NEW HORIZON
COLLEGE OF ENGINEERING

Department of Computer Science and Engineering

Academic Year

2025-26

7th and 8th Semester Scheme & Syllabus
2025-26
BATCH: 2022-26
CREDITS: 160

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NEW HORIZON COLLEGE OF ENGINEERING

VISION

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

MISSION

- To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students
- To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation
- To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities

QUALITY POLICY

To provide services of the highest quality both curricular and co-curricular so that our students can integrate their skills and serve the industry and society equally well at the global level

VALUES

- Academic Freedom
- Integrity
- Inclusiveness
- Innovation
- Professionalism
- Social Responsibility

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION

To emerge as a department of eminence in Computer Science and Engineering in serving the Information Technology Industry and the nation by empowering students with a high degree of technical and practical competence.

MISSION

- To strengthen the theoretical and practical aspects of the learning process by strongly encouraging a culture of research, innovation and hands-on learning in Computer Science and Engineering
- To encourage long-term interaction between the department and the IT industry, through the involvement of the IT industry in the design of the curriculum and its hands-on implementation
- To widen the awareness of students in professional, ethical, social and environmental dimensions by encouraging their participation in co-curricular and extracurricular activities

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Graduate of the program will be able to:

PE01: Develop proficiency as computer scientists with an ability to solve a wide range of computational problems in industry, government, or other work environments.

PE02: Attain the ability to adapt quickly to new environments and technologies, assimilate new information, and work in multi-disciplinary areas with a strong focus on innovation and entrepreneurship.

PE03: Possess the ability to think logically and the capacity to understand technical problems with computational systems.

PE04: Possess the ability to collaborate as team members and team leaders to facilitate cutting- edge technical solutions for computing systems and thereby providing improved functionality.

PEO TO MISSION STATEMENT MAPPING

Mission Statements	PEO1	PEO2	PEO3	PEO4
To strengthen the theoretical and practical aspects of the learning process by strongly encouraging a culture of research, innovation and hands-on learning in Computer Science and Engineering	3	3	3	2
To encourage long-term interaction between the department and the IT industry, through the involvement of the IT industry in the design of the curriculum and its hands-on implementation	3	3	3	2
To widen the awareness of students in professional, ethical, social and environmental dimensions by encouraging their participation in co-curricular and extracurricular activities	2	2	2	3

Correlation: 3 – High, 2 – Medium, 1 – Low

PROGRAM OUTCOMES (POs)

The student will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex Computer Science and engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems in Computer Science and Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design / Development of Solutions: Design solutions for complex engineering problems and design system components or processes of Computer Science and Engineering that meet the specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments in Computer Science and Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities related to Computer Science and Engineering with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice in Computer Science and Engineering.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions of Computer Science and Engineering in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual and as a member or leader to diverse teams, and in multidisciplinary settings.

PO10: 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 report and design documentation, make effective presentations, and give and receive clear instructions.

PO11: 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 and in multidisciplinary environments.

PO12: 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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

The student will be able to:

PSO1: Ability to design, develop, implement computer programs and use knowledge in various domains to identify research gaps and hence to provide solution to new ideas and innovations.

PSO2: Work with and communicate effectively with professionals in various fields and pursue lifelong professional development in computing.

MAPPING OF PEOs to POs & PSOs

	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEO1	3	3	2	2	2	1	1	1	1	1	1	1	1	1
PEO2	3	3	3	3	3	2	2	2	2	2	2	2	3	2
PEO3	3	3	3	3	3	3	3	2	2	2	2	2	3	3
PEO4	1	1	1	1	1	2	2	3	3	3	3	3	1	1

Correlation: 3 – High, 2 – Medium, 1 – Low

NEW HORIZON COLLEGE OF ENGINEERING
B. E. in Computer Science and Engineering
Scheme of Teaching and Examinations for 2022- 2026 BATCH (2022 Scheme)

VII Semester													
S. No.	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	Contact Hours	Marks		
					L	T	P	S			CIE	SEE	Total
1	PCC	22CSE71	Full Stack Technologies	CS	3	0	0	0	3	3	50	50	100
2	PCCL	22CSL71	Full Stack Technologies Lab	CS	0	0	1	0	1	2	50	50	100
3	PCC	22CSE72	Software Testing	CS	3	0	0	0	3	3	50	50	100
4	PCCL	22CSL72	Software Testing Lab	CS	0	0	1	0	1	2	50	50	100
5	PCC	22CSE73	Generative AI	CS	3	0	0	0	3	3	50	50	100
6	PROJ	22CSE74	Project Phase – II	CS	0	0	10	0	10	20	100	100	200
7	OEC	23NHOP7XX	Industrial Open Elective Course-II	Offering Dept.	3	0	0	0	3	3	50	50	100
Total									24	36	400	400	800

PCC: Professional Core Course, IPCC: Integrated Professional Core Course, PCCL: Professional Core Course laboratory, PEC: Professional Elective Course, OEC: Open Elective Course, PROJ: Project work, L: Lecture, T: Tutorial, P: Practical S: SDA: Self Study for Skill Development, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Industrial Open Elective Course – II (OEC): Credit for OEC is 03 (L: T: P: S) can be considered as (3: 0: 0: 0). The teaching and learning of these Courses will be based on hands-on. The Course Assessment will be based on CIE and SEE in practical mode. This Courses will be offered by Centre of Excellence to students of all the branches. Registration to Industrial open electives shall be documented and monitored on college level.

Project Phase - II:

The objective of the Project work is

- **(i) To encourage independent learning and the innovative attitude of the students.**
- **(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.**
- **(iii) To impart flexibility and adaptability.**
- **(iv) To inspire team working.**
- **(v) To expand intellectual capacity, credibility, judgment and intuition.**
- **(vi) To adhere to punctuality, setting and meeting deadlines.**
- **(vii) To install responsibilities to oneself and others.**
- **(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.**

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25.

Credit Definition: **1- hour Lecture (L) per week=1Credit** **2-hoursTutorial(T) per week=1Credit** **2- hours Practical / Drawing (P) per week=1Credit** **2-hous Self Study for Skill Development (SDA) per week = 1 Credit**	**03-Credits courses are to be designed for 40 hours in Teaching-Learning Session** **02- Credits courses are to be designed for 25 hours of Teaching-Learning Session** **01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions**

NEW HORIZON COLLEGE OF ENGINEERING
B. E. in Computer Science and Engineering
Scheme of Teaching and Examinations for 2022- 2026 BATCH (2022 Scheme)

VIII Semester													
S. No.	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	Contact Hours	CIE	SEE	Total
					L	T	P	S					
1	PEC*	22CSE81X	Professional Elective Course-III	CS	3	0	0	0	3	3	50	50	100
2	PEC*	22CSE82X	Professional Elective Course-IV	CS	3	0	0	0	3	3	50	50	100
3	INT	22CSE83	Internship	CS	0	0	10	0	10	20	100	100	200
4	NCMC	22IKK84	Indian Knowledge Systems	XX	0	0	0	0	0	1	50	-	50
Total									16	27	250	200	450

PEC*: Professional Elective Course (Online / Hybrid), **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, **INT**: Industry Internship / Research Internship / Rural Internship, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation. **NCMC** : Online Assessment

Professional Elective Course-III			
22CSE811	Concurrent Programming	22CSE814	Entrepreneurship and Resource Management
22CSE812	Human Computer Interaction	22CSE815	Social Media Networks
22CSE813	Soft Computing		

Professional Elective Course-IV			
22CSE821	Design Thinking	22CSE824	Ethics in AI
22CSE822	Service Oriented Architecture	22CSE825	Storage Area Networks
22CSE823	Recommender Systems		

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Internship.

Internship: The mandatory Internship is for **14 to 20 weeks**. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent SEE examination after satisfying the internship requirements. If the students are opting for the 8th semester, the following internship options are available:

- Industry Internship
- Research Internship
- Skill Enhancement Courses
- Post-Placement Training as Internship
- Online Internship

Industry internship: It is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints. Students undertaking industry internships must ensure the organization is listed on the VTU Internship Portal. If not, request the organization to register on the portal.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research. Research internships must be carried out in recognized research centers. Ensure that these centers are registered on the portal.

Skill Enhancement Courses: Students can take Skill-based courses with credits totalling the same as those of the internship. Students must be taken from registered providers listed on the VTU Internship Portal.

Post-Placement Training as Internship: The post-placement training is also considered an internship. For students placed during their 6th/7th semester and willing to take the training during their final year, colleges must inform the recruiting companies in advance to register on the VTU Internship Portal.

Online Internship: Reputed online internship platforms, including those identified by NSDC, are already listed on the VTU Internship portal. If colleges come across other eligible organizations not yet listed, they are informed to ask the organization to register on the VTU Internship portal.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship. The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship. With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (within or outside the state or abroad), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide.

Credit Definition: 1-hour Lecture (L) per week=1 Credit 2-hoursTutorial(T) per week=1 Credit 2-hours Practical / Drawing (P) per week=1 Credit 2-hous Self Study for Skill Development (SDA) per week = 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

Seventh Semester Syllabus

FULL STACK TECHNOLOGIES			
Course Code	**22CSE71**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22CSE71.1	Obtain basic knowledge of full stack development frameworks and their practical application.
22CSE71.2	Illustrate the architecture of Node JS in the context of dynamic web-based applications.
22CSE71.3	Apply the principles of MongoDB to facilitate effective client/ server communication.
22CSE71.4	Analyze the concepts of connecting Node.js with MongoDB for efficient client/ server communication.
22CSE71.5	Identify the fundamentals of Express in NodeJS.
22CSE71.6	Evaluate the role of React in constructing enterprise software solutions.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE71.1	3	3	3	2	2	-	-	-	1	1	-	2	2	-
22CSE71.2	3	3	3	2	2	-	-	-	1	1	-	2	2	-
22CSE71.3	3	3	3	2	2	-	-	-	1	1	-	2	2	-
22CSE71.4	3	3	3	2	2	-	-	-	1	1	-	2	2	-
22CSE71.5	3	3	3	2	2	-	-	-	1	1	-	2	2	-
22CSE71.6	3	3	3	2	2	-	-	-	1	1	-	2	2	-

MODULE-1	**INTRODUCTION TO FULL STACK**	**22CSE71.1**	**8 Hours**
Understanding the Basic Web Development Framework, User, Browser, Webserver, Backend Services, MVC Architecture, Understanding the different stacks, Angular, Node, Mongo DB, React, Basic commands in Go programming.			
Self-study / Case Study /Applications	Explore full stack development through modern web architecture using Angular, React and modern tools such as Node.js and MongoDB.		
Text Book	Text Book 1: 1.1, 1.2.		
MODULE-2	**NODE JS & GO**	**22CSE71.2**	**8 Hours**
Basics of Node JS, Working with Node packages, Using Events, Listeners, Timers, Callbacks, Handling Data I/O, Implementing HTTP services in Node.js, Go-variables, data types, arrays, loops, function, struct & map.			
Self-study / Case Study / Applications	Investigate Node.js architecture, focusing on its event-driven, non-blocking model, and explore packages, callbacks, and HTTP services along with Go programming fundamentals for backend development.		
Text Book	Text Book 1: 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 5.1.		
MODULE-3	**MONGODB**	**22CSE71.3, 22CSE71.4**	**8 Hours**
Understanding NoSQL and MongoDB, Building MongoDB Environment, User accounts, Access control, Managing collections, Connecting to MongoDB from Node.js.			
Self-study / Case Study / Applications	Apply NoSQL concepts using MongoDB to facilitate efficient client-server communication by managing collections, user accounts, access control and integrate MongoDB with Node.js to enable real-time data interactions and support flexible schema designs for dynamic applications.		
Text Book	Text Book 1: 12.1, 12.2, 12.3, 12.5, 13.2.		
MODULE-4	**EXPRESS AND ANGULAR**	**22CSE71.5**	**8 Hours**
Implementing Express in Node.js, Configuring routes, Using Request and Response objects, Angular, Typescript, Angular Components, Expressions, Data binding.			
Self-study / Case Study / Applications	Identify the functionalities of Express in the Node.js ecosystem, including routing, middleware, request handling while exploring Angular with TypeScript for building dynamic front-end components using data binding and component-based architecture.		
Text Book	Text Book 1: 18.1, 18.2, 18.3, 18.4, 20.1, 22.1, 23.1, 24.1.		

MODULE-5	REACT	22CSE71.6	8 Hours

MERN Stack, Setup and deploy MERN, Basic React applications, React Components, React State, Express REST APIs, Modularization and Webpack, Version control, Container and components of React.

Self-study / Case Study / Applications	Evaluate the role of React in building enterprise-level applications by leveraging reusable components, state management, and modular design while understanding the setup and deployment of full stack MERN applications, integration of Express-based REST APIs, use of version control, and utilization of Webpack for production-ready development.
Text Book	Text Book 2: 5.2, 8.1.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018. ISBN: 978-0-134-65553-6.
2. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React and Node', Second Edition, Apress, 2019. ISBN: 978-1-4842-4390-9.

Reference Books:

1. Adam Jones, MEAN Stack Full-Stack Development, Apress, First Edition, 2024.
2. Mykyta Chernenko, Full Stack Web Development with TypeScript 5, Packt Publishing, First Edition, 2024.
3. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018.
4. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018.

Web links and Video Lectures (e-Resources):

- https://www.tutorialspoint.com/the_full_stack_web_development/index.asp
- https://www.udemy.com/course/the-full-stack-web-development
- https://www.coursera.org/specializations/full-stack-react
- https://www.fullstackpathway.com/
- Go Tutorial (w3schools.com)

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Develop front-end and back-end components
- Design and manage databases
- Implement user authentication and authorization

- Create and consume RESTful APIs
- Deploy full stack applications
- Practice version control and team collaboration
- Conduct project-based learning for real-world application
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare flowcharts and handouts
  - Organizing group wise discussions on issues
  - Seminars

FULL STACKTECHNOLOGIES LAB			
Course Code	**22CSL71**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22CSL71.1	Design and develop responsive web pages using HTML, CSS, JavaScript, and TypeScript.
22CSL71.2	Build interactive front-end components and single-page applications using modern frameworks like React JS.
22CSL71.3	Implement back-end logic and RESTful APIs using Node.js, Express, and integrate with databases like MongoDB.
22CSL71.4	Develop and deploy full-stack web applications for real-world scenarios such as chat modules, leave management, dashboards, and content management systems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSL71.1	3	3	3	3	2	1	-	-	1	1	2	1	3	**3**
22CSL71.2	3	3	3	3	2	1	-	-	1	1	2	1	3	**3**
22CSL71.3	3	3	3	3	3	1	-	-	1	1	2	1	3	**3**
22CSL71.4	3	3	3	3	2	1	-	-	1	1	2	1	3	**3**

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• **HTML5 semantic elements** • **CSS Flexbox/Grid for layout** • **CRUD operations (Create, Read, Update, Delete) in Database Management system**	2	NA
	PART-A		
1.	a) Write a program to build a Chat module using HTML, CSS and JavaScript. b) Develop a program to design a static webpage using HTML. c) Write a program to design a website using HTML, CSS and JavaScript.	2	22CSL71.1
2.	Develop a dashboard for project management where the statuses of various tasks are available. New tasks can be added, and the status of existing tasks can be changed among Pending, InProgress or Completed.	2	22CSL71.2
3.	Develop a classifieds web application to buy and sell used products using Node JS.	2	22CSL71.3
4.	Develop a Project for Product Catalog Management	2	22CSL71.3
5.	Develop a leave management system for an organization where users can apply different types of leave such as casual leave and medical leave. They also can view the available number of days using events and timers.	2	22CSL71.4
6.	Developing a Content Management System.	2	22CSL71.4
	PART-B		
7.	Write a program to design a calculator Application using Typescript.	2	22CSL71.1

8.	a) Write a program to design a voting application using React JS. b) Develop a user login component using React JS.	2	22CSL71.2
9.	Perform CRUD operations using Express JS and MongoDB.	2	22CSL71.3
10.	Build a REST API with Node, Express, and MongoDB.	2	22CSL71.3
11.	Develop a micro blogging application (like twitter) that allows people to post their content which can be viewed by people who follow them.	2	22CSL71.4
12.	Develop a portfolio website for yourself which gives details about yourself for a potential recruiter with both front-end & back-end.	2	22CSL71.4

PART-C

Beyond Syllabus Virtual Lab Content

(To be done during Lab but not to be included for CIE or SEE)

Real-Time Weather Dashboard

Create a location-aware weather dashboard that displays real-time weather conditions for the user's current city using data from an external API like OpenWeatherMap. The application should allow users to search and save multiple cities, compare current weather and forecast trends, and visualize temperature and humidity data using interactive charts. Enhance the user experience with theme customization (e.g., day/night mode), and implement Progressive Web App (PWA) features so that basic weather data is available even when offline. The system should also generate alerts for severe weather conditions based on forecasted data.

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	5	10
L4	Analyze	5	5
L5	Evaluate	5	5
L6	Create	5	5

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	15
L4	Analyze	20
L5	Evaluate	10
L6	Create	0

Suggested Learning Resources:

Reference Books:

1. Jennifer Robbins," Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics", O'Reilly Media,2018, ISBN: 9781491960202.
2. Marijn Haverbeke," Eloquent JavaScript: A Modern Introduction to Programming", No Starch Press,2018, ISBN: 9781593279509.
3. Vasan Subramanian," Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node", Apress,2019, ISBN: 9781484243900.

SOFTWARE TESTING			
Course Code	**22CSE72**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22CSE72.1	Understand the fundamental concepts in software testing.
22CSE72.2	Evaluate test cases for various black box and white box testing techniques.
22CSE72.3	Categorize the significance of integration and system testing
22CSE72.4	Investigate the importance of acceptance testing.
22CSE72.5	Analyze regression testing process and minimization.
22CSE72.6	Apply the software automation process using selenium tool.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE72.1	3	**2**	**-**	**-**	**1**	-	-	**-**	**-**	**-**	-	1	**2**	-
22CSE72.2	3	3	3	**-**	**3**	-	-	**-**	**-**	**-**	-	**-**	3	2
22CSE72.3	3	3	3	**-**	**2**	-	-	**-**	**2**	**1**	-	**-**	3	2
22CSE72.4	3	3	3	**2**	**2**	-	-	**-**	2	2	-	**-**	3	2
22CSE72.5	3	3	3	**2**	**2**	-	-	**-**	1	1	-	**1**	3	2
22CSE72.6	3	3	3	**2**	**3**	-	-	-	2	2	**1**	2	3	3

MODULE-1	**INTRODUCTION**	**22CSE72.1**	**6 Hours**

Basics of Software Testing: Faults, Errors, and Failures, testing objectives, Principles of testing, Requirements Behavior and Correctness, Reliability, Testing and debugging, Test metrics and measurements, Testing and Verification.
A Perspective on Testing: Definition, Test Cases, Types of testing, Software Quality and Reliability, Software defect tracking.

Case Study	**Testing an Online Banking Application**
Text Book	Text Book 1: Chapter 1,2

MODULE-2	**WHITE BOX AND BLACK BOX TESTING**	**22CSE72.2**	**8 Hours**

White box testing: Static testing, static analysis tools, Structural testing: Module functional testing, Code coverage testing, Code complexity testing.
Black Box testing: Requirements based testing, Boundary value analysis, Equivalence partitioning, State based testing, Decision table testing, Model based testing and model checking, Differences between white box and Black box testing.

Case Study	**Testing an ATM Withdrawal System**
Text Book	Text Book 1: Chapter 3,4

MODULE-3	**INTEGRATION, SYSTEM AND ACCEPTANCE TESTING**	**22CSE72.3 22CSE72.4**	**8 Hours**

Integration Testing: Top down and bottom-up integration, Bi-directional integration.
System testing: System integration, Scenario Testing, Defect Bash, Functional versus Nonfunctional testing, Design verification, Deployment testing, Beta testing, Scalability testing, Reliability testing, Stress testing.
Acceptance testing: Acceptance criteria, test cases selection and execution.

Case Study	**Case Study on Integration, System, and Acceptance Testing of an Online Food Delivery Application"**
Text Book	Text Book 1: Chapter 5,6

MODULE-4	**TEST SELECTION & MINIMIZATION FOR REGRESSION TESTING**	**22CSE72.5**	**8 Hours**

Regression testing: Regression test process, Initial Smoke and Sanity test, Selection of regression tests, Execution Trace, Dynamic Slicing, Test Minimization, Tools for regression testing
Ad hoc Testing: Pair testing, Exploratory testing, Iterative testing, Defect seeding.

Case Study	**Case Study on Regression and Ad hoc Testing of an E-Commerce Website**
Text Book	Text Book 1: Chapter 8,10

MODULE-5	**SOFTWARE TEST AUTOMATION**	**22CSE72.6**	**10 Hours**

Introduction to Selenium: Selenium IDE installation – Recording and running test cases using Selenium IDE – Selenium Commands.
Software Test Automation: Fundamentals of Test Automation, Design and Architecture for Automation
Introduction to Web Driver: Architecture, Installation of Selenium Web Driver, Challenges in Automation Selenium Web Driver.
Testing in Emerging Technologies : Introduction to Testing in Machine Learning and Block Chain Technology.

Case Study	**Case Study on Test Automation using Selenium WebDriver and its Applications in Emerging Technologies**
Text Book	Text Book 1: Chapter 16,17 Text Book 2: Chapter 13

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	10	-	5
L4	Analyze	5	7.5	5
L5	Evaluate	-	7.5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	10
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Desikan and G. Ramesh, "Software Testing: Principles and Practices", Pearson Education, Sixth Impression, 2008.
2) Gayathri Mohan, "Full Stack Testing – A practical Guide for Delivering High Quality Software", Oreilly, 2022.

Reference Books:

1) Dorothy Graham, Rex Black, Erik van Veenendaal, "Foundations of Software Testing: ISTQB Certification", Cengage Learning India Pvt. Ltd.; 4th edition, 2020.

Web links and Video Lectures (e-Resources):

- **https://nptel.ac.in/courses/106101061**
- **https://www.youtube.com/c/seleniumconf**
- **https://se-iitkgp.vlabs.ac.in/exp/designing-test-suites/**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Role-play exercise where students act as “developers” and “testers” for a small program.
- Students perform boundary value and equivalence partitioning on a given function.
- Conduct a Defect Bash where teams intentionally inject and detect defects in a sample codebase.
- Group work to simulate “System Testing” on a mini food-delivery app prototype.
- Mini project using Selenium WebDriver for login automation.

SOFTWARE TESTING LAB			
Course Code	**22CSL72**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

22CSL72.1	Apply fundamental software testing concepts to solve real-world problems using unit and integration testing strategies.
22CSL72.2	Design and evaluate test cases using black box and white box testing techniques with the help of open-source tools.
22CSL72.3	Develop and execute automated test cases using Selenium IDE for validating software functionality.
22CSL72.4	Set up and configure Selenium WebDriver and create test scripts to verify and assert web elements in dynamic web applications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSL72.1	3	2	2	**-**	2	-	-	-	**1**	**1**	-	1	3	**2**
22CSL72.2	3	3	3	**2**	3	-	-	-	**-**	**1**	-	1	3	2
22CSL72.3	3	3	3	**2**	3	-	-	-	**1**	**2**	-	**2**	3	**2**
22CSL72.4	3	3	3	**2**	3	-	-	-	**2**	**2**	1	**2**	3	**3**

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	• Basic Java Programming • HTML & CSS Fundamentals • Assertion Techniques	2	NA
	PART-A		
1	Consider any ATM system, design and develop a program in a language of your choice for the same. Create the test cases for the following scenarios: Unsuccessful operation due to invalid account type. i) Successful selection of amount to be withdrawn. ii) Expected message due to amount to withdraw is greater than possible balance. iii) Unsuccessful operation due to enter wrong PIN number 3 times Execute the test cases manually and discuss the result.	2	22CSL72.1
2	Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept two integers which are supposed to be Accept a person's weight (kg) and height (m), compute BMI = weight / height^2 and classify: • < 18.5: Underweight • 18.5–24.9: Normal • 25–29.9: Overweight • ≥ 30: Obese Execute the test cases manually and discuss the result.	2	22CSL72.1
3	Design, develop, code and run the program in any suitable language to implement the Commission Problem. Analyze it from the perspective boundary value testing. Create different test cases based on the following variants, execute the test cases by using Junit and discuss the test results.	2	22CSL72.2

	i) Normal Boundary Value Testing ii) Robust Boundary Value Testing iii) Worst-Case Boundary Value Testing iv) Robust Worst-Case Boundary Value Testing		
4	Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective boundary value testing. Create different test cases, execute these test cases by using JUnit and discuss the test results. i) Weak Normal Equivalence Class Testing ii) Strong Normal Equivalence Class Testing iii) Weak Robust Equivalence Class Testing iv) Strong Robust Equivalence Class Testing	2	22CSL72.2
5	Demonstrate White box testing techniques using open-source testing tool JUnit and ECLEMMA. Implement and execute test cases for achieving full statement coverage, decision/branch coverage and condition coverage for the triangle program	2	22CSL72.2
6	Demonstrate White box testing techniques using open-source testing tool JUnit and ECLEMMA. Implement and execute test cases for achieving full statement coverage, decision/branch coverage and condition coverage for Next Date function	2	22CSL72.2
PART-B			
7	Designing Test Cases using Selenium IDE	2	22CSL72.3
8	Write an automated selenium script to login into a web page	2	22CSL72.3
9	Write a test program to list the total number of objects present on a web page	2	22CSL72.3
10	Write a test program to demonstrate URL and title check point	2	22CSL72.3
11	Write a test program to demonstrate selecting and deselecting option from multi select dropdown	2	22CSL72.4
12	Write a test program to demonstrate Synchronization.	2	22CSL72.4

PART-C

Beyond Syllabus Virtual Lab Content

Selenium Grid – Parallel and Cross-Browser Testing

- Objective: Introduce distributed testing with Selenium Grid.
- Activity: Execute test cases across multiple browsers and operating systems.
- Learning Outcome: Exposure to real-time continuous integration/continuous deployment (CI/CD) environments.

API Testing using Postman

- Objective: Introduce students to REST API testing.
- Activity: Write and execute API tests using Postman's interface and scripting.
- Learning Outcome: Understand back-end testing and integration test strategies.

https://se-iitkgp.vlabs.ac.in/exp/designing-test-suites/

(To be done during Lab but not to be included for CIE or SEE)

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	5	10
L4	Analyze	5	5
L5	Evaluate	10	10
L6	Create		

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**05**
L3	**Apply**	**10**
L4	**Analyze**	**20**
L5	**Evaluate**	**15**
L6	**Create**	

Suggested Learning Resources:

JUnit 5 User Guide

- https://junit.org/junit5/docs/current/user-guide/

Selenium Official Documentation

- https://www.selenium.dev/documentation/

NPTEL Course: Software Testing by Prof. N. L. Sarda (IIT Bombay)

- https://nptel.ac.in/courses/106101061

Generative AI

Course Code	**22CSE73**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

22CSE73.1	Understand the fundamental concepts of generative AI
22CSE73.2	Apply the techniques involved and monitor the prompt for Generative AI
22CSE73.3	Compute the functions and feedback for generative models
22CSE73.4	Analyze advanced architectures and algorithms in generative AI
22CSE73.5	Interpret the effectiveness of generative models in real-world applications
22CSE73.6	Discover the ethical implications and societal impacts of generative AI

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CSE73.1	1	1	-	-	-	-	1	-	-	-	-	-	-	-
22CSE73.2	2	3	1	-	-	-	-	-	-	-	-	-	2	-
22CSE73.3	2	3	2	-	-	-	-	-	-	-	-	3	2	-
22CSE73.4	3	3	3	-	-	-	-	-	-	-	-	3	2	-
22CSE73.5	1	2	2	-	-	-	-	-	-	-	2	-	2	2
22CSE73.6	2	3	2	-	1	-	1	2	-	-	**2**	-	2	2

MODULE-1	**Introduction to Generative AI**	**22CSE73.1**	**8Hours**

Overview of Generative AI - History and Evolution- Importance of generative models in AI and Machine Learning- Challenges of Generative Modeling – Future of Gen AI – Ethical Aspects of AI – Responsible AI – Use Cases.

Case Study	Analyze real-world case studies (e.g., ChatGPT, DALL·E, MidJourney, or healthcare/genomics applications) to evaluate the impact of Generative AI on society, industry, and ethics.
Textbook	Textbook1:Chapter1,2

MODULE-2	**Prompts in Generative AI**	**22CSE73.2**	**8Hours**

Generative language models- NLP and ML foundations, common NLP task, optimizing prompt-based models, Tuning and optimization techniques, Pre-training and transfer learning – Designing effective prompts – prompt generation strategies – Monitoring prompt effectiveness.

Case Study	Implement a case study using GPT-based models (e.g., text summarization, question answering, or chatbot building). Analyze the effectiveness of prompts and demonstrate prompt optimization strategies.
Textbook	Textbook2: Chapter2,3

MODULE-3	**Generative Models**	**22CSE73.3**	**8Hours**

Reinforcement Learning from Human Feedback- The Process of Building a Model- Moving from Instruct GPT to ChatGPT- Instruct GPT- ChatGPT- The Changing API-Chat Completion API- Moving Away from Chat-
Moving Beyond Chat to Functions-Prompt Engineering as Play Writing.

Case Study	Prompt engineering to create personalized tutoring systems Improve customer support chatbots with iteration Prompt
Textbook	Textbook2: Chapter5,6

MODULE-4	**Generative Adversarial Networks**	**22CSE73.4, 22CSE73.5**	**8Hours**

Understanding GANs: Introduction to Generative Adversarial Networks (GANs)- Generator and Discriminator, GAN Architectures: DCGAN, WGAN, CycleGAN, Training GANs: Challenges and Solutions, Evaluation Metrics Applications of GANs: Image Generation, Style Transfer, Data Augmentation.

Application	Implementation of simple GAN model, training Gan model.compare results with different architecture

Text Book	Text Book 1: Chapter 8,10		
MODULE-5	**Ethical and Future Prospects of Generative AI**	**22CSE73.6**	**8Hours**
Ethical Implications: Bias and Fairness Misuse and Security Concerns, Future Directions: Continual Learning, Multi-modal Generation, AI Creativity and Co-creativity, Responsible AI Practices: Guidelines and Best 22 Practices, Transparency and Accountability			
Case Study	Conduct a case study on ethical dilemmas in Generative AI (e.g., deepfakes, AI-generated misinformation, or bias in LLMs and propose mitigation strategies aligning with Responsible AI guidelines.		
Text Book	Text Book 1: Chapter 16,17 Text Book 2: Chapter 13		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	5
L2	Understand	5	-	5
L3	Apply	5	7.5	-
L4	Analyze	5	7.5	-
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Generative AI for Everyone – Altaf Rehmani – BlueRose One – 2024
2) Prompt Engineering for Generative AI, by James Phoenix, Mike Taylor, Published by O'Reilly Media, Inc. in 2024, ISBN: 9781098153434

Reference Books:

1) The Art of Prompt Engineering with Chatgpt: A Hands-OnGuide: 3 (LearnAI Tools the FunWay!) by Nathan Hunter published in 2023.
2) Generative Deep Learning, David Foster, O'Reily Books, 2024.

Web links and Video Lectures (e-Resources):

- **https://youtu.be/_ZvnD73m40o**
- **https://youtu.be/jC4v5AS4RIM**
- **https://www.youtube.com/watch?v=QZosTTcg7F8&pp=ygUZcHJvbXB0IGVuZ2luZWVyaW5nIGNvdXJzZQ%3D%3D**
- **https://www.youtube.com/watch?v=6eul1pfGKwk&pp=ygUZcHJvbXB0IGVuZ2luZWVyaW5nIGNvdXJzZQ%3D%3D**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Video demonstration of latest trends in GenerativeAI .
- Demonstration of sample projects done using ChatGPT
- For active participation of students, instruct the students to prepare quality prompts and Handouts
- Organizing Group wise discussion

PROJECT WORK

Course Code	**22CSE74**	**CIE Marks**	**100**
L:T:P:S	**0:0:10:0**	**SEE Marks**	**100**
Hrs / Week	**-**	**Total Marks**	**200**
Credits	**10**	**Exam Hours**	**03**

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

22CSE74.1	Recall societal problems under sustainable development goals and classify them under different domains of computer science and engineering with an interdisciplinary perspective, addressing them at TRL 1 (Basic principles observed and reported).
22CSE74.2	Demonstrate the ability to conduct comprehensive literature reviews using appropriate research databases, search strategies, and citation management tools to identify relevant sources of information, reaching TRL 2 (Formulation of technology concept/application).
22CSE74.3	Apply knowledge of relevant programming languages, software and hardware development methodologies, tools, and technologies to address project requirements effectively at TRL 3 (Experimental proof of concept).
22CSE74.4	Experiment with the models for the proposed system and validate the design outcomes through simulation or prototyping at TRL 4 (Technology validated in lab environment).
22CSE74.5	Interpret and demonstrate effective communication skills through technical presentations and documentation of project outcomes at TRL 4–5 (Technology validated/tested in relevant environment).
22CSE74.6	Create a research-oriented article logically, following a structured format with well-defined sections such as Introduction, background, methodology, results, discussion, and conclusion, aligned to TRL 5 (Technology tested in relevant environment).

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CSE74.1	2	2	1	-	-	3	3	1	-	1	1	2	3	2
22CSE74.2	2	3	2	3	1	1	1	2	1	2	-	3	2	2
22CSE74.3	3	2	3	2	3	1	1	1	2	2	2	2	2	3
22CSE74.4	2	3	3	3	3	-	1	1	2	2	2	2	2	3
22CSE74.5	1	1	1	1	1	-	-	1	3	3	2	2	1	2
22CSE74.6	1	2	2	2	1	1	1	2	2	3	1	3	2	2

Project Work: Roadmap, activities, and deliverables

Goal Selection and Project Planning:

- Identification of suitable topic based on Sustainable Development Goals.
- Forming project teams based on common interests and skill sets.
- Teams' involvement in developing project proposals outlining objectives, strategies, and expected outcomes.

Research and Needs Assessment:

Survey conduction by thorough research on the chosen SDGs, including global and local context, challenges, and opportunities.

- Conduct needs assessments to identify specific issues or gaps that student projects can

address Interdisciplinary approaches :

- Applying interdisciplinary approaches and innovative solutions to tackle sustainability

challenges. Deployment:

- Deploy the project on appropriate hardware and software environments, considering scalability, security, and performance requirements.
- Configure servers, databases, and other infrastructure components to support the application's operation.
- Conduct deployment testing to ensure a smooth transition from development to production.

Knowledge Sharing and Communication:

- students to share their project experiences and insights through presentations, reports, and social media.
- Foster peer-to-peer learning and collaboration by creating platforms for knowledge

Eighth Semester Syllabus

Professional Elective Course-III (3:0:0:0)	
22CSE811	**Concurrent Programming**
22CSE812	**Human Computer Interaction**
22CSE813	**Soft Computing**
22CSE814	**Entrepreneurship and Resource Management**
22CSE815	**Social Media Networks**

CONCURRENT PROGRAMMING			
Course Code	**22CSE811**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22CSE811.1	Recognize the basic concurrency concepts and the problems in concurrent applications.
22CSE811.2	Analyze the thread management executor framework using client server concurrency models.
22CSE811.3	Design concurrent programs using memory and progress models.
22CSE811.4	Apply Amdahl's Law and its implications to improve the performance and scalability of parallel and concurrent systems.
22CSE811.5	Evaluate various approaches to implementing concurrent queues and stacks in terms of performance and correctness.
22CSE811.6	Analyze the concept of transactional memory and its use as an alternative to lock-based synchronization.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE811.1	3	3	3	3	3	-	-	-	-	-	3	-	3	-
22CSE811.2	2	2	3	3	2	-	-	-	1	-	-	2	3	-
22CSE811.3	1	2	2	3	3	-	-	-	-	-	2	1	3	-
22CSE811.4	2	2	2	3	2	-	-	-	-	-	2	1	3	-
22CSE811.5	2	2	2	3	2	-	-	-	-	-	-	1	3	-
22CSE811.6	1	2	3	3	3	-	-	-	1	-	-	2	3	-

MODULE-1	**FUNDAMENTALS OF CONCURRENT PROGRAMMING**	**22CSE811.1**	**8 Hours**

Basic concurrency concepts, concurrency versus parallelism, synchronization, immutable object, atomic operations and variables, possible problems in concurrent applications-Data race, Deadlock, Livelock

Self-study / Case Study / Applications	An e-commerce company operates a large warehouse that handles thousands of product orders and updates inventory in real-time. To ensure fast order processing and stock updates, the system is designed using **concurrent programming** principles. Multiple threads operate simultaneously to handle customer orders, restocking, and status checks. When thousands of users place orders concurrently: • Inventory can be **overdrawn** (if threads interfere). • Product counts might **not update correctly**. • Delays and incorrect responses reduce customer satisfaction. To solve this, the warehouse system must be **concurrent, efficient, and thread-safe**.
Text Book	Textbook 1: Chapter 1; Textbook 2: Chapter 2,5

MODULE-2	**THREAD MANAGEMENT & EXECUTOR FRAMEWORK**	**22CSE811.2**	**8 Hours**

Thread pools, Executors, managing large number of threads, serial, coarse-grained, fine-grained concurrency, Client–server concurrency models, Callable & Future interfaces

Self-study / Case Study / Applications	Develop a task scheduling system that handles simultaneous job submissions from multiple users. Each job must be executed efficiently using a fixed number of threads, and the system should support features such as task prioritization, timeout handling, and graceful shutdown. Implement the solution using Java's Executor Framework to manage thread creation, execution, and lifecycle, ensuring optimal resource utilization and thread safety under high concurrency.
Text Book	Textbook 1: Chapter 2; Text Book 3: Chapter 6,8;

MODULE-3	**CONCURRENT OBJECTS**	**22CSE811.3**	**8 Hours**

Concurrency and Correctness, Sequential Objects, Quiescent consistency, Sequential Consistency, The Nonblocking Property, Progress conditions, Dependent Progress Conditions, The Java Memory Model, Volatile Fields, Final Fields.			
Self-study / Case Study / Applications	Design a shared online banking system where multiple users can simultaneously perform transactions such as deposits, withdrawals, and balance inquiries on shared account objects. The system must ensure that the account balances remain consistent and accurate under concurrent access, using thread-safe concurrent objects without introducing race conditions, data corruption, or deadlocks. Implement the system using appropriate concurrent data structures and synchronization mechanisms provided in Java.		
Text Book	Text Book 2: Chapter ,3,9		
MODULE-4	**PERFORMANCE AND SCALABILITY TESTING**	**22CSE811.4**	**8 Hours**
Amdahl's law, cost introduced by threads, reducing lock contention, testing Concurrent Programs-Testing for correctness, performance, complementary testing approaches			
Self-study / Case Study / Applications	Design and execute a performance and scalability test for a web-based student registration system that experiences high traffic during peak admission periods. The system should be evaluated for response time, throughput, resource utilization, and behavior under varying loads, including stress, load, and spike conditions. Identify performance bottlenecks and provide recommendations for improving system scalability to handle thousands of concurrent users efficiently.		
Text Book	Textbook 3: Chapter 8,11,12		
MODULE-5	**Concurrent Stacks &Queues**	**22CSE811.5 22CSE811.6**	**8 Hours**
Concurrent Queues and the ABA Problem, concurrent Stacks and elimination, Transactional Memories-software transactional memory			
Self-study / Case Study / Applications	Implement a multi-threaded task dispatching system where multiple producer threads submit tasks to a shared queue and multiple consumer threads process them concurrently. Use thread-safe concurrent queue or stack implementations to ensure correct task ordering and avoid race conditions, deadlocks, or data loss during high-concurrency operations. Analyze the system's correctness and performance under different load conditions.		
Text Book	Textbook 2: 10,11,17; Textbook 3: Chapter 5,12		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	10	15
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	05	5	5
L5	Evaluate	05	-	5
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	--
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. "Mastering Concurrency Programming with Java 9", Javier Fernandez Gonzalez, Packt Publication 2nd Edition 2017
2. "Art of Multiprocessor Programming" Maurice Herlihy & Nir Shavit,2nd Edition 2020
3. "Java Concurrency in Practice", Brian Goetz ,Pearson Publication ,1st Edition 2006

Reference Books:

1. Concurrent Programming in Java™: Design Principles and Patterns, Second Edition by Doug Lea, Publisher: Addison Wesley, Pub Date: October 01, 1999.
2. Herbert Schidlt, "Java Complete Reference", Tata-McGraw-Hill, Thirteenth Edition, Paperback, 2023.

Web links and Video Lectures (e-Resources):

https://www.coursera.org/learn/concurrent-programming-in-java
https://www.udemy.com/course/multithreading-and-parallel-computing-in-java
https://www.toptal.com/software/introduction-to-concurrent-programming
https://gowthamy.medium.com/concurrent-programming-introduction-1b6eac31aa66

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case study
- Video

HUMAN COMPUTER INTERACTION			
Course Code	**22CSE812**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

22CSE812.1	Apply knowledge of human cognitive and perceptual abilities to design user-centric interfaces.
22CSE812.2	Apply interaction design principles and usability guidelines to develop intuitive and accessible interfaces.
22CSE812.3	Analyze various HCI models and theories to improve interface effectiveness and user engagement.
22CSE812.4	Apply cognitive and physical models to evaluate and enhance human-computer interaction efficiency.
22CSE812.5	Design mobile application interfaces considering platform constraints and interaction styles.
22CSE812.6	Create responsive and interactive web interfaces using modern design principles and process flows.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE812.1	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**-**
22CSE812.2	**2**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**3**	**-**
22CSE812.3	**2**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**3**	**-**
22CSE812.4	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**3**	**-**
22CSE812.5	**2**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**3**	2
22CSE812.6	**2**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**3**	2

MODULE-1	**Foundations of HCI**	**22CSE812.1 22CSE812.4**	**8 Hours**

The Human:

Input/Output channels – visual, auditory, and haptic perception; Memory – sensory memory, short-term (working memory), long-term, and Reasoning and problem-solving approaches.

The Computer:

Devices – input/output hardware, Processing and networks in interactive systems.

Interaction:

Models and frameworks of interaction; Ergonomics in interface design; Interaction styles – command line, menus, direct manipulation; Elements of the WIMP interface, Interactivity

Text Book	Text Book 1: Chapter 1,2,3

MODULE-2	**DESIGN PROCESS & EVALUATION**	**22CSE812.2**	**8 Hours**

Design and Development:

Basics of interaction design – process, scenarios, navigation, screen layout; Iterative prototyping techniques.

HCI in Software Engineering:

HCI role in SDLC; Usability engineering; Iterative Design and Prototyping, Design Rationale

Design Guidelines:

Principles to Support Usability: Learnability, Flexibility, Robustness; Standards, Guidelines, Golden rules and Heuristics

Text Book	Text Book 1: Chapter 5,6,7,9

MODULE-3	MODELS AND THEORIES	22CSE812.3 22CSE812.4	8 Hours
Cognitive models – GOMS, Physical and Device Models: Keystroke-level model, Three-state model. **Socio-organizational issues** – Organizational Issues, Capturing Requirements. **Communication and collaboration models** – Face-to-Face Communication, Text-Based Communication. Hypertext, multimedia, and WWW			
Text Book	Text Book 1: Chapter 12,13,14,21		
MODULE-4	**MOBILE HCI**	**22CSE812.5**	**8 Hours**
Mobile ecosystem – platforms, application frameworks; **Types of mobile applications –** widgets, native apps, games;Mobile information architecture, Mobile 2.0, **Elements of mobile design –** touch gestures, layout constraints; Tools for UI prototyping.			
Text Book	Text Book 2: Chapter 2,6,7,8,10		
MODULE-5	**WEB INTERFACE DESIGN**	**22CSE812.6**	**8 Hours**
Web interface design core principles– responsiveness, feedback, clarity; **Interaction techniques** – drag & drop, contextual tools, direct selection; Overlays, inlays, and virtual pages in web UIs; Process Flow – Interactive Single-Page Process, Inline Assistant Process, Dialog Overlay Process, Configuration Process, Static Single-Page Process			
Text Book	Text Book 3: Chapter 1,2,3		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	-	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, and Russell Beale, Human-Computer Interaction, 3rd Edition, Pearson Education, 2004. (Recommended for Unit I, II & III)
2. Brian Fling, Mobile Design and Development, First Edition, O'Reilly Media Inc., 2009. (Recommended for IV)
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009. (Recommended for V)

Reference Books:

1. Don Norman, The Design of Everyday Things, Revised and Expanded Edition, Basic Books, 2013. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, and Steven Jacobs,

2. Designing the User Interface: Strategies for Effective Human-Computer Interaction, 6th Edition, Pearson, 2016.
3. Helen Sharp, Yvonne Rogers, and Jenny Preece, Interaction Design: Beyond Human–Computer Interaction, 6th Edition, Wiley, 2023.

Web links and Video Lectures (e-Resources):

1. **Coursera – Human-Computer Interaction by UC San Diego**
   https://www.coursera.org/learn/human-computer-interaction
2. **Human–Computer Interaction** – Prof. Pradeep Yammiyavar, IIT Guwahati https://nptel.ac.in/courses/106103115

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Perception Test Workshop – Students perform short vision, hearing, and memory tests to understand human cognitive limits.

Activity: Paper Prototyping Sprint – Groups design a paper interface for a given task (e.g., booking a train ticket) and test with peers.

SOFT COMPUTING

Course Code	**22CSE813**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs/Week	**03**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22CSE813.1	Apply the fundamental knowledge of Soft Computing concepts in building intelligent machines
22CSE813.2	Use fuzzy rules and reasoning to develop decision making and expert system
22CSE813.3	Apply the fundamentals of Genetic Algorithms in soft computing applications
22CSE813.4	Apply swarm intelligence and bio-inspired algorithms to solve real-world optimization problems.
22CSE813.5	Demonstrate the application of soft computing techniques in various domains such as image processing, control systems, and intelligent prediction.
22CSE813.6	Analyze and implement soft computing approaches to solve complex, interdisciplinary real-world problems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE813.1	2	3	2	-	2	-	-	-	-	-	2	1	1	1
22CSE813.2	2	3	3	-	2	-	-	-	-	-	2	1	2	1
22CSE813.3	3	2	3	-	3	-	-	-	-	-	1	2	2	1
22CSE813.4	3	2	2	-	1	-	-	-	-	-	2	2	2	2
22CSE813.5	1	3	2	-	1	-	-	-	-	-	1	2	2	2
22CSE813.6	1	2	3	-	2	-	-	-	-	-	3	2	3	3

MODULE-1	**Introduction to Soft Computing**	**22CSE813.1**	**8Hours**

Soft Computing Constituents-From Conventional AI to Computational Intelligence- Evolution of neural networks - basic models - important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian product of relation - classical relation. Genetic algorithm: Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

Self Study:	Students should explore basic models, sets/relations, and optimization concepts with real-world applications.
Text book	Textbook1:Chapter1,2

MODULE-2	FUZZY LOGIC	**22CSE813.2**	**8Hours**

Membership Functions & Fuzzification, Defuzzification, Fuzzy Arithmetic & Extension Principle, Fuzzy Measures & Integrals, Rule Base & Approximate Reasoning, Inference Systems & Expert Systems, Fuzzy Decision Making.

Self Study:	Compare methods (Centroid, Maximum, Weighted Average) with small examples and show how each gives different crisp outputs.
Text book	Textbook1: Chapter 4,5

MODULE-3	**Genetic Algorithms**	**22CSE813.3**	**8 Hours**

Elements of Genetic Algorithms, A simple Genetic Algorithm, Genetic algorithms and traditional search methods, Working of Genetic algorithms, Genetic algorithms in problem solving - Data analysis and prediction, Genetic algorithms in scientific models, modeling interactions between learning and evolution- The Baldwin effect, evolutionary reinforcement learning, measuring evolutionary activity- The two armed bandit problem, Mathematical models of simple Genetic algorithms, encoding for a Genetic algorithm, adapting the encoding, Selection methods, Genetic operators, Parameters for Genetic algorithms.

Self Study:	Explore how Genetic Algorithm concepts are combined with reinforcement learning; find one real-world application.
Text book	Textbook 3: Chapter 1, 2, 4, 5

MODULE-4	Swarm Intelligence: Algorithms and Applications	22CSE813.4	8Hours
Particle Swarm Optimization: Principles of Bird Flocking and Fish Schooling, Bat Algorithm, Ant Colony Optimization, Artificial Bee Colony Algorithm, Krill Herd Optimization, Roach Infestation Optimization, Cuckoo Search Algorithm.			
Self Study	Study pheromone trails and pathfinding; simulate solving a shortest path or TSP problem.		
Text book	Textbook 2: Chapter 14		
MODULE-5	Soft Computing in Real-World Applications	**22CSE813.5 22CSE813.6**	**8Hours**
Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, Intrusion Detection Systems using Neural Networks and Fuzzy Logic, Prediction of Disease Outbreaks using Neuro-Fuzzy Systems.			
Self Study	Explore how neural networks, fuzzy logic, or evolutionary algorithms are used in image fusion for satellite imagery. Identify at least one case study (e.g., COVID-19, dengue, malaria) where prediction was enhanced using soft computing.		
Text Book	Textbook 2: Chapter 15		

CIE Assessment Pattern(50Marks–Theory)

RBT Levels		Marks Distribution		
		Test(s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	5
L2	Understand	5	-	5
L3	Apply	5	7.5	-
L4	Analyze	5	7.5	-
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks–Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. J.S.R. Jang, C.T. Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence", Pearson India, 2015.
2. Fakhreddine O. Karray and Clarence De Silva, *Soft Computing and Intelligent Systems Design: Theory, Tools and Applications*, Pearson Education, 2004.
3. Melanie Mitchell, "An Introduction to Genetic Algorithms", MIT Press, 1999 David E. Goldberg, "Genetic Algorithms in search optimization and Machine Learning", Addison-Wesley Publishing Company, Inc 1989

Reference Books:

1. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" Prentice Hall, 1997.
3. David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning" Pearson Education

India, 2013
Web links and Video Lectures(e-Resources): ● **https://www.classcentral.com/course/swayam-soft-computing-techniques-379926** ● **https://onlinecourses.nptel.ac.in/noc20_cs17/preview** ● **https://cse.iitkgp.ac.in/~dsamanta/courses/sca/**
Activity-Based Learning (Suggested Activities in Class)/Practical Based learning ● Video demonstration of the latest trends in soft computing. ● Quizzes & Assignments ● Contents related activities (Activity-based discussions) ● For active participation of students, instruct the students to prepare network models ● Organizing Groupwise discussions

ENTREPRENEURSHIP AND RESOURCE MANAGEMENT			
Course Code	**22CSE814**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**03**

Course outcomes:

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

24CSE814.1	Explore the types of entrepreneur and its economic growth
24CSE814.2	Apply various types of motivation strategy to get the work from the sub ordinates.
24CSE814.3	Address the different Business structure in the current scenario
24CSE814.4	Explore the steps involved in starting a new Business
24CSE814.5	Analyze the profit and loss in the business
24CSE814.6	Apply the various methodologies to support the entrepreneur

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
24CSE814.1	3	3	-	-	-	-	-	2	3	3	3	2	-	3
24CSE814.2	3	3	-	-	-	-	-	2	3	3	3	2	-	3
24CSE814.3	3	3	-	-	-	-	-	2	3	3	3	2	-	3
24CSE814.4	3	3	-	-	-	-	-	2	3	3	3	2	-	3
24CSE814.5	3	3	-	-	-	-	-	2	3	3	3	2	-	3
24CSE814.6	3	3	-	-	-	-	-	2	3	3	3	2	-	3

MODULE-1	**ENTREPRENEURSHIP**	**24CSE814.1**	**8 Hours**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

Case Study/ Self Study	**Explore the technical journey of MyGate Apartment Security app in India.** Understand factors contributing to entrepreneurial success and the strategic thinking in a changing competitive business environment..

Text Book: T1: Chapter 1,2,9

MODULE-2	**MOTIVATION**	**24CSE814.2**	**8 Hours**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

Case Study	Nike, one of the world's largest sportswear manufacturers, had very humble beginnings. Investigate on how the vision and energy of its founder, Philip Knight took it to new heights.

Text Book: T1: Chapter 10,11,12

MODULE-3	**BUSINESS**	**24CSE814.3 & 24CSE814.4**	**8 Hours**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

Self Study/ Case Study	Traditionally, men were the target of the financial service providers, while women were seen as less confident regarding the matters of finance. Recent societal developments, such as more women working from home had changed the scenario. Explore how HSBC strategy to women's disposition to risk taking, and how did it differ from those of men? To what extent did it vary by age, income or education?

Text Book: T1: Chapter 13,14,15

MODULE-4	**FINANCING AND ACCOUNTING**	**24CSE814.5**	**8 Hours**

Financial Needs and Sources – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.			
Self Study	Understand why companies go in for a share buyback. Know the process of share buyback Know the various methods of buyback. Also understand the impact of buybacks on the market price of shares.		
Text Book: T1: Chapter 17			
MODULE-5	**SUPPORT TO ENTREPRENEURS**	**24CSE814.6**	**8 Hours**
Financial and Operational Challenges in Small Businesses – Concept, Magnitude, Causes and Consequences, Corrective Measures- Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.			
Self Study	Ministry of Electronics and Information Technology (MeitY) has launched an umbrella program Digital India-GENESIS to discover, support, grow, and make successful startups in Tier-II and Tier-III cities with emphasis on collaborative engagement among startups, government, and corporates for promoting digitization based on the principals of inclusivity, accessibility, affordability. Explore the Tier-II and Tier-III requirements to support entrepreneurs.		
Text Book: T1: chapter 19,20,21			

CIE Assessment Pattern (50 Marks)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	5	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	10	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	--
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	20
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi,2013
2. Donald F Kuratko, "Entreprenuership - Theory, Process and Practice", 9th Edition, Cengage Learning, 2014

Reference Books:

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech.2005
3. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

SOCIAL MEDIA NETWORKS			
Course Code	**22CSE815**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22CSE815.1	Infer and identify the various concepts in social media and also learn to use social media in an ethical manner
22CSE815.2	Make use of graph theory approach to model social networks.
22CSE815.3	Analyze the social networks to draw insights on the interactions between/within social groups.
22CSE815.4	Evaluate the structure of a social network and identify the influential entities.
22CSE815.5	Interpret the fundamental principles for analyzing social media marketing and its importance.
22CSE815.6	Select and utilize data analysis methods for addressing real world problems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE815.1	3	-	-	-	-	3	-	3	3	-	-	3	2	-
22CSE815.2	3	-	-	1	-	3	-	3	3	-	-	3	2	-
22CSE815.3	3	-	-	1	2	3	-	3	3	-	-	3	3	2
22CSE815.4	3	-	-	1	2	3	-	3	3	-	-	3	3	2
22CSE815.5	3	-	1	-	2	3	-	3	3	-	-	3	3	3
22CSE815.6	3	-	-	-	2	3	-	3	3	-	-	3	3	3

MODULE-1	**INTRODUCTION**	**22CSE815.1**	**8 Hours**

Understand What Social Networking is, Social Media Characteristics, What is Social Media and Why It is Important, Types of Social Media, Core Values, Challenges, Advantages and Disadvantages, Future of Social Networking, Various social networking sites - FACEBOOK, INSTAGRAM, TWITTER, LINKEDIN - Why and how they matter, Key Features, Marketing - What You Need to Know.

Case Study	Evolution and Impact of Instagram in Influencer Marketing.
Text Book	Text Book: 2 ; Chapter: 1.1-1.4, 2.1-2.2, 3.1, 6.1

MODULE-2	**BUILDING A NETWORK**	**22CSE815.2**	**8 Hours**

Networks as Graphs – Actors, Ties, Networks, Multiplex Networks, Weighted Ties, Group, Geodesic Distance, Graph Connectivity, Degree of an Actor – Indegree and Outdegree, Types of nodes – Carrier, Transmitter, Receiver, Isolate, Representation of Social Network Data – Sociomatrix and Edge List, Network Relationships & Reciprocity, Transitivity, Popularity Structural Equivalence, Clique, Star.

Self-study	Explore how LinkedIn's network structure impacts connection suggestions.
Text Book	Text Book: 1; Chapters: 2.1-2.6, 3.1-3.3

MODULE-3	STRENGTH OF WEAK TIES & HOMOPHILY	22CSE815.3	8 Hours
Granovetter's strength of weak ties, Triads, Clustering Coefficient and Neighbourhood Overlap, Structure of Weak Ties, Bridges and Local Bridges, Embeddedness, Structural Holes, Social Capital, Tie Strength, Social Media and Passive Engagement, Betweenness measures and Graph Partitioning, Finding Communities in a Graph, Girvan Newman Algorithm, Strong and Weak Relationship, Introduction to Homophily.			
Case Study	Study how YouTube recommends content using graph communities and homophily.		
Text Book	Text Book: 1; Chapters: 3.4-3.6, 4.1-4.4, 5.1-5.3		
MODULE-4	**NETWORK PROPERTIES**	**22CSE815.4, 22CSE815.5**	**8 Hours**
Network Density, Properties of Nodes – Degree Centrality, Closeness Centrality, Betweenness Centrality, Centrality of a Network - Network Degree Centrality, Network Closeness Centrality, Network Betweenness Centrality, Page rank centrality			
Application	Measuring Influence in Twitter using PageRank and Centrality Measures		
Text Book	Text Book: 1; Chapters: 14.1-14.8		
MODULE-5	**SOCIAL MEDIA MINING AND SNA IN REAL WORLD**	**22CSE815.6**	**8 Hours**
FB/VK and Twitter analysis: Natural language processing and sentiment mining. Properties of large social networks: friends, connections, likes, re-tweets.			
Application	Sentiment Analysis of Tweets on a Trending Topic Using Python (e.g., Tweepy + TextBlob)		
Text Book	Text Book: 2; Chapters: 2.3-2.5, 3.2-3.5, 9.1-9.3, 10.1-10.3		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	-	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) David Easley & Jon Kleinberg (Cambridge University Press) "Networks, Crowds, and Markets: Reasoning about a Highly Connected World".
2) Matthew A. Russell & Mikhail Klassen (O'Reilly) "Mining the Social Web", 3rd Edition.

Reference Books:

1) James M Cook, University of Maine at Augusta "What is a Social Network"
2) Robert A Hanneman, Department of Sociology, University of California, Riverside, "Introduction to Social Network methods".
3) Christina Falci, Department of Sociology, University of Nebraska, Lincoln, "Social Network Analysis"
4) Matthew Ganis & Avinash Kohirkar, "Social Media Analytics"
5) Bobbi J Carothers, American Evaluation Association, Denver, Colorado, "Network Analysis from Start to finish: Techniques, Tools and Tips for Evaluating your Network"
6) Matthew Denny, Institute for Social Science Research, University of Massachusetts, AMHERST, "Social Network Analysis"
7) Timothy Baldwin, University of Melbourne, "Semantic Analysis of Social Media"

Web links and Video Lectures (e-Resources):

- **Pew Research Center – Social Media Fact Sheet**
  https://www.pewresearch.org/internet/fact-sheet/social-media/
- **TeachEngineering – Graph Theory and Social Networks (University of Colorado Boulder initiative)**
  https://www.teachengineering.org/activities/view/uno_graphtheory_lesson01_activity1
- **YouTube – Overview of Social Network Analysis (Trusted Educational Channel)**
  https://www.youtube.com/watch?v=fgr_g1q2ikA
- **YouTube – Introduction to Social Media Analytics (Institutional Upload)**
  https://www.youtube.com/watch?v=P33xa4l4GTM
- **MeaningCloud – Media & Text Analytics Solutions** (Industry-recognized analytics platform)
  https://www.meaningcloud.com/solutions/media-analysis
- **History Cooperative – The History of Social Media** (Scholarly Article)
  https://historycooperative.org/the-history-of-social-media/
- **NPTEL (IIT Kharagpur) – Social Networks** *(Comprehensive course with SNA fundamentals and applications)*
  https://nptel.ac.in/courses/106105154
- **NPTEL (IIT Madras) – Introduction to Social Media Analytics** *(MOOC focusing on analytics and mining techniques)*
  https://nptel.ac.in/courses/110106081

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- **Group Discussion:** Compare key features and user base of major social platforms (Facebook, Instagram, LinkedIn, Twitter).
- **Role-Play:** Simulate social networking formation in a classroom with name tags and connection cards.
- **Group Case Analysis:** Present real-world examples of weak ties and strong ties (LinkedIn hiring, Twitter news propagation).
- **Interactive Charting:** Have students draw small networks and calculate degree, closeness, and betweenness manually.
- **Video Analysis:** Watch and analyze a YouTube algorithm documentary (like "The Social Dilemma").

Professional Elective Course - IV- (3:0:0:0)	
22CSE821	**Design Thinking**
22CSE822	**Service Oriented Architecture**
22CSE823	**Recommender Systems**
22CSE824	**Ethics in AI**
22CSE825	**Storage Area Networks**

DESIGN THINKING			
Course Code	**22CSE821**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**03**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

22CSE821.1	Obtain the depth knowledge about creative design thinking in every stage of problem
22CSE821.2	Explore the various stages of engineering design process with the help of real-life examples
22CSE821.3	Apply design thinking approach to real world problems to evolve an innovative solution
22CSE821.4	Analyze and identify the technology gap present in the problem.
22CSE821.5	Build the foundational ideas of innovation based on the embodiment engineering design process.
22CSE821.6	Develop a design, Gantt chart, Pert chart using modern tool for the identified real world problem statement as a team and submit reports / give a presentation.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE821.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
22CSE821.2	3	-	-	-	-	-	-	-	-	-	-	-	-	
22CSE821.3	3	-	-	-	-	-	-	-	-	-	-	-	-	
22CSE821.4	-	3	-	-	-	-	-	-	-	-	-	-	2	
22CSE821.5	-	-	3	-	-	-	-	-	-	-	-	-	2	
22CSE821.6	-	-	2	-	2	2	2	2	2	2	2	2	2	2

MODULE-1	**UNDERSTAND, ANALYZE AND FORMULAT THE PROBLEM**	**22CSE821.1, 22CSE821.3, 22CSE821.4**	**8 Hours**

The Why and How of Design Thinking; Principles – Process – Plan; Search field – Understand-analysis-reformulate the problem.

Applications /Case Study / Case Let	Analyze a real-life example where Design Thinking principles were applied to identify and solve a human-centered problem.
Text Book	Text Book 1: Chapter 1, 2. Text Book 2: Chapter 1, 2

MODULE-2	**OBSERVE, DEFINE AND IDEATION**	**22CSE821.1, 22CSE821.3, 22CSE821.4**	**8 Hours**

Observation phase- Tips - Empathetic design & methods; Defining the problem; Ideate Phase - Creative Process – principles – techniques – Evaluation Ideas.

Applications /Case Study / Case Let	Reflect on how diverse team ideation improves idea quality and leads to more user-focused innovation.
Text Book	Text Book 2: Chapter 3, 4, 5

MODULE-3	**PROTOTYPE, TEST AND IMPLEMENTATION**	**22CSE821.1, 22CSE821.3, 22CSE821.5**	**8 Hours**

Prototype Phase – Development – Visualization & Presentation techniques; Test Phase – interviews – surveys – kano model – Desirability test; Implementation phase- conduct workshops – requirement – Agility for design thinking.

Applications /Case Study /	Analyze a product that was significantly improved after user testing and evaluation.

Case Let			
Text Book	Text Book 2: Chapter 6, 7 ,8		
MODULE-4	**ENGINEERING DESIGN PROCESS**	**22CSE821.2, 22CSE821.5**	**8 Hours**
Design Level – Systematic design – Design Process – Ethics; Establishing functional structure – decomposition – procedure – Reverse Engineering – Example; Performance specification method – Example; Developing Concepts - Developing working structure – Steps – Brainstorming – Creativity.			
Applications /Case Study / Case Let	Explore how brainstorming and creative thinking techniques support the generation of innovative design concepts.		
Text Book	Text Book 3: Chapter 1, 5, 6, 7,		
MODULE-5	**EMBODIMENT DESIGN**	**22CSE821.2, 22CSE821.6**	**8 Hours**
Steps – Checklist – Rules – Principles – Guidelines – Evaluation – Example; Design for tomorrow.			
Applications /Case Study / Case Let	Create a design checklist for evaluating the embodiment of a physical product (e.g., medical device, kitchen tool).		
Text Book	Text Book 4: Chapter 7. Text Book 5: Chapter 10.		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	--	--	--
L2	Understand	5	--	--
L3	Apply	5	5	--
L4	Analyze	10	10	--
L5	Evaluate	5	--	5
L6	Create	--	--	5

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	--
L2	Understand	10
L3	Apply	10
L4	Analyze	20
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: a design thinking tool kit for managers", Columbia University Press, 1893, ISBN 978-0-231-52796-5.
2) Christian Mueller-Roterberg, "Handbook of Design Thinking - Tips & Tools for how to design thinking", 2018.
3) Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011,ISBN-13: 978-0-495-66814-5.
4) G. Pahl and W. Beitz J. Feldhusen and K.-H. Grote, "Engineering Design A Systematic Approach", 3rd Edition, Springer-Verlag London Limited 2007, ISBN 978-1-84628-318-5.
5) Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation" HarperCollins e-books, 2009 ISBN 978-0-06-193774-3.

Reference Books:

1) Johnny Schneider, “Understanding Design Thinking, Lean and Agile”, O'Reilly Media, 2017, ISBN 9781491980477.
2) Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009, ISBN-13: 978-1422177808.
3) Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011, ISBN-13: 978-3-642-13756-3.
4) Jeanne Liedtka, Andrew King, Kevin Bennett, “ Solving Problems with Design Thinking - Ten Stories of What Works”, Columbia Business School Publishing, 2013,ISBN-13: 978 0 231 16356 9.

Web links and Video Lectures (e-Resources):

- **https://onlinecourses.swayam2.ac.in/imb24_mg37/preview**
- **https://iimkozhikode.emeritus.com/iimk-design-thinking-and-innovation-ai-programme?utm_source=bing&utm_medium=Search&utm_campaign=B-365d_IN_BG_SE_IIMK-PCPDTIM_Core_Phrase&utm_content=Design_Thinking&utm_term=design%20thinking%20course&msclkid=6f1d891a93f31cdef410e16f66584bf5**
- **https://venturewell.org/class-exercises**
- **https://www.coursera.org/learn/uva-darden-design-thinking-innovation**
- **https://www.ibm.com/design/thinking/**
- **https://collegedunia.com/courses/design-thinking**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Design Challenges: Present the real-world design challenges and come up with innovative solutions. These challenges can range from product design to service design.
- User Research and Empathy Activities: Engage in activities that involve interacting with potential users or customers. They can conduct interviews, surveys, and observations to gain a deeper understanding of user needs and pain points.
- Prototyping Workshops: Learn to create prototypes using various tools and materials. Encourage them to build physical and digital prototypes to test their design concepts.
- Design Thinking Workshops: Participate in design thinking workshops where students can work on real projects. These workshops can include brainstorming, ideation, and collaborative problem-solving activities.
- Role-Playing Scenarios: Engage in role-playing scenarios to understand user experiences and perspectives. This can help them to empathize with users and design solutions that address their needs.
- Field Studies: Plan field trips to observe and study real-world design challenges. They can gain insights from visiting companies, organizations, or places where design thinking is applied.

SERVICE-ORIENTED ARCHITECTURE			
CourseCode	**22CSE822**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22CSE822.1	Understand the fundamentals of distributed computing, XML, SOA, and web service architecture and standards.
22CSE822.2	Summarize and differentiate between various web service technologies including SOAP, REST, WSDL, and UDDI.
22CSE822.3	Apply Java and .NET technologies to implement SOA-based solutions using JAX-WS, JAXB, JAXR, and related APIs.
22CSE822.4	Analyze and compare service composition approaches such as orchestration and choreography, including WS-* specifications.
22CSE822.5	Identify the interoperable web services using principles of service contract, message exchange patterns, and WS-Policy.
22CSE822.6	Evaluate security mechanisms in SOA including XML Encryption, XML Signature, and SAML for secure web service development.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE822.1	3	2	-	-	-	-	-	-	-	-	-	-	2	3
22CSE822.2	3	2	2	-	-	-	-	-	-	-	-	-	2	3
22CSE822.3	3	2	2	2	2	-	-	-	-	-	-	-	2	3
22CSE822.4	3	2	-	2	3	-	-	-	-	-	-	-	2	3
22CSE822.5	2	-	-	2	3	-	-	-	-	-	-	-	2	3
22CSE822.6	2	-	-	-	2	-	-	-	-	-	-	-	2	3

MODULE-1	**Introduction To distributed Computing, SOA and Web Services**	**22CSE822.1**	**8 Hours**

Introduction, Concepts of Distributed Computing, XML, and Fundamental of SOA, Evolution of SOA, Web Services Fundamental and Standard: Web Services: Definition, Architectures and Standards. Directory services, SOAP, REST WSDL, UDDI.

Self-study / Case Study / Applications	A retail company adopted distributed computing with XML-based data exchange and fundamental SOA principles to build scalable and loosely coupled applications.
Text Book	Text Book 2: 3.1, 4.1, 5.1, Text Book 1:2.1, 2.2, 2.3, 2.4, 2.5, 3.2

MODULE-2	**Principles of Service-Oriented Architecture, SOA and WS.**	**22CSE822.2**	**8 Hours**

Principles of Service-Oriented Architecture-Service Orientation and object-orientation, SOA Standards Stack, SOA with Web Services, Key Principles of SOA.

Self-study / Case Study / Applications	Implementing Service-Oriented Architecture in an E-Governance System using Web Services and SOA Principles.
Text Book	Text Book 1: 5.2, 5.3, 5.4, Text Book 2: 8.1, 8.2, 8.5

MODULE-3	**Advanced Web Service Specifications and Messaging Frameworks**	**22CSE822.3, 22CSE822.4**	**8 Hours**

Message Exchange Pattern, Coordination, Atomic Transactions, Business Activities, Orchestration, Choreography, WS-Addressing, WS- Reliable Messaging, WS-Policy (including WS-Policy Attachments and WS-Policy Assertions), WS-Metadata Exchange, WS-Security (including XML-Encryption, XML- Signature, and SAML).			
Self-study / Case Study / Applications	An online travel booking system used WS-Addressing and WS-Policy to enable reliable service discovery and secure coordination between airline, hotel, and payment services.		
Text Book	Text Book 2: 6.1, 6.3, 6.4, 6.5, 6.6, 6.7, 7.1, 7.2, 7.4, 7.5,7.6,		
MODULE-4	**Service Life Cycle and Business Process Composition in SOA**	**22CSE822.5**	**8 Hours**
RPC versus Document Orientation, Service Life Cycle, Service Creation, Service Design and Build, Service Deployment, Publish Web service using UDDI, Service Discovery, Service Selection, Service Composition, Service Execution and Monitoring, Service Termination, Service Composition and Modeling Business Processes with Business Process Execution Language (BPEL).			
Self-study / Case Study / Applications	A financial services firm adopted document-oriented web services over RPC for better scalability and maintainability throughout the service life cycle, from creation to deployment.		
Text Book	Text Book 2: 4.2, 4.4, 5.3, 10.1, Text Book 1: 13.4		
MODULE-5	**Description: Modeling & Representation & Resource Description Framework**	**22CSE822.6**	**8 Hours**
Modeling to enable Interoperation, Integration versus Interoperation, Common Ontologies, Knowledge Representations, RDF Basics, Key primitives, XML Syntax, Storing RDF, RDF Scheme			
Self-study / Case Study / Applications	Case Study on Resource Description Framework for Data Integration in a University		
Text Book	Text Book 1: 6.1, 6.2, 6.3, 6.4, 7.2,7.3,7.4 ,7.6,7.7		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Munindar P. Singh, Michael N. Huhns, "Service-Oriented Computing: Semantics, Processes, Agents", John Wiley & Sons, Ltd., 1st edition 2005, ISBN-10: 0470091495, ISBN-13: 978-0470091494.
2) Thomas Erl, "Service-Oriented Architecture: Analysis & Design for Services and Microservices (Second Edition)", Pearson Education/Pearson PTR, December 2016, ISBN-10: 013385870X, ISBN-13: 978-0133858709.

Reference Books:

1) Mark D. Hansen, "SOA Using Java™ Web Services", Pearson (Prentice Hall), 1st edition May 2007, ISBN-10: 0132394057, ISBN-13: 978-0132394057.
2) Thomas Erl, Anish Karmarkar, Priscilla Walmsley et al., "Web Service Contract Design and Versioning for SOA", Pearson Education / Prentice Hall, 1st edition March 2017, ISBN-13: 978-0134767437.

Web links and Video Lectures (e-Resources):

• https://www.coursera.org/learn/service-oriented-architecture

•https://courses.edx.org/courses/BerkeleyX/CS_CS169.1x/1T2014/8e8cf6e05c8f43749fbac0938f4acbaa/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- **Case Study Analysis:**
  Provide a case study of a legacy monolithic system vs. SOA-based system. Ask students to identify tangible benefits gained by SOA adoption (e.g., agility, reuse).
- **Hands-on SOAP Service Creation:**
  Using tools like SoapUI or Eclipse, students create a simple SOAP Web Service with WSDL. Then test it by sending requests and viewing responses.
- **Message Exchange Patterns Simulation:**
  Role-play or simulate various message exchange patterns (one-way, request-response, solicit-response) with students as services exchanging messages.
- **WS-Addressing & Reliable Messaging Labs:**
  Configure SOAP services with WS-Addressing headers; simulate message retries to understand reliability guarantees.
- **Principles Brainstorming Workshop:**
  Students brainstorm and present how each service orientation principle (loose coupling, abstraction, reusability) applies in real-world scenarios.
- **Configuration Scenario Roleplay:**
  Simulate deployment of different service layer configurations (distributed vs co-located) and discuss trade-offs.
- **WS-BPEL Process Modeling:**
  Using tools like Eclipse BPEL Designer, students create a basic business process

RECOMMENDER SYSTEMS			
Course Code	**22CSE823**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

22CSE823.1	Apply foundational recommender system techniques to real-world problems and address key challenges.
22CSE823.2	Implement collaborative filtering techniques using both memory-based and model-based approaches to generate personalized recommendations.
22CSE823.3	Demonstrate content-based filtering methods using item features and user profiles to generate personalized recommendations.
22CSE823.4	Analyze hybrid recommender systems that combine multiple recommendation methods.
22CSE823.5	Evaluate recommender systems using metrics to deliver accurate and fair recommendations.
22CSE823.6	Investigate advanced recommender system techniques including context-aware, knowledge-based and social recommendation approaches.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE823.1	3	3	3	2	1	1	-	-	1	1	-	2	2	2
22CSE823.2	3	3	3	2	1	1	-	-	1	1	-	2	2	2
22CSE823.3	3	3	3	2	1	1	-	-	1	1	-	2	2	2
22CSE823.4	3	3	3	2	1	1	-	-	1	1	-	2	2	2
22CSE823.5	3	3	3	2	1	1	-	-	1	1	-	2	2	2
22CSE823.6	3	3	3	2	1	1	-	-	1	1	-	2	2	2

MODULE-1	**INTRODUCTION TO RECOMMENDER SYSTEMS**	**22CSE823.1**	**8 Hours**

Introduction to Recommender Systems, Applications and Examples, Types of Recommender Systems – Collaborative Filtering, Content-Based, Knowledge-Based, Hybrid – Recommendation Process, Data Types and Representations, Rating Prediction vs. Item Ranking, Challenges in Recommender Systems – Cold Start, Sparsity, Scalability, Basic Evaluation Metrics.

Self-study / Case Study /Applications	Explore real-world applications of recommender systems on platforms such as Amazon, Netflix, and Spotify; analyze various recommendation scenarios using modern tools including Python, Surprise and TensorFlow to identify appropriate techniques across different domains.
Text Book	Text Book 1: Chapter 1

MODULE-2	**COLLABORATIVE FILTERING**	**22CSE823.2**	**8 Hours**

Memory-Based Collaborative Filtering, User-Based Collaborative Filtering, Item-Based Collaborative Filtering, Similarity Measures – Pearson Correlation, Cosine Similarity, Jaccard Index – Neighborhood Selection, Rating Prediction, Model-Based Collaborative Filtering, Matrix Factorization Techniques, Singular Value Decomposition – SVD – Non-negative Matrix Factorization – NMF – Handling Implicit Feedback

Self-study / Case Study / Applications	Implement collaborative filtering algorithms using real datasets, compare the performance of user-based and item-based approaches, analyze the impact of different similarity measures on recommendation quality and explore matrix factorization techniques for large-scale systems.
Text Book	Text Book 1: Chapter 2, 3.

MODULE-3	**CONTENT-BASED FILTERING**	**22CSE823.3**	**8 Hours**

Content-Based Recommendation Principles, Item Representation and Feature Extraction, Text Processing for Recommendations, TF-IDF and Vector Space Model, User Profile Learning, Classification-Based Approaches, Naive Bayes and Decision Trees for Recommendations, Similarity Measures for Content-Based Systems, Advantages and Limitations of Content-Based Filtering, Handling Overspecialization.

Self-study / Case Study / Applications	Apply content-based filtering techniques to domains such as movie, news, and music recommendations using relevant features like genre, article content and audio attributes, while developing user profiles and analyzing recommendation diversity.
Text Book	Text Book 1: Chapter 4, Text Book 2: Chapter 4

MODULE-4	HYBRID AND ADVANCED RECOMMENDER SYSTEMS	22CSE823.4	8 Hours
Hybrid Recommender Systems Design, Hybridization Techniques – Weighted, Switching, Mixed, Feature Combination, Cascade, Feature Augmentation, Meta-level – Deep Learning for Recommender Systems, Neural Collaborative Filtering, Autoencoders for Recommendations, Recurrent Neural Networks for Sequential Recommendations, Convolutional Neural Networks for Recommendation, Ensemble Methods in Recommender Systems.			
Self-study / Case Study / Applications	Implement hybrid recommender systems by combining collaborative and content-based approaches, explore deep learning architectures using tools like TensorFlow or PyTorch to enhance recommendation performance, and apply ensemble techniques to improve accuracy over traditional methods.		
Text Book	Text Book 1: Chapter 7, 8, Text Book 2: Chapter 5, 6.		
MODULE-5	**EVALUATION AND SPECIALIZED RECOMMENDER SYSTEMS**	**22CSE823.5, 22CSE823.6**	**8 Hours**
Evaluation Methodologies, Accuracy Metrics – MAE, RMSE, Precision, Recall, F1-Score – Ranking Metrics – NDCG, MAP – Beyond Accuracy Metrics – Diversity, Novelty, Serendipity, Coverage – A/B Testing and Online Evaluation, Knowledge-Based Recommender Systems, Constraint-Based and Case-Based Reasoning, Context-Aware Recommender Systems, Social Recommender Systems, Group Recommender Systems, Fairness and Bias in Recommender Systems.			
Self-study / Case Study / Applications	Evaluate recommender systems using multiple metrics and understand trade-offs between accuracy and diversity, implement knowledge-based systems for specialized domains, develop context-aware recommendations incorporating temporal, spatial and social contexts & address ethical considerations in recommendation systems.		
Text Book	Text Book 1: Chapter 9, 10, Text Book 2: Chapter 7, 8.		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Charu C. Aggarwal, "Recommender Systems: The Textbook", Springer, First Edition, 2016. ISBN: 978-3-319-29657-9.
2. Francesco Ricci, Lior Rokach, Bracha Shapira, "Recommender Systems Handbook", Springer, Third Edition, 2022. ISBN: 978-1-0716-2197-4.

Reference Books:

1. Jannach, Dietmar, et al. "Recommender Systems: An Introduction", Cambridge University Press,2010.
2. Falk, Kurt. "Practical Recommender Systems", Manning Publications, 2019.

3. Grus, Joel. "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2019.
4. Sarwar, Badrul, et al. "Recommender Systems for E-Commerce: Challenges and Solutions", Electronic Commerce Research, 2000.

Web links and Video Lectures (e-Resources)

- https://www.coursera.org/learn/machine-learning-recommender-systems
- https://www.edx.org/course/recommender-systems-introduction
- https://recsys.acm.org/ (ACM Recommender Systems Conference)
- https://www.kaggle.com/learn/intro-to-machine-learning
- https://surprise.readthedocs.io/en/stable/ (Python Surprise Library)
- https://pytorch.org/tutorials/intermediate/recommendation_tutorial.html

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Implement collaborative filtering algorithms from scratch using Python
- Build content-based recommendation systems using real-world datasets
- Develop hybrid recommender systems by combining collaborative and content-based techniques
- Apply deep learning models (Neural Collaborative Filtering, Autoencoders) for recommendations using tools like TensorFlow or PyTorch
- Create a movie recommendation system using the MovieLens dataset
- Analyze solutions to the cold start and sparsity problems in recommender systems
- Evaluate recommendation models using metrics such as Precision, Recall, and NDCG
- Contents related activities (Activity-based discussions)
    - Encourage students to create flowcharts, concept maps or handouts for key recommendation algorithms
    - Organize group discussions on real-world challenges like cold start, scalability and bias in recommender systems
    - Conduct seminars or student presentations on advanced topics such as deep learning in recommendation, context-aware systems or fairness in AI

ETHICS IN AI			
Course Code	**22CSE824**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

22CSE824.1	Apply legal and ethical frameworks to evaluate the governance of AI systems.
22CSE824.2	Apply human rights centred design principles and normative frameworks to address ethical dilemmas and stakeholder conflicts in AI.
22CSE824.3	Analyse justice-based moral frameworks to assess accountability and responsibility in AI systems.
22CSE824.4	Evaluate ethical risks, societal impacts, and responsibilities of AI applications across health, legal, public, and scientific domains
22CSE824.5	Design ethical frameworks to address the societal impact of AI across diverse populations and contexts
22CSE824.6	Synthesize interdisciplinary knowledge to propose comprehensive ethical approaches for AI design, deployment, and governance.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CSE824.1	2	-	-	-	-	2	-	-	-	2	-	2	-	-
22CSE824.2	3	-	-	-	2	-	-	-	-	2	-	2	2	-
22CSE824.3	-	3	-	-	2	-	-	-	-	2	-	2	2	-
22CSE824.4	-	3	-	2	-	2	-	2	-	-	-	2	2	-
22CSE824.5	-	-	3	2	-	2	2	3	2	-	-	2	2	2
22CSE824.6	-	-	3	2	3	2	2	3	2	-	-	2	2	3

MODULE-1	**Introduction to AI and Ethical Implications**	**22CSE824.1**	**8 Hours**
Overview of AI, generative AI vs predictive AI, Introduction & Overview for Law and Regulation ethical concerns in AI development, societal impacts of AI, and ethical decision-making frameworks in AI systems. Ethical theories (deontology, utilitarianism, virtue ethics) and definitions of "ethics" vs. "morality" in AI.			
Self-study / Case Study / Applications	examine the Cambridge Analytica data misuse scandal as a case study to understand privacy and governance failures, and analyze the autonomous vehicle trolley dilemma for applying ethical theories in real contexts. explore bias in predictive policing tools, ethical concerns of facial recognition in public surveillance, and the implications of generative AI in creative industries,		
Text Book	Text Book 1: Ch 1		
MODULE-2	**Framework and Modes**	**22CSE824.2**	**8 Hours**
AI Governance by Human Rights- Centered Design, Deliberation and Oversight: End to Ethics Washing, The Incompatible Incentives of Private-Sector AI. Normative Modes: Codes and standards. The Role of Professional Norms in the Governance of Artificial Intelligence.			
Self-study / Case Study / Applications	Students can examine the EU AI Act as a case of rights-based governance and contrast it with industry ethics codes to see gaps between regulation and self-regulation. They may also study examples of ethics washing in big tech and explore how professional bodies like IEEE/ACM set norms for responsible AI.		
Text Book	Text Book 1: Ch 3		
MODULE-3	**Concepts and Issues**	**22CSE824.3**	**8 Hours**
Moral Framework of Justice in AI: on the Limits, Failing and Ethics of Fairness, Accountability in Computer Systems-Responsibility and AI, The concept of Handoff as a Model for Ethical Analysis and Design			

Self-study / Case Study / Applications	Students can study the COMPAS algorithm bias case in criminal justice as an example of fairness failures, and review accountability issues in self-driving car accidents. For self-study, they may explore responsibility gaps in AI decision-making and the idea of shared human–AI accountability		
Text Book	Text book 1: Ch3,21		
MODULE-4	**Predictive AI Model's implications and Ethics of Data**	**22CSE824.4**	**8 Hours**
Introduction to supervised learning, predictive analytics, algorithmic bias, fairness in predictive modelling, and consequences of biased predictions in decision-making, Privacy issues, data ownership, consent in data usage, differential privacy, transparency in data collection, ethical data handling.			
Self-study / Case Study / Applications	Students can examine the Cambridge Analytica case to understand data misuse and consent issues, and the Amazon hiring algorithm bias as an example of unfair predictive modelling. For self-study, they may explore differential privacy in healthcare data and the trade-off between transparency and data protection.		
Text Book	Text book 2:Ch 5,8		
MODULE-5	**Cases and Application**	**22CSE824.5 22CSE824.6**	**8 Hours**
Ethics of AI in Transport - Ethics of AI in Biomedical Research, Ethics of AI in Law: Basics Questions, Beyond Bias:" Ethical AI" in Criminal Law. In-depth study of specific ethical issues (e.g., AI in military applications, surveillance technologies, AI in creative industries), regulatory challenges, and developing ethical guidelines.			
Self-study / Case Study / Applications	Students can review self-driving car accident cases to discuss transport ethics and AI in predictive policing for law and justice concerns. For self-study, they may explore ethical issues in military drones, AI in creative industries, and global regulatory challenges.		
Text Book	Text book 1: Ch 27, 30 Text book 2:Ch 9		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	5
L3	Apply	10	5	5
L4	Analyze	5	5	-
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	10
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. The Oxford Handbook of Ethics of AI, by Markus D Dubber, Frank Pasquale, Sunit Das, Oxford Press,2020. ISBN: 978-0-19-006739-7
2. AI Ethics (2023) by Paula Boddington. Springer

Reference Books:

1. The Ethics of Artificial Intelligence: Principles, Challenges, and Opportunities (2023) by Luciano Floridi.
2. Artificial Intelligence: A Guide for Thinking Humans by Melanie Mitchell, 2019. ISBN: 9780374715236, 0374715238

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/courses/res-ec-001-exploring-fairness-in-machine-learning-for- international-development-spring-2020/pages/module-one-introduction/
- https://swayam-plus.swayam2.ac.in/courses/course-details?id=P_INTEL_02

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group discussion on real-world problems.
- Contents-related activities (Activity-based discussions)
- Organizing Group discussions on real-world problems
- Seminars

STORAGE AREA NETWORKS			
Course Code	**22CSE825**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

22CSE825.1	Gain a comprehensive knowledge on architecture of Software-Defined Networking (SDN) and its relevance to modern network infrastructures.
22CSE825.2	Analyze the components and functionalities of SDN, including controllers, data planes, and Northbound/Southbound APIs.
22CSE825.3	Design and implement basic SDN solutions using common SDN controllers and programming languages.
22CSE825.4	Evaluate the benefits and challenges of deploying SDN in various network environments, including data centers and enterprise networks.
22CSE825.5	Explore advanced topics in SDN, such as network function virtualization (NFV), intent-based networking, and network programmability
22CSE825.6	Apply SDN principles to optimize and manage network resources, with a focus on specific application areas, such as storage area networks (SANs).

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE825.1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
22CSE825.2	3	3	2	-	-	-	-	-	-	-	-	-	2	-
22CSE825.3	-	2	2	2	2	-	-	-	-	-	-	2	3	2
22CSE825.4	-	2	3	2	2	-	-	-	-	-	-	2	3	2
22CSE825.5	2	2	2	-	3	-	-	-	-	-	-	2	3	3
22CSE825.6	-	-	3	-	3	-	-	-	-	-	-	2	3	3

MODULE-1	**Introduction to Software-Defined Networking (SDN)**	**22CSE825.1 22CSE825.2**	**8 Hours**

Introduction to SDN, Evolution of SDN, Principles of SDN, SDN Architecture, SDN Components: Southbound and Northbound APIs, Benefits and Challenges of SDN, Use Cases and Applications

Self-study / Case Study / Applications	Analyze real-world SDN deployments and their impact on network management.
Text Book	Text Book: 1 Chapters: 1,2,3 Pages (1-65)

MODULE-2	**SDN Controllers and OpenFlow**	**22CSE825.2**	**8 Hours**

SDN Controllers: Open Daylight, ONOS, Ryu, Functionalities, Roles, OpenFlow Protocol: Architecture, Protocols, Types of Communication, OpenFlow Message Types: Different types of OpenFlow Messages, Controller to Switch, Asynchronous, Symmetric, OpenFlow in Action: Network device, Traffic overflow

Self-study / Case Study / Applications	Implement a simple SDN application using a chosen controller and OpenFlow.
Text Book	Text Book: 1 Chapters: 7,4,8 Pages (146-210)

MODULE-3	**Network Function Virtualization (NFV)**	**22CSE825.3, 22CSE825.4**	**8 Hours**

Introduction to NFV: Concepts of NFV, Virtualization, NFV Architecture: NFV architectural framework, NFV Infrastructure (NFVI), Virtualized Network Functions (VNFs), NFV Management and Orchestration (MANO), SDN and NFV Integration, NFV Use Cases

Self-study /	Analyze the deployment of a virtualized network function in a cloud environment

Case Study / Applications			
Text Book	Text Book : 1 Chapters: 9,10 Pages (211-265)		
MODULE-4	**Network Programmability and Automation**	**22CSE825.4, 22CSE825.5**	**8 Hours**
Network Programmability Concepts: Principles, Imperative and Declarative approaches, Benefits of programmatic network control, Network Automation Tools: Frameworks (e.g., Ansible, Python with network libraries, Netmiko), DevOps for Networking (NetDevOps), Network Orchestration Platforms			
Self-study / Case Study / Applications	Develop a simple network automation script to configure a network device		
Text Book	Text Book : 1 Chapters: 11,12,13 Pages (266-330)		
MODULE-5	**Advanced Topics and SAN Integration**	**22CSE825.6**	**8 Hours**
SDN for Storage Area Networks, Intent-Based Networking (IBN), Network Slicing, Emerging Trends in Software-Defined Networking			
Self-study / Case Study / Applications	Research on a specific emerging trend in SDN or its application in a real-world scenario		
Text Book	Text Book : 1 Chapters: 14,15,16 Pages (353-420)		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	-	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1. Goransson, P., Black, C., & Culver, T. (2017). Software Defined Networks: A Comprehensive Approach (2nd ed.). Morgan Kaufmann.
2. Nadeau, T. D., & Gray, K. (2013). SDN: Software Defined Networks: An Introduction. O'Reilly Media.
3. Haleplidis, D., Pentikousis, K., Denazis, S., Salani, M., Van Adrichem, N., & van der Meer, S. (2015). Software-Defined Networking (SDN): A Comprehensive Survey. IEEE Communications Surveys & Tutorials, 17(4), 2197-2226.

Reference Books:

1. Feamster, N., Rexford, J., & Zegura, E. (2014). *The Road to SDN: An Intellectual History of Programmable Networks*. ACM SIGCOMM Computer Communication Review.

2. Kreutz, D., Ramos, F. M. V., Verissimo, P. E., Rothenberg, C. E., Azodolmolky, S., & Uhlig, S. (2015). *Software-Defined Networking: A Comprehensive Survey*. Proceedings of the IEEE, 103(1), 14–76.
3. Dixit, A., Hao, F., Mukherjee, S., Lakshman, T. V., & Kompella, R. (2013). *Towards an Elastic Distributed SDN Controller*. ACM SIGCOMM HotSDN.

Web links and Video Lectures (e-Resources):

- **Open Networking Foundation (ONF): https://opennetworking.org/**
- **Coursera - Software Defined Networking: https://www.coursera.org/learn/sdn**
- **SDN and NFV Tutorials: Various online platforms like YouTube, Udemy, and edX offer tutorials and courses on SDN and NFV**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes & Assignments
- Demonstration of Networking using Router Packets
- Video demonstration of latest trends in Storage Area Networks
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to use Frame work methodology by using open-source software.
  - Organizing Group wise discussions on issues
  - Seminars

INTERNSHIP			
Course Code	**22CSE83**	**CIE Marks**	**100**
L:T:P:S	**0:0:10:0**	**SEE Marks**	**100**
Hrs / Week	**-**	**Total Marks**	**200**
Credits	**10**	**Exam Hours**	**03**

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

22CSE83.1	Classify appropriate workplace behaviors in a professional setting.
22CSE83.2	Demonstrate content knowledge appropriate to job assignment.
22CSE83.3	Interpret evidence of increased content knowledge gained through practical experience.
22CSE83.4	Analyze the nature and function of the organization in which the internship experience takes place.
22CSE83.5	Evaluate how the internship placement site fits into their broader career field.
22CSE83.6	Compile the internship experience in terms of their personal, educational and career needs.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CSE83.1	3	3	3	3	3	-	3	-	3	-	-	3	3	3
22CSE83.2	3	3	3	3	3	1	2	-	3	-	-	3	3	3
22CSE83.3	3	3	3	3	3	1	2	-	3	-	-	3	3	3
22CSE83.4	3	3	3	3	3	2	2	-	3	-	-	3	3	3
22CSE83.5	3	3	3	3	3	1	2	-	3	-	-	3	3	3
22CSE83.6	3	3	3	3	3	-	2	-	3	-	-	3	3	3

Research internship Outcomes

- Generating technical paper/s and publishing in refereed journal/s.
- Possibility of acquiring intellectual ownership and patent.
- Build a prototype for an idea on which the research was carried out.
- File patent/s.
- Add academic knowledge to the field.
- Enhanced ability in arranging meetings, presentations, seminars, trainings, etc.
- Improved conscientiousness and ethics

Industrial Internships Outcomes

- To bridge a gap between the theoretical knowledge obtained in the classrooms and the practical skills required in the actual workplace.
- Understanding of the analytical concepts and tools, hone their skills in the real-life situations and build confidence in applying the skills learned.
- Have ample opportunities to attend seminars, symposiums, workshops, etc. This in turn provides an opportunity to establish rapports with professionals and pioneers in their respective fields for further growth.
- Have wide scope to publish paper/s in journals and also helps to acquire team spirit, motivated acts, techniques to resolve conflicts, develop a lot of leadership skills etc.
- Increases the prospect of placement in the same concern, provided the intern has exhibited a clear understanding of basics and successfully completed the internship.
- Fosters to substantiate the issues with facts and figures.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Internship.

Internship: The mandatory Internship is for **14 to 20 weeks**. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent SEE examination after satisfying the internship requirements. If the students are opting for the 8th semester, the following internship options are available:

- Industry Internship
- Research Internship
- Skill Enhancement Courses
- Post-Placement Training as Internship
- Online Internship

Industry internship: It is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints. Students undertaking industry internships must ensure the organization is listed on the VTU Internship Portal. If not, request the organization to register on the portal.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research. Research internships must be carried out in recognized research centers. Ensure that these centers are registered on the portal.

Skill Enhancement Courses: Students can take Skill-based courses with credits totalling the same as those of the internship. Students must be taken from registered providers listed on the VTU Internship Portal.

Post-Placement Training as Internship: The post-placement training is also considered an internship. For students placed during their 6th/7th semester and willing to take the training during their final year, colleges must inform the recruiting companies in advance to register on the VTU Internship Portal.

Online Internship: Reputed online internship platforms, including those identified by NSDC, are already listed on the VTU Internship portal. If colleges come across other eligible organizations not yet listed, they are informed to ask the organization to register on the VTU Internship portal.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship. The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship. With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (within or outside the state or abroad), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide.

Evaluation Procedure:

Assessment of CIE marks

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the internship, shall be based on the evaluation of the diary, report, presentation skill and question and answer session in the ratio 50:25:25.

Assessment of SEE marks

Contribution to the internship and the performance shall be assessed individually in semester-end examination (SEE) conducted at the department.

Marks shall be awarded based on the evaluation of the diary, report, presentation skill and question and answer session in the ratio 50:25:25.

CIE Assessment Pattern (100 Marks)

RBT Levels		Exam Marks Distribution (100)
L1	Remember	-
L2	Understand	20
L3	Apply	20
L4	Analyze	20
L5	Evaluate	20
L6	Create	20

SEE Assessment Pattern (100 Marks)

RBT Levels		Exam Marks Distribution (100)
L1	Remember	-
L2	Understand	20
L3	Apply	20
L4	Analyze	20
L5	Evaluate	20
L6	Create	20

INDIAN KNOWLEDGE SYSTEMS			
Course Code	**22IKK84**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**1**	**Total Marks**	**50**
Credits	**0**	**Exam Hours**	**--**

Course outcomes:

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

22IKK84.1	Provide an overview of the concept of the Indian Knowledge System and its importance.
22IKK84.2	Appreciate the need and importance of protecting traditional knowledge.
22IKK84.3	Recognize the relevance of Traditional knowledge in different domains.
22IKK84.4	Establish the significance of Indian Knowledge systems in the contemporary world.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22IKK84.1	2	-	-	-	-	-	-	3	-	-	-	1
22IKK84.2	-	-	-	-	-	2	-	-	-	-	-	-
22IKK84.3	-	-	2	2	-	-	-	-	-	-	-	-
22IKK84.4	-	-	-	-	-	3	2	-	-	-	-	-

MODULE-1	**INTRODUCTION TO INDIAN KNOWLEDGE SYSTEMS (IKS)**	**22IKK84.1, 22IKK84.2**	**5 Hours**

Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.

MODULE-2	**TRADITIONAL KNOWLEDGE IN PROFESSIONAL DOMAIN**	**22IKK84.3**	**5 Hours**

Linguistics, Number and measurements- Mathematics, Chemistry, Physics, Art, Dyes and painting technology, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.

MODULE- 3	**TRADITIONAL KNOWLEDGE IN GOVERNANCE AND ECONOMICS**	**22IKK84.4**	**5 Hours**

Governance and public administration, United Nations Sustainable development goals, an overview of Indian economic thought–Arthasastra and Nitisastra, Leadership and Motivation, Planning and Organizing, Financial Management

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s) (MCQs)	AAT
		25	**25**
L1	**Remember**	**5**	**5**
L2	**Understand**	**5**	**5**
L3	**Apply**	5	5
L4	**Analyze**	**5**	5
L5	**Evaluate**	**5**	**5**
L6	**Create**	**-**	**-**

Suggested Learning Resources:

Reference Books:

1. **Introduction to Indian Knowledge System- concepts and applications**, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93- 91818-21-0

2. **Traditional Knowledge System in India**, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230

3. **Knowledge Traditions and Practices of India**, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334
Web links and Video Lectures (e-Resources): 1. https://iksindia.org/lectures-and-videos.php 2. http://nptel.ac.in/courses/121106003/ 3. http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf 4. https://www.youtube.com/watch?v=LZP1StpYEPM
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Reflection and Discussion • Case Studies

Appendix A: List of Assessment Patterns

S.NO	Pattern of Assessments
1	Assignments
2	Group Discussions
3	Case Study / Caselets
4	Practical-Orientation on Design Thinking
5	Participatory & Industry-Integrated Learning
6	Practical Activities / Problem Solving Exercises
7	Class Presentations
8	Analysis of Industry / Technical / Business Reports
9	Reports on Industrial Visit
10	Industrial / Social / Rural Projects
11	Participation in external seminars / Workshops
12	Any Other Academic Activity
13	Online / Offline Quizzes

APPENDIX B: Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

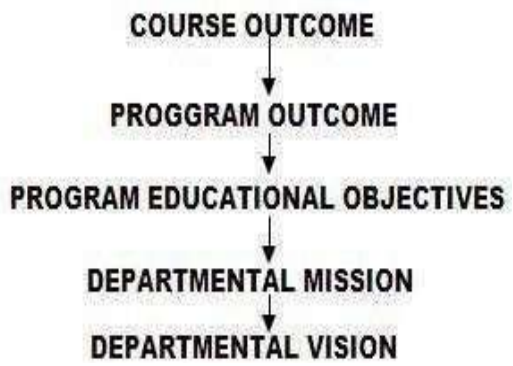
There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX C: The Graduate Attributes of NBA

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

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

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.

Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

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

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

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.

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

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

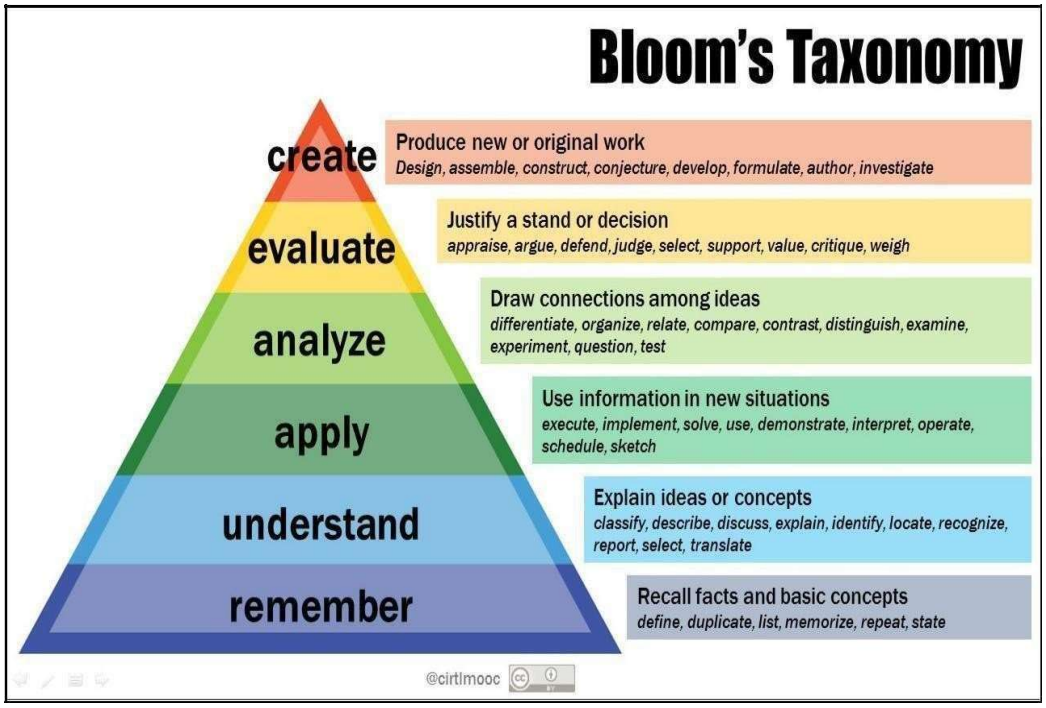
Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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 and in multidisciplinary environments.

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.

APPENDIX D: BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.



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