the regional workforce's proficiency in digital media, graphic design, and photography-related industries, allowing them to create high-quality visual content for regional projects and businesses.
National	At the national level, the syllabus is significant as it aligns with the broader goals of promoting digital literacy, fostering creativity, and enhancing the competitiveness of the national workforce in various industries. Proficiency in image selection and manipulation using Adobe Photoshop is valuable in sectors such as graphic design, advertising, photography, and multimedia production. It contributes to the national workforce's skill set and capacity to produce visually appealing content.
Global	In the global context, the syllabus remains relevant as Adobe Photoshop is a widely used software worldwide. The skills acquired through the syllabus enable individuals to compete and contribute in the global digital media and design industry. The demand for image selection and manipulation skills is prevalent across borders, making the syllabus globally relevant and providing individuals with opportunities to work on international projects.
Employability	The syllabus enhances employability by equipping individuals with specific technical skills in image

	selection and manipulation using Adobe Photoshop. Proficiency in these skills can open up job opportunities in photography studios, design agencies, advertising firms, e-commerce companies, and other organizations that require precise and accurate selection and manipulation of images.
Entrepreneurship	The syllabus supports entrepreneurship by providing individuals with the necessary skills to start their own photography, graphic design, or digital media businesses. With knowledge of image selection and manipulation using Adobe Photoshop, individuals can offer specialized services, create visually appealing products, and establish their own creative ventures.
Skill Development	The syllabus focuses on developing technical skills in various aspects of image selection and manipulation using Adobe Photoshop. These skills contribute to the overall skill development of individuals in the field of digital media, graphic design, photography, and related industries. It allows individuals to work with greater precision and efficiency when manipulating and refining image selections.
Professional Ethics	
Gender	
Human Values	The syllabus aligns with human values such as creativity, attention to detail, and the pursuit of excellence in visual communication. It encourages individuals to exercise their creativity while maintaining precision and accuracy in manipulating image selections.
Environment & Sustainability	
Unit IV	**Layer and Channels**
Local	The syllabus content is relevant at the local level as it provides individuals with skills in working with layers, masks, and channels in Adobe Photoshop. These skills can be applied by individuals and businesses in the local community for various purposes, such as graphic design, digital media production, and image editing for local projects and events.
Regional	The relevance at the regional level is similar to the local level. The skills and knowledge gained from the syllabus can be utilized by professionals and organizations in the

	region to meet their design and image editing needs. It contributes to the regional workforce's proficiency in digital media, graphic design, and photography-related industries, allowing them to create high-quality visual content for regional projects and businesses.
National	At the national level, the syllabus is significant as it aligns with the broader goals of promoting digital literacy, fostering creativity, and enhancing the competitiveness of the national workforce in various industries. Proficiency in working with layers, masks, and channels using Adobe Photoshop is valuable in sectors such as graphic design, advertising, photography, and multimedia production. It contributes to the national workforce's skill set and capacity to produce visually appealing content.
Global	In the global context, the syllabus remains relevant as Adobe Photoshop is a widely used software worldwide. The skills acquired through the syllabus enable individuals to compete and contribute in the global digital media and design industry. The demand for layer-based editing, advanced masking techniques, and channel manipulation is prevalent across borders, making the syllabus globally relevant and providing individuals with opportunities to work on international projects.
Employability	The syllabus enhances employability by equipping individuals with specific technical skills in working with layers, masks, and channels in Adobe Photoshop. Proficiency in these skills can open up job opportunities in graphic design studios, advertising agencies, photography studios, e-commerce companies, and other organizations that require advanced image editing and manipulation.
Entrepreneurship	The syllabus supports entrepreneurship by providing individuals with the necessary skills to start their own graphic design, digital media, or photography businesses. With knowledge of working with layers, masks, and channels in Adobe Photoshop, individuals can offer specialized services, create visually appealing products, and establish their own creative ventures.
Skill Development	The syllabus focuses on developing technical skills in various aspects of working with layers, masks, and channels in Adobe Photoshop. These skills contribute to the overall skill development of individuals in the field of

	digital media, graphic design, photography, and related industries. It allows individuals to work with greater flexibility, creativity, and control over image editing and manipulation processes.
Professional Ethics	The syllabus enhances employability by equipping individuals with specific technical skills in working with layers, masks, and channels in Adobe Photoshop. Proficiency in these skills can open up job opportunities in graphic design studios, advertising agencies, photography studios, e-commerce companies, and other organizations that require advanced image editing and manipulation.
Gender	
Human Values	The syllabus aligns with human values such as creativity, attention to detail, and the pursuit of excellence in visual communication. It encourages individuals to exercise their creativity while maintaining precision and accuracy in working with layers, masks, and channels.
Environment & Sustainability	
SDG	SDG4, SDG7 and SDG9
NEP 2020	The syllabus aligns with the skill development objectives of NEP 2020 and prepares students for employment and entrepreneurship opportunities in the digital media and design industry.
POE/4th IR	The syllabus integrates the concepts and skills of digital imaging and Adobe Photoshop with the principles of the Fourth Industrial Revolution and the POE framework, promoting purposeful learning outcomes and engaging learning experiences for students.

(DEPARTMENT ELECTIVE -II)

NATURAL LANGUAGE PROCESSING

Department:	Department of Computer Science and Engineering		

Course Name:	Course Code	L–T–P	Credits
NATURAL LANGUAGE PROCESSING	**ENSP302**	4-0-0	4

Type of Course:	Minor (Department Elective II)

Pre-requisite(s), if any: Strong programming skills, particularly in Python.

Brief Syllabus:
The ultimate objective of NLP is to read, decipher, understand, and make sense of the human languages in a manner that is valuable.
It helps resolve ambiguity in language and adds useful numeric structure to the data for many downstream applications, such as speech recognition or text analytics.

UNIT WISE DETAILS

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

Content Summary: Natural Language Processing in real world, What is language, Approached to NLP,

Build NLP model: Eights Steps for building NLP Model, Web Scrapping

Unit Number: 2	Title: Text Representation	No. of hours: 10

Content Summary: Basic Vectorization, One-Hot Encoding, Bag of Words, Bag of N Grams, TF-IDF, Pre-trained Word Embedding, Custom Word Embeddings, Vector Representations via averaging, Doc2Vec Model, Visualizing Embeddings using TSNW and Tensorbaord

Text Classification: Application of Text Classification, Steps for building text classification system, Text classification using Naïve Bayes Classifier, Logistic Regression, and Support Vector Machine, Neural embedding for Text Classification, text classification using deep learning, interpret text classification model

Unit Number: 3	Title: Information Extraction	No. of hours: 10

Content Summary: Applications of Information Extraction, Processes for Information Extraction. Key phrase Extraction, Named Entity Recognition, Disambiguation and linking of named entity, Relationship extraction

Chatbot: Real life applications of chatbot, Chatbot Taxonomy, Dialog Systems, Process of building a dialog, Components of Dialog System, End to End Approach, Rasa NLU

Unit Number: 4	Title: NLP for social media	No. of hours: 10

Content Summary: Application of NLP in social media, challenges with social media, Natural Language Processing for Social Data, Understanding Twitter Sentiments, Identifying memes and Fake News

NLP for E-Commerce: E-commerce catalog, Search in E-Commerce, How to build an e-commerce catalog, Review and Sentiment Analysis, Recommendations for E-Commerce

*SELF-LEARNING COMPONENTS:

https://onlinecourses.nptel.ac.in/noc23_cs45/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: Natural Language Processing with Python by Steven Bird, Ewan Klein and Edward Loper

Foundations of Statistical Natural Language Processing by Christopher Manning and Hinrich Schütze

Define Course Outcomes (CO)

COs	Statements
CO1	**Understand** the fundamentals of Natural Language Processing (NLP).
CO2	**Analyze** and represent text data using various techniques.
CO3	**Implement** text classification and information extraction techniques
CO4	**Apply** NLP techniques to analyze social media data
CO5	**Develop** practical solutions using NLP for real-world problems

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	-	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	2	-	-	-	-	-	-	3
CO3	3	-	--	-	3	-	2	-	-	-	-	3
CO4	-	-	3	-	1	-	-	-		-	2	2
CO5	3	2	-	2	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	2	-	-	-
CO2	-	3	-	-
CO3	3	-	-	-
CO4	-	-	2	-
CO5	-	-	-	3

Relevance of the Syllabus to various indicators

Unit I	**Introduction to NLP**
Local	Understanding NLP in real-world scenarios can address local language processing needs and applications.
Regional	NLP techniques can be applied regionally to various language-related tasks and projects.
National	NLP is significant for various national-level language processing initiatives and applications.
Global	NLP has widespread global applications, addressing language challenges across different cultures and regions.
Employability	Proficiency in NLP opens up employment opportunities in fields requiring language processing, AI, and data analysis skills.
Entrepreneurship	NLP knowledge can inspire entrepreneurial ventures, such as developing innovative NLP models or language-based startups.
Skill Development	Learning NLP enhances analytical and programming skills, vital for developing language-based AI applications.
Professional Ethics	Applying NLP ethically is essential to ensure responsible use of language processing technologies and avoid biases.
Gender	NLP applications should be unbiased and inclusive, considering the diverse linguistic needs of individuals of all genders.
Human Values	Implementing NLP with human values fosters language understanding and communication to improve human interactions.
Environment & Sustainability	NLP can be applied to develop sustainable language technologies and promote multilingual environmental awareness.
Unit II	**Text Representation**
Local	Text representation techniques can be tailored to local language data, improving the effectiveness of NLP applications in local contexts.

Regional	Text representation methods can be applied to regional language data for diverse NLP applications in specific geographic regions.
National	Text representation is crucial for handling various languages used nationally, enhancing the versatility of NLP systems.
Global	Text representation techniques enable effective NLP across different languages and cultures, making it globally applicable.
Employability	Proficiency in text representation methods enhances employability in NLP-related fields, data science, and AI industries.
Entrepreneurship	Knowledge of text representation can inspire the development of language processing tools and solutions catering to specific markets.
Skill Development	Learning text representation methods develops expertise in feature engineering and model training for NLP tasks.
Professional Ethics	Applying text representation ethically is essential to maintain accurate and unbiased language processing systems.
Gender	Gender-aware text representation avoids gender biases and ensures inclusive language understanding in NLP applications.
Human Values	Text representation with ethical considerations promotes human values and fosters responsible use of language technologies.
Environment & Sustainability	Text representation can be applied to promote environmental awareness and communication in diverse languages.
Unit III	**Information Extraction**
Local	Information extraction techniques can be applied to extract valuable insights from local language data for regional applications.
Regional	Regional information extraction applications can address specific language-related challenges in a particular geographic area.

National	Information extraction is valuable for various national-level language processing projects and knowledge discovery applications.
Global	Global information extraction aids in understanding multilingual data, supporting cross-cultural analysis and applications.
Employability	Proficiency in information extraction techniques enhances employability in NLP, data analysis, and information retrieval roles.
Entrepreneurship	Knowledge of information extraction can inspire the development of specialized language processing tools for diverse industries.
Skill Development	Learning information extraction methods develops expertise in pattern recognition and knowledge extraction from unstructured data.
Professional Ethics	Applying information extraction ethically ensures responsible use of data and protects individuals' privacy in language processing.
Gender	Gender-aware information extraction promotes inclusive language analysis and avoids reinforcing gender biases in the output.
Human Values	Information extraction with ethical considerations respects individual values and fosters meaningful knowledge discovery.
Environment & Sustainability	Information extraction can support environmental research and awareness by analyzing language data related to sustainability.
Unit IV	**NLP for Social Media**
Local	NLP for social media can address local language usage in social platforms, supporting community engagement and language understanding.
Regional	Regional NLP applications in social media can capture language nuances specific to various regions and enhance social analytics.

National	NLP for social media is significant for national-level sentiment analysis, understanding public opinions, and monitoring social trends.
Global	Global NLP for social media enables monitoring sentiments across cultures, tracking global trends, and addressing language-based challenges.
Employability	Proficiency in NLP for social media enhances employability in digital marketing, social media analytics, and sentiment analysis roles.
Entrepreneurship	Knowledge of NLP for social media can inspire the development of social media monitoring tools, fake news detection systems, and analytics.
Skill Development	Learning NLP for social media develops expertise in sentiment analysis, language processing for online content, and social data analytics.
Professional Ethics	Applying NLP in social media ethically ensures responsible use of social data, user privacy protection, and unbiased sentiment analysis.
Gender	Gender-aware NLP in social media avoids reinforcing gender stereotypes and respects the diverse language use of individuals of all genders.
Human Values	NLP for social media with ethical considerations promotes constructive online conversations, combats misinformation, and encourages empathy.
Environment & Sustainability	NLP for social media can be applied to analyze social discussions related to environmental issues, promoting awareness and action.
SDG	SDG 4
NEP 2020	-
POE/4th IR	-

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)	

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

19.	Abstract	Page No.
20.	Introduction (description of broad topic)	
21.	Motivation	
22.	Literature Review	
23.	Gap Analysis	
24.	Problem Statement	

25.	Objectives	
26.	Tools/platform used	
27.	Methodology	
28.	Experimental Setup	
29.	Evaluation Metrics	
30.	Results And Discussion	
31.	Conclusion & Future Work	
32.	References	
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34.	Annexure II: Screenshots of all the MS-Team Meetings with links (online)/ handwritten comments(offline) from guide	
35.	Annexure III Complete implementation code	
36.	Annexure IV Research Paper (Published/Submitted)	

**MINOR PROJECT REPORT
TEMPLATE**

SMART CCTV

Minor Project Report

Submitted in partial fulfilment of the requirement of the degree of

BACHELOR OF TECHNOLOGY

to

K.R Mangalam University

by

**BHAVYA GAURI (Roll)
HARSH YADAV (Roll)
HRIDYESH (Roll)**

Under the supervision of

Dr. Pankaj Agarwal

Department of Computer Science and Engineering

School of Engineering and Technology

K.R Mangalam University, Gurugram- 122001, India

CERTIFICATE

This is to certify that the Project Synopsis entitled, "**SMART CCTV**" submitted by "**Bhavya Gauri(19CSU066), Harsh Yadav(19CSU) and Hridyesh(19CSU)**" to **K.R Mangalam University, Gurugram, India,** is a record of bona fide synopsis work carried out by them under my supervision and guidance and is worthy of consideration for the partial fulfilment of the degree of **Bachelor of Technology** in **Computer Science and Engineering** of the University.

<Signature of supervisor>

<Name and designation of supervisor>

Date: 3rd JUNE 2022

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37.	Abstract	Page No.
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43.	Objectives	
44.	Tools/platform Used	
45.	Methodology	
46.	Experimental Setup	
47.	Evaluation Metrics	
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54.	Annexure IV Research Paper (Published/Submitted)	

1. ABSTRACT

We are all aware of the importance of Closed-Circuit Television (CCTV) cameras. One of the most significant roles of a CCTV system is its capacity to transmit secure and timely information, which leads to increased security and situational awareness in security and operational contexts. Security cameras capture live and recorded footage that provides an actionable picture of an organization's security. Operators can use visual data to respond to an impending threat or operational problem, as well as plan ahead of time for a variety of occurrences. There is a constant rise of crimes due to various reasons like poverty, unemployment, religious conflicts, political issues, etc. There has been a significant rise in surveillance systems in India, as shown in the figure below. Even though recent decades have seen the emergence of CCTV surveillance as a mainstream crime prevention measure used around the world, one drawback of the regular CCTV cameras is that it only monitors a particular frame. Hence, in this project, we transformed the regular CCTV using artificial intelligence and machine learning algorithms, and implemented them in python, to add features like in-out movement detection-that tells whether a person is entering the area under surveillance or leaving it, and records this with time stamps, facial recognition of family members-it reads the input data and recognizes the faces added as input. It also detects noise in any frame, that is, captures any unnecessary movements in a frame, other than just monitoring the area for regular surveillance. Machine learning and AI is becoming more prevalent, as cameras are able to more accurately gather data and make predictions based on integrated analytical softwares that are being developed. While the shift to a 'smart home' environment is also playing its role, as consumers have easier access than ever to easy-to-install wireless devices and doorbell camera like such, to feel more secure.

KEYWORDS: CCTV, Surveillance, Machine Learning, Artificial Intelligence
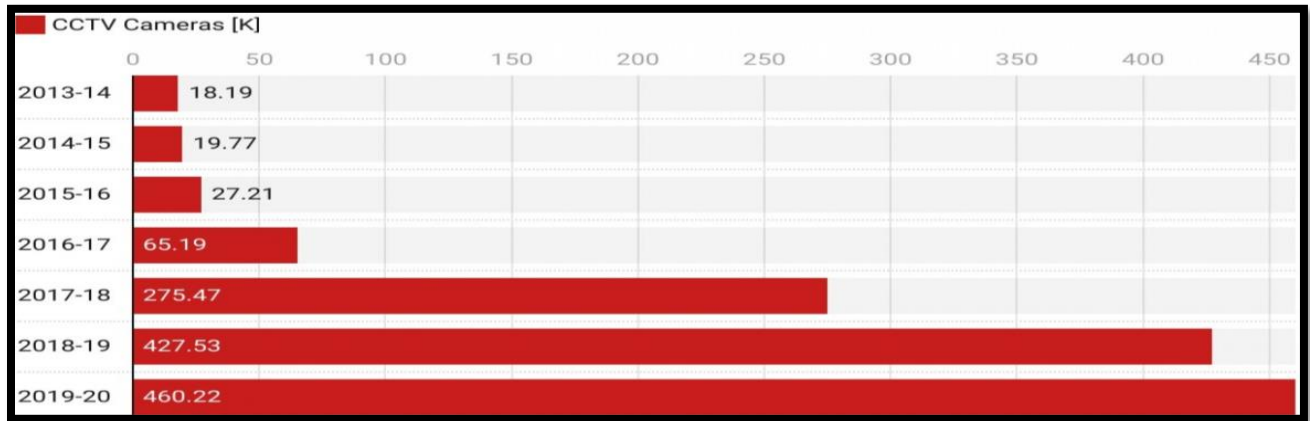
Fig 1: Rise in CCTV cameras by police in India over the years 2013 to 2020.

2. INTRODUCTION

Urbanization, rapid economic liberalization, growing large-scale political turmoil, fierce conflicts, and inadequate and inappropriate policies are the basis of crime in urban areas. In addition, poverty and inequality caused by rising expectations and a sense of moral anger among some members of society contribute to increasing and increasing the level of crime. Structural adjustment programs pursued to promote economic growth, such as layoffs, shrinking civil servants, and selling civil servants, have led to increased poverty and inequality. One of the consequences of these programs is the sharp rise in unemployment, which is a major cause of crime epidemics and increases, especially in urban areas.

Not just this, Covid-19 pandemic and subsequent lockdown increased the crime rates in India itself by 28%. Unfortunately, the world we live in is becoming increasingly unsafe for all of us. We've seen a steady increase in the registered crime cases over the decade. Using **Home Surveillance Camera** we can detect crimes such as kidnapping, murder, burglary, etc. The emergence of closed-circuit television (CCTV) surveillance is a mainstream crime prevention measure used around the world. CCTV can dramatically increase the security of your property and keep your family protected. Once you get CCTV installed in your house, you no more need to worry about break-ins or burglary while you are away. Because whatever happens, it will still be

recorded in your CCTV cameras. Thus, these cameras let you be, free of worry while you are away on a vacation or especially during business trips. It can very well help mitigate the crime in the first place and curb it. If a potential burglar sees your household is fully secured with CCTV in every nook and corner, it might as well put him off and because of the fear, he will deter from any crime that he earlier intended to do.

The importance of adequate security measures for homes and business spaces cannot be stressed enough. Many shops, commercial spaces, educational institutions, and public areas are now under the watchful eyes of surveillance systems. The recordings can be used to monitor and thwart crime. CCTV footages can also be produced as evidence in the court of law. The advancement in technology has also enabled sophisticated night vision cameras to capture every movement outside your house at night. This way you can be sure about the safety of you and your loved ones. With a sharp increase in setting up of CCTV cameras for commercial surveillance, the prices of CCTV systems have recorded a drastic decline. A smarter version of CCTV cameras will always add to the above benefits, as it can not only monitor the area under surveillance but also keep a check on the in-out movements, motion detection and family facial recognition, for a better safety provided to its customers, through a very simple and accessible GUI. Hence, the investment made on CCTV camera is a necessity.

3. MOTIVATION

In recent decades, there have been a vast number of reasons contributing to the unexpectedly growing crimes. Urbanization, rapid economic liberalization, growing large-scale political turmoil, fierce conflicts, and inadequate and inappropriate policies can be listed as the basis of crime in urban areas. Moreover, crime rate has significantly increased due to current pandemic, and has made things worse for the security officials of all countries.

Even though we can never know the intentions of any person, but with the help of a CCTV camera, we can mitigate the risk of crime occurring around us, prevent the crime in the first place because if criminal would know that they are under surveillance, it might put them off and because of the fear, they will deter from any crime that they earlier intended to do.

In May 2021, Comparitech published a report on the use of CCTV cameras in 150 major cities across the globe. They found around 770 million cameras globally. The rising number of CCTV cameras in India is a cause of grave concern. Figure 1 shows that around 1.54 million cameras are spread among India's top 15 cities. New Delhi (5,51,500), Hyderabad (3,75,000), Chennai (2,80,000), and Indore (2,00,600) have the most surveillance cameras in the country. It is worth noting that almost 91.1% of CCTV cameras installed in the country are present only in these four cities. Also, CCTV Market Size is expected to Reach USD 46.52 Billion by 2030 at a 13.1% CAGR as suggested in a report by Market Research Future (MRFR).

The CCTVs eradicate the fear among the people in order to deter crime occurrence. Presence of the surveillance services assures the people that the surveyed areas deem more secure than the areas under no surveillance hence more people access the protected areas compared to the areas with no CCTV. The main goal of this project was to enhance the working of the currently used CCTV cameras, add in features that would increase the security of the households, are easy to access and are very effective in monitoring and mitigating any crimes.

The project adds in features like in-out detection, noise detection and facial recognition of family members along with monitoring the frame with time stamps.

4. LITERATURE REVIEW

CCTV AS AN INVESTIGATIVE TOOL:

There has been extensive research on the value of CCTV for preventing crime, but little on its value as an investigative tool. The study by Matthew Ashby sought to establish how often CCTV provides useful evidence and how this is affected by circumstances, analysing 251,195 crimes recorded by British Transport Police that occurred on the British railway network between 2011 and 2015. CCTV was available to investigators in 45% of cases and judged to be useful in 29% (65% of cases in which it was available). Useful CCTV was associated with significantly increased chances of crimes being solved for all crime types except drugs/weapons possession and fraud. Images were more likely to be available for more-serious crimes, and less likely to be available for cases occurring at unknown times or in certain types of locations. Although this research was limited to offences on railways, it appears that CCTV is a powerful investigative tool for many types of crime.

INDOOR HOME SURVEILLANCE USING IOT:

The use of traditional CCTV to monitor the secured area have three limitations, which are requiring a huge volume of storage to store all the videos regardless there are intruders or not, does not notify the users immediately when there are motions detected, and users must always check the CCTV recorded videos regularly to identity any intruders. Therefore, a smart surveillance monitoring system is proposed to solve this problem by detecting intruders and capturing image of the intruder. Notifications will also be sent to the user immediately when motions are detected. This smart surveillance monitoring system only store the images of the intruders that triggered the motion sensor, making this system uses significantly less storage space.

ATM ROBBERY PREVENTION USING CCTV AND MACHINE LEARNING:

The idea if designing and implementation of the real-time ATM robbery prevention project came with the observation of real-time ATM robbery incidents around us. In this research paper by International Journal of Advanced Research, the project gives the alert at the instant of time when the thief is about to break the ATM machine.so, to overcome the drawbacks in the existing systems in our society. Whenever the thief is bringing the tools for the robbery into the ATM or when the thief is trying to use the tool to break, the CCTV camera on the ATM sense whether the person is bringing tools using the deep learning techniques and machine learning. Here the OpenCV and TensorFlow are used as the platform and the python language is used for the deep learning technics and Keras API were used for object detection.

IDENTIFYING MOVING BODIES WITH CCTV AND ML ALGORITHMS:

In this research paper publishes by IEEE, the project aims at observing that if there is a database of facial data present then the task of recognition boils down to comparison of each and every face detected from the video with every face saved in the database. Now this process involves capturing the faces beforehand. This is actually a very tedious job, so the database of images is created (/updated) as and when new faces come into the camera view. The labelling of the faces can be done at leisure (by a human) or not be done at all. The current system once deployed does not need a database of images to start with. It creates its own collection of images, and then tracks the future occurrences of those images.

REAL TIME DETECTION AND TRACKING OF PEDESTRIANS WITH CNN:

This research moves with the approach to match the extracted features of individual detections in subsequent frames, hence creating a correspondence of detections across multiple frames. The developed framework is able to address challenges like cluttered scenes, change in illumination, shadows and reflection, change in appearances and partial occlusions. However, total occlusion and similar persons in the same frame remain a challenge to be addressed. The framework is able to generate the detection and the tracking results at the rate of four frames per second, where CCTVs are spread over a huge range of area.

5. GAP ANALYSIS

From the numerous researches done for enhancement of CCTV by applying machine learning algorithms, artificial intelligence, internet of things and convolutional neural network, the resultant CCTV camera is always a stronger product than the traditional version which just monitors a particular frame. But all these projects are carried out on external safety measures such as traffic management, security of borders, bank robbery and theft, but not many researches are carried out for safety at internal household level, or, they do not provide the best set of functionalities required for a safer household. Our project covers facial recognition of family members, in and out movement detection, motion detection in frame as well as monitoring the entire frame.

Hence, we have covered a good subset of requirements, all available under one place, which will help the consumers feel more secure while they are away, and the easily accessible recordings with the help of a simple GUI will add up to the pros of the project.

6. PROBLEM STATEMENT

The closed-circuit television (CCTV) is one of the devices used to monitor the secured area for any intruders. The presence of surveillance cameras can act as a strong deterrent to criminals and thieves, as it is possible to identify people and track their movements, using the recorded footages.

The use of traditional CCTV to monitor the secured area, but they have their own set of limitations, some of which are requiring a huge volume of storage to store all the videos regardless there are intruders or not, does not notify the users when there are motions detected, and users must always check the CCTV recorded videos regularly to identity any intruders or unusual event occurring in the area and manually check for each mishappening. This creates a need of smarter CCTV cameras, which can ease the user's task by automating most of these tasks. Such a camera would prove to be better in terms of providing security, mitigating risks of crime, preventing crimes and also monitoring and recording the footage if the crime occurs.

7. OBJECTIVES

The features include:

1. **Monitor** – monitors the area under surveillance.

2. **Identify** – Identifies the family members.

3. **Noise Detection**– Finds any motion in the frame.

4. **In Out Detection** – Finds who enters and exits.

The objective is to overcome the gap from various projects and to create a smart CCTV camera for households that can add a sense of security and help mitigate the crimes. The recorded footages can be considered as evidence,

provided a crime occurs. The use of machine learning algorithms is done to make it smarter, and a GUI is created using tkinter in python to make it accessible and easy to understand for its users.

8. PLATFORM USED

For this project, we have used various latest technologies which will be evaluated in this chapter with every detail of why it is used.

PROGRAMMING LANGUAGE: **PYTHON**

We have used Python language as it is relatively new as compared to other languages like Java, C++, etc and comes with so many features. We can perform Machine Learning, Computer Vision, Artificial Intelligence, etc with python and construction of GUI application is also easily achieved in Python.

Python is a widely used general-purpose, high level programming language. It was created by Guido van Rossum in 1991 and further developed by the Python Software Foundation. It was designed with an emphasis on code readability, and its syntax allows programmers to express their concepts in fewer lines of code. Python is a programming language that lets you work quickly and integrate systems more efficiently. There are two major Python versions: **Python 2 and Python 3**

Reasons for Selecting this language:

1. Short and Concise Language.
2. Easy to Learn and use.
3. Good Technical support over Internet
4. Many Packages for different tasks.
5. Run on Any Platform.
6. Modern and OOP language

Some specific features of Python are as follows:

1. An *interpreted* (as opposed to *compiled*) language. Contrary to e.g. C or Fortran, one does not compile Python code before executing it. In addition, Python can be used **interactively**: many Python interpreters are available, from which commands and scripts can be executed.

2. A free software released under an **open-source** license: Python can be used and distributed free of charge, even for building commercial software.

3. **Multi-platform**: Python is available for all major operating systems, Windows, Linux/Unix, MacOS X, most likely your mobile phone OS, etc.

4. A very readable language with clear non-verbose syntax.

5. A language for which a large variety of high-quality packages are available for various applications, from web frameworks to scientific computing.

6. A language very easy to interface with other languages, in particular C and C++.

7. Some other features of the language are illustrated just below. For example, Python is an object-oriented language, with dynamic typing (the same variable can contain objects of different types during the course of a program).

The features included in the project are:

1. **Monitor** – monitors the area under surveillance.

2. **Identify** – Identifies the family members.

3. **Noise Detection**– Finds any motion in the frame.

4. **In Out Detection** – Finds who enters and exits.

Each feature is discussed in detail in the next section, the methodology used in the features is elaborated and the process model used for the completion of the project is also mentioned below.

9.METHODOLOGY

1.MONITOR FEATURE – SKIMAGE MODULE USED

This feature is used to find things which are stolen from the frame is visible to webcam. This means that it constantly monitors the frames and checks if an object is present in one frame and missing from the other. If some object is missing, the frame is captured along with the time stamp and recorded in the logs.

This uses **Structural Similarity Index Metric (SSIM)** to find the differences in the two frames. The two frames are captured first when noise was not happened and second when noise stopped happening in the frame.

SSIM is used as a metric to measure the *similarity* between two given images. As this technique has been around since 2004, a lot of material exists explaining the theory behind SSIM but very few resources go deep into the details, that too specifically for a gradient-based implementation as SSIM is often used as a loss function.

The Structural Similarity Index (SSIM) metric extracts 3 key *features* from an image:

- **Luminance**
- **Contrast**
- **Structure**

The comparison between the two images is performed on the basis of these 3 features. Given below in the figure is the visual representation of how SSIM compares two frames with the help of these three features.

Figure 2: Structured Similarity Index Metric Working
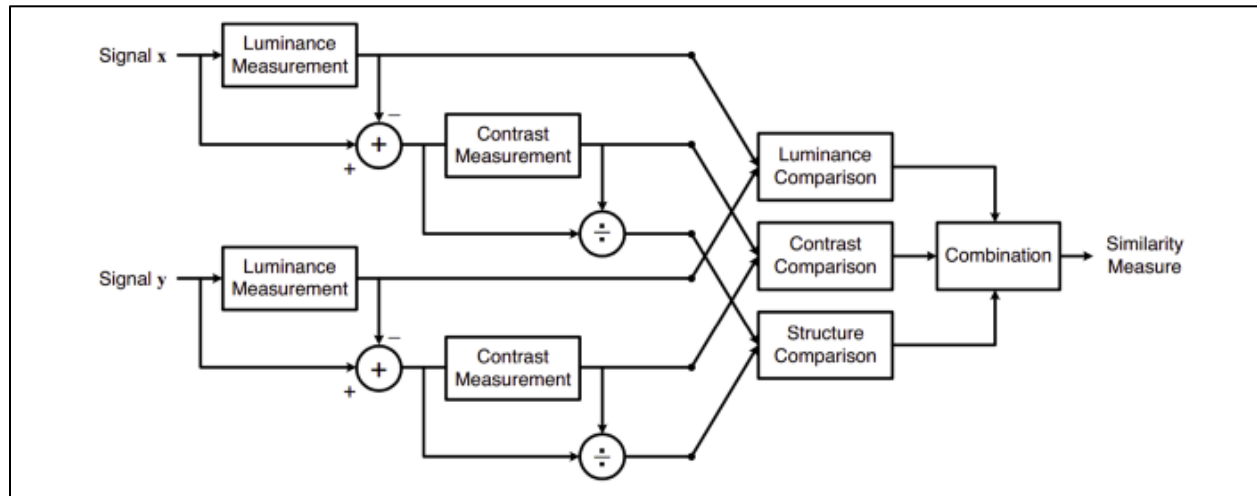
This system calculates the *Structural Similarity Index* between 2 given images which is a value between -1 and +1. *A value of +1* indicates that the 2 given images are **very similar or the same** while a *value of -1* indicates the 2 given images are **very different.** Often these values are adjusted to be in the range [0, 1], where the extremes hold the same meaning.

Luminance: Luminance is measured by *averaging* over all the pixel values. Its denoted by μ (Mu) and the formula is given below,

$$\mu_x = \frac{1}{N} \sum_{i=1}^{N} x_i. \tag{2}$$

The luminance comparison function $l(\mathbf{x}, \mathbf{y})$ is then a function of μ_x and μ_y.

where xi is the ith pixel value of the image x. N is the total number of pixel values. Source: https://www.cns.nyu.edu/pub/eero/wang03-reprint.pdf

Contrast: It is measured by taking the *standard deviation (square root of variance)* of all the pixel values. It is denoted by σ (sigma) and represented by the formula below,

$$\sigma_x = \left(\frac{1}{N-1} \sum_{i=1}^{N} (x_i - \mu_x)^2 \right)^{\frac{1}{2}}. \tag{4}$$

The contrast comparison $c(\mathbf{x}, \mathbf{y})$ is then the comparison of σ_x and σ_y.

Where x and y are the two images and mu is the mean of the pixel values of the image. Source: https://www.cns.nyu.edu/pub/eero/wang03-reprint.pdf

Structure: The structural comparison is done by using a consolidated formula (more on that later) but in essence, we divide the input signal with its *standard deviation* so that the result has unit standard deviation which allows for a more robust comparison.

$$(\mathbf{x} - \hat{\mu}_x)/\sigma_x$$

where x is the Input Image

Luckily, thanks to skimage package in python we don't have to replicate all this mathematical calculation in python since skimage has pre build feature that do all of these tasks for us with just calling its in-built function.

We just have to feed in two images/frames which we have captured earlier, so we just feed them in and its gives us out the masked image with score.

2.IDENTIFY THE FAMILY MEMBERS – OPENCV MODULE USED:

This feature is very useful for project, it is used to find if the person in the frame is known or not. This feature is carried out in two steps:

1. Find the faces in the frames
2. Use LBPH face recognizer algorithm to predict the person from already trained model.

1 – Detecting faces in the frames

This is done via **Haarcascade** classifiers which are again in-built in openCV module of python. The figure below shows how OpenCV is used to detect faces in a frame.
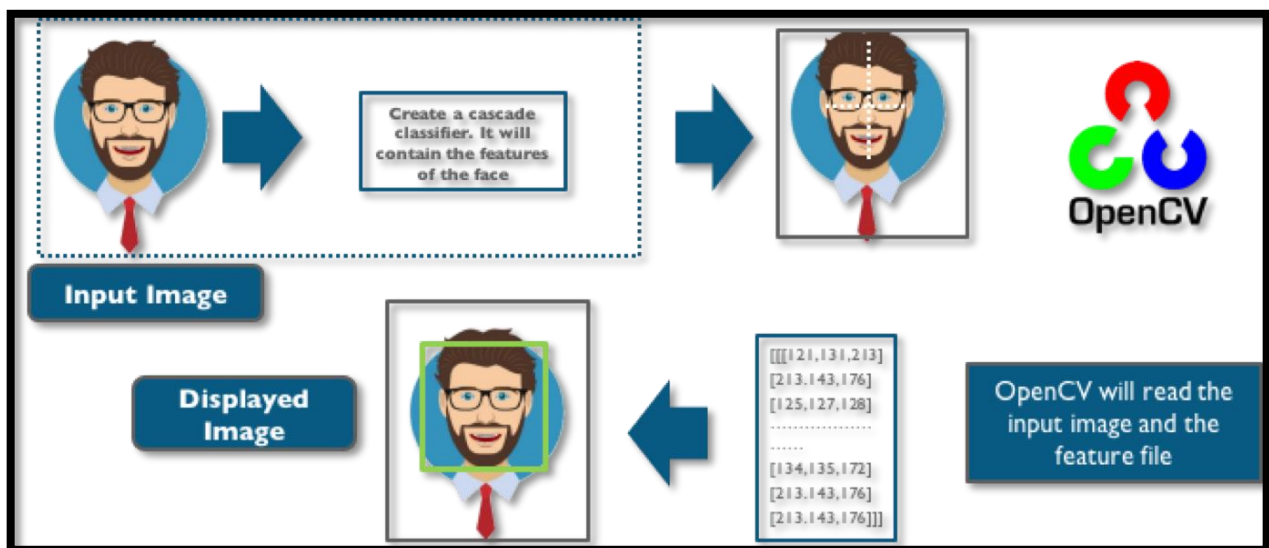
Figure 3:How Haarcascade is implemented in python using OpenCV

Cascade classifier, or namely *cascade of boosted classifiers working with haar-like features*, is a special case of **ensemble learning**, called **boosting**. It typically relies on Adaboost classifiers (and other models such as Real Adaboost, Gentle Adaboost or Logitboost).

Cascade classifiers are trained on a few hundred sample images of image that contain the object we want to detect, and other images that do not contain those images.

There are some common features that we find on most common human faces:

1. *A dark eye region compared to upper-cheeks.*
2. *A bright nose bridge region compared to the eyes.*
3. *Some specific location of eyes, mouth, nose, etc.*

The characteristics are called **Haar Features**. The feature extraction process will look like this:

Haar features are similar to these **convolution kernels** which are used to detect the presence of that feature in the given image.

For doing all this, OpenCV module in python language has inbuild function called cascadeclassifier which we have used in order to detect for faces in the frame. The images given below show how and what kind of features are extracted by cascade classifier.
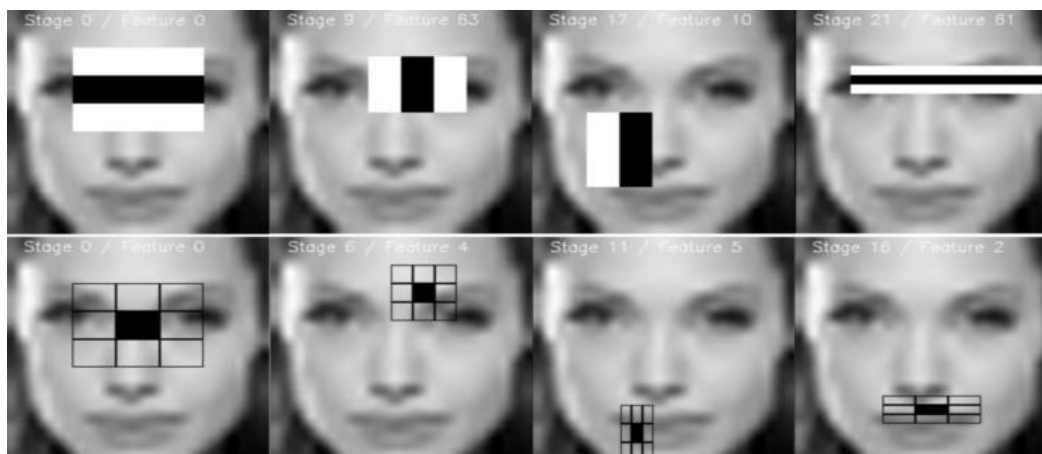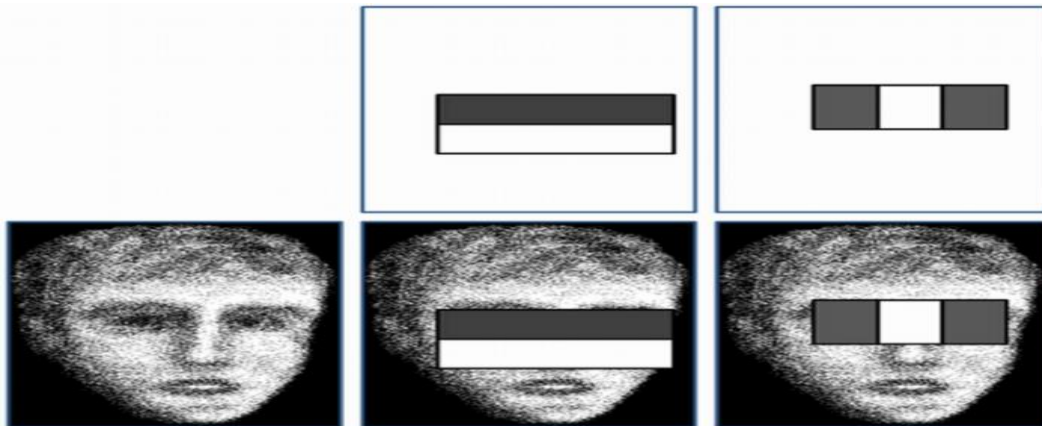
2 – Using LBPH for face recognition

So now we have detected for faces in the frame and this is the time to identify it and check if it is in the dataset which we've used to train our LBPH model.

The LBPH uses 4 parameters:

- **Radius**: the radius is used to build the circular local binary pattern and represents the radius around the central pixel. It is usually set to 1.
- **Neighbours**: the number of sample points to build the circular local binary pattern. Keep in mind: the more sample points you include, the higher the computational cost. It is usually set to 8.
- **Grid X**: the number of cells in the horizontal direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.
- **Grid Y**: the number of cells in the vertical direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8

The first computational step of the LBPH is to create an intermediate image that describes the original image in a better way, by highlighting the facial
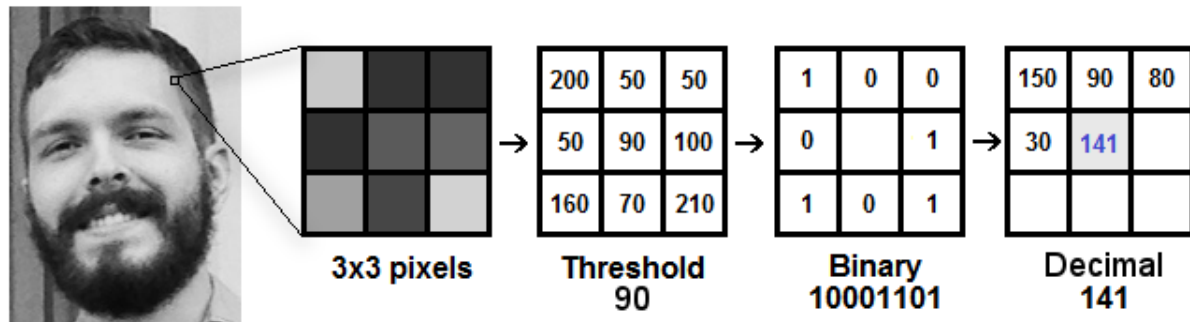
characteristics. To do so, the algorithm uses a concept of a sliding window, based on the parameters **radius** and **neighbours**. Which is shown perfectly via the above image.

Extracting the Histograms: Now, using the image generated in the last step, we can use the **Grid X** and **Grid Y** parameters to divide the image into multiple grids, as can be seen in the following image:

| Original Image | LBP Result | Regions/Grids (Grid X - Grid Y) | Histogram of each region | Concatenated Histogram |
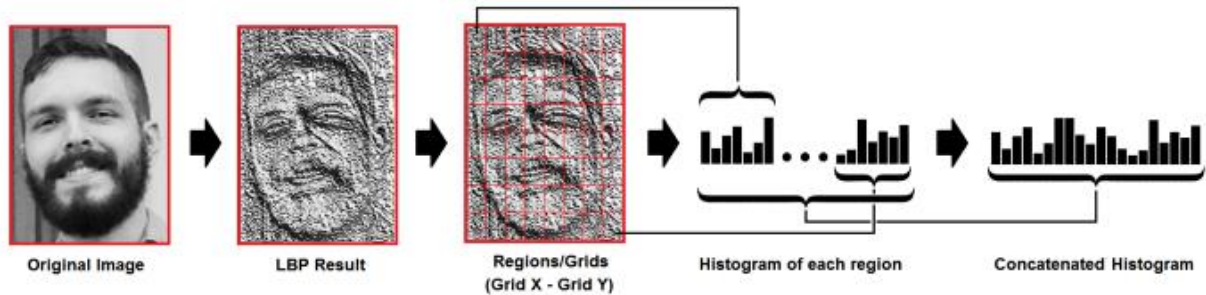
And after all this the model is trained and later on when we want to make predictions the same steps are applied to the make and its histograms are compared with already trained model and in such way this feature works.

3.DETECT NOISE IN THE FRAME:

This feature is used to find the noises in the frames well this is something you would find in most of the CCTVs but in this module we'll see how it works.

Talking in simple way all the frames are continuously analysed and checked for noises. Noise is checked in the consecutive frames. Simply we do the absolute difference between two frames and in this way the difference of two images are analysed and Contours (boundaries of the motion are detected) and if there are no boundaries then no motion. If there is any boundary, then this is considered as motion in the frame.

frame1	frame2	frame2 - frame1	abs (frame2 - frame1)
10 90 16 16 0 11 11 11 18 30 33 33 18 18 18 18	10 90 16 16 0 13 17 11 18 34 31 33 18 17 19 18	0 0 0 0 0 2 6 0 0 4 -2 0 0 -1 1 0	0 0 0 0 0 2 6 0 0 4 2 0 0 1 1 0

As you would know all images are just integer/ float values of pixels which tells the brightness of pixel and similarly every pixel that has values of brightness.

Hence, we just do absolute difference because negative will make no sense at all.

4.DETECTING VISITORS IN ROOM (IN-OUT MOTION DETECTION):

This is the feature which can detect if someone has entered in the room or gone out.

So it works using following steps:

1 – It first detect for noises in the frame.

2 – Then if any motion happen it find from which side does that happen either left or right.

3 – Last it checks if motion from left ended to right, then it will detect it as entered and capture the frame.

Basically, to know from which side does the motion happened we first detect for motion and later on we draw rectangle over noise and last step is we check the co-ordinates if those points lie on left side then it is classified as left motion.

This covers all the features, their working as well as their implementation in Python, using different modules like OpenCV, SKimage ,etc.

10. ENVIRONMENTAL SETUP

SOFTWARE REQUIREMENTS

Below are the requirements to run this software :

1. Windows/Linux/Mac OS any version, hence it can run on any platform.
2. Python3, it needs python to be installed in system to run successfully.
3. Packages in python -
    a. openCV
    b. skimage
    c. numpy
    d. tkinter

HARDWARE REQUIREMENTS

In terms of hardware requirements there is not much required at all but still below requirements are must:

1. Working PC or Laptop
2. Webcam with drivers installed
3. Flashlight/ LED if using this at night.

PLATFORMS ALREADY TESTED ON:

It is tested on Linux Mint, Linux Ubuntu, Windows 7 and Windows 10.

11. RESULTS AND DISCUSSIONS

THE GUI:
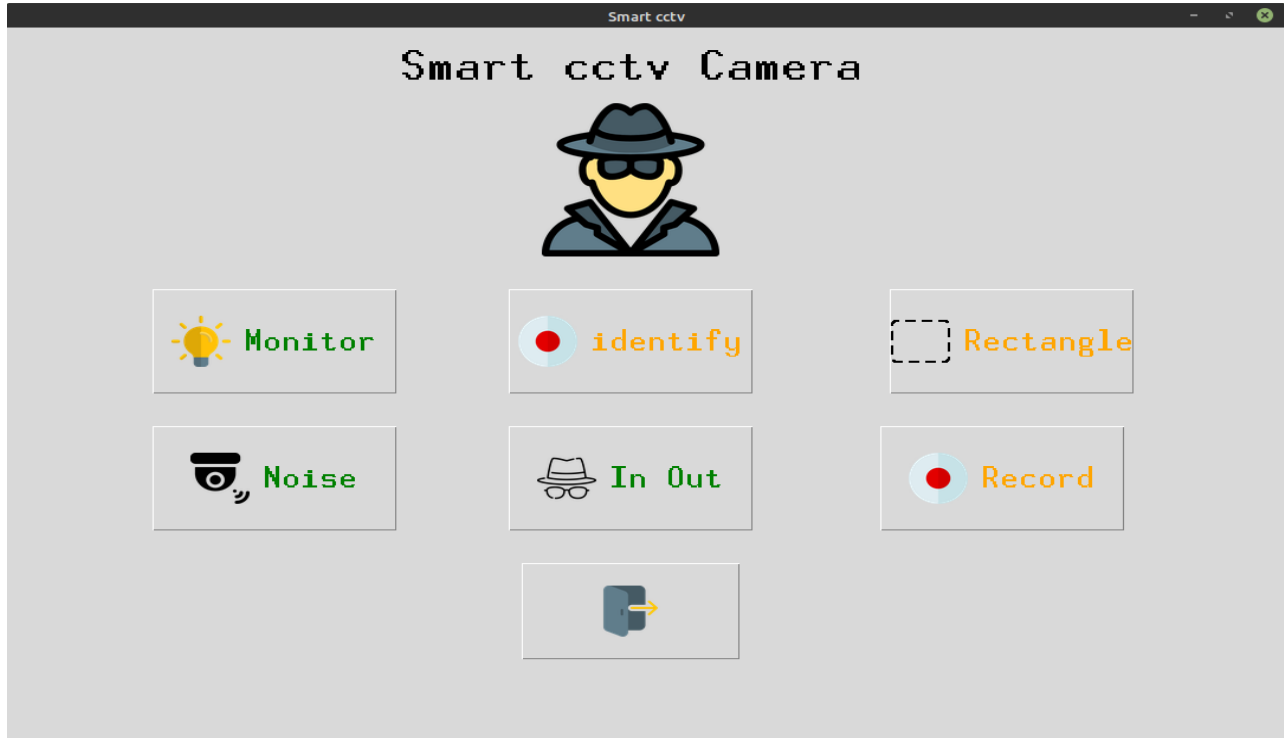
MONITOR FEATURE:

Correctly detecting the missing speaker from the frame.
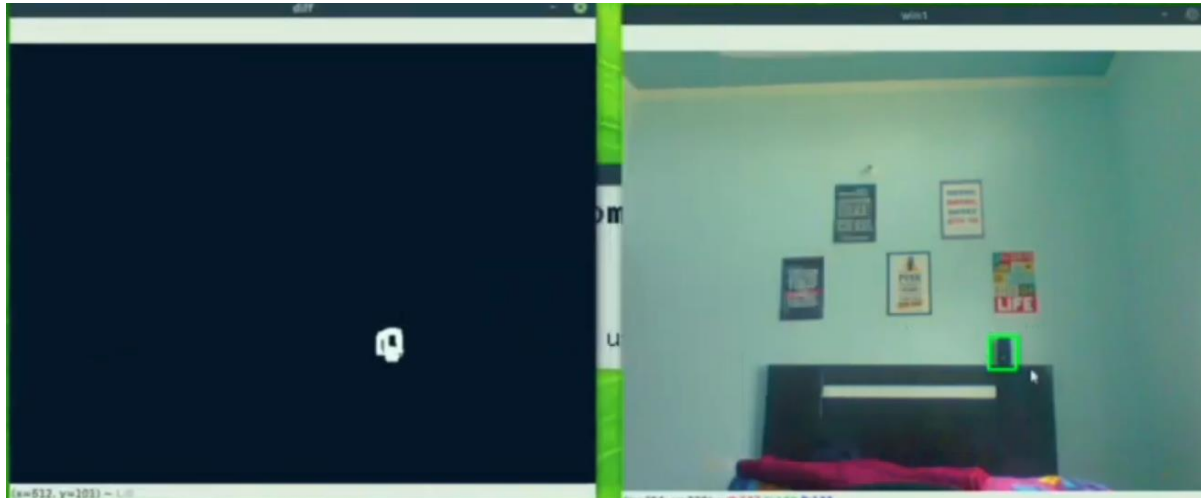
2.NOISE DETECTION FEATURE:

Detecting hand motion correctly.
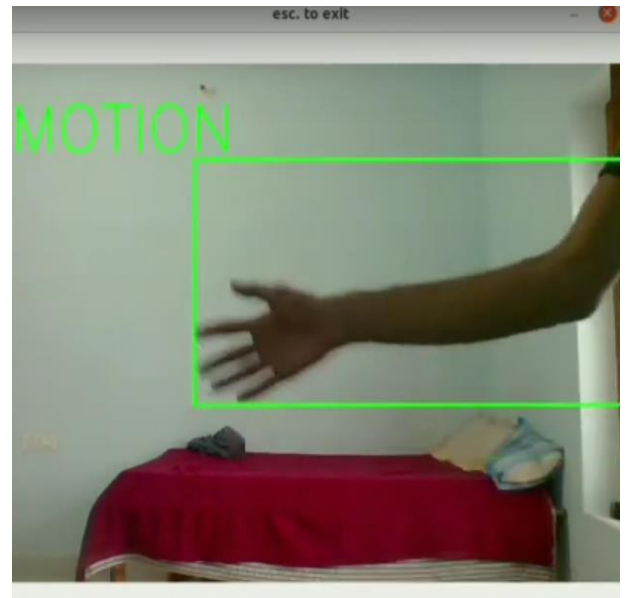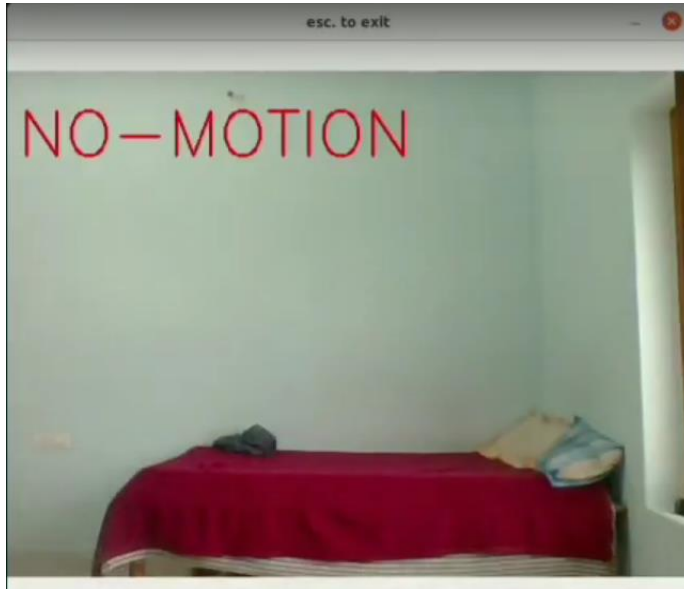
3.IN-OUT MOVEMENT DETECTION:

Saves the image locally as – entered the room.
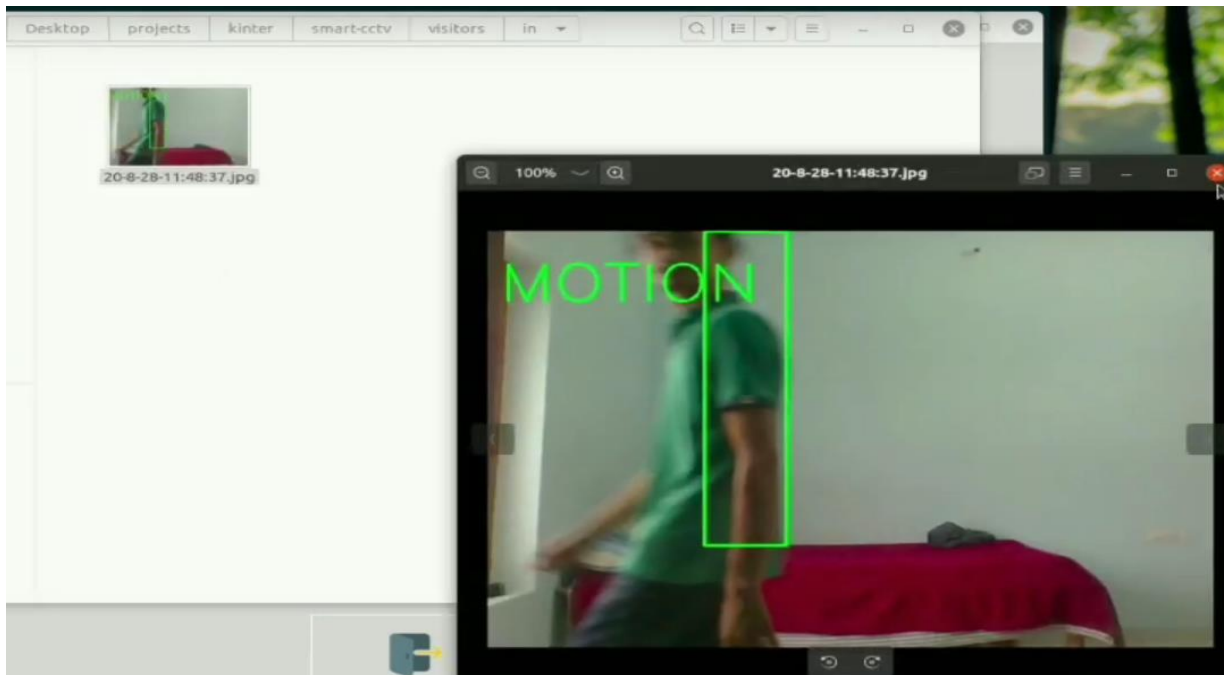
12. FUTURE WORK

The project is working well for all the features including- monitoring, facial detection, noise recognition and in-out movement detection. The future work can include enhancing the model by using a better face recognition approach like Dlib, as haarcascade classifier is not very accurate at all times. The project is scaled for a very limited user base, so it can only detect a little motion and only a couple entries and exits simultaneously. It can be scaled up for more number of users and thus can be used in other domains like bank security management, school security, etc. Better technology for night vision can be implemented as it is not appropriate for darker regions.

13. CONCLUSIONS

In recent decades, there have been a vast number of reasons contributing to the unexpectedly growing crimes. Urbanization, rapid economic liberalization, growing large-scale political turmoil, fierce conflicts, and inadequate and inappropriate policies can be listed as the basis of crime in urban areas. Moreover, crime rate has significantly increased due to current pandemic, and has made things worse for the security officials of all countries.

The closed-circuit television (CCTV) is one of the devices used to monitor the secured area for any intruders. But the traditional CCTVs have their own set of flaws, which make them less effective for securing the area. This project tries to implement Machine Learning algorithms to enhance the working of traditional CCTVs, by adding functionalities:

1. **Monitor** – monitors the area under surveillance.

2. **Identify** – Identifies the family members.

3. **Noise Detection**– Finds any motion in the frame.

4. **In Out Detection** – Finds who enters and exits.

This will help make a stronger system for security concerns, and will make the users feel more secure when they are not at home. It will not only mitigate the risks of crime occurrence, but also capture anything and everything that can be considered as a proof against the criminal , provided the crime takes place.

14. REFERNCES

For making this project we have used many websites and research papers. The links are below specified:

- Structural Similarity from medium
- face detection
- LBPH algorithm
- openCV
- tech with tim
- https://researchbriefings.files.parliament.uk/documents/SN05624/SN05624.pdf
- http://joiv.org/index.php/joiv/article/view/172

We have also used so many other youtube channels and google and stack overflow to solve our errors.

We used Official python documentations to code in python.

ANNEXURE I:

RESPONSIBILITY CHART

ROLL NUMBER	NAME	RESPONSIBILITIES
19CSU066	BHAVYA GAURI	IDENTIFY MODULE, IN-OUT MOTION DETECTION, DOCUMENTATION-REPORT AND PRESENTATION
19CSU120	HARSH YADAV	MONITOR MODULE, INTEGRATION, IN-OUT MODULE
19CSU127	HRIDYESH	NOISE DETECTION MODULE, INTEGRATION, IN-OUT MODULE

COMPLETE IMPLEMENTATION

The coding part in below with specific modules discussed above.

Main.py

```
import tkinter as tk
import tkinter.font as font
from in_out import in_out
from motion import noise
from rect_noise import rect_noise
from record import record
from PIL import Image, ImageTk
from find_motion import find_motion
from identify import maincall

window = tk.Tk()
window.title("Smart cctv")
window.iconphoto(False, tk.PhotoImage(file='mn.png'))
window.geometry('1080x700')


frame1 = tk.Frame(window)

label_title = tk.Label(frame1, text="Smart cctv Camera")
label_font = font.Font(size=35, weight='bold',family='Helvetica')
label_title['font'] = label_font
label_title.grid(pady=(10,10), column=2)


icon = Image.open('icons/spy.png')
icon = icon.resize((150,150), Image.ANTIALIAS)
icon = ImageTk.PhotoImage(icon)
label_icon = tk.Label(frame1, image=icon)
label_icon.grid(row=1, pady=(5,10), column=2)

btn1_image = Image.open('icons/lamp.png')
btn1_image = btn1_image.resize((50,50), Image.ANTIALIAS)
btn1_image = ImageTk.PhotoImage(btn1_image)

btn2_image = Image.open('icons/rectangle-of-cutted-line-geometrical-shape.png')
btn2_image = btn2_image.resize((50,50), Image.ANTIALIAS)
btn2_image = ImageTk.PhotoImage(btn2_image)

btn5_image = Image.open('icons/exit.png')
btn5_image = btn5_image.resize((50,50), Image.ANTIALIAS)
btn5_image = ImageTk.PhotoImage(btn5_image)

btn3_image = Image.open('icons/security-camera.png')
btn3_image = btn3_image.resize((50,50), Image.ANTIALIAS)
btn3_image = ImageTk.PhotoImage(btn3_image)

btn6_image = Image.open('icons/incognito.png')
btn6_image = btn6_image.resize((50,50), Image.ANTIALIAS)
```

```python
btn4_image = Image.open('icons/recording.png')
btn4_image = btn4_image.resize((50,50), Image.ANTIALIAS)
btn4_image = ImageTk.PhotoImage(btn4_image)

btn7_image = Image.open('icons/recording.png')
btn7_image = btn7_image.resize((50,50), Image.ANTIALIAS)
btn7_image = ImageTk.PhotoImage(btn7_image)


# --------------- Button ------------------#
btn_font = font.Font(size=25)
btn1 = tk.Button(frame1, text='Monitor', height=90, width=180, fg='green',command =
find_motion, image=btn1_image, compound='left')
btn1['font'] = btn_font
btn1.grid(row=3, pady=(20,10))

btn2 = tk.Button(frame1, text='Rectangle', height=90, width=180, fg='orange',
command=rect_noise, compound='left', image=btn2_image)
btn2['font'] = btn_font
btn2.grid(row=3, pady=(20,10), column=3, padx=(20,5))

btn_font = font.Font(size=25)
btn3 = tk.Button(frame1, text='Noise', height=90, width=180, fg='green', command=noise,
image=btn3_image, compound='left')
btn3['font'] = btn_font
btn3.grid(row=5, pady=(20,10))

btn4 = tk.Button(frame1, text='Record', height=90, width=180, fg='orange', command=record,
image=btn4_image, compound='left')
btn4['font'] = btn_font
btn4.grid(row=5, pady=(20,10), column=3)


btn6 = tk.Button(frame1, text='In Out', height=90, width=180, fg='green', command=in_out,
image=btn6_image, compound='left')
btn6['font'] = btn_font
btn6.grid(row=5, pady=(20,10), column=2)

btn5 = tk.Button(frame1, height=90, width=180, fg='red', command=window.quit,
image=btn5_image)
btn5['font'] = btn_font
btn5.grid(row=6, pady=(20,10), column=2)

btn7 = tk.Button(frame1, text="identify", fg="orange",command=maincall, compound='left',
image=btn7_image, height=90, width=180)
btn7['font'] = btn_font
btn7.grid(row=3, column=2, pady=(20,10))

frame1.pack()
window.mainloop()
```

Monitors is divided into two modules.

1.find_noise.py
2.spot_diff.py

```python
import cv2
from spot_diff import spot_diff
import time
import numpy as np


def find_motion():

motion_detected = False
is_start_done = False

cap = cv2.VideoCapture(0)

check = []

print("waiting for 2 seconds")
time.sleep(2)
frame1 = cap.read()

_, frm1 = cap.read()
frm1 = cv2.cvtColor(frm1, cv2.COLOR_BGR2GRAY)


while True:
_, frm2 = cap.read()
frm2 = cv2.cvtColor(frm2, cv2.COLOR_BGR2GRAY)

diff = cv2.absdiff(frm1, frm2)

_, thresh = cv2.threshold(diff, 30, 255, cv2.THRESH_BINARY)

contors = cv2.findContours(thresh, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)[0]

#look at it
contors = [c for c in contors if cv2.contourArea(c) > 25]


if len(contors) > 5:
cv2.putText(thresh, "motion detected", (50,50), cv2.FONT_HERSHEY_SIMPLEX, 2, 255)
motion_detected = True
is_start_done = False
```

```python
elif motion_detected and len(contors) < 3:
    if (is_start_done) == False:
        start = time.time()
        is_start_done = True
        end = time.time()

    end = time.time()

    print(end-start)
    if (end - start) > 4:
        frame2 = cap.read()
        cap.release()
        cv2.destroyAllWindows()
        x = spot_diff(frame1, frame2)
        if x == 0:
            print("runnig again")
            return

        else:
            print("found motion sending mail")
            return

else:
    cv2.putText(thresh, "no motion detected", (50,50),
    cv2.FONT_HERSHEY_SIMPLEX, 2, 255)

cv2.imshow("winname", thresh)

_, frm1 = cap.read()
frm1 = cv2.cvtColor(frm1, cv2.COLOR_BGR2GRAY)

if cv2.waitKey(1) == 27:

    break

return
```

spot_diff.py

```python
import cv2
import time
from skimage.metrics import structural_similarity
from datetime import datetime

def spot_diff(frame1, frame2):

frame1 = frame1[1]
frame2 = frame2[1]

g1 = cv2.cvtColor(frame1, cv2.COLOR_BGR2GRAY)
g2 = cv2.cvtColor(frame2, cv2.COLOR_BGR2GRAY)

g1 = cv2.blur(g1, (2,2))
g2 = cv2.blur(g2, (2,2))

(score, diff) = structural_similarity(g2, g1, full=True)

print("Image similarity", score)

diff = (diff * 255).astype("uint8")
thresh = cv2.threshold(diff, 100, 255, cv2.THRESH_BINARY_INV)[1]

contors = cv2.findContours(thresh, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)[0]
contors = [c for c in contors if cv2.contourArea(c) > 50]

if len(contors):
for c in contors:

x,y,w,h = cv2.boundingRect(c)

cv2.rectangle(frame1, (x,y), (x+w, y+h), (0,255,0), 2)

else:
print("nothing stolen")
return 0

cv2.imshow("diff", thresh)
cv2.imshow("win1", frame1)
cv2.imwrite("stolen/"+datetime.now().strftime('%-y-%-m-%-
d-%H:%M:%S')+".jpg", frame1)
```

identify.py

```python
import cv2
import os
import numpy as np
import tkinter as tk
import tkinter.font as font

def collect_data():
name = input("Enter name of person : ")

count = 1
ids = input("Enter ID: ")

cap = cv2.VideoCapture(0)

filename = "haarcascade_frontalface_default.xml"

cascade = cv2.CascadeClassifier(filename)

while True:
_, frm = cap.read()

gray = cv2.cvtColor(frm, cv2.COLOR_BGR2GRAY)

faces = cascade.detectMultiScale(gray, 1.4, 1)

for x,y,w,h in faces:
cv2.rectangle(frm, (x,y), (x+w, y+h), (0,255,0), 2)
roi = gray[y:y+h, x:x+w]

cv2.imwrite(f"persons/{name}-{count}-{ids}.jpg", roi)
count = count + 1
cv2.putText(frm, f"{count}", (20,20), cv2.FONT_HERSHEY_PLAIN, 2,
(0,255,0), 3)
cv2.imshow("new", roi)
```

```python
def train():
    print("training part initiated !")

    recog = cv2.face.LBPHFaceRecognizer_create()

    dataset = 'persons'

    paths = [os.path.join(dataset, im) for im in os.listdir(dataset)]

    faces = []
    ids = []
    labels = []
    for path in paths:
        labels.append(path.split('/')[-1].split('-')[0])

        ids.append(int(path.split('/')[-1].split('-')[2].split('.')[0]))

        faces.append(cv2.imread(path, 0))

    recog.train(faces, np.array(ids))

    recog.save('model.yml')

    return

def identify():
    cap = cv2.VideoCapture(0)

    filename = "haarcascade_frontalface_default.xml"

    paths = [os.path.join("persons", im) for im in os.listdir("persons")]
    labelslist = []
    for path in paths:
        if path.split('/')[-1].split('-')[0] not in labelslist:
            labelslist.append(path.split('/')[-1].split('-')[0])

    print(labelslist)
    recog = cv2.face.LBPHFaceRecognizer_create()

    recog.read('model.yml')

    cascade = cv2.CascadeClassifier(filename)

    while True:
        _, frm = cap.read()

        gray = cv2.cvtColor(frm, cv2.COLOR_BGR2GRAY)
```

```python
faces = cascade.detectMultiScale(gray, 1.4, 1)

for x,y,w,h in faces:
cv2.rectangle(frm, (x,y), (x+w, y+h), (0,255,0), 2)
roi = gray[y:y+h, x:x+w]

label = recog.predict(roi)

cv2.putText(frm, f"{labelslist[label[0]]}", (x,y),
cv2.FONT_HERSHEY_SIMPLEX, 1, (0,0,255), 3)


cv2.imshow("identify", frm)

if cv2.waitKey(1) == 27:
cv2.destroyAllWindows()
cap.release()
break

def maincall():


root = tk.Tk()

root.geometry("480x100")
root.title("identify")

label = tk.Label(root, text="Select below buttons ")
label.grid(row=0, columnspan=2)
label_font = font.Font(size=35, weight='bold',family='Helvetica')
label['font'] = label_font

btn_font = font.Font(size=25)

button1 = tk.Button(root, text="Add Member ", command=collect_data,
height=2, width=20)
button1.grid(row=1, column=0, pady=(10,10), padx=(5,5))
button1['font'] = btn_font

button2 = tk.Button(root, text="Start with known ", command=identify, height=2,
width=20)
button2.grid(row=1, column=1,pady=(10,10), padx=(5,5))
button2['font'] = btn_font
root.mainloop()
```

in_out.py

```python
import cv2
from datetime import datetime
def in_out():
    cap = cv2.VideoCapture(0)


    right, left = "", ""

    while True:
        _, frame1 = cap.read()
        frame1 = cv2.flip(frame1, 1)
        _, frame2 = cap.read()
        frame2 = cv2.flip(frame2, 1)

        diff = cv2.absdiff(frame2, frame1)

        diff = cv2.blur(diff, (5,5))

        gray = cv2.cvtColor(diff, cv2.COLOR_BGR2GRAY)

        _, threshd = cv2.threshold(gray, 40, 255, cv2.THRESH_BINARY)

        contr, _ = cv2.findContours(threshd, cv2.RETR_TREE,
cv2.CHAIN_APPROX_SIMPLE)

        x = 300
        if len(contr) > 0:
            max_cnt = max(contr, key=cv2.contourArea)
            x,y,w,h = cv2.boundingRect(max_cnt)
            cv2.rectangle(frame1, (x, y), (x+w, y+h), (0,255,0), 2)
            cv2.putText(frame1, "MOTION", (10,80), cv2.FONT_HERSHEY_SIMPLEX, 2,
(0,255,0), 2)


        if right == "" and left == "":
            if x > 500:
                right = True

            elif x < 200:
                left = True
```

```python
        elif left:
            if x > 500:
                print("to right")
                x = 300
                right, left = "", ""
                cv2.imwrite(f"visitors/out/{datetime.now().strftime('%-y-%-m-%-d-%H:%M:%S')}.jpg", frame1)


    cv2.imshow("", frame1)

    k = cv2.waitKey(1)

    if k == 27:
        cap.release()
        cv2.destroyAllWindows()
        break
```

motion.py

```python
import cv2

def noise():
    cap = cv2.VideoCapture(0)

    while True:
        _, frame1 = cap.read()
        _, frame2 = cap.read()

        diff = cv2.absdiff(frame2, frame1)
        diff = cv2.cvtColor(diff, cv2.COLOR_BGR2GRAY)

        diff = cv2.blur(diff, (5,5))
        _, thresh = cv2.threshold(diff, 25, 255, cv2.THRESH_BINARY)

        contr, _ = cv2.findContours(thresh, cv2.RETR_TREE, cv2.CHAIN_APPROX_SIMPLE)

        if len(contr) > 0:
            max_cnt = max(contr, key=cv2.contourArea)
            x,y,w,h = cv2.boundingRect(max_cnt)
            cv2.rectangle(frame1, (x, y), (x+w, y+h), (0,255,0), 2)
            cv2.putText(frame1, "MOTION", (10,80),
cv2.FONT_HERSHEY_SIMPLEX, 2, (0,255,0), 2)

        else:
            cv2.putText(frame1, "NO-MOTION", (10,80),
cv2.FONT_HERSHEY_SIMPLEX, 2, (0,0,255), 2)

        cv2.imshow("esc. to exit", frame1)

        if cv2.waitKey(1) == 27:
            cap.release()
            cv2.destroyAllWindows()
            break
```

Finding noise in the rectangle.

```
import cv2

donel = False
doner = False
x1,y1,x2,y2 = 0,0,0,0


def select(event, x, y, flag, param):
    global x1,x2,y1,y2,donel, doner
    if event == cv2.EVENT_LBUTTONDOWN:
        x1,y1 = x,y
        donel = True
    elif event == cv2.EVENT_RBUTTONDOWN:
        x2,y2 = x,y
        doner = True
        print(doner, donel)

def rect_noise():

    global x1,x2,y1,y2, donel, doner
    cap = cv2.VideoCapture(0)



    cv2.namedWindow("select_region")
    cv2.setMouseCallback("select_region", select)

    while True:
        _, frame = cap.read()

        cv2.imshow("select_region", frame)

        if cv2.waitKey(1) == 27 or doner == True:
            cv2.destroyAllWindows()
            print("gone--")
```

```python
    diff = cv2.blur(diff, (5,5))
    _, thresh = cv2.threshold(diff, 25, 255, cv2.THRESH_BINARY)

    contr, _ = cv2.findContours(thresh, cv2.RETR_TREE,
cv2.CHAIN_APPROX_SIMPLE)

    if len(contr) > 0:
        max_cnt = max(contr, key=cv2.contourArea)
        x,y,w,h = cv2.boundingRect(max_cnt)
        cv2.rectangle(frame1, (x+x1, y+y1), (x+w+x1, y+h+y1), (0,255,0), 2)
        cv2.putText(frame1, "MOTION", (10,80),
cv2.FONT_HERSHEY_SIMPLEX, 2, (0,255,0), 2)

    else:
        cv2.putText(frame1, "NO-MOTION", (10,80),
cv2.FONT_HERSHEY_SIMPLEX, 2, (0,0,255), 2)

    cv2.rectangle(frame1, (x1,y1), (x2, y2), (0,0,255), 1)
    cv2.imshow("esc. to exit", frame1)

    if cv2.waitKey(1) == 27:
        cap.release()
        cv2.destroyAllWindows()
        break
```

At-last this is most required feature which is recording:

```
import cv2
from datetime import datetime

def record():
    cap = cv2.VideoCapture(0)

    fourcc = cv2.VideoWriter_fourcc(*'XVID')
    out = cv2.VideoWriter(f'recordings/{datetime.now().strftime("%H-%M-%S")}.avi', fourcc,20.0,(640,480))

    while True:
        _, frame = cap.read()

        cv2.putText(frame, f'{datetime.now().strftime("%D-%H-%M-%S")}', (50,50), cv2.FONT_HERSHEY_COMPLEX,
                    0.6, (255,255,255), 2)

        out.write(frame)

        cv2.imshow("esc. to stop", frame)

        if cv2.waitKey(1) == 27:
            cap.release()
            cv2.destroyAllWindows()
            break
```