NEW HORIZON
COLLEGE OF ENGINEERING

Department of Computer Science and Engineering
Academic Year 2024-25

M.Tech (CSE)

1st & 2nd Semester Scheme & Syllabus

BATCH: 2024-26

CREDITS: 80

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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 byfostering a culture of research and innovation among faculty members and students
- To encourage long-term interaction between the academia and industry through theirinvolvement 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 conclusionsusing first principles of mathematics, natural sciences and engineering sciences.

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

PO4: 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.

PO5: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO6: 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 pursuelifelong professional development in computing.

MAPPING OF PEOs to POs & PSOs

	PO's						PSO's	
	1	2	3	4	5	6	1	2
PEO1	3	3	2	2	2	1	1	1
PEO2	3	3	3	3	3	2	3	2
PEO3	3	3	3	3	3	3	3	3
PEO4	1	1	1	1	1	2	1	1

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

NEW HORIZON COLLEGE OF ENGINEERING
Scheme of Teaching and Examinations –2024
M.Tech., COMPUTER SCIENCE AND ENGINEERING
Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)
Scheme of Teaching and Examinations for 2024 - 2026 BATCH (2024 Scheme)

I SEMESTER

Sl.No	Course	Course Code	Course Title	Credit Distribution					CONTACT HRS	CIE	SEE	TOTAL
				L	T	P	S	CREDITS				
1	BSC	24SCS11	Mathematics for Computational Thinking	2	1	0	0	3	3	50	50	100
2	PCC	24SCS12	Advanced Algorithms	3	0	0	0	3	3	50	50	100
3	PCC	24SCS13	Concurrent Programming	3	0	0	0	3	3	50	50	100
4	PCC	24SCS14	UX/ UI design principles	2	0	0	1	3	4	50	50	100
5	MCC	24SCS15	Research methodology and IPR	2	0	0	1	3	4	50	50	100
6	PCCL	24SCL16	Advanced algorithms lab	0	0	2	0	2	4	50	50	100
7	PCCL	24SCL17	UX/ UI design principles lab	0	0	2	0	2	4	50	50	100
			TOTAL	**13**	**1**	**4**	**2**	**19**	**25**	**350**	**350**	**700**

Note: During the 1st semester, students should enroll 2 online courses (Minimum) and must finish the courses before 4th semester and the evaluation will take place during the 4th semester.

Legends: BSC- Basic Science Courses, PCC: Professional core. IPCC-Integrated Professional Core Courses, MCC-Mandatory Credit Course, AUD/AEC –Audit Course/Ability

Enhancement Course (A pass in AUD/AEC is mandatory for the award of the degree), PCCL-Professional Core Course lab, L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Integrated Professional Core Course (IPCC): Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Audit Courses /Ability Enhancement Courses Suggested by BOS (ONLINE courses):

Audit Courses: These are prerequisite courses suggested by the concerned Board of Studies.

Skill Development Activities: Under Skill development activities in a concerning course, the students should

- Interact with industry (small, medium, and large).
- Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
- Involve in case studies and field visits/ fieldwork.
- Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
- Handle advanced instruments to enhance technical talent.
- Gain confidence in modeling of systems and algorithms for transient and steady-state operations, thermal study, etc.
- Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks

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II SEMESTER

Sl.No	Course	Course Code	Course Title	Credit Distribution					CONTACT HRS	CIE	SEE	TOTAL
				L	T	P	S	CREDITS				
1	PCC	24SCS21	Cloud Computing & Virtualization	3	0	0	0	3	3	50	50	100
2	PCC	24SCS22	Devops	2	0	0	1	3	3	50	50	100
3	PCC	24SCS23	Artificial Intelligence	3	0	0	0	3	3	50	50	100
4	PEC	24SCS24X	Professional Elective - 1	3	0	0	0	3	3	50	50	100
5	PEC	24SCS25X	Professional Elective - 2	3	0	0	0	3	3	50	50	100
6	PCCL	24SCL26	Cloud Computing & Virtualization lab	0	0	2	0	2	4	50	50	100
7	PCCL	24SCSL27	Devops lab	0	0	2	0	2	4	50	50	100
			TOTAL	**14**	**0**	**4**	**1**	**19**	**23**	**350**	**350**	**700**

Note: During the 1st semester, students should enroll 2 online courses (Minimum) and must finish the courses before 4th semester and the evaluation will take place during the 4th semester.

1. **Mini Project**: It can include hands-on practice, coding, mobile app development, and report preparation etc. CIE (Continuous Internal Evaluation) marks will be awarded by a committee comprising the HoD (Head of Department) as Chairman, the guide/co-guide (if any), and a senior faculty member of the department. All postgraduate students in the program must complete mini-project. **The CIE marks for Mini-Project work will be based on the evaluation of the Mini-Project work and Report, Presentation skills, and performance in the Question and Answer session, in the ratio 50:25:25**. Mini-Project is considered a passing requirement and is necessary for vertical progression and the award of the degree. Students who do not take up or complete the Mini Project will be declared as failing the course and will need to complete it during a subsequent semester.

2. **Internship**: All the students shall have to undergo a mandatory internship of **06 weeks during the vacation of II and III semesters**. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in the internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

242SCS24X - PROFESSIONAL ELECTIVE - 1		24SCS25X - PROFESSIONAL ELECTIVE - 2	
Course code	**Course Name**	**Course code**	**Course Name**
24SCS241	Design Thinking	24SCS251	Cyber Security Management
24SCS242	Microservices Design Pattern	24SCS252	Software Project Management
24SCS243	Soft Computing	24SCS253	Recommender Systems
24SCS244	Computer Vision	24SCS254	Entrepreneurship & Innovation Management
24SCS245	Bioinformatics	24SCS255	Geographic Information Systems

First Semester Syllabus

MATHEMATICS FOR COMPUTATIONAL THINKING

Course Code	**24SCS11**	**CIE Marks**	**50**
L:T:P:S	**2:1:0:0**	**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:

24SCS11.1	Understand vector spaces and related topics arising in magnification and rotation of images.
24SCS11.2	Compute orthogonal and orthonormal basis vectors required to analyze image and signal processing problems and apply the technique singular valued decomposition for the data compression and solving consistent linear systems
24SCS11.3	Apply the graph theory concepts in solving problems related to computer science.
24SCS11.4	To apply the concept of sampling theory in computational processes.
24SCS11.5	Illustrate the fundamental concepts of queuing model, queuing system and queuing theory arising in various fields engineering.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCS11.1	3	3	-	-	-	-	-	-
24SCS11.2	3	3	-	-	-	-	-	-
24SCS11.3	3	3	-	-	-	-	-	-
24SCS11.4	3	3	-	-	-	-	-	-
24SCS11.5	3	3	-	-	-	-	-	-

MODULE-1	**Vector Spaces**	**24SCS11.1**	**9 Hours**

Vector spaces; subspaces Linearly independent and dependent vectors Basis and dimension; Coordinate vectors-Illustrative examples.

Case Study	Case study on vector spaces.
Text Book	Text Book 3: 4.1, 4.2, 4.3, 4.4, 4.5

MODULE-2	**Orthogonality and Least Squares**	**24SCS11.2**	**9 Hours**

Orthogonality: Inner product, orthogonal sets, orthogonal projections, orthogonal bases. Eigenvalues and Eigenvectors, orthogonal diagonalization, Singular valuedecomposition

Text Book	Text Book 1: 2.13, 2.14, 2.16

MODULE-3	**Graph Theory**	**24SCS11.3**	**9 Hours**

Basic Concepts of Graphs, Sub graphs, Matrix representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphism, Paths and Circuits, Eulerian and Hamiltonian Graphs, Eccentricity, radius, diameter, (Theorems without Proofs). Algorithms-Prims Algorithm, Kruskal's Algorithm.

Text Book	Text Book 4: 1.1, 1.2, 1.3, 1.6, 4.1,4.2,

MODULE-4	**Sampling Theory**	**24SCS11.4**	**9 Hours**

Testing of hypothesis by t-test,χ^2 test, F-test, Analysis of Variance (ANOVA): one way classification.

Case Study	Case studies on ANOVA
Text Book	Text Book 1: 27.1, 27.2, 27.3, 27.4, 27.5, 27.14, 27.17, 27.19.

MODULE-5	**Queing Theory**	**24SCS11.5**	**9 Hours**

Symbolic representation of Queuing model, Poisson queue system, Little law, types of stochastic process, birth-death process.

Case Study	Case Studies on birth-death process
Text Book	Text book 5: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	5	-
L2	Understand	5	5	-
L3	Apply	10	5	10

L4	**Analyze**	2.5	-	-
L5	**Evaluate**	2.5	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**10**
L2	**Understand**	**10**
L3	**Apply**	**20**
L4	**Analyze**	**5**
L5	**Evaluate**	**5**
L6	**Create**	**-**

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) David C Lay, Linear Algebra and its applications, Addison-Wesley Publishers, Fourth Edition, 2012, ISBN: 9780321385178.
4) J. A. Bondy and U. S. R. Murty, —Graph Theory and Applications||, Macmillan Press, 1982, ISBN: 978-1-84996-690-0.
5) T.Veeranjan, Probability, Statistics and Random Process, Tata McGraw Hill Education Private Limited, 3rd Edition, 2008, ISSN : 978-0-07-066925-3

Reference Books:

1) Gilbert Strong, "Linear Algebra and its Applications", Cengage Learning, 4th Edition, 2006, ISBN: 97809802327.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232

R.E, Walpole, R.H.Myres, S.L.Myres and Keying Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson, 2012. ISBN : 978-0-321-62911-1

N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

1)https://youtu.be/Qwu8uY-7-2M?si=RgxCcvzsoCZOSU7G
2) https://youtu.be/jQJorvFGE1k?si=iiQN_8fPIhqqrFWp
3) https://youtu.be/F79wYnoFYxQ?si=QQmHNpZTX895aJ58
4) https://youtu.be/VQGnTZQCXvs?si=IFs_jcnP25veRldP
5) https://youtu.be/HS6aGeq3Fds?si=KdBXAEI2j8uq-DQE
6) https://youtu.be/o2Bzp967gZs?si=Xl-yesqWfyX1CjzL
7) https://youtu.be/EapYu79wA3M?si=vnCE6N5BNiakskW2
8) https://youtu.be/gXbThCXjZFM?si=j7rPRVRLQVTjTEDY
9)https://youtu.be/RWDKNOoU_KI?si=iBiMbXBWnQ4xEkxI
10)https://youtu.be/9UbC7p18PDw?si=XqMMjJO-aaKLxdrm
11) https://youtu.be/5M7bOXrn54A?si=5P1sWdkzgeg2URXy
12) https://youtu.be/36cAE1Ovpq4?si=JoRRGkMzMFwSxfE_
13) https://youtu.be/vFz2FG65HBc?si=D_PVoS7unAw92WFB
14)https://youtu.be/Qugzp3ldZEY?si=AETF-MGmkzikoEEK
15) https://youtu.be/4H9dMn919cs?si=umtJm1hhqwd6GN9Q
16) https://youtu.be/VtksT_vacAc?si=GUvVbACgeHXzCSsg
17) https://youtu.be/Wo75G99F9fM?si=l1C9DeVYfidhopbJ

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

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Algorithms/Flowcharts/Programming Codes
  - Organizing Group wise discussions on related topics
  - Seminars

ADVANCED ALGORITHMS			
Course Code	**24SCS12**	**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:

24SCS12.1	Describe the workings of both iterative and recursive algorithms, highlighting their characteristics and differences in problem-solving approaches.
24SCS12.2	Comprehend graph search algorithms and their impact on spatial and temporal complexities in problem-solving contexts.
24SCS12.3	Apply number theoretic algorithms and evaluate their efficiency and effectiveness in tackling computational problems.
24SCS12.4	Evaluate the implementation and functionality of diverse string-matching algorithms, understanding their strengths, weaknesses, and performance metrics.
24SCS12.5	Formulate approaches aimed at optimizing algorithms, considering factors like time complexity, space utilization, and overall efficiency.
24SCS12.6	Implement high-performing programming solutions tailored to real-world scenarios, focusing on optimization and effectiveness.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCS12.1	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**-**
24SCS12.2	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**-**
24SCS12.3	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**-**
24SCS12.4	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**-**
24SCS12.5	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**-**
24SCS12.6	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**-**

MODULE-1	**Review of Analysis Techniques and Amortized Analysis**	**24SCS12.1**	**8 Hours**

Growth of Functions, Asymptotic notations, Standard notations and common functions, Recurrences and Solution of Recurrence equations-The substitution method, The recurrence – tree method, The master method; Aggregate, Accounting and Potential Methods. Case Study.

Text Book: T1: Chapter 2, 3, 4, 16

MODULE-2	**Graph Algorithms and Polynomials and the FFT**	**24SCS12.2**	**8 Hours**

Bellman - Ford Algorithm, Single source shortest paths in a DAG, Johnson's Algorithm for sparse graphs, Flow networks and Ford-Fulkerson method, Maximum bipartite matching. Representation of polynomials, The DFT and FFT, Efficient implementation of FFT, Case Study.

TextBook: T1: Chapter 22, 23, 24, 25 , 30

MODULE-3	**Number - Theoretic Algorithms**	**24SCS12.3**	**8 Hours**

Elementary notions, GCD,Modular Arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, RSACrypto system, Primality testing, Integer factorization. Case based scenario.

Text Book: T1: Chapter 31.

MODULE-4	**String-Matching Algorithms**	**24SCS12.4**	**8 Hours**

Naïve string Matching, Rabin - Karp algorithm, String matching with finite automata, Knuth- Morris-Pratt algorithm, Boyer – Moore algorithms. Case based scenario

Text Book: T1: Chapter 32, T3: Chapter 20

MODULE-5	**Probabilistic and Randomized Algorithms**	**24SCS12.5 & 24SCS12.6**	**8 Hours**

Probabilistic algorithms, Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms, Probabilistic numeric algorithms, Case study

Text Book: T1: chapter 5, T3:Chapter 24

CIE Assessment Pattern (50 Marks)

RBT Levels		Marks Distribution			
		Test (s)	AAT1(Assignment)	AAT2(Quiz)	AAT3(Case Study Presentation)
		25	7.5	7.5	10
L1	Remember	5	-	-	
L2	Understand	5	2.5	-	
L3	Apply	5	3	2.5	
L4	Analyze	5	2	3	5
L5	Evaluate	5	-	2	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. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein: Introduction to Algorithms, Fourth Edition, Prentice-Hall of India, ISBN: 9780262046305, 2022.
2. Jeff Erickson: Algorithms, Jeff Erickson., 2019, ISBN: 1792644833, 9781792644832, 2019.
3. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, ISBN: 8131505219, 9788131505212, 2008.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd Edition, Silicon press, ISBN-13: 978-0-929306-41-4, ISBN: 0-929306-41-4, 2007.

CONCURRENT PROGRAMMING			
Course Code	**24SCS13**	**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:

24SCS13.1	Comprehend fundamental concepts prevalent in dynamic programming languages.
24SCS13.2	Analyze the architectural principles behind concurrent programming enabling scalability through asynchronous code.
24SCS13.3	Implement event-driven programming constructs and methodologies effectively.
24SCS13.4	Investigate concurrent programming in the context of basic web applications.
24SCS13.5	Evaluate deployment paradigms for concurrent applications.
24SCS13.6	Develop the necessary database prerequisites for concurrent application development.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCS13.1	3	-	3	3	2	-	3	-
24SCS13.2	-	3	3	3	2	3	3	-
24SCS13.3	-	-	3	3	2	3	3	-
24SCS13.4	-	-	3	3	2	3	3	-
24SCS13.5	-	-	3	3	2	3	3	-
24SCS13.6	-	-	3	3	2	3	3	-

MODULE-1	**Introduction to JavaScript and HTML forms**	**24SCS13.1**	**8 Hours**

Variables, Operators, Control Structures and Loop statements, Switch statement, Arrays, Functions, String functions; HTML Forms - getElementById, Email function, Radio Button, Dropdown Lists, Checkboxes and Validating forms, Event Handling, Form Validation, AJAX for Form Submission, Form Accessibility, Advanced Input Types (added)

Skill Development Activities

1: Programming Logic and Functions

Problem Statement: Develop a program in JavaScript to generate the Fibonacci sequence up to a specified number 'n'. Implement the solution using a function and demonstrate how the sequence is produced for a given input.

Instructions:

a) Write a JavaScript function, **generateFibonacci(n)**, that takes an integer 'n' as input.
b) Inside the function, create logic to generate the Fibonacci sequence up to 'n' terms.
c) Print or display the generated sequence as output.
d) Test your function by displaying the Fibonacci sequence up to the 10th term.

2: HTML Form Validation and JavaScript Interaction

Problem Statement: Create an HTML form to collect user details and implement JavaScript-based validation for the form inputs, including email and password confirmation.

Instructions:

a) Design an HTML form that collects user information: name, email, password, and password confirmation.
b) Implement JavaScript functions to validate the form inputs:
- Ensure the email input follows the correct email format.
- Validate that the password matches the confirmed password.
- Display appropriate error messages if the validation fails.

	c) Apply the getElementById method to access form elements for validation. d) Test your form by attempting to submit with incorrect or incomplete inputs to observe the validation in action.

MODULE-2	Basics of Node.js & Asynchronous Node.js	24SCS13.2	8 Hours

Definition, Concepts, Usage of node.js, Core modules, printing in color, Import npm modules, Debugging and Error messages. Asynchronous Node.js: Asynchronous basics, Call Stack, Callback, Queue, Event loop, Http requests, Error handling, Callback function, Callback abstraction and Callback chaining

Skill Development Activities	**3: Asynchronous HTTP Server with Node.js** **Problem Statement:** Develop a Node.js program that creates an asynchronous HTTP server and handles delayed responses. **Instructions:** a) Write a Node.js script that utilizes the http core module to create an HTTP server listening on port 3000. b) Implement asynchronous handling of HTTP requests using a 2-second delay before responding. c) Upon receiving a request, the server should respond with a message after the delay. d) Explain the asynchronous nature of Node.js by describing how the event loop, callback queue, and callback function are involved in processing delayed responses. e) Test the server by accessing "http://localhost:3000/" in a browser or using tools like Postman. **4: npm Module Usage for Console Styling in Node.js** **Problem Statement:** Create a Node.js program demonstrating the usage of a npm module for colorful console printing. **Instructions:** a) Install the 'chalk' npm module using the command npm install chalk. b) Write a Node.js script that imports the 'chalk' module and showcases its usage for console output styling. c) Print multiple messages to the console, each with different colors, text styles, and background colors using 'chalk'. d) Explain the significance of using 'chalk' or similar npm modules for console output enhancement in Node.js applications. e) Discuss the advantages and potential use cases of utilizing npm modules for styling console output.

MODULE-3	Event Driven Programming	24SCS13.3	8 Hours

Introduction, Example and Node Applications working paradigm, Event Emitter – Class, Methods and Events, Buffers – create, read and write, convert buffers to JSON format, Streams – read, write, piping and chaining, Globalobjects - filename, dirname, setTimeout(cbms), clearTimeout(t), console and process object.

Skill Development Activities	**5: Event Emitters and Buffered File Handling** **Objective:** Develop a Node.js program that utilizes Event Emitters for file handling, working with Buffers, and converting data to JSON format. Instructions: a) Implement an Event Emitter class named 'FileProcessor' with methods for reading, writing, and handling file events. b) Utilize the 'fs' core module to handle file operations (reading and writing) using Buffers. c) Create event handlers for 'read', 'write', and 'error' events within the 'FileProcessor' class. d) Demonstrate reading data from a text file, processing it as a Buffer, and converting it to JSON format. e) Use event emitters to emit events upon successful file read or write operations.

	f) Display the contents of the file in JSON format. **Program 6: Working with Streams and Global Objects in Node.js** **Objective:** Develop a Node.js program demonstrating the usage of Streams, Global Objects, and the Console & Process objects. **Instructions:** Create a Node.js script that showcases the use of streams for reading and writing data from one file to another using piping and chaining techniques. a) Access and display information about the global objects 'filename' and 'dirname' within the script.Utilize the 'console' object to output formatted messages to the console, highlighting details about the current process. b) Implement a function that utilizes setTimeout to display a message after a specified delay and clear the timeout using clearTimeout. c) Explain how streams enable efficient handling of large datasets and their advantages over traditional file handling techniques. d) Discuss the role and significance of global objects, console methods, and process-related functionalities in Node.js applications.

MODULE-4	**Web Servers and API from browser**	**24SCS13.4**	**8 Hours**
Introduction, Web Application architecture, creating a web server using Node, serving up HTML and JSON, Static assets, CSS, JS images, Dynamic Pages with Templating, Accessing the Query String, Default Function Parameters, Browser HTTP Requests with Fetch, Creating a Search Form.			
Skill Development Activities	**Program 7: Creating a Basic Web Server with Node.js** **Objective:** Develop a simple Node.js application to create a web server serving static assets (HTML, CSS, JS, images) and dynamic content using templating, handling query strings, and implementing default function parameters. **Instructions:** a) Create a Node.js script that initializes an HTTP server using the 'http' core module. b) Serve static assets (HTML, CSS, JS, images) by setting up routes for different file types and sending appropriate responses. c) Implement a templating engine (like EJS or Handlebars) to render dynamic pages using Node.js. d) Demonstrate accessing and parsing query strings from URL requests to fetch user inputs. e) Utilize default function parameters in the server-side code for handling missing or undefined parameters. f) Use the Fetch API in a basic HTML file to make HTTP requests to your Node.js server and retrieve data. **Program 8: Implementing a Search Form with Node.js and Fetch API** **Objective:** Develop a Node.js application that includes a search form and handles HTTP requests initiated by the Fetch API from a web browser. **Instructions:** a) Design a simple HTML file containing a search form that takes user input. b) Write a Node.js script that sets up a server and handles GET requests to a specific endpoint for search queries. c) Implement a route on the server to process search queries received from the browser using the Fetch API. d) Use the query parameters passed in the Fetch request to perform a basic search operation (e.g., searching through an array or predefined data). e) Return the search results back to the client-side (browser) as JSON data in the Fetch response. f) Display the search results on the web page using JavaScript to handle the response data.		

MODULE-5	Application Deployment and Databases	24SCS13.5 & 24SCS13.6	8 Hours

Introduction to any one Online development platform (like GitHub, Heroku), Version control, Exploring, Integrating, Setting up SSH keys, Pushing code.MongoDB and NoSQL introduction - Installation, Connecting and Inserting, Querying, Update and Delete documents.

Skill Development Activities

Program 9: GitHub Integration & Version Control

Objective: Set up a GitHub repository, integrate it with a local project, and demonstrate version control operations.

Instructions:

a) Create a new repository on GitHub.
b) Initialize a local project directory with Git, set up version control, and connect it to the GitHub repository.
c) Write a simple program or use an existing project to demonstrate version control operations:
    a. Create multiple code versions by adding, modifying, and deleting files.
    b. Commit these changes with descriptive commit messages.
    c. Branch out, merge branches, and resolve merge conflicts if necessary.
d) Explore the use of SSH keys for secure communication between the local system and GitHub.
e) Push the local repository's code to the GitHub remote repository.

Program 2: MongoDB Operations - Installation & CRUD Operations

Objective: Set up MongoDB, establish a connection, and perform CRUD operations on a database.

Instructions:

a) Install MongoDB locally on your machine or use a cloud-based service.
b) Write a Node.js script to establish a connection to the MongoDB server using the 'mongodb' Node.js driver.
c) Implement functions for inserting, querying, updating, and deleting documents in a MongoDB collection:
    a. Insert new documents into a collection.
    b. Retrieve documents based on specific criteria using query operations.
    c. Update existing documents by modifying their fields.
    d. Delete documents from the collection based on certain conditions.
d) Demonstrate these CRUD operations on a sample database and collection.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessments based on SDA	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	5
L3	Apply	5	5	5
L4	Analyze	10	5	-
L5	Evaluate	-	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. Learning Node.js Development, Andrew Mead, Packt Publisher, 2018, ISBN: 978-1- 78839-554-0
2. A PDF Reference for The Complete Node.js Dev Course-tutorial, Taught by Andrew Mead.
3. Node.js, Tutorial Point Simply easy learning, Online contents.

Reference Books:

1. Beginning Node.js by Basarat Syed, Apress, 1st ed. Edition, ISBN: 978-1484201886.
2. Node.js Web Development: Create real-time server-side applications with this practical step-by-step guide, David Herron, 3rd Revised edition, Packt Publishing, ISBN: 978- 1785881503

UX / UI DESIGN PRINCIPLES

Course Code	**24SCS14**	**CIE Marks**	**50**
L:T:P:S	**2:0:0:1**	**SEE Marks**	**50**
Hrs / Week	**4**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**03**

Course outcomes:

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

24SCS14.1	Understand the foundational principles underlying user interface design characteristics.
24SCS14.2	Explain the user interface design process, citing pertinent case studies for illustration.
24SCS14.3	Demonstrate the framework of user experience, creating designs that transcend multiple platforms.
24SCS14.4	Analyze the critical elements of user experience pivotal to successful business strategies.
24SCS14.5	Evaluate the requirements and structural components integral to designing user experience elements.
24SCS14.6	Construct the framework and surface presentation of user experience elements, formulating the skeleton and visual plane.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCS14.1	3	-	-	-	-	3	3	-
24SCS14.2	3	3	3	3	-	3	3	-
24SCS14.3	-	3	3	3	-	3	3	-
24SCS14.4	-	3	3	3	-	3	3	-
24SCS14.5	-	3	3	3	-	3	3	-
24SCS14.6	-	3	3	3	-	3	3	-

MODULE-1	**User Interface Introduction & Characteristics**	**24SCS14.1**	**8 Hours**

Definition, Importance and Benefits of good design, **Characteristics of Graphical Systems:** GUI, Advantage and disadvantages of graphical systems, Characteristics of GUI. **Characteristics of Web User Interface:** GUI vs. Web page design, Merging of graphical Business systems and the web, Principles of user interface design.

Skill Development Activities

Activity-1: Comparative Analysis and Design Principles

Objective: Enhance understanding of different interface designs and principles through comparative analysis.

Instructions:

Research and Presentation: It is a group activity. Each group is assigned with one type of graphical system (GUI) and one aspect of web user interfaces (Web page design). Instructed them to do a research and create presentations:

- Describe the characteristics, advantages, and disadvantages of their assigned system.
- Discuss principles of user interface design relevant to their systems.

Comparative Analysis: After presentations, a group discussion will be conducted to compare GUIs and Web page designs:

- Analyze similarities and differences between GUIs and web interfaces.
- Identify principles that overlap or differ in the two design approaches.

Case Study Review: Consider any case studies showcasing successful integration or challenges when merging graphical business systems with web interfaces.

Practical Application: Task participants must create a comparative analysis report highlighting key design principles and merging techniques between GUIs and web interfaces.

Outcome: Improved comprehension of design characteristics, benefits, and principles through comparative analysis and practical application.

<table>
<tr><td>MODULE-2</td><td colspan="2">User Interface Design Process</td><td>24SCS14.2</td><td>8 Hours</td></tr>
<tr><td colspan="5">Obstacles and pitfalls in development path, Five commandments, Common Usability problems, Practical and objective measures of usability; Clients: Important human characteristics in design, Human considerations in design, user’s psychological and physical characteristics, methods for understanding users.</td></tr>
<tr><td>Skill Development Activities</td><td colspan="4">Activity-2: User-Centric Design
Objective: Enhance understanding of user characteristics, usability problems, and methods for user-centered design.
Instructions:
User Characteristics Analysis:
• Introduce participants to various human characteristics influencing design (psychological, physical).
• Discuss on how these characteristics impact user experience and design decisions.
• Could be a group activity to research and present on specific user characteristics (e.g., cognitive abilities, motor skills).
Usability Problems Identification:
• Consider case studies or examples showcasing common usability problems in design.
• Analyze these problems, identifying the root causes and their impact on user experience.
• Encourage discussions on practical measures to mitigate or solve these problems.
Usability Testing and Measures:
• Conduct a usability testing session with a simple prototype or existing interface.
• Observe users interacting with the interface and note usability issues.
• Discuss how to objectively measure usability, considering metrics like task completion time, error rates, etc.
Client's Perspective and User Understanding:
• Introduce the importance of understanding clients' needs and user requirements in design.
• Perform role-playing sessions where participants represent designers and clients, focusing on effective communication.
• Explore methods (interviews, surveys, personas) for understanding users and gathering requirements.
Design Recommendations and Prototyping:
• Based on insights gained, task participants to propose design recommendations to address common usability problems.
• Create low-fidelity prototypes reflecting improvements based on user-centric design principles.
• Perform discussions on iterating designs based on feedback and iterative usability testing.

Outcome: Improved comprehension of user-centric design principles, identification of usability problems, practical usability testing experience, and effective methods for understanding user needs. This activity fosters a user-centered mindset among participants, emphasizing the importance of human characteristics, usability, and client considerations in design.</td></tr>
<tr><td>MODULE-3</td><td colspan="2">UX AND Design Thinking</td><td>24SCS14.3</td><td>8 Hours</td></tr>
<tr><td colspan="5">Introduction:Product development cycle, characteristics of good user experience, The role of a beginner UX designer, responsibility of an entry level UX designer.
Design thinking: A UX design framework, Designing cross platform experience, UX research, research methods, primary research, secondary research, bias in UX research.</td></tr>
</table>

Skill Development Activities	**Activity: Entry-Level UX Design Workshop** **Objective:** Develop foundational skills for beginner UX designers, emphasizing design thinking and research methodologies. **Instructions:** **Introduction to UX Design and Roles:** • Provide an overview of the product development cycle and the essential characteristics of good user experience. • Discuss the responsibilities and role of an entry-level UX designer in a team. • Share case studies or examples highlighting the impact of a beginner UX designer's role in successful products. **Design Thinking Framework and Cross-Platform Experience:** • Introduce design thinking as a problem-solving framework in UX design. • Perform a group activity on a hypothetical cross-platform experience design challenge. • Complete the stages of empathizing, defining, ideating, prototyping, and testing for their designs. **UX Research Methods:** • Brainstorm on UX research methodologies covering primary and secondary research techniques. • Provide examples and case studies demonstrating bias in UX research and how it can affect design outcomes. • Discussion on mitigating bias and ensuring validity in research. **Practical Research Exercise:** • Perform a group activity on specific UX research method (e.g., user interviews, surveys, competitor analysis). • Task each group with conducting a short research activity related to the hypothetical cross-platform design challenge. • Present their findings, discussing the relevance of their research in the design process. **Reflection and Design Presentation:** • Have each group reflect on their design thinking process, research findings, and insights gained. • Present their design concepts, explaining how research influenced their design decisions. • Feedback and discussions among participants on different approaches and lessons learned. **Outcome:** Improved understanding of the UX design process, application of design thinking in cross-platform experience, familiarity with various UX research methods, and awareness of the responsibilities and impact of an entry-level UX designer. This activity aims to provide hands-on experience and foundational knowledge crucial for beginners entering the field of UX design.
MODULE-4	**User Experience and Its Elements** | **24SCS14.4** | **8 Hours**
Introducing User Experience, From Product design to User experience design, Designing for experience, User experience and the web, Good user experience is good business. **Elements:** The five planes, Building from bottom to top, A basic duality, Elements of User experience, Strategy Plane – Defining the strategy, Product Objectives, User needs.	
Skill Development Activities	**Activity: User Experience Elements and Strategy** **Objective:** Enhance understanding of the five planes of user experience and strategize product objectives based on user needs. **Instructions:** **Introduction to User Experience Elements:**

	• Provide an overview of the five planes of user experience: strategy, scope, structure, skeleton, and surface. • Explain how these planes build upon each other to create a holistic user experience. • Discuss the importance of understanding each plane for designing successful products. **Group Activity - Exploring User Experience Elements:** • Divide participants into groups, assigning each group one plane of the user experience to focus on. • Task each group with exploring and presenting characteristics, components, and examples related to their assigned plane. • Discuss on how each plane contributes to overall user experience design. **Defining Strategy and Product Objectives:** • Introduce the strategy plane and its role in defining product objectives aligned with user needs. • Conduct an interactive session on identifying and understanding user needs and expectations. • Craft the product objectives that resonate with identified user needs. **Case Study Analysis and Strategy Development:** • Provide case studies showcasing successful products or services and their strategic planning processes. • Break participants into smaller groups to analyze these case studies and extract strategic insights. • Formulate a strategy plan for a hypothetical product, aligning it with user needs. **Presentation and Strategy Refinement:** • Have groups present their formulated strategy plans to the larger audience. • Perform feedback and discussions on different strategic approaches and their alignment with user needs. • Facilitate a session to refine and improve the strategies based on group discussions and feedback. **Outcome:** Enhanced comprehension of the five planes of user experience, understanding the role of strategy in product design, and the ability to align product objectives with user needs. This activity aims to provide participants with practical knowledge and skills essential for developing strategic thinking in user experience design.
MODULE-5	**User Experience Design Framework** | **24SCS14.5 & 24SCS14.6** | **8 Hours**
Scope Plane – Defining the scope Functionality and content, Defining requirements, Functional specification. **Structure Plane** – Defining the structure, Interaction Design, Information architecture. **Skeleton Plane** – Defining the Skeleton, Convention and Metaphor, Wireframes **Surface Plane** – Defining the surface, Making sense of the senses, Contrast and Uniformity, Design composite and Styleguides.	
Skill Development Activities	**Activity: Journey Across the User Experience Planes** **Objective:** Enhance understanding and proficiency across the scope, structure, skeleton, and surface planes of user experience design. **Instructions:** **Introduction to User Experience Planes:** • Provide an overview of the four planes - Scope, Structure, Skeleton, and Surface - emphasizing their significance in user experience design. • Discuss how each plane contributes to the overall user experience and the sequential nature of their development. **Practical Exercises on Each Plane:** • Conduct tutorials on each plane, focusing on practical exercises and activities:

	• Scope Plane: Define scope, functionality, requirements, and create functional specifications for a hypothetical product. • Structure Plane: Explore interaction design principles, build information architecture, and discuss defining structures. • Skeleton Plane: Engage in exercises on convention, metaphor, and wireframing techniques to develop a basic skeleton. • Surface Plane: Discuss making sense of senses, contrast, uniformity, and delve into creating design composites and style guides. **Cross-Plane Design Challenges:** • Formulate cross-plane design challenges, combining elements from each plane. • Assign mixed-discipline groups, tasking them to collaborate and create a comprehensive design solution. • Emphasize the importance of integrating learning from each plane into their solutions.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessments based on SDA	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	5
L3	Apply	5	5	5
L4	Analyze	10	5	-
L5	Evaluate	-	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. The Elements of User Experience: User-Centered Design for the Web and Beyond, Jesse James Garrett, Second Edition, 2011, ISBN: 13: 978-0-321-68368-7.
2. A Project Guide to UX Design: For user experience designers in the field or in the making (2nd. ed.). Russ Unger and Carolyn Chandler. New Riders Publishing, USA, 2012.
3. Wilbent. O. Galitz, "The Essential Guide to User Interface Design", John Wiley& Sons,2001.
4. Ben Sheiderman, "Design the User Interface", Pearson Education, 1998**Reference Books:**
1. The Elements of User Experience: User-Centered Design for the Web and Beyond, Second Edition Jesse James Garrett, Pearson Education. 2011.
2. The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Third Edition Wilbert O. Galitz, Wiley Publishing, 2007.
3. The UX Book Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson and Pardha S. Pyla, Elsevier, 2012
4. Alan Cooper, "The Essential of User Interface Design", Wiley – Dream Tech Ltd.,2002.
5. Wilbert O. Galitz, The Essential Guide to User Interface Design, John Wiley & Sons, Second Edition 2002.

RESEARCH METHODOLOGY AND IPR

Course Code	**24SCS15**	**CIE Marks**	**50**
L:T:P:S	**2:0:0:1**	**SEE Marks**	**50**
Hrs / Week	**4**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**03**

Course outcomes:

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

24SCS15.1	Outline the research objectives aimed at articulating and refining a specific research problem.
24SCS15.2	Provide a condensed overview of the research literature, drawing from credible journals and other reputable resources.
24SCS15.3	Employ appropriate methodologies, tools, or techniques in devising the research design.
24SCS15.4	Conduct an analysis of multiple parametric hypothesis tests to substantiate the research discoveries and document the outcomes.
24SCS15.5	Interpret diverse manifestations of intellectual property and explore their significance within business contexts.
24SCS15.6	Develop strategies and identify resources pertinent to patent-related endeavors.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	
24SCS15.1	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**-**	
24SCS15.2	**3**	**3**	**3**	**1**	**2**	**-**	**3**	**-**	
24SCS15.3	**3**	**3**	**3**	**1**	**2**	**-**	**3**	**-**	
24SCS15.4	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	
24SCS15.5	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	
24SCS15.6	**3**	**3**	**3**	**1**	**-2**	**-**	**3**	**-**	

MODULE-1	**Research Methodology An Introduction**	**24SCS15.1**	**8 Hours**

Introduction: Meaning of Research, Objectives, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, Illustrations.

Self-study / Case Study / Applications	1. Evaluate the importance of a well-defined research problem in the context of research endeavors. Discuss the potential challenges researchers might face in the process of selecting and defining a research problem, providing strategies to mitigate these challenges. 2. Critically examine the technique(s) used in defining a research problem. Compare and contrast the effectiveness of different techniques, citing examples where appropriate. Discuss how the choice of technique can impact the trajectory and outcomes of a research study.

MODULE-2	**Literature Review Writing**	**24SCS15.2**	**8 Hours**

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to the research problem, Searching the existing literature, Reviewing the selected literature, Developing a theoretical/conceptual framework, Writing about the literature re- viewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Self-study / Case Study / Applications	Conduct a comprehensive literature review on the advancements and applications of quantum computing in comparison to classical computing architectures. Explore the theoretical foundations, technological developments, potential advantages, and limitations of quantum computing over traditional computing paradigms. Discuss key research papers, case studies, and significant findings in this field to provide a

	comprehensive overview of the current landscape and future prospects of advanced computing technologies.		
MODULE-3	**Design of Sampling**	**24SCS15.13**	**8 Hours**
Introduction: Sample Design, Sampling and Non- sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. **Measurement and Scaling:** Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Techniques, Multidimensional Scaling, Deciding the Scale. **Data Collection:** Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.			
Self-study / Case Study / Applications	Evaluate a healthcare study's measurement scale selection, discussing the reliability and validity of Likert scales in measuring patient satisfaction, addressing potential sources of measurement error and justifying the choice of a specific scaling technique for multidimensional assessment.		
MODULE-4	**Testing of Hypotheses**	**24SCS15.4**	**8 Hours**
Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis, Chi-square Test: Test of Difference of more than two proportions, Test of independence of attributes, Test of goodness of fit, Cautions in Using Chi Square Tests. **Interpretation and Report Writing:** Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Presentation, and Writing Research Reports.			
Self-study / Case Study / Applications	**Hypothesis Testing for Mean:** A manufacturing company claims that the average lifespan of its product is 50 months. A sample of 30 products resulted in a mean lifespan of 48 months with a standard deviation of 5 months. At a 5% significance level, test the company's claim. **Hypothesis Testing for Proportion:** A researcher claims that the proportion of people preferring Product A over Product B is 0.6. In a survey of 200 individuals, 120 prefer Product A. Test the claim at a 1% significance level. **Hypothesis Testing for Difference of Two Means:** Compare the average scores of two teaching methods given to two different groups of students. Group A's mean score is 75 with a standard deviation of 10, and Group B's mean score is 80 with a standard deviation of 12. For a significance level of 0.05, test if there's a significant difference between the teaching methods. **Chi-square Test for Difference of More than Two Proportions:** A survey examines the preference for four different ice cream flavors among people of different age groups. In a sample of 500 respondents, test whether the preference for flavors is the same across age groups (significance level of 0.05).		
MODULE-5	**IP & Patents Act**	**24SCS15.5 & 24SCS15.6**	**8 Hours**
Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, 1970, Trade Mark Act, 1999, The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957, The Protection of Plant Varieties and Farmers' Rights Act, 2001, The Semiconductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity. **Patents Act:** Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Patentable Subject			

Matter, Rights Conferred, Exceptions, Term of protection, Conditionson Patent Applicants, Process Patents.	
Self-study / Case Study / Applications	1. List a few innovating patentable ideas. 2. Discuss the role of patents in fostering innovation and economic growth within the pharmaceutical industry. Analyze the balance between patent protection and public access to essential medicines, considering the ethical and societal implications. Provide examples and arguments supporting both sides of this debate, and propose strategies that strike a balance between incentivizing innovation and ensuring affordable access to life-saving medications.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessments	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	5
L3	Apply	5	5	5
L4	Analyze	10	5	-
L5	Evaluate	-	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. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International, 4th Edition, 2018.
2. Research Methodology a step-by-step guide for beginners, Ranjit Kumar, AGE Publications, 3rd Edition, 2011.
3. Study Material (For the topic Intellectual Property under module 5), Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September2013.

Reference Books:

1. Research Methods: the concise knowledge base Trochim Atomic Dog Publishing 2005.
2. Conducting Research Literature Reviews: From the Internet to Paper, Fink A Sage Publications, 2009.

ADVANCED ALGORITHMS LAB			
Course Code	**24SCSL16**	**CIE Marks**	**50**
L:T:P:S	**0:0:2:0**	**SEE Marks**	**50**
Hrs / Week	**4**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

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

24SCSL16.1	Understand the intricacies search problems through application of various algorithmic methods.
24SCSL16.2	Apply optimized algorithms to find the shortest path using positive and negative weights effectively.
24SCSL163	Analyse the graph algorithm for the Ford-Fulker son method, encryption and decryption- RSA
24SCSL164	Evaluate various algorithmic design techniques for Knuth-Morris-Pratt (KMP) ,Rabin Karp Algorithm-hashing and other string matching algorithms.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCSL16.1	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**-**
24SCSL16.2	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**-**
24SCSL16.3	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**-**
24SCSL16.4	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**-**

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	● **Demo of C++/JAVA/Python Installation with Simple Programs**	2	NA
	PART-A		
1	Design a program to implement **the maximum value among an array's n elements** and evaluate the best and worst-case scenarios for the given elements.	2	**24SCSL16.1**
2	Develop a program for performing **linear search and binary search.** Evaluate the best and worst-case scenarios for the given elements.	2	**24SCSL161**
3	Design and develop a program to implement the **Bellman-Ford algorithm** for finding the shortest path in a weighted graph: a) Provide a detailed plan on how to represent the graph data structure. b) Explain the steps involved in implementing the Bellman-Ford algorithm, including initialization, edge relaxation, and cycle detection. c) Describe the methodology to handle graphs with negative edge weights and analyze the presence of negative cycles.	2	**24SCSL16.2**
4	Design a program to implement **Dijkstra's algorithm** for determining the shortest path in a weighted graph with non-negative edge weights? a) Explain the graph representation suitable for implementing Dijkstra's algorithm. b) Elaborate on the steps involved in the algorithm, including initialization, prioritization, and relaxation of edges. c) Highlight the conditions under which Dijkstra's algorithm might not function optimally	2	**24SCSL16.2**
5	Design a program to implement **Ford-Fulkerson algorithm** greedy approach for calculating the **maximum** possible **flow** in a network or a graph.	2	**24SCSL16.3**
6	Design a program that utilizes the Sieve of Eratosthenes algorithm to generate prime numbers within a specified range. a) Detail the steps involved in Sieve of Eratosthenes and its mathematical principles for sieving out primes. b) Implement the algorithm within the program to generate prime numbers efficiently.	2	**24SCSL16.3**

	c) Analyse the algorithm's time complexity and discuss how it performs concerning larger ranges of numbers. Enhance the program to optimize memory usage for extremely large ranges and evaluate its impact on performance.		
	PART-B		
7	Design, develop, and implement a robust program that demonstrates the **RSA** (Rivest Shamir-Adleman) algorithm's functionalities using small prime numbers for encryption and decryption. a) Validate the RSA algorithm's implementation accuracy through extensive testing with different input sizes. b) Handle edge cases gracefully, considering scenarios involving very small prime numbers or specific input conditions. c) Measure the computational efficiency and execution time of the RSA algorithm using small prime values.	2	**24SCSL16.3**
8	Develop a program to **perform string matching using the brute force (naïve)** algorithm, aiding in pattern detection within given text strings. a) Describe the algorithm's methodology, emphasizing comparisons and shifts during the search process. b) Evaluate the algorithm's time complexity and efficiency for different text and pattern lengths. c) Discuss scenarios where the naïve approach excels or experiences limitations based on input characteristics.	2	**24SCSL16.4**
9	Design and develop a program incorporating the **Knuth-Morris-Pratt (KMP)** algorithm to match a given pattern within a text. a) Explain the KMP algorithm's intricacies, such as pre-processing and efficient pattern matching techniques. b) Verify the correctness and accuracy of the program through various test cases involving different text and pattern lengths.	2	**24SCSL16.4**
10	Develop a program implementing the **Rabin-Karp algorithm** for efficient pattern matching. a) Discuss the algorithm's hashing techniques and sliding window approach for pattern search. b) Evaluate and analyze the performance of the Rabin-Karp algorithm concerning different text and pattern sizes.	2	**24SCSL16.4**
11	Implement the **Finite Automata-based string-matching algorithm** within the program. a) Explain the construction of the Finite Automata and its role in pattern matching. b) Measure and analyze the algorithm's performance, considering variations in text and pattern lengths.	2	**24SCSL16.4**
12	Design and implement a **Monte Carlo-based algorithm for testing the primality of integers.** a) Explain the probabilistic nature of the algorithm and its approach to determining primality. b) Validate the correctness and accuracy of the algorithm with various integer inputs	2	**24SCSL16.4**

PART-C

Beyond Syllabus Virtual Lab Content

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

1. https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessment	Test (s)
		30	20
L1	Remember	-	--
L2	Understand	5	05
L3	Apply	10	05

L4	**Analyze**	**10**	**05**
L5	**Evaluate**	**5**	**05**
L6	**Create**	--	--

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1) Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Second Edition, 2017, Pearson Education, ISBN: 978-9332585485.
2) Design and Analysis of Algorithms, S. Sridhar, 2014, Oxford University Press, ISBN: 9780198093695

UX/UI DESIGN PRINCIPLES LAB			
Course Code	**24SCSL17**	**CIE Marks**	**50**
L:T:P:S	**0:0:2:0**	**EE Marks**	**50**
Hrs / Week	**4**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

Course outcomes:

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

24SCSL17.1	Understand the core principles of user interface design characteristics.
24SCSL17.2	Explore the user interface design thinking process through the analysis of pertinent case studies
24SCSL17.3	Create prototypes for user experience frameworks
24SCSL17.4	Deploy web applications using UI/UX principles

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCSL17.1	3	3	3	3	2	-	3	-
24SCSL17.2	3	3	2	3	2	-	3	-
24SCSL17.3	3	2	3	3	2	-	3	-
24SCSL17.4	3	2	3	2	2	-	3	-

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Basic understanding of design principles and Proficiency in using design software tools, as well as a creative mindset and an interest in user-centered design concepts.	2	NA
	PART-A		
1.	Need for Navigation Design and implementing Navigation Design: In the context of Navigation interface design, describe a specific scenario where a lack of Navigation-user design led to a suboptimal user experience. How could we incorporate the principles of UX design have improved the situation?	2	24SCSL17.1
2.	Need for Design and UX Design: In the context of a user interface design, describe a specific scenario where a lack of user-centered design led to a suboptimal user experience. How could we incorporate the principles of UX design have improved the situation?	2	24SCSL17.1
3.	Importance of Design Thinking: Conduct a mini design thinking activity within your laboratory group. Select a real-world problem or challenge and lead the participants through the stages of design thinking, including empathizing, defining, ideating, prototyping, and testing. Share the outcomes and lessons learned from this exercise.	2	24SCSL17.2
4.	UPI Case Study and Design Thinking - Explore the user-centered design approach through a case study of the Unified Payments Interface (UPI) in the context of India's digital payments landscape.	2	24SCSL17.2
5.	Sharing and Exporting UI/UX Design – Understand and analysis of the importance of a Sharing and Exporting design in UI/UX design.	2	24SCSL17.2
6.	Custom and Operation Control - Explore the impact of Custom and Operation Control working and tools used.	2	24SCSL17.2

	PART-B		
7.	Ui/UX Prototype - Develop a working prototype using prototyping tools	2	24SCSL17.3
8.	Designing Sections and Adding Contents - Populate the sections of the website prototype with content and apply basic styling.	2	24SCSL17.3

PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

2. https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessment	Test (s)
		30	20
L1	Remember	-	--
L2	Understand	5	05
L3	Apply	10	05
L4	Analyze	10	05
L5	Evaluate	5	05
L6	Create	--	--

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1) Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Second Edition, 2017, Pearson Education, ISBN: 978-9332585485.
2) Design and Analysis of Algorithms, S. Sridhar, 2014, Oxford University Press, ISBN: 9780198093695

Second Semester Syllabus

CLOUD COMPUTING & VIRTUALIZATION			
Course Code	**24SCS21**	**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:

24SCS21.1	Understand the core concepts of cloud computing architecture and deployment models.
24SCS21.2	Comprehend virtualization technology implementation and the components of cloud infrastructure.
24SCS21.3	Apply different mechanisms within cloud infrastructure and manage resource billing.
24SCS21.4	Analyze the cloud programming model through a framework for distributed processing across computer clusters.
24SCS21.5	Evaluate security mechanisms in the cloud to maintain data confidentiality and integrity.
24SCS21.6	Create cloud computing infrastructure and services using simulation application frameworks.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCS21.1	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
24SCS21.2	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**-**
24SCS21.3	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**-**
24SCS21.4	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**-**
24SCS21.5	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**-**
24SCS21.6	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**-**

MODULE-1	**Cloud Computing– An Introduction**	**24SCS21.1**	**8 Hours**

Cloud Computing Architecture – The Cloud Reference Model – Cloud Characteristics –Cloud Deployment Models: Public, Private, Community, Hybrid Clouds – Cloud Delivery Models: IaaS, PaaS, SaaS – Open-Source Private Cloud Software: Eucalyptus, Open Nebula, Open Stack.

Skill Development Activities	**Perform the tasks to develop insight into the AWS environment:** **1. Create and Configure an EC2 Instance:** • Log in to your AWS Management Console. • Navigate to the EC2 service. • Launch a new EC2 instance by selecting an Amazon Machine Image (AMI) of your choice, like a basic Linux or Windows instance. • Follow the step-by-step wizard to configure the instance settings, such as instance type, security groups, and key pairs. • Access the newly created instance using SSH or RDP depending on the operating system, and perform basic tasks like installing software or updating packages. **2.Set Up and Test S3 Bucket:** • Access the AWS Management Console. • Go to the S3 service. • Create a new S3 bucket with a unique name in a selected region. • Upload a file (e.g., an image, text file, etc.) to this newly created bucket. • Configure permissions for the file and the bucket, setting up access control settings like making the file public or private.

	• Retrieve the URL of the uploaded file and test access (if public) or access control by trying to access it through the URL and adjusting permissions accordingly.

MODULE-2	**Virtualization**	**24SCS21.2**	**8 Hours**

Data Center Technology, Virtualization, Characteristics of Virtualized Environments, and Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Implementation Levels of Virtualization, Tools and Mechanisms: Xen, VMWare, Microsoft Hyper-V, KVM, VirtualBox.

Skill Development Activities	**AWS Computing and Marketplace - Experiment with AWS computing services and serverless computing using AWS Lambda** **3. Experiment with AWS Marketplace:** **Objective:** Find and deploy a software or solution from the AWS Marketplace. 1. Access the AWS Management Console. 2. Go to the AWS Marketplace. 3. Browse through the categories or use the search bar to find a specific software or solution you're interested in (e.g., a content management system, security tool, etc.). 4. Select the desired product and review its details, pricing, and supported configurations. 5. Click on "Continue to Subscribe" or "Buy Now" and follow the instructions to deploy the software to your AWS account. 6. Once deployed, access the software and configure it as needed, following any documentation or guidelines provided by the vendor. **4. Experiment with AWS Lambda Function:** **Objective:** Create a simple AWS Lambda function and trigger it using an event source. 1. Log in to your AWS Management Console. 2. Go to the AWS Lambda service. 3. Click on "Create function" and choose the option to author from scratch. 4. Define the function details like name, runtime (e.g., Node.js, Python, etc.), and permissions. 5. Write a simple function code. For example, a Node.js functions that logs a message to the console. 6. Save the function and then create a trigger. You can use an S3 bucket upload event, API Gateway, or another trigger source of your choice. 7. Configure the trigger and link it to the Lambda function. 8. Test the function by invoking the trigger. For instance, if you use an S3 bucket upload event, upload a file to the specified bucket to trigger the Lambda function. 9. Verify that the Lambda function executes as expected by checking Cloud Watch logs or any relevant output.

MODULE-3	**Cloud Computing Mechanism**	**24SCS21.3**	**8 Hours**

Cloud Storage, Cloud Usage Monitor, Resource Replication – Specialized Cloud Mechanism: Load Balancer, SLA Monitor, Pay-per-use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi Device Broker, State Management Database–Cloud Management Mechanism: Remote Administration System, Resource Management System, SLA Management System, Billing Management System.

Skill Development Activities	**Elastic Cloud Compute-Auto Scaling, Elastic Load Balancing, Catalog Market place of AWS** – It provides an opportunity to understand and implement a scalable infrastructure using Auto Scaling, Elastic Load Balancing for EC2 instances, and also explores the AWS Marketplace Catalog for potential add-ons or solutions to enhance the AWS-based application or system.

	Objective: Set up an Auto Scaling Group with Elastic Load Balancing for EC2 instances and explore the AWS Marketplace Catalog. **EC2 Instance Setup:** • Log in to your AWS Management Console. • Navigate to the EC2 service. • Launch an EC2 instance or use an existing one. • Configure the instance settings like instance type, network settings, and storage. • Once the instance is running, ensure it has a web server or an application installed. **Elastic Load Balancer (ELB):** • Create an Elastic Load Balancer (ELB) from the EC2 Dashboard. • Configure the ELB with your EC2 instance(s) as its targets. • Set up listeners and health checks to ensure the ELB routes traffic properly. **Auto Scaling Group:** • Create an Auto Scaling Group from the EC2 Dashboard. • Configure the Auto Scaling Group with the desired minimum, maximum, and desired number of instances. • Attach the ELB created earlier to the Auto Scaling Group for load balancing. **Testing Auto Scaling:** • Test the Auto Scaling configuration by simulating increased demand. For instance, you can generate increased traffic or load on your application. • Observe how Auto Scaling responds by automatically provisioning additional instances to handle the load. **AWS Marketplace Catalog:** • Go to the AWS Marketplace from your AWS Management Console. • Explore the catalog to find a relevant software or solution that could complement your EC2 instances or application. • Read the details, pricing, and documentation of the selected product. • If possible, deploy the chosen product into your AWS environment and test its integration with your setup.

MODULE-4	**Programming Model and Security**	**24SCS21.4 & 24SCS21.5**	**8 Hours**
Apache Hadoop, Hadoop Map Reduce, Hadoop Distributed File System, Hadoop I/O, Developing a MapReduce Application, MapReduce Types and Formats, Map Reduce Features, Hadoop Cluster Setup, Administering Hadoop, Threat Agents, Cloud Security Threats. Cloud Security Mechanism: Encryption, Hashing, Digital Signature, Public Key Infrastructure, Identity and Access Management, Single Sign-on, Cloud Based Security Groups.			

Skill Development Activities	**Experiment with Users, Groups, and Roles-Understanding Credentials, Security Policies, IAM abilities and limitations of AWS -** Practical experience in setting up IAM users, groups, and roles, defining policies, and understanding how these elements interact within the AWS ecosystem. Additionally, observing the abilities and limitations of IAM helps in comprehending the security measures and access controls within AWS. **Objective:** Set up Users, Groups, and Roles in AWS IAM, define policies, and explore their abilities and limitations. **Steps:** **1. IAM User Setup:** • Log in to your AWS Management Console. • Go to the IAM service. • Create a new IAM user with programmatic access (access key ID and secret access key) and console access (login credentials). • Define a username, access type, and assign permissions based on policies. • Save the access key ID and secret access key securely for later use. **2. IAM Group Creation:** • Create an IAM group and assign permissions to the group by attaching policies. • Add the previously created IAM user(s) to this group. **3. IAM Role Definition:** • Define an IAM role with specific permissions, assuming an access scenario (e.g., EC2 instance accessing S3 bucket). • Define trust relationships to specify which entities can assume the role (e.g., EC2 service or specific IAM users). **4. Setting Security Policies:** • Define and attach IAM policies to users, groups, or roles to grant or restrict access to AWS resources. • Experiment with various policy conditions, granting specific actions or resources and denying certain actions. **5. Testing IAM Abilities and Limitations:** • Log in using different IAM users to understand their respective access levels and limitations within the AWS Management Console. • Test permissions by attempting various actions (e.g., creating EC2 instances, accessing S3 buckets) according to the assigned policies. **6. Observe IAM Limitations:** • Understand and note the limitations of IAM, such as service-specific limitations, restrictions in policy conditions, or access controls.
MODULE-5	**Cloud Computing Tools and Applications** | **24SCS21.6** | **8 Hours**
Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture (User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud, Scientific Applications – Healthcare, Geo-science and Biology. Business and Consumer Applications – CRM and ERP, Social Networking, Media Applications and Multiplayer, Online Gaming.	
Skill Development Activities	**Hands-on: Cloud simulators** **Create a Simple Simulation:** • Write a basic Java program utilizing CloudSim libraries. • Define a Datacenter with one or multiple Hosts. • Create a set of Virtual Machines (VMs) with specified characteristics (e.g., processing power, RAM, bandwidth).

	• Generate Cloudlets (tasks) representing computing jobs to be executed by the VMs. **Configure Simulation Parameters:** • Set parameters like the number of Data centers, Hosts, VMs, Cloudlets, scheduling policies, and simulation duration. **Run the Simulation:** • Execute the simulation and observe the progression of tasks (Cloudlets) being allocated to VMs, their execution, and completion. • Monitor the resource utilization within the simulated cloud infrastructure.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessments based on SDA	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	5
L3	Apply	5	5	5
L4	Analyze	10	5	-
L5	Evaluate	-	-	-
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	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. Thomas Erl, Zaigham Mahood, Ricardo Puttini, "Cloud Computing, Concept, Technology & Architecture", Prentice Hall, 2013.
2. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", TataMcGraw-Hill, 2013.
3. Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing, A Practical Approach", Tata McGraw-Hill Edition, 2010.

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", Universities Press (India) Private Limited, 2014.
2. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 4th Edition, 2015.
3. James E Smith and Ravi Nair, "Virtual Machines", Elsevier, 2005.
4. John Ritting house & James Ransome, "Cloud Computing, Implementation, Management and Strategy", CRC Press, 2010.
5. Cloud computing a practical approach – Anthony T.Velte, Toby J.Velte Robert Elsenpeter, TATA McGraw-Hill, New Delhi–2010.

DEVOPS			
Course Code	**24SCS22**	**CIE Marks**	**50**
L:T:P:S	**2:0:0:1**	**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:

24SCS22.1	Understand DevOps principles to meet software development requirements.
24SCS22.2	Understand the process of CI using Jenkins.
24SCS22.3	Implement containerization using Docker.
24SCS22.4	Deploy an application on Kubernetes cluster.
24SCS22.5	Explore IaC to provision cloud resources and manage the configuration of remote server.
24SCS22.6	Apply varios methods to monitoring the server and application metrics.

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**
24SCS22.1	3	3	3	3	-	-	3	-
24SCS22.2	3	3	3	3	3	-	3	-
24SCS22.3	3	3	3	3	-	-	3	-
24SCS22.4	3	3	3	3	-	-	3	-
24SCS22.5	3	3	3	3	3	-	3	-
24SCS22.6	3	3	3	3	-	-	3	-

MODULE-1	**Introduction**	**24SCS22.1**	**8 Hours**

Software Engineering - Traditional vs Agile Process Models; What is DevOps?; Why DevOps?; Introduction To AWS, Azure and GCP; Source Code Management using Version Control Systems – Git, GitHub, GitLab, BitBucket; Compile and Build Using Maven - Introduction, Installation of Maven, POM files, Maven Build Lifecycle, Maven Commands, Create and Build Artifacts, Maven Profiles, Maven Repositories, Maven Plugins, Dependency Management.

MODULE-2	**Continuous Integration Using Jenkins**	**24SCS22.2**	**8 Hours**

Introduction to CI/CD, Jenkins Architecture Overview, Install & Configure Jenkins, Build Jobs and Configurations, Jenkins Plugins, Jenkins Integration with other Tools

MODULE-3	**Containerization with Docker**	**24SCS22.3**	**8 Hours**

Virtualization vs Containerization, Introduction to Docker and DockerHub, Docker Commands, Understanding and Building Docker Images, Creating Containers, Working with Containers – Containerize an Application

MODULE-4	**Container Orchestration using Kubernetes**	**24SCS22.4**	**8 Hours**

Introduction to Kubernetes, Advantages of Kubernetes, Kubernetes Architecture, Deploying a Kubernetes Cluster, Creating Kubernetes Objects, Deploying an Application to Kubernetes Cluster.

MODULE-5	**IaC, Configuration Management, Monitoring and Observability**	**24SCS22.5 & 24SCS22.6**	**8 Hours**

IaC: Introduction to Terraform, How does Terraform Work?, Statefile Management, Install Terraform, Provision Cloud Resources using Terraform Configuartion Files, **Configuration Management**: Introduction to Ansible, Start automating with Ansible, Building an Inventory, Creating a Playbook, Ansible Concepts, **Monitoring and Observability:** Introduction to Prometheus, Grafana and OpenTelemetry, Difference between Logs, Metrics and Traces.

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

SUGGESTED ACTIVITIES:

1. Creating a new Git repository, cloning existing repository, checking changes into a Git repository, pushing changes to a Git remote, Creating a Git branch
2. Installing Docker container on windows/Linux, issuing docker commands
3. Building Docker Images for Python Application
4. Setting up Docker and Maven in Jenkins and First Pipeline Run
5. Running Unit Tests and Integration Tests in Jenkins Pipelines Suggested Learning Resources:

Reference Books:

1. Len Bass, Ingo Weber and Liming Zhu, —" DevOps: A Software Architect 's Perspective", Pearson Education, 2016
2. Joakim Verona - "Practical DevOps" - Packet Publishing, 2016
3. Viktor Farcic -" The DevOps 2.1 Toolkit: Docker Swarm" - Packet Publishing, 2017
4. Mark Treveil, and the Dataiku Team-" Introducing MLOps" - O'Reilly Media- 2020

ARTIFICIAL INTELLIGENCE			
Course Code	**24SCS23**	**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:

24SCS23.1	Understand the fundamental concepts of artificial intelligence, including its history, types, and key problem-solving techniques.
24SCS23.2	Understand the various searching techniques to get the desired outcomes for an application
24SCS23.3	Apply knowledge representation and reasoning techniques to solve complex problems in AI systems.
24SCS23.4	Implement various machine learning algorithms.
24SCS23.5	Analyze various learning algorithms and Inference systems to understand their structure, functioning, and effectiveness in solving domain specific tasks through intelligent decision-making.
24SCS23.6	Evaluate the structure, working, types, and applications of expert systems and and key success factors, to understand their effectiveness in solving real-world problems.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**
24SCS23.1	**3**	**2**	**3**	**3**	**2**	**1**	**3**	-
24SCS23.2	**3**	**2**	**3**	**3**	**2**	**1**	**3**	-
24SCS23.3	**3**	**2**	**3**	**3**	**2**	**1**	**3**	-
24SCS23.4	**3**	**2**	**3**	**3**	**2**	**1**	**3**	-
24SCS23.5	**3**	**2**	**3**	**3**	**2**	**1**	**3**	-
24SCS23.6	**3**	**2**	**3**	**3**	**2**	**1**	**3**	-

MODULE-1	**Introduction to Artificial Intelligence and Problem Solving**	**24SCS23.1**	**8 Hours**

AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, structure of agents, problem solving agents, problem formulation, AI Techniques, Problem Types and Characteristics, State Space Search, Production Systems and its characteristics, Applications of Artificial Intelligence.

Case Study	Simple Cooking Advisor
Text Book	Text Book 1: 1.1,1.2,1.3Text Book 2:2.1,2.2,2.3,2.4

MODULE-2	**Searching Techniques**	**24SCS23.2**	**8 Hours**

Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth firstSearch, Bi-Directional Search and Uniform-Cost Search. Informed Search Algorithms (Heuristic search): Introduction, Heuristic evaluation function,Generate-and-Test, Best-First Search, A* Algorithm, Problem Reduction Algorithm, AO* Algorithms, Hill climbing, Simulated Annealing, Constraint Satisfaction Algorithm (CSP).

Case Study	Finding the Cheapest Bus Route
Text Book	Text Book 1 :3.1,3.2,3.3,3.4,3.5

MODULE-3	**Knowledge and Reasoning**	**24SCS23.3**	**8 Hours**

Knowledge and Reasoning: Knowledge Representation Issues: Representations and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation; Using PredicateLogic: Representing Simple Facts in Logic, Representing Instance and ISA Relationships, Computable Functions and Predicates, Resolution, Natural Deduction.

Case Study	Medical Diagnosis System
Text Book	Text Book 1 : 4.1,4.2,4.3,4.4

MODULE-4	Learning Algorithms	24SCS23.4 & 24SCS23.5	8 Hours
Learning: Introduction, Types of Learning, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Applications of Learning, Case-Based Reasoning			
Case Study	Case Study for Email spam detection		
Text Book	Text Book 1 : 17.1,17.2,17.3,17.4		
MODULE-5	**Expert systems**	**24SCS23.6**	**8 Hours**
Expert systems: Introduction, basic concepts, structure of expert systems, the human element in expert systems how expert systems works, problem areas addressed by expert systems, expert systems success factors, types of expert systems and Applications.			
Case Study	Case Studies on birth-death process		
Text Book	20.1,20.2,20.3,20.4		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	5	-
L2	Understand	5	5	-
L3	Apply	5	5	10
L4	Analyze	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) 1."Artificial Intelligence", by Elaine Rich, Kevin Knight, Shivashankar B. Nair, McGraw Hill.
2) 2."Artificial Intelligence, Structures, Strategies for Complex Problem Solving", by George F Luger, Addison Wesley.

Reference Books:

1) 1. "Artificial Intelligence: Foundations of Computational Agent", by David L Poole, Alan K. Mackworth, Cambridge University Press.
2) "Artificial Intelligence: A Modern Approach, Prentice Hall series of Artificial Intelligence.

Web links and Video Lectures (e-Resources):

1) https://cs221.stanford.edu
2) https://www.kaggle.com/learn/machine-learning
3) https://www.youtube.com/playlist?list=PLkDaE6sXhPqQ5s2cW2g1iGgC4eD9W6xZ2
4) https://www.youtube.com/playlist?list=PLD6B6F0A3B1D4D3D8A7E3C5E8A7B2E0C

CLOUD COMPUTING & VIRTUALIZATION LAB			
Course Code	**24CSL26**	**CIE Marks**	**50**
L:T:P:S	**0:0:2:0**	**SEE Marks**	**50**
Hrs / Week	**4**	**Total Marks**	**100**
Credits	**2**	**Exam Hours**	**3**

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

24CSL26.1	Understand and implement virtualization technologies using tools such as Oracle VirtualBox and VMware Workstation to simulate real-world cloud environments.
24CSL26.2	Apply the principles of Platform as a Service (PaaS) to design, develop, and deploy scalable web applications using cloud-based tools and services.
24CSL26.3	Analyse cloud computing environments by simulating scheduling algorithms using CloudSim, performing file transfers between virtual machines, and configuring an OpenStack private cloud setup.
24CSL26.4	Create cloud solutions by deploying a Hadoop cluster, launching a Windows VM on AWS, and hosting a WordPress website on AWS.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24CSL26.1	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**3**
24CSL26.2	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**3**
24CSL26.3	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**3**
24CSL26.4	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**3**

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	PART-A		
1	Create virtual environments using VirtualBox and KVM to run different flavors of Linux or Windows operating systems on top of the host OS.	2	**24CSL26.1**
2	Compiling and Running C Code in a Virtual Machine Environment	2	**24CSL26.1**
3	Creating a HelloWorld App and Simple Python Web Projects on Google App Engine	2	**24CSL26.2**
4	Creating and Launching Web Applications Through GAE Launcher	2	**24CSL26.2**
5	Simulating a Cloud Environment and Executing a Scheduling Algorithm Using CloudSim	2	**24CSL26.3**
	PART-B		
6	File Sharing and Transfer Between VMs in a Virtualized Environment	2	**24CSL26.4**
7	Demonstrating the Setup and Configuration of an OpenStack Private Cloud	2	**24CSL26.4**
8	Deploying a Single Node Hadoop Cluster and Executing WordCount	2	**24CSL26.4**
9	Creating and accessing a Windows Virtual Machine Using AWS EC2	2	**24CSL26.5**

10	Creating and hosting a WordPress Website on AWS	2	**24CSL26.5**

PART – C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

- https://www.vlab.co.in/broad-area-computer-science-and-engineering
- https://azure.microsoft.com/en-us/products/lab-services

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Assessment	Test (s)
		30	20
L1	Remember	-	--
L2	Understand	5	05
L3	Apply	10	05
L4	Analyze	10	05
L5	Evaluate	5	05
L6	Create	--	--

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

1. **Cloud Computing, Second Edition, Kris Jamsa, Jones & Bartlett Learning**
2. **https://cloud.google.com/docs**

DEVOPS LAB

Course Code	**24SCL27**	**CIE Marks**	**50**
L:T:P:S	**0:0:2:0**	**SEE Marks**	**50**
Hrs / Week	**4**	**Total Marks**	**100**
Credits	**2**	**Exam Hours**	**03**

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

24SCL27.1	Understand the version controlling and source code management.
24SCL27.2	Build CI/CD pipeline to deploy different applications.
24SCL27.3	Create and manage Docker images and Docker containers.
24SCL27.4	Deploy an application on Kubernetes cluster.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCL27.1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**
24SCL27.2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**
24SCL27.3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**
24SCL27.4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Demo of Devops Installation with Simple Programs	2	**NA**
	PART-A		
1	Exploring Git Commands through Collaborative Coding.	2	**24SCL27.1**
2	Implement GitHub Operations using Git.	2	**24SCL27.2**
3	Implement GitLab Operations using Git.	2	**24SCL27.2**
4	Implement BitBucket Operations using Git.	2	**24SCL27.2**
5	Applying CI/CD Principles to Web Development Using Jenkins, Git, and Local HTTP Server	2	**24SCL27.3**
	PART-B		
6	Exploring Containerization and Application Deployment with Docker	2	**24SCL27.3**
7	Applying CI/CD Principles to Web Development Using Jenkins, Git, using Docker Containers	2	**24SCL27.3**
8	Demonstrate Maven Build Life Cycle	2	**24SCL27.4**
9	Demonstrating Container Orchestration using Kubernetes	2	**24SCL27.4**

10	Create the GitHub Account to demonstrate CI/CD pipeline using Cloud Platform.	2	**24SCL27.4**

PART-C
Beyond Syllabus Virtual Lab Content

Demonstrating Infrastructure as Code (IaC) with Terraform

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Evaluation	Test
		30	**20**
L1	**Remember**	-	-
L2	**Understand**	5	5
L3	**Apply**	15	10
L4	**Analyze**	10	5
L5	**Evaluate**	-	-
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	10
L3	**Apply**	30
L4	**Analyze**	10
L5	**Evaluate**	-
L6	**Create**	-

24SCS23X - PROFESSIONAL ELECTIVE 1		24SCS23X - PROFESSIONAL ELECTIVE 2	
Course code	**Course Name**	**Course code**	**Course Name**
24SCS241	Design Thinking	24SCS251	Cyber Security Management
24SCS242	Microservices Design Pattern	24SCS252	Software Project Management
24SCS243	Soft Computing	24SCS253	Recommender Systems
24SCS244	Computer Vision	24SCS254	Entrepreneurship & Innovation Management
24SCS245	Bioinformatics	24SCS255	Geographic Information Systems

DESIGN THINKING

Course Code	**24SCS241**	**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:

24SCS241.1	Understand the concept of design thinking as it pertains to products and services.
24SCS241.2	Acquire proficiency in tools used for design thinking.
24SCS241.3	Explore more on design thinking through real-life examples.
24SCS241.4	Explore practical methods for applying design thinking in real-world scenarios.
24SCS241.5	Analyze the business models behind successful designs.
24SCS241.6	Build the foundational ideas of innovation and design thinking.

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**
24SCS241.1	3	3	3	3	2	-	3	-
24SCS241.2	3	3	3	3	2	-	3	-
24SCS241.3	3	3	3	3	2	-	3	-
24SCS241.4	3	3	3	3	2	-	3	-
24SCS241.5	3	3	3	3	2	-	3	-
24SCS241.6	3	3	3	3	2	-	3	-

MODULE-1	**Process of Design**	**24SCS241.1**	**8 Hours**

Understanding Design thinking - Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping .

Self-study / Case Study / Applications	Introduction about the design thinking: Chalk and Talk method Theory and practice through presentation MVP and Prototyping through live examples and videos
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16

MODULE-2	**Tools for Design Thinking**	**24SCS241.2& 24SCS241.3**	**8 Hours**

Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design

Self-study / Case Study / Applications	Case studies on design thinking for real-time interaction and analysis Simulation exercises for collaborated enabled design thinking Live examples on the success of collaborated design thinking
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15

MODULE-3	**Design Thinking Stages**	**&24SCS241.4**	**8 Hours**

Design Thinking Stages - Empathize, Design, Ideate, Prototype and Test

Self-study / Case Study / Applications	Attend a design thinking workshop from the expert and then presentation by thestudents on their learning
Text Book	Text Book 2: 12.1 to 12.10
Skill Development	**Activity-1: Design Challenge - Redesign Everyday Objects** **Objective:** Develop problem-solving and creativity skills by redesigning commonobjects.

Activity	**Materials Needed:** Various everyday objects (pen, chair, mug, etc.), Drawing materials (paper, markers,pencils), Timer, Presentation space **<u>Activity-2: Design Thinking Challenge - Redefine User Experiences</u>** **Objective:** Develop empathy and problem-solving skills by redefining userexperiences in specific scenarios. **Materials Needed:** Scenario cards (printed with different user scenarios orsituations), Whiteboard or flip chart, Sticky notes, Markers		
MODULE-4	**Design Thinking in Business**	**24SCS241.5**	**8 Hours**
Design Thinking to Business Process modeling – Agile in Virtual collaboration environment – Scenario based Prototyping			
Self-study / Case Study / Applications	Case studies on design thinking and business acceptance of the design Simulation on the role of virtual eco-system for collaborated prototyping		
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10		
MODULE-5	**Design Thinking for Strategic Innovations**	**24SCS241.6**	**8 Hours**
Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design.			
Self-study / Case Study / Applications	Business model examples of successful designs Presentation by the students on the success of design Live project on design thinking in a group of 2 students		
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**		
		Test (s)	**Qualitative Assessments based on SDA**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	**5**	**-**	**-**
L2	**Understand**	**5**	**-**	**5**
L3	**Apply**	**5**	**5**	**5**
L4	**Analyze**	**10**	**10**	**-**
L5	**Evaluate**	**-**	**-**	**-**
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	20
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.

Reference Books:

1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.
2. Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
4. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

Web links and Video Lectures (e-Resources):

1. www.tutor2u.net/business/presentations/./productlifecycle/default.html
2. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
3. www.bizfilings.com
4. https://www.mindtools.com/brainstm.html
5. https://www.quicksprout.com/./how-to-reverse-engineer-your-competit
6. www.vertabelo.com/blog/documentation/reverse-engineering
7. http://dschool.stanford.edu/dgift/

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 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.

MICRO SERVICES DESIGN PATTERN

Course Code	**24SCS242**	**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:

24SCS242.1	Analyze the fundamental concepts essential for modeling Microservices.
24SCS242.2	Classify different types of Microservice communication styles.
24SCS242.3	Apply the understanding of protocol technology to effectively communicate and propagate data asynchronously among Microservices, ensuring eventual consistency.
24SCS242.4	Develop a workflow plan by synthesizing strategies for optimizing business processes.
24SCS242.5	Evaluate the correlation or divergence between logical and physical architecture.
24SCS242.6	Create an intricate end-to-end testing protocol to appraise and refine Microservices design.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCS242.1	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**
24SCS242.2	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**-**
24SCS242.3	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**
24SCS242.4	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**
24SCS242.5	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**
24SCS242.6	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**

MODULE-1	**Microservices: Introduction**	**24SCS242.1**	**8 Hours**

Key concepts of Microservices, Monolith, Enabling technology, Advantages of Microservices. Modeling Microservices – Good Microservices attributes, Types of coupling, Domain-driven design, Alternatives to business domain boundaries, Mixing models and exceptions.

Skill Development Activities	**1. Microservices Mind Map Creation:** Create a comprehensive mind map or diagram that visually depicts the key concepts of Microservices. Include elements such as Monolith vs. Microservices architecture, enabling technologies (like containers, APIs, etc.), and a detailed breakdown of the advantages of adopting Microservices. This task encourages synthesis of knowledge and understanding of the core concepts. **2. Case Study Analysis:** Identify and highlight the good attributes of Microservices architecture in a given case study. Also discuss the design and implementation of Microservices within the context of the case study.

MODULE-2	**Microservice Communication Styles**	**24SCS242.2**	**8 Hours**

From In-Process to Inter-Process, Technology for Inter-Process communication, Styles of Microservice communication, Pattern: Synchronous blocking and Asynchronous non-blocking, Communication through common data, Request-Response communication, Event – drive communication.

Skill Development Activities	3. Develop a multi-faceted inter-process communication program that showcases diverse communication paradigms, including sockets, message queues, RPC (Remote Procedure Call), and shared memory. 4. How easily can the socket-based IPC system be integrated into an existing software infrastructure? Discuss potential challenges and considerations for seamless integration.

MODULE-3	**Implementing Microservice Communication**	**24SCS242.3**	**8 Hours**

<table>
<tr><td colspan="4">Looking for the Ideal technology, Technology choices–Remote Procedure calls, REST, GraphQL, Message Brokers, Serialization formats, Schemas, Handling change between Microservices, Service Discovery, Service Meshes and API gateways.</td></tr>
<tr><td>Skill Development Activities</td><td colspan="3">5. Comparative Analysis of Communication Technologies:
Objective: Evaluate and compare the efficiency and suitability of Remote Procedure Calls (RPC), REST, GraphQL, and Message Brokers for inter-service communication in a microservices architecture.
Methodology: Develop separate microservices implementing each communication technology. Measure and analyze factors such as latency, data transfer efficiency, ease of implementation, and flexibility.
Outcome: A comparative report highlighting the strengths and weaknesses of each technology, aiding in informed technology selection.
6. Adaptability Testing with Serialization Formats and Schemas:
Objective: Investigate the impact of changes in data structures and schemas on inter-service communication.
Methodology: Create microservices communicating through different serialization formats (e.g., JSON, XML) and schemas. Introduce changes to the schema and assess how well each technology adapts to schema evolution.
Outcome: Findings on how effectively RPC, REST, GraphQL, or Message Brokers handle schema changes and serialization format variations.</td></tr>
<tr><td>MODULE-4</td><td colspan="2">Build Workflow</td><td>24SCS242.4</td><td>8 Hours</td></tr>
<tr><td colspan="4">Database transactions, Distributed transactions, Sagas. Build: Continuous Integration, Build pipelines and continuous delivery, Mapping source code and build to Microservices.</td></tr>
<tr><td>Skill Development Activities</td><td colspan="3">7. Database Transaction Performance Analysis:
Objective: Assess the performance and behavior of database transactions under varying conditions.
Methodology: Create a series of experiments simulating different transaction scenarios (e.g., read-heavy, write-heavy, concurrent transactions). Measure transaction throughput, latency, and database locking mechanisms under load.
Outcome: Insights into the performance characteristics of database transactions, aiding in tuning and optimizing transactional behavior.
8. Distributed Transactions and Consistency Testing:
Objective: Explore the challenges and approaches to maintaining data consistency in distributed transactional systems.
Methodology: Set up multiple microservices communicating with distributed databases. Create experiments that involve transactions spanning across services. Evaluate consistency models (e.g., strong consistency, eventual consistency) in distributed environments.
Outcome: Understanding the complexities and trade-offs associated with maintaining data consistency across distributed transactions.</td></tr>
<tr><td>MODULE-5</td><td colspan="2">Deployment and Testing</td><td>24SCS242.5 & 24SCS242.6</td><td>8 Hours</td></tr>
<tr><td colspan="4">From logical to physical, Principles of Microservice deployment, Deployment options, Kubernetes and container orchestration. Testing: Types of tests, Test scope, Implementing service tests, Implementing End-to-End tests.</td></tr>
<tr><td>Skill Development Activities</td><td colspan="3">9. Logical to Physical Architecture Mapping:
Objective: Demonstrate the translation process from logical architecture design to physical deployment setups.
Methodology: Create a simplified system design with logical components representing Microservices. Experiment with mapping these logical</td></tr>
</table>

components to physical resources (e.g., servers, containers) considering factors like scalability, performance, and fault tolerance.

- **Outcome:** Insights into the challenges and considerations involved in translating conceptual architectural designs into practical deployment configurations.

10. Kubernetes and Container Orchestration:

- **Objective:** Explore the functionalities and capabilities of Kubernetes in orchestrating Microservices deployed in containers.
- **Methodology:** Set up a Kubernetes cluster and deploy a Microservices-based application. Experiment with Kubernetes features like service discovery, scaling, load balancing, and auto-healing. Analyze the impact on deployment, monitoring, and management.
- **Outcome:** Understanding the benefits and challenges of using Kubernetes for container orchestration in Microservices environments.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessments based on SDA	MCQ's
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	5
L3	Apply	10	5	5
L4	Analyze	10	10	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Building Microservices, by Sam Newman, 2nd Edition, 2021, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492034025
2. Microservices with Docker, Flask and React Michael Herman, 2017, EBOOK

Reference Books:

1. Production ready Microservices, Susan J. Fowler, O'Reilly, 2017, ISBN: 978-1-491-96597-9.

SOFT COMPUTING			
Course Code	**24SCS243**	**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:

24SCS243.1	Explore the principles underlying soft computing methods
24SCS243.2	Analyze the principles of neuro-fuzzy systems specifically designed to address optimization problems
24SCS243.3	Apply knowledge and skills in designing and implementing convolutional neural networks (CNNs) for solving real-time classification problems
24SCS243.4	Critically evaluate the methods and techniques involved in text analysis within the domain of natural language processing
24SCS243.5	Analyze the principles underlying swarm optimization algorithms
24SCS243.6	Apply programming skills to develop Python-based implementations of nature-inspired computing models

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**
24SCS243.1	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**
24SCS243.2	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**-**
24SCS243.3	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**
24SCS243.4	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**
24SCS243.5	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**
24SCS243.6	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**

MODULE-1	**Artificial Intelligence**	**24SCS243.1**	**8 Hours**

A Brief Introduction – Pitfalls of traditional AI –Why Computational Intelligence? – Computational intelligence concept - Importance of tolerance of imprecision and uncertainty – Constituent techniques – Overview of Artificial Neural Networks, Fuzzy Logic, Defuzzification, Evolutionary Computation, MOEA (Multi-Objective Evolutionary Algorithm) approaches.

Skill Development Activities	Python implementation of Fuzzy and evolutionary programs - explore the implementation and functioning of a Fuzzy Logic Controller in Python using scikit-fuzzy and the creation of a genetic algorithm using the deap library, providing insights into their methodologies and applications.

MODULE-2	**Neuro Fuzzy Modelling**	**24SCS243.2**	**8 Hours**

Introduction, Neuro-Fuzzy Hybrid Systems, Genetic Neuro-Hybrid Systems, Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems Simplified Fuzzy ART MAP,

Skill Development Activities	Python implementation of neuro Fuzzy model programs - Implement a Neuro-Fuzzy model in Python using libraries like scikit-fuzzy or other suitable tools. Adjustments and variations may be needed based on specific applications or complexities of the model.

MODULE-3	**Deep Learning - Convolutional Neural Networks**	**24SCS243.3**	**8 Hours**

Introduction, Historical Perspective and Biological Inspiration, Broader Observations About Convolutional Neural Networks , The Basic Structure of a Convolutional Network, Padding, Strides, Typical Settings, The ReLU Layer Pooling, Fully Connected Layers, Inter leaving Between Layers, Local Response Normalization, Hierarchical Feature Engineering, Training a Convolutional Network, Back propagating Through Convolutions, Back propagation as Convolution with Inverted / Transposed Filter, Convolution / Back propagation as Matrix Multiplications, Data Augmentation.

Skill Development Activities	Python implementation of deep learning programs - Illustrate the essential steps for creating a simple neural network using Tensor Flow in Python. Adjustments can be made to the network architecture, optimizer, loss function, and other parameters based on specific requirements and the nature of the problem being solved.

MODULE-4	**Natural Language Processing**	**24SCS243.4**	**8 Hours**
Introducing NLP: patterns and structure in language, Essential reading, Recommended reading, Additional reading, Learning outcomes, Introduction Basic concepts, Tokenized text and pattern matching Activity: Recognizing names, Parts of speech - Identify parts of speech, Constituent structure, Activity: Writing production rules, Finite-state machines - Word structure, Using the Natural Language Toolkit, Corpora Computational tools for text analysis			
Skill Development Activities	Python implementation of NLP program – Perform the fundamental NLP techniques such as tokenization, stop words removal, lemmatization, and frequency analysis using the nltk library in Python		
MODULE-5	**Swarm Algorithms**	**24SCS243.5 & 24SCS243.6**	**8 Hours**
Ant System, Ant Colony System, Bees Algorithm The Firefly algorithm-algorithm analysis – implementation – variants and Applications.			
Skill Development Activities	Python implementation of swarm algorithm: Key steps in the implementation of a Particle Swarm Optimization (PSO) algorithm in Python – **1.** Initialization of Swarm and Parameters **2.** Objective Function Evaluation **3.** Updating Particle Velocity and Position **4.** Finding Global Best Position **5.** Termination Condition and Stopping Criteria **6.** Performance and Parameter Tuning		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessments based on SDA	MCQ's
		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	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Text Books:

1. S.N. Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley Indiav Pvt. Ltd, 2011.
2. Neural Networks and Deep Learning: 2018, Charu C. Aggarwal

Reference Books:

1. Jason Brownlee, Clever Algorithms: Nature – Inspired Programming Recipes, Revision 2, 16th June 2012 Chapter-6
2. Yang, Cui, XIao, Gandomi, Karamanoglu, "Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013.

COMPUTER VISION

Course Code	**24SCS244**	**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:

24SCS244.1	Explore the foundational concepts and principles underlying image processing techniques essential for computer vision applications.
24SCS244.2	Exemplify the image enhancement and filtering methods used to improve image quality by reducing noise and enhancing overall image clarity.
24SCS244.3	Apply geometric transformation methods, such as translation, rotation, scaling, and nonlinear warping, in the context of manipulating images for various purposes.
24SCS244.4	Analyze the principles and methodologies behind image segmentation, focusing on its significance in detecting and classifying objects within images.
24SCS244.5	Evaluate the techniques related to 3D vision and motion analysis, examining their role and effectiveness in various computer vision applications.
24SCS244.6	Create the diverse applications leveraging the principles and capabilities of computer vision, showcasing its versatility in different domains and industries.

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**
24SCS244.1	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**
24SCS244.2	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**-**
24SCS244.3	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**
24SCS244.4	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**
24SCS244.5	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**
24SCS244.6	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**

MODULE-1	**Getting Started With Opencv**	**24SCS244.1**	**8 Hours**

Introduction to Computer Vision and images, Basic image operations, Mathematical operations on images, Applications, Image Annotation. Video IO using High GUI, Binary image Processing: Thresholding, Erosion/Dilation, Opening and Closing, Connected Component Analysis, Contour Analysis, Blob Detection.

Skill Development Activities	Build QR Code Detector, image annotation using python, Morphological operations in MATLAB

MODULE-2	**Image Enhancement and Filtering**	**24SCS244.2**	**8 Hours**

Color spaces, Color Transforms, Image Filtering, Image Smoothing, Image Gradients,
Advanced Image Processing and Computational Photography: Hough transforms, High Dynamic Range Imaging, Seamless Cloning, Image In painting.

Skill Development Activities	Create own Instagram filter, Chroma Keying

MODULE-3	**Geometric Transforms**	**24SCS244.3 & 24SCS244.4**	**8 Hours**

Image features: Geometric Transforms, Image Features, Feature Matching, Applications Image Segmentation and Recognition: Image Segmentation using GrabCut, Introduction to AI, Image Classification, Object Detection

Skill Development Activities	Create Panorama for multiple images, Create your own Selfie App with the features like Skin smoothing filter and Sunglass filter.

MODULE-4	3d Vision and Motion	24SCS244.5	8 Hours
Methods for 3D vision – projection schemes – shape from shading – photo metric stereo –shape from texture – shape from focus – active range finding – surface representations – point – based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow –layered motion.			
Skill Development Activities	Hands-on:3D motion capture with just a phone		
MODULE-5	**Face Recognition, Object Detection**	**24SCS244.6**	**8 Hours**
Overview, Two Stage Object Detectors, Singlest age object detectors, YOLO, Measure Performance of Object Detectors, Train a Custom object Detector using YOLO. Text Detection and Recognition: Overview of OCR, GraphicText Recognition using Tesseract, Text Detection, Modified Pipeline for scene Text Recognition using Tesseract (Python), Scene Text recognition using Keras OCR(Python),Comparing Keras – OCR and Tesseract (Python)			
Skill Development Activities	Hands-on: Train a face mask detector, Case Study: Automatic Number Plate Recognition(Python)		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessments based on SDA	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	5
L3	Apply	5	5	5
L4	Analyze	10	10	-
L5	Evaluate	-	-	-
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	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1. R. Szeliski — Computer Vision: Algorithms and Applications, 2nd ed. 2022 Edition
2. E.R.Davies — Computer & Machine Vision, Fifth Edition, Academic Press, 2017.

Reference Books:

1. Learning OpenCV 4 Computer Vision with Python 3: Get to grips with tools, techniques, and algorithms for computer vision and machine learning, 3rd Edition, 2020
2. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2013
3. Simon J.D. Prince, "Computer Vision: Models, Learning, and Inference," Cambridge University Press, 2012
4. D.L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects," Packt Publishing, 2012

BIOINFORMATICS

Course Code	**24SCS245**	**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:

24SCS245.1	Gain insights into how biological knowledge can aid in tackling intricate computational challenges.
24SCS245.2	Explore genetic information and biological sequences, and employ various computational techniques to analyze DNA sequences.
24SCS245.3	Apply diverse algorithms to detect patterns in sequences, aiding in mutation identification and contributing to the advancement of disease discovery, a widespread societal issue.
24SCS245.4	Utilize Hidden Markov Models to analyze biological sequences, offering solutions for challenges within the healthcare industry.
24SCS245.5	Harness genetic algorithms for the identification and proposal of solutions to real-time issues with significant societal impact.
24SCS245.6	Employ neural networks and bio-inspired algorithms to investigate and resolve problems spanning various engineering sectors.

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**
24SCS245.1	3	3	3	-	-	2	3	3
24SCS245.2	3	3	3	-	-	2	3	3
24SCS245.3	3	3	3	-	-	2	3	3
24SCS245.4	3	3	3	-	-	2	3	3
24SCS245.5	3	3	3	-	-	2	3	3
24SCS245.6	3	3	3	-	-	2	3	3

MODULE-1	**Biological Computation**	**24SCS245.1**	**8 Hours**

Biological Introduction, Models and simulations, Exercises. Introduction to Python Language: Variables and predefined Functions, Developing Python code, Developing Python programs, Object-oriented programming, pre-defined classes and methods.

Text Book	Text Book 1: Chapter – 1, 2

MODULE-2	**Cellular and Molecular Biology Fundamentals**	**24SCS245.2**	**8 Hours**

The Cell, The Genetic Information, Genes, Human Genome, Biological Resources and Databases. Basic Processing of Biological Sequences, Exercises and programming Projects.

Text Book	Text Book 1: Chapter – 3

MODULE-3	**Pattern Analysis**	**24SCS245.3**	**8 Hours**

Finding Patterns in Sequences, Exercises and Programming Projects. Hidden Markov Models, Exercises and Programming Projects.

Text Book	Text Book 2: 2, 5, 6,

MODULE-4	**Evolutionary Biology and Evolutionary Computation**	**24SCS245.4 &24SCS245.5**	**8 Hours**

Genetic Algorithms, Example Applications, Analysis of Behavior of Genetic Algorithms, Genetic Programming, A second look at the Evolutionary process.			
Text Book	Text Book 1: Chapter 4		
MODULE-5	**Artificial Neural Networks**	**24SCS245.6**	**8 Hours**
The perceptron, Learning in a multilayered network, Associative memory, Unsupervised learning,Exercises. Swarm Intelligence, Artificial Immune System, Artificial Life, Systems Biology.			
Text Book	Text Book 1: Chapter 4, 5, Text Book 2: Chapter 7, 8		
Skill Development Activity	**Activity-1: Sequence Alignment Practical:** **Objective:** Develop skills in sequence alignment techniques. **Activity:** For a given sequences (DNA, RNA, or protein), use the bioinformatics tools(like BLAST or Clustal Omega) to perform pair-wise or multiple sequence alignments. Interpret the alignment results and understand the sequence similarities. **Activity-2: Literature Review and Presentation:** **Objective:** Improve research and communication skills. **Activity:** Consider a bioinformatics-related research topic. Conduct a literature review, summarize key findings, and present a critical analysis of the study's methodology, results, and implications as a journal / conference paper.		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Marks Distribution**		
		Test (s)	**Qualitative Assessment (s)-SDA**	**MCQ's**
		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. Lam, E., & Unger, R. (2011). "Biological Computation." CRC Press.
2. Rocha, M., & Ferreira, P. G. (Year). "Bioinformatics Algorithms: Design and Implementation in Python." Academic Press.

Reference Books:

1. Baldi, P., & Brunak, S. (Year). "Bioinformatics: The Machine Learning Approach" (2nd Edition).

MITPress.

2. Shortliffe, E. H., & Cimino, J. J. (Year). "Biomedical Informatics: Computer Applications in Healthcare and Biomedicine" (4th Edition). Springer.

Web links and Video Lectures (e-Resources):

- https://www.ncbi.nlm.nih.gov/
- https://www.ebi.ac.uk/
- https://www.uniprot.org/

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

- **Biological Database Development**: Design and develop a biological database for a specific research problem.
- **Case Studies in Precision Medicine**: Analyze case studies where bioinformatics plays a pivotal role in personalized medicine, cancer genomics, and pharmaco genomics.
- **Biomedical Literature Mining**: Use text-mining tools to extract information from scientific literature, focusing on gene-disease associations, drug interactions, and pathway analysis.
- **Bioinformatics Challenges and Competitions:** Participate in bioinformatics competitions and coding challenges to enhance their problem-solving skills

24SCS23X - PROFESSIONAL ELECTIVE 2	
Course code	**Course Name**
24SCS251	Cyber Security Management
24SCS252	Software Project Management
24SCS253	Recommender Systems
24SCS254	Entrepreneurship & Innovation Management
24SCS255	Geographic Information Systems

CYBER SECURITY MANAGEMENT			
Course Code	**24SCS251**	**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:

24SCS251.1	Understand the fundamental terminologies in the field of cyber security and the current threat landscape.
24SCS251.2	Analyze the diverse categories and attributes of cybercrimes, while synthesizing theappropriate protocols for reporting.
24SCS251.3	Apply legal framework in India concerning cybercrimes, including penalties and sanctions.
24SCS251.4	Summarize the matters pertaining to the privacy and security of personal data.
24SCS251.5	Identify the key elements of a cyber security strategy.
24SCS251.6	Assess risk-based evaluations, the necessity for security measures, and the requirement for cyber security audits and compliance.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCS251.1	3	3	2	-	-	2	2	-
24SCS251.2	3	3	2	-	-	2	2	-
24SCS251.3	3	3	2	-	-	2	2	-
24SCS251.4	3	3	2	-	-	2	2	-
24SCS251.5	3	3	2	-	-	2	2	-
24SCS251.6	3	3	2	-	-	2	2	-

MODULE-1	**Overview of Cyber security**	**24SCS251.1**	**8 Hours**

Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyber warfare, Case Studies.

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

MODULE-2	**Cyber crimes**	**24SCS251.2**	**8 Hours**

Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransom ware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyber bullying, website defacement, Cyber squatting, Pharming, Cyber espionage, Crypto jacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cyber crime against persons - cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.

Text Book	Text Book 1: Chapter 2, 3

MODULE-3	**Cyber Law**	**24SCS251.3**	**8 Hours**

Cyber crime and legal landscape around the world, IT Act, 2000 and its amendments. Limitations of IT Act, 2000. Cyber crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.

Text Book	Text Book 2: 1,2,3,4,5

MODULE-4	**Data Privacy and Data Security**	**24SCS251.4 24SCS251.5**	**8 Hours**

Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues.

Self-study / Case Study /	1. Data Privacy and Data Security in Healthcare 2. Setting privacy settings on social media platforms.

Applications	3. Do's and Don'ts for posting content on Social media platforms. 4. Registering complaints on a Social media platform.		
Text Book	Text Book 3: 3, 4, 5, 6, 7		
MODULE-5	**Cyber security Management, Compliance and Governance**	**24SCS251.6**	**8 Hours**
Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, Nationalcyber security policy and strategy.			
Self-study / Case Study / Applications	1. Explain the significance of cyber security management, compliance, and governance in today's digital landscape. Introduce the purpose of the report and the objectives of your self-study. 2. Prepare password policy for computer and mobile device. 3. List out security controls for computer and implement technical security controls in the personal computer. 4. List out security controls for mobile phone and implement technical security controls in the personal mobile phone. Log into computer system as an administrator and check the security policies in the system		
Text Book	Text Book 3: 8, 9, 10, 11		
Skill Development Activity	**Activity-1: Enhance incident response and decision-making skill:** Create simulated scenarios (e.g., data breach, phishing attack). Form 2-member teams responsible for responding to the scenario, making decisions, and mitigating the cyber threat. perform discussion, analysis, and documentation of response strategies. **Activity-2: Security Policy Review - Review and update security policies and procedures where participants:** Assess existing security policies of any firm such as access control, data handling, and incident response. Identify gaps or outdated policies and propose revisions to ensure alignment with current threats and best practices.		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)-SDA	MCQ's
		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. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.

Reference Books:

1. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.
2. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.
3. Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.

Web links and Video Lectures (e-Resources):

- https://www.cybrary.it/
- https://www.sans.org/
- https://academy.kaspersky.com/
- https://owasp.org/

https://www.cisa.gov/cybersecurity

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

- **Incident Response Simulations**: Create realistic incident scenarios and practice responding to security incidents. This could include scenarios like data breaches, malware infections, or denial-of-service attacks.
- **Security Policy Development:** Develop comprehensive security policies for various organizations. This includes crafting policies for access control, data protection, incident response, and compliance.
- **Risk Assessment and Management Workshops**: Conduct risk assessments for different organizations. They can identify potential threats, vulnerabilities, and the associated risks. Understand how to develop risk management plans to mitigate these risks.

SOFTWARE PROJECT MANAGEMENT			
Course Code	**24SCS252**	**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:

24SCS522.1	Recognize project management terminologies and processes.
24SCS522.2	Provide a summary of project integration, scope, and schedule management elements.
24SCS522.3	Calculate project cost and assess quality management.
24SCS522.4	Analyze software project resource allocation and communication management.
24SCS522.5	Assess the effectiveness of software project risk management.
24SCS522.6	Develop strategies for software procurement and stakeholder management.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
24SCS522.1	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**
24SCS522.2	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**-**
24SCS522.3	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**
24SCS522.4	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**
24SCS522.5	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**
24SCS522.6	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**

MODULE-1	**Introduction to Project Management Terminologies**	**24SCS252.1**	**8 Hours**

Basics of Project Management: Project definition, attributes, constraints, project lifecycle **Project Management process:** Project Stakeholders, Project management knowledge areas, Project management tools and techniques, Project success. **Program and Project Portfolio Management:** Programs, Project Portfolio Management, Organizational Project Management, Roles and responsibilities of project manager.

Skill Development Activities	1. **Case Study Analysis on Organizational Influences in Project Management:** • Task: Analyze case studies or real-world scenarios showcasing organizational influences on project life cycles. Identify and discuss the impact of project stakeholders, project governance, and the creation of project teams on project outcomes. Present findings and recommendations on how these influences can be leveraged or managed effectively in different organizational contexts. 2. **Mapping Project Management Knowledge Areas:** • Task: Create a comprehensive mapping or mind map illustrating the various knowledge areas in project management. Explore and interlink different aspects such as project scope, time, cost, quality, risk, communication, and resource management. Highlight their interconnectedness and how they contribute to successful project execution.

MODULE-2	**Project Integration Management**	**24SCS252.2**	**8 Hours**

Strategic Planning and Project Selection: Strategic planning, Identifying potential projects, Methods for selecting projects, Project management plan contents

Project Scope Management: Planning scope management, Requirements collection, Defining Scope, Creating the Work Breakdown Structure, Scope validation and control

Project Schedule Management: Planning schedule management, Defining activities, sequencing activities, Estimating activity durations, Critical path method (CPM), Project Evaluation Review Technique (PERT).

Skill Development Activities	**Stakeholder Engagement and Communication Plan:** • Task: Develop a stakeholder engagement and communication plan for a specific project. Identify key stakeholders; analyze their interests, expectations, and levels of influence. Create a communication strategy outlining the frequency, channels, and content of communication with

	stakeholders throughout the project lifecycle. Implement the plan to ensure effective coordination and collaboration among stakeholders. **Work Breakdown Structure (WBS:** • Task: Conduct a collaborative session with project team members to create a Work Breakdown Structure (WBS). Define project deliverables, break them down into smaller, manageable components, and organize them hierarchically. Validate the WBS with stakeholders to ensure alignment with project scope and objectives. Review the WBS periodically to accommodate changes and maintain scope control.		
MODULE-3	**Cost and Quality Management**	**24SCS252.3**	**8 Hours**
Project Cost Management: Principles of cost management, Planning cost management, Cost estimation tools and techniques, Determining the budget, Controlling costs. **Project Quality Management:** Planning quality management, managing quality, controlling quality, Tools and techniques for quality control, Improving IT project quality.			
Skill Development Activities	**Project Quality and Cost management Exercise:** **Task:** You are the project manager for a mid-sized software development project. The goal is to build a custom CRM solution for a client. The project has a budget of $500,000 and a timeline of 6 months. The client has emphasized that both quality and budget adherence are top priorities. Plan the cost and quality management metrics for o the above project.		
MODULE-4	**Resource and Communication Management**	**24SCS252.4**	**8 Hours**
Project Resource Management: The Importance of Resource Management, Keys to Managing and Leading People, Motivation Theories, Developing Resource Management Plan, Estimating activity resources. **Project Communications Management:** Importance of Project Communications Management, Managing Communications, monitoring communications, Suggestions for Improving Project Communications			
Skill Development Activities	**Cost Estimation and Budget Allocation Exercise:** • Task: Simulate a project scenario or select a real project to estimate costs and allocate budgets. Identify individual activities and resources required for the project. Estimate costs associated with each activity, including materials, labor, equipment, and overheads. Allocate budgets considering these estimations and create a comprehensive project budget. Monitor and control expenses against the budget throughout the project lifecycle. **Quality Assurance Review and Improvement Initiative:** • Task: Initiate a quality assurance review and improvement program within a project team or organization. Establish quality standards and benchmarks aligned with project objectives. Develop a Quality Management Plan outlining quality processes, metrics, and responsibilities. Conduct regular quality assurance checks during project execution to ensure adherence to standards. Implement corrective actions and continuous improvement strategies based on quality assessment results.		
MODULE-5	**Risk and Procurement Management**	**24SCS252.5 & 24SCS252.6**	**8 Hours**
Project Risk Management: Identifying Risks, Performing Qualitative Risk Analysis, Performing Quantitative Risk Analysis, Monitoring Risks. **Project Procurement Management:** Planning Procurement Management, Types of Contracts, Tools and Techniques for Planning Procurement Management, Controlling Procurements. **Project Stakeholder management**: Identifying Stakeholders, Planning Stakeholder Engagement, Managing Stakeholder Engagement, Monitoring Stakeholder Engagement.			

Skill Development Activities	**Risk Assessment and Mitigation Plan:** • Task: Organize a session involving project stakeholders and team members to identify and assess project risks. Use risk identification techniques such as brainstorming or SWOT analysis to identify potential risks. Analyze and prioritize these risks based on their impact and probability. Develop a comprehensive risk mitigation plan outlining strategies to address and mitigate identified risks. Implement risk responses and continuously monitor risks throughout the project lifecycle. **Procurement Strategy Development:** • Task: Develop a procurement strategy for acquiring necessary resources (workers, materials, equipment) for a project. Assess project requirements, identify procurement needs, and define procurement objectives. Outline a procurement plan detailing the procurement process, selection criteria, vendor evaluation, and contract negotiation strategies. Implement the procurement plan ensuring adherence to budgetary constraints and project timelines. Monitor and manage procurement activities to ensure optimal resource acquisition.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessments based on SDA	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	5
L3	Apply	10	5	5
L4	Analyze	5	10	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Information Technology Project Management, Kathy Schwalbe ,9th edition,2019, ISBN-13: 978-1-337-10135-6

2. PMP Project Management Professional Study Guide, Kim Heldman, 10th edition 2021, ISBN: 978-1119658979

Reference Books:

1. A Guide to the Project Management Body of Knowledge (PMBOK Guide)–Seventh Edition and the Standard for Project Management, By Project Management InstituteProject Management Institute, ISBN: 9781628257007, 2021.

Web links and Video Lectures (e-Resources):

- https://www.geeksforgeeks.org/software-engineering-software-project-management-spm
- https://www.tutorialspoint.com/software_engineering/software_project_management.htm
- https://archive.nptel.ac.in/courses/106/105/106105218/

RECOMMENDER SYSTEMS			
Course Code	**24SCS253**	**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:

24SCS253.1	Comprehend the fundamental concepts of recommender systems.
24SCS253.2	Differentiate between classification models and cluster analysis techniques.
24SCS253.3	Demonstrate on content-based recommendation systems to utilize item features to suggest other items.
24SCS253.4	Investigate on the collaborative filtering employs algorithms to personalize recommendations based on user reviews and preferences.
24SCS253.5	Assess the effectiveness of constraint-based recommenders in automatically explaining items for customer support.
24SCS253.6	Develop a context-aware recommender system by integrating user context analysis to deliver personalized services.

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**
24SCS253.1	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**
24SCS253.2	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**-**
24SCS253.3	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**
24SCS253.4	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**
24SCS253.5	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**
24SCS253.6	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**

MODULE-1	**Introduction**	**24SCS253.1**	**8 Hours**

Recommender System function, Data and knowledge sources, Recommendation techniques, Application and evaluation, Recommender systems and human computer interaction, Recommender systems as a multi-disciplinary field.

Mining methods for Recommender Systems: Data pre-processing –similarity measures, sampling, reducing dimensionality, denoising.

Skill Development Activities	**Case Study Analysis:** • Task: Analyze case studies of real-world recommender systems to understand their functions, various data and knowledge sources utilized, applied recommendation techniques, and methods of evaluation. Summarize the impact of these systems on user experience and business success. **Design and Implement a Recommender System:** • Task: Develop a prototype of a recommender system focusing on human-computer interaction principles. Gather data from diverse sources, apply multiple recommendation techniques, and evaluate the system's performance. Consider user feedback and interaction patterns for system refinement.

MODULE-2	**Classification**	**24SCS253.2**	**8 Hours**

Nearest Neighbors, Decision trees, Ruled-based classifiers, Bayesian classifiers, Artificial Neural Networks, Support Vector Machines, Ensembles of classifiers, Evaluating classifiers. Cluster Analysis: k-means, Association rule mining.

Skill Development Activities	**Classifier Implementation Project:** • Task: Implement various classifiers (nearest neighbors, decision trees, etc.) using a programming language. Provide sample datasets to train and test these classifiers. Evaluate the performance of each classifier in terms of

	accuracy, precision, and recall. Compare and analyze the results to understand the strengths and weaknesses of different classification algorithms. **Cluster Analysis Experiment:** • Task: Conduct a cluster analysis experiment using k-means and association rule mining. Utilize real or synthetic datasets to apply these techniques. Evaluate and compare the effectiveness of k-means in clustering data and association rule mining in discovering interesting relationships between items. Discuss the challenges and limitations of each method, considering different data types and structures.

MODULE-3	**Content-Based Recommender Systems**	**24SCS253.3**	**8 Hours**
Basics of content-based recommender systems – high level architecture, advantages and drawbacks. State of the art of content based recommender systems – Item representation, methods for learning user profiles. Neighborhood – based recommendation: User – based rating prediction, User-based classification, Regression vs. classification, Item-based recommendation, User-based vs. Item-based recommendation.			
Skill Development Activities	**Comparative Analysis of Recommender Systems Architectures** • Objective: Compare and contrast the high-level architectures, advantages, and drawbacks of content-based recommender systems with state-of-the-art techniques. **Implementing Neighborhood-Based Recommendation Techniques** • Objective: Develop a comparative analysis of neighborhood-based recommendation methods, specifically focusing on user-based and item-based techniques.		

MODULE-4	**Components of Neighborhood Methods**	**24SCS253.4**	**8 Hours**
Rating normalization, Similarity weight computation, Neighborhood selection. Advanced techniques– Dimensionality reduction methods, Graph-based methods. Collaborative filtering: Introduction, Matrix factorization models - SVD, SVD++, Time-aware factor model, Neighborhood Models –similarity measures, similarity based interpolation.			
Skill Development Activities	Numerical problems on • Rating Normalization • Similarity Weight Computation • Neighborhood Selection • Dimensionality Reduction Methods		

MODULE-5	**Development of RSs**	**24SCS253.5 & 24SCS253.6**	**8 Hours**
Developing constraint based recommenders – Development of recommender knowledge bases, User guidance in recommendation processes, Calculating recommendations. Context–aware recommender systems– Context, Modeling contextual information in RSs, Obtaining contextual information. Recommendation system properties, Applications of Recommender Systems.			

Skill Development Activities	Developing Constraint-Based Recommenders
	• Objective: Enhance skills in building constraint-based recommendation systems.
	• Description:
	  • Identify a project to develop constraint-based recommendation systems, where constraints play a crucial role in recommendations (e.g., dietary restrictions in a food app, budget limitations in a shopping app).
	  • Design and develop knowledge bases that encode constraints, implement user guidance features, and calculate recommendations based on these constraints.
	  • Evaluate the effectiveness and accuracy of the recommendation systems based on their ability to adhere to constraints while providing relevant recommendations.		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessments based on SDA	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	5
L3	Apply	10	5	5
L4	Analyze	5	10	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Recommender Systems Handbook, Francesco Ricci, LiorRokach, Bracha Shapira, Paul B.Kantor, ISBN: 978-0-387-85819-7 Springer Science + Business Media, LLC 2011.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st edition.
3. Jannach D., Zanker M and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st edition.

Reference Books:

1. M.D.Ekstrand, J.T.Riedl, J.A.Konstan, Collaborative filtering recommender systems

ENTREPRENEURSHIP & INNOVATION MANAGEMENT

Course Code	**24SCS254**	**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:

24SCS254.1	Comprehend management fundamentals, including planning, decision-making, and the roles of managers in organizational contexts
24SCS254.2	Apply the management principles effectively in real-world scenarios to manage and lead teams, motivate employees, communicate efficiently, coordinate tasks, and maintain control
24SCS254.3	Apply the business practices and contribute to entrepreneurial development
24SCS254.4	Analyze the entrepreneurial opportunities, and conduct comprehensive feasibility analyses for potential business ventures.
24SCS254.5	Evaluate the effectiveness of business models, financial strategies, and project network plans, and evaluate their impact on successful entrepreneurial endeavors.
24SCS254.6	Demonstrate the ability to launch and manage entrepreneurial ventures successfully.

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**
24SCS254.1	3	3	3	-	-	2	3	-
24SCS254.2	3	3	3	-	-	2	3	-
24SCS254.3	3	3	3	-	-	2	3	-
24SCS254.4	3	3	3	-	-	2	3	-
24SCS254.5	3	3	3	-	-	2	3	-
24SCS254.6	3	3	3	-	-	2	3	-

MODULE-1	**Foundations of Management and Planning: Principles and Practice**	**24SCS254.1**	**8 Hours**

Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art &Profession Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision

Text Book	Text Book 1: Chapter 1

MODULE-2	**Foundations of Organizational Management and Control**	**24SCS254.2**	**8 Hours**

Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalization, Committees–Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; Staffing-Need and Importance, Recruitment and Selection Process. Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioral Approach of Leadership; Coordination- Meaning, Types, Techniques of Coordination; Controlling – Meaning, Need for Control System, Benefits ofControl, Essentials of Effective Control System, Steps in Control Process.

Text Book	Text Book 1: Chapters 7, 8 ,9, 11, 15 to 18

MODULE-3	Corporate Social Responsibility	24SCS254.3	8 Hours
Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance, Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship			
Text Book	Text Book 1: Chapter 3, Text Book 2: Chapter 2		
MODULE-4	**Family Business Dynamics and Entrepreneurial Feasibility Analysis**	**24SCS254.4**	**8 Hours**
Role and Importance of Family Business, Contributions of Family Business in India, Stages of Development of a Family Business, Characteristics of a Family-owned Business in India, Various types of family businesses. Idea Generation and Feasibility Analysis- Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility; Financial Feasibilities; Political Feasibilities; Economic Feasibility; Social and Legal Feasibilities; Technical Feasibilities; Managerial Feasibility, Location and Other Utilities Feasibilities			
Text Book	Text Book 2: chapter 3		
MODULE-5	**Strategic Business Planning, Financing, and Project Network Analysis for Entrepreneurship**	**24SCS254.5, 24SCS254.6**	**8 Hours**
Business model – Meaning, designing, analyzing and improvising; Business Plan – Meaning, Scope and Need; Financial, Marketing, Human Resource and Production/Service Plan; Business plan Formats; Project report preparation and presentation; Why some business plan fails? Financing and How to start a Business? Financial opportunity identification; Banking sources; Nonbanking Institutions and Agencies; Venture Capital – Meaning and Role in Entrepreneurship; Government Schemes for funding business; Pre launch, Launch and Post launch requirements; Procedure for getting License and Registration; Challenges and Difficulties in Starting an Enterprise & Project Design and Network Analysis: Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network, Network Techniques, Need for Network Techniques, Steps in PERT, CPM, Advantages, Limitations and Differences.			
Text Book	Text Book 2: Chapter 5, 7, 8. Text Book 3: Chapters 20.		
Skill Development Activity	**Activity-1: Innovation Hackathons** **Objective:** Enhance creativity, problem-solving, and teamwork **Activity:** Participate an innovation hackathon where participants work in teams on specific challenges or problems relevant to a chosen industry. Within a stipulated time (e.g., 24 hours) for ideation, prototyping, and pitching innovative solutions. **Activity-2: Entrepreneurial Case Studies Analysis:** **Objective:** Improve decision-making and problem-solving skills in an entrepreneurialcontext. **Activity:** In a given case studies of successful and failed entrepreneurial ventures, analyze these cases, identify key factors contributing to success or failure. Discuss lessons learned and strategies that could have been implemented differently		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)-SDA	MCQ's
		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. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017.ISBN-13:978-93-5260-535-4.
2. Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath, Pearson Education2008, ISBN978-81-7758-260-4.

Reference Books:

1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4
2. Dynamics of Entrepreneurial Development and Management by Vasant Desai. HPH 2007, ISBN: 978-81-8488-801-2

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ge24/preview
- https://biodesign.berkeley.edu/bioinspired-design-course/
- https://www.youtube.com/watch?v=cwxXY9Qe8ss
- https://www.youtube.com/watch?v=V2GvQXvjhLA
- https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design%20Workshop%20Report_2232327_October%202022_Final.508.pdf

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

- **Startup Simulation Games**: Use entrepreneurship simulation games where students create and manage virtual startups, making decisions related to product development, marketing, and finance.
- **Business Model Canvas Workshops**: Work in teams to create business models using the Business Model Canvas. This hands-on activity encourages creativity and critical thinking.
- **Pitch Competitions**: Participate / Organize pitch competitions where students present their innovative business ideas to a panel of judges. This exercise helps to refine their pitching skills and business concepts.
- **Entrepreneurial Guest Speakers**: Invite successful entrepreneurs and innovators to share their experiences and insights with the class to provide real-world perspectives.
- **Idea Generation Workshops**: Participate brainstorming sessions and idea generation workshops to develop innovative concepts and products.
- **Design Thinking Workshops**: Collaborate design thinking methods, including empathy mapping, prototyping, and testing. These workshops can help them approach problem-solving in a human-

centered way.

- **Innovation Challenges**: Present innovation challenges where students must come up with creative solutions to real-world problems.
- **Business Plan Development**: Learn through the process of developing comprehensive business plans, covering aspects like market analysis, financial projections, and risk assessment.
- **Incubator Programs**: Contribute on incubator program where students can work on their startup ideas with mentorship and resources.
- **Prototyping and Minimum Viable Product (MVP) Development**: Create prototypes or MVPs of their innovative products or services, allowing them to test their ideas in the real world.

GEOGRAPHIC INFORMATION SYSTEMS			
Course Code	**24SCS255**	**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:

24SCS255.1	Understand the foundational principles underpinning Geographic Information Systems (GIS) and their role in various application areas
24SCS255.2	Develop competence by efficiently integrating and managing diverse geospatial data sources within GIS tasks
24SCS255.3	Apply the processing of geospatial data, adeptly managing and manipulating both raster and vector data while implementing necessary corrections
24SCS255.4	Demonstrate advanced proficiency in spatial data analysis, integration, and visualization techniques within GIS
24SCS255.5	Analyze complex spatial data by employing advanced techniques such as conducting trend surface analysis to model and understand spatial trends
24SCS245.6	Showcase a profound understanding of GIS analytical models, particularly Digital Terrain Models and hydrologic modeling, by effectively applying them in practical scenarios.

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**
24SCS245.1	3	3	3	-	3	2	3	-
24SCS245.2	3	3	3	-	3	2	3	-
24SCS245.3	3	3	3	-	3	2	3	-
24SCS245.4	3	3	3	-	3	2	3	-
24SCS245.5	3	3	3	-	3	2	3	-
24SCS245.6	3	3	3	-	3	2	3	-

MODULE-1	**Foundations of Geographic Information Systems and Spatial Data Models**	**24SCS255.1**	**8 Hours**

Introduction to GIS: Definitions, history and evolution, place of GIS in Geoinformatics, Components of GIS, interdisciplinary relations, Discrete geographic objects, Continuous geographic features, Vector and

<table>
<tr><td colspan="4">Raster Data structures, GIS application areas, careers in GIS. Spatial Data Types and Models: Spatial Data types, Non-spatial / Attribute Data types, Tessellations to represent geographic objects, Data models: Basic Data Models –raster and vector, Spaghetti model andTopological model, Advanced data models, raster and vector data formats.</td></tr>
<tr><td>Text Book</td><td colspan="3">Text Book 1: Chapter 1</td></tr>
<tr><td>MODULE-2</td><td>Data Acquisition and Integration Techniques in Geospatial Information Management</td><td>24SCS255.2</td><td>8 Hours</td></tr>
<tr><td colspan="4">Primary and secondary methods of acquisition of spatial and non-spatial data: surveying, remote sensing, Photogrammetry, Global Navigation Satellite System (GNSS), Database creation, Data capturing, map scanning and digitizing, data exchange standards, topology building, editing and cleaning, linking ofspatial and non-spatial data</td></tr>
<tr><td>Text Book</td><td colspan="3">Text Book 1: Chapters 7, 8 ,9, 11, 15 to 18</td></tr>
<tr><td>MODULE-3</td><td>Geospatial Data Processing, Quality Assurance, and Standards in GIS</td><td>24SCS255.3</td><td>8 Hours</td></tr>
<tr><td colspan="4">Data Processing: Hardware and software needed, Database Management Systems (DBMS), Linking GIS and DBMS, Raster and Vector data editing, data conversion, Corrections, scale changes, Coordinate thinning, Geo-referencing and map projections, sliver removal, edge matching, interactive editing, rubber sheeting.
Data Quality and Standards: Definition of data quality, components of geographic data quality, Sources of error in geographic data, error propagation and error management; quality assurance & quality control (QA/QC). Geographic data standards, components and types of GIS standards, international GIS standards, interoperability of GIS</td></tr>
<tr><td>Text Book</td><td colspan="3">Text Book 1: Chapter 3, Text Book 2: Chapter 2</td></tr>
<tr><td>MODULE-4</td><td>Spatial Data Analysis and Integration & Visualization</td><td>24SCS255.4</td><td>8 Hours</td></tr>
<tr><td colspan="4">Spatial Data Analysis and Integration: Spatial Measurements, Queries, Vector Data Analysis, Raster Data Analysis, Network Analysis, Terrain analysis, spatial analysis of 3-Dimentional data, Data integrationand map overlay.
Data Visualization: GIS and Maps, Visualization process, visualization strategies, mapping qualitative and quantitative data, map / information dissemination.</td></tr>
<tr><td>Text Book</td><td colspan="3">Text Book 2: Chapter 3</td></tr>
<tr><td>MODULE-5</td><td>Advanced Spatial Data Analysis</td><td>24SCS255.5, 24SCS255.6</td><td>8 Hours</td></tr>
<tr><td colspan="4">Advanced Spatial Data Analysis and Modelling: Trend surface analysis, Spatial interpolation, fuzzy analysis, GIS analytical models: Digital Terrain Models, Hydrologic modelling, Spatial Multi Criteria Analysis and engineering GIS applications, recent advances in GIS & Spatial Data Analytics (SDA), Career opportunities in GIS and SDA.</td></tr>
<tr><td>Text Book</td><td colspan="3">Text Book 2: Chapter 5, 7, 8. Text Book 3: Chapters 20</td></tr>
<tr><td>Skill Development Activity</td><td colspan="3">Activity-1: Geocoding and Reverse Geocoding
Objective: Develop skills in converting addresses to geographic coordinates (geocoding) and vice versa.
Activity: Use Google Maps Geocoding API to perform batch geocoding of addresses or locations. Geocode a dataset of addresses and visualize the results on a map. Then, reverse geocode coordinates to retrieve addresses and display them.

Activity-2: Spatial Analysis with Google Earth Engine:
Objective: Introduce advanced spatial analysis and remote sensing techniques.
Activity: Use Google Earth Engine to perform spatial analysis tasks such as land cover classification, change detection, or time-series analysis. Script using Earth Engine's JavaScript API for geospatial analysis.</td></tr>
</table>

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)-SDA	MCQ's
		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. Concepts and Techniques of Geographic Information Systems, CP Lo Albert K W Yeung, 2005 Prantice Hall of India.
2. Principles of GIS for Land Resources Assessment by P.A.Burrough, Oxford: Science publications, 1986.
3. Geographic Information Systems – An introduction by Tor Bernhardsen, John Wiley and Sons, Inc., New York, 2002.

Reference Books:

1. GIS – A computing Perspective by Michael F. Worboys, Taylor & Francis, 1995.
2. Remote Sensing and Image Interpretation by Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.
3. Geographical Information Systems – Principles and Applications, Volume I edited by David J. Maguire, Michael F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.
4. Geographical Information Systems – Principles and Applications, Volume II edited by David J. Maguire, Michael F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ge24/preview
- https://biodesign.berkeley.edu/bioinspired-design-course/
- https://www.youtube.com/watch?v=cwxXY9Qe8ss
- https://www.youtube.com/watch?v=V2GvQXvjhLA
- https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design%20Workshop%20Report_2232327_October%202022_Final.508.pdf

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

- **Geospatial Data Collection Field Trips:** Plan field trips where students collect geospatial data using GPS devices, mobile apps, and other tools. This hands-on experience helps them understand data acquisition and its challenges.
- **GIS Software Workshops:** Participate in workshops using popular GIS software like ArcGIS or QGIS. Students can learn how to create maps, perform spatial analyses, and work with real geospatial datasets.
- **Geospatial Data Visualization Projects:** Collaborate to create interactive maps and visualizations using online platforms like Mapbox or Leaflet. This encourages them to explore different ways of presenting geospatial data.
- **Spatial Analysis Case Studies:** Analyze real-world spatial problems and use GIS to find solutions. Work on projects related to urban planning, environmental monitoring, or disaster management.
- **GIS Modeling Projects:** Attend challenges to build geospatial models for predictive analysis. They can work on projects related to wildlife habitat modeling and use change prediction, or disease spread modeling.

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.

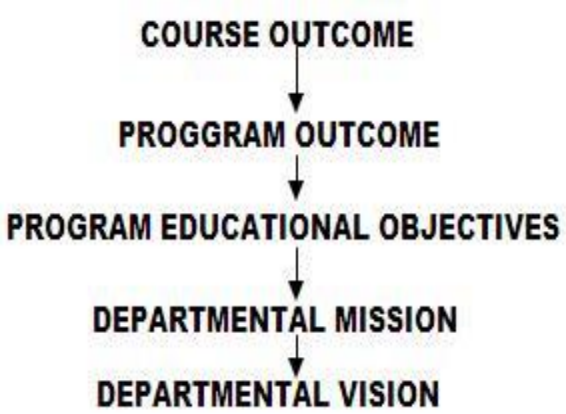
There are three educational Outcomes as defined by the National Board of Accreditation:

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.

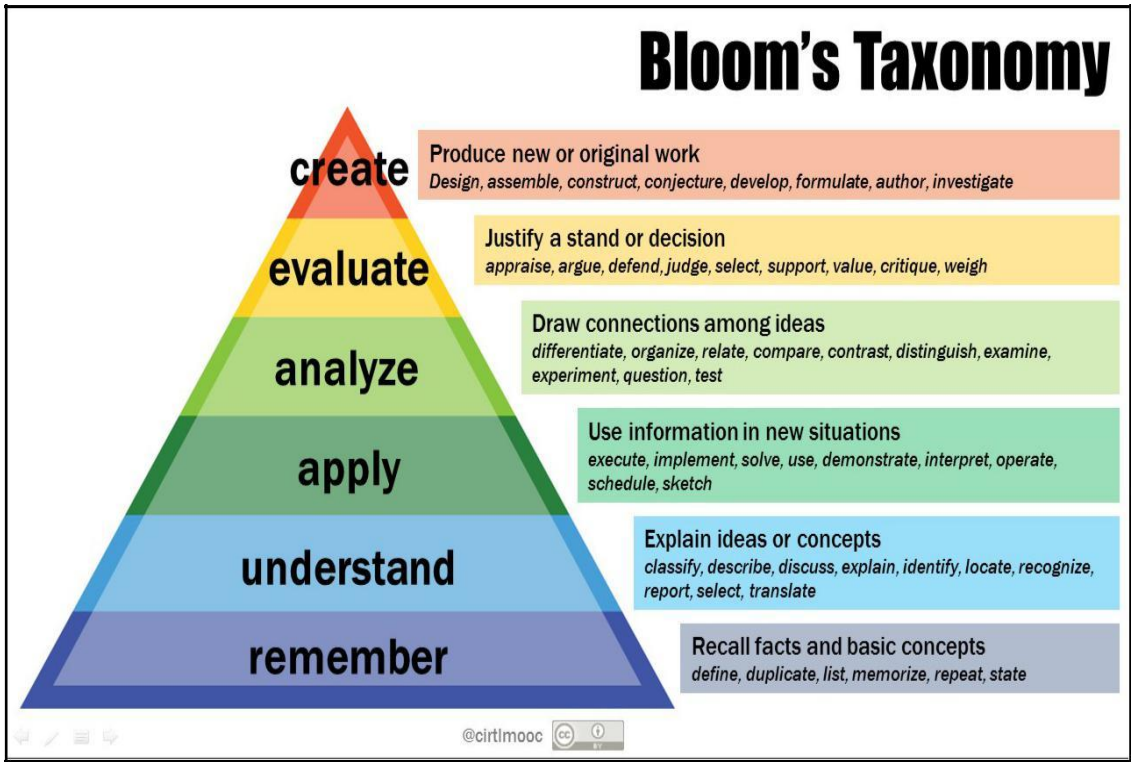
Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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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