NEW HORIZON COLLEGE OF ENGINEERING

Department of Computer Science and Engineering

Academic Year

2026-27

3rd and 4th Semester Scheme & Syllabus

2026-27

BATCH: 2025-29

CREDITS: 160

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NEW HORIZON COLLEGE OF ENGINEERING

VISION

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

MISSION

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

QUALITY POLICY

To provide educational services of the highest quality, both curricular and co-curricular, to enable students to integrate 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

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM OUTCOMES (POs)

The student will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems

PO2: Problem Analysis: Identify, formulate, review research literature and analyse complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/ develop systems/ components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUTCOMES (PSOs)

The student will be able to:

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

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

MAPPING OF PEOs to POs & PSOs

	POs											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
PEO1	3	3	2	2	2	1	1	1	1	1	1	2	2
PEO2	3	3	3	3	3	2	2	2	2	2	2	3	2
PEO3	3	3	3	3	3	3	2	2	2	2	2	3	3
PEO4	1	1	1	1	1	2	3	3	3	3	3	1	3

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

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Computer Science and Engineering

Scheme of Teaching and Examinations for 2025- 2029 BATCH (2025 Scheme)

III Semester																		
Sl. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**TLP Contact Hours / Sem**	**TW & SL / Sem**	**Total Hours /Sem**	**Exam Hrs**	**Marks**		
					L	**T**	**P**	**S**						**CIE**	**SEE**	**Total**
1	BSC	25MAC31	Numerical Methods, Vector Spaces and Probability Distributions	BS	3	0	0	0	3	45	45	90	3	50	50	**100**
2	PCC	25CSK32	Data Structures	CS	3	0	0	0	3	45	45	90	3	50	50	**100**
3	PCCL	25CSLK32	Data Structures Lab	CS	0	0	1	0	1	30	-	30	3	50	50	**100**
4	PCC	25CSE33	Digital Logic and Computer Organization	CS	3	0	0	0	3	45	45	90	3	50	50	**100**
5	PCCL	25CSL33	Digital Logic Lab	CS	0	0	1	0	1	30	-	30	3	50	50	**100**
6	PCC	25CSE34	Optimization Techniques	CS	3	0	0	0	3	45	45	90	3	50	50	**100**
7	HSMS	25CSK35	Software Engineering and Project Management	CS	3	0	0	0	3	45	45	90	3	50	50	**100**
8	AEC	25CSE36X	Ability Enhancement Course – III	CS	0	0	1	0	1	30	-	30	3	50	50	**100**
9	PROJ	25CPD37	Community Project using Innovation and Design Thinking	CS	0	0	1	0	2	-	30	30	3	50	50	**100**
10	NCMC	25NSS30	National Service Scheme	-	0	0	0	0	0	-	30	30	--	50	--	**50**
		25PED30	Physical Education and Sports	-												
		25YOG30	Yoga	-												
		25MUS30	Music	-												
								Total	**20**	**315**	**285**	**600**	**27**	**500**	**450**	**950**

11	NCMC	25DMAT31*	Basic Applied Mathematics -I	BS	0	0	0	0	0	15	15	30	--	50	--	**50**

BSC: Basic Science Course, **PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC**: Non-Credit Mandatory Course, **AEC:** Ability Enhancement Course, **PROJ:** Mini Project work, **L:** Lecture, **T:** Tutorial, **P:** Practical **S: SDA:** Skill Development Activity, **TW & SL**- Term Work & Self Learning, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **CIE:** Continuous Internal Evaluation, **SEE**:Semester End Evaluation.

25DMAT31*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Ability Enhancement Course – III (0-0-1-0)			
25CSE361	Exploratory Data Analysis	25CSE364	Microsoft Visio
25CSE362	Project Management with Git	25CSE365	Bio Inspired Design and Innovation (1-0-0-0)
25CSE363	Web Design Technologies		

Community Project using Innovation and Design Thinking: A community is a social unit or group of people sharing socially-significant characteristics, such as place, set of norms, culture, religion, values, customs, or identity. The Community Project using Innovation and Design Thinking course involves addressing complex issues within such a community through a human-centered lens. By integrating design thinking methodologies, these projects move beyond traditional service to focus on empathy, iterative problem-solving, and the creation of sustainable, innovative solutions. Whether establishing welfare initiatives like orphanages, implementing renewable energy systems, or developing environmental technologies, the process begins with deep community engagement to uncover latent needs before defining specific challenges. This experiential learning activity encourages students to identify, analyze, and address real-life problems by synthesizing engineering knowledge with creative strategy. The design thinking framework guides students through stages of empathy, ideation, and rapid prototyping, ensuring that the final interventions are not only technically sound but also culturally appropriate and user-validated. This approach promotes social responsibility and civic engagement while fostering interdisciplinary collaboration and the practical application of theoretical concepts. By navigating the ambiguity of real-world constraints through an innovative mindset, students contribute meaningfully to community welfare and sustainable development. Students may undertake these projects individually or in collaborative groups 2 to 4 members.

CIE:
The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work shall be based on the rubrics.

25CSK35(HSMS)- This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.
For IT allied Branches: Software Product/ Project Management
For Core Branches: Engineering Economics and Management / Industrial Management and Entrepreneurship.

National Service Scheme /Physical Education/Yoga/ Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PED) (Sports and Athletics), Yoga (YOG), and Music (MUS) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester and IV semester (for 2 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga or Music.

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Computer Science and Engineering

Scheme of Teaching and Examinations for 2025- 2029 BATCH (2025 Scheme)

IV Semester																	
Sl. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**TLP Contact Hours / Sem**	**TW & SL / Sem**	**Total Hours /Sem**	**Exam Hrs**	**Marks**		
					L	**T**	**P**	**S**						**CIE**	**SEE**	**Total**
1	BSC	25MAC41	Discrete Mathematics and Graph Theory	BS	3	0	0	0	3	45	45	90	3	50	50	**100**
2	PCC	25CSK42	Object Oriented Programming using Java	CS	3	0	0	0	3	45	45	90	3	50	50	**100**
3	PCCL	25CSLK42	Object Oriented Programming using Java LAB	CS	0	0	1	0	1	30	-	30	3	50	50	**100**
4	PCC	25CSE43	Operating Systems	CS	3	0	0	0	3	45	45	90	3	50	50	**100**
5	PCCL	25CSL43	Linux Operating System Lab	CS	0	0	1	0	1	30	-	30	3	50	50	**100**
6	PCC	25CSK44	Database Management Systems	CS	3	0	0	0	3	45	45	90	3	50	50	**100**
7	PCCL	25CSLK44	Database Management Systems Lab	CS	0	0	1	0	1	30	-	30	3	50	50	**100**
8	PEC	25CSE45X	Professional Elective Course-I	CS	3	0	0	0	3	45	45	90	3	50	50	**100**
9	AEC	25CSE46X	Ability Enhancement Course – IV	CS	0	0	1	0	1	30	-	30	3	50	50	**100**
10	PROJ	25EPP47	Environmental Science Project	Any Dept	0	0	2	0	2	-	60	60	3	50	50	**100**
11	NCMC	25NSS40	National Service Scheme	-	0	0	0	0	0	-	30	30	--	50	--	**50**
		25PED40	Physical Education and Sports	-												
		25YOG40	Yoga	-												
		25MUS40	Music	-												
								Total	**21**	**345**	**315**	**660**	**30**	**550**	**500**	**1050**

12	NCMC	25DMAT41*	Basic Applied Mathematics -II	BS	0	0	0	0	0	15	15	30	--	50	--	**50**

BSC: Basic Science Course, **PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC:** Ability Enhancement Course, **PROJ:** Mini Project work, **L**: Lecture**, T:** Tutorial**, P:** Practical **S: SDA:** Skill Development Activity, **TW & SL**- Term Work & Self Learning**, K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **CIE:** Continuous Internal Evaluation, **SEE**:Semester End Evaluation.

25DMAT41*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Professional Elective Course-I			
25CSE451	Knowledge Engineering	25CSE454	Computer Graphics and Animation
25CSE452	Introduction to Cloud Computing and Virtualization	25CSE455	Fundamentals of Information Security
25CSE453	Software Testing	25CSE456	Theory of Computation

Ability Enhancement Course – IV (0-0-1-0)			
25CSE461	Data Visualization	25CSE464	UI UX Design
25CSE462	IoT Programming	25CSE465	Programming in C++
25CSE463	Automated Software Testing		

Environmental Science Project: The Environmental Science Project is an applied learning component designed to develop students' awareness, understanding, and responsibility toward the environment. It provides an opportunity to study real-world environmental issues and apply scientific and engineering principles to design feasible and sustainable solutions. Central to this course is the alignment with the United Nations Sustainable Development Goals (SDGs), providing a global framework for students to address urgent environmental challenges through localized action.

The topics under environment include, but are not limited to, climate change, biodiversity, air and water pollution, land use, excess use of natural resources, earthquakes, rise in the earth's temperature, power generation, and soil erosion. By exploring these themes, students contribute to the realization of specific global targets, including Clean Water and Sanitation, Affordable and Clean Energy, Climate Action, Life Below Water, and Life on Land.

The project involves problem identification, field surveys, case studies, data collection, environmental audits, analysis, and the proposal of remedial or preventive measures. These interventions are aimed at improving biodiversity, air quality, and thermal comfort while promoting Responsible Consumption and Production and Sustainable Cities and Communities. Students can take up the project individually or in a group not exceeding four members. Participants are also encouraged to opt for Interdisciplinary Projects, fostering the collaborative thinking essential for achieving a sustainable balance between human activity and the natural world.

CIE:

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

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the project work shall be based on the rubrics. The marks awarded for the project report shall be the same for all the batch mates.

National Service Scheme /Physical Education/Yoga/ Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PED) (Sports and Athletics), Yoga (YOG), and Music (MUS) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester and IV semester (for 2 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga or Music.

Third Semester Syllabus

NUMERICAL METHODS, VECTOR SPACES AND PROBABILITY DISTRIBUTIONS (Common for AIML & CSE)			
Course Code	**25MAC31**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

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

25MAC31.1	Apply numerical techniques to solve engineering problems involving nonlinear equations and estimation of unknown data values.
25MAC31.2	Analyze engineering problems and select appropriate numerical techniques to obtain accurate approximate solutions.
25MAC31.3	Apply the concepts of vector spaces, inner product spaces, orthogonality, and linear transformations to represent and solve engineering and scientific problems.
25MAC31.4	Analyze engineering problems involving uncertainty and random processes and select appropriate probability distributions.
25MAC31.5	Apply the principles of statistical hypothesis testing by formulating null and alternative hypotheses to take the decision for the samples in the real time scenarios.
25MAC31.6	Analyze small-sample data to make statistical inferences, including tests for mean, variance and goodness of fit

MODULE-1	**NUMERICAL SOLUTIONS AND INTERPOLATION**	**25MAC31.1**	**9 Hours**
Numerical solution of algebraic and transcendental equations - Newton-Raphson Method. Interpolation / Extrapolation: Newton's forward and backward formulae for equal intervals, Newton divided differences, Lagrange's formulae for unequal intervals.			
Self-study	Numerical solution of algebraic and transcendental equations using bisection method, Regula – Falsi method. Inverse Lagrange interpolation		
Text Book	Text Book 1: 28.2, 28.3, 29.6, 29.10, 29.11, 29.13, Text Book 2: 19.2, 19.3.		
MODULE-2	**NUMERICAL INTEGRATION, SOLUTION OF DIFFERENTIAL EQUATIONS**	**25MAC31.2**	**9 Hours**
Numerical integration by Simpson's 1/3rd, 3/8th & Weddle's rules. Application of numerical integration to velocity, area and volume. Numerical solution to 1st order & 1st degree ordinary differential equations by Taylor's series method, Modified Euler's method and Runge-Kutta method of 4th order.			
Self-study	Numerical differentiation, Numerical integration by Trapezoidal rule. Numerical solution to 1st order & 1st degree ordinary differential equations by Picard's method.		
Text Book	Text Book 1: 32.3, 32.5, 32.7, 32.9, 30.7, 30.8, 30.10, Text Book 2: 19.5, 21.1.		
MODULE-3	**VECTOR SPACES AND LINEAR TRANSFORMATIONS**	**25MAC31.3**	**9 Hours**
Vector Space examples, Subspaces, Linear dependence and Independence, Spanning Sets, Basis and dimension. Inner product space, Orthogonal and Orthonormal basis by Gram Schmidt orthogonalization process. Introduction to Linear Transformations, matrix of linear transformation, rank and nullity theorem			
Self-study	Verifying the given basis is Orthogonal and Orthonormal basis. Orthogonal compliment, projection mapping.		
Text Book	Text Book 3: 4.1, 4.2, 4.3, 4.4, 4.5.		
MODULE-4	**PROBABILITY DISTRIBUTIONS**	**25MAC31.4**	**9 Hours**
Random variables, discrete and continuous random variables, probability density functions, Expectation and Standard deviation. Discrete Probability distribution, Binomial and Poisson Distributions. Continuous Probability distribution, Normal distribution. Joint probability distribution - dependent and independent Random variables, Covariance, Correlation coefficient.			
Self-study	Basic probability theory, Baye's theorem, Bernoulli distribution, uniform distribution, exponential distribution		
Text Book	Text Book 1: 25.12, 25.13, 26.8, 26.9, 26.10, 26.11, 26.12, 26.14, 26.15, 26.16.		
MODULE-5	**SAMPLING THEORY**	**25MAC31.5, 25MAC31.6**	**9 Hours**

Sampling, Sampling distributions, Level of significance, Type-I & Type-II errors, one tail and two tail tests, test of hypothesis of large samples for means and proportions, Inferences for variance and proportion. Central limit theorem, confidence limits for means, Student's t-distribution, F-distribution and Chi-square distribution for test of goodness of fit for small samples.	
Self-study	Confidence limits problems.
Text Book	Text Book 1: 27.2, 27.4, 27.6, 27.8, 27.10, 27.12, 27.14, 27.16, 27.18, 27.20,

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s) - 25	**AAT1 - 15**	**AAT2 - 10**
L1	**Remember**	-	**-**	**-**
L2	**Understand**	5	**-**	**-**
L3	**Apply**	10	**5**	5
L4	**Analyze**	10	5	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**	**20**
L5	**Evaluate**	**-**
L6	**Create**	**-**

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.
3) David C Lay, Linear Algebra and its applications, Addison-Wesley Publishers, Fourth Edition, 2012, ISBN: 9780321385178

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=f_EqOpgRwRM&t=16s
- https://www.youtube.com/watch?v=Xb9Ypn77LBo&t=16s
- https://www.youtube.com/watch?v=csgvZol6Wfw
- https://www.youtube.com/watch?v=Atv3IsQsak8
- https://www.youtube.com/watch?v=aEF5PPbv8Oc
- https://www.youtube.com/watch?v=Pwk7p8WiCh0
- https://www.youtube.com/watch?v=LGxE_yZYigI
- https://www.youtube.com/watch?v=RFlAiEXRwoo
- https://www.youtube.com/watch?v=RFlAiEXRwoo&t=128s
- https://www.youtube.com/watch?v=sMYtHaSIXbU

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

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

DATA STRUCTURES			
Course Code	**25CSK32**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

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

25CSK32.1	Apply appropriate data structures and Abstract Data Types to solve programming and data organization problems.
25CSK32.2	Analyze the operational characteristics and applications of stacks and queues for solving computational problems.
25CSK32.3	Design linked list-based solutions for efficient data storage and manipulation.
25CSK32.4	Develop tree-based solutions for efficient data organization, searching, and retrieval.
25CSK32.5	Evaluate graph traversal techniques for efficient data representation and problem solving.
25CSK32.6	Interpret sorting and hashing techniques for efficient data access, storage, and retrieval.

MODULE-1	**INTRODUCTION**	**25CSK32.1**	**9 Hours**
Data, Data Objects, Data Types, Abstract Data Types, Data Structures, Classification, Data Structure Operations, Arrays, Dynamic Arrays, Multidimensional Arrays, Strings, Structures, Self- Referential Structures, Unions, Sparse Matrices, Pointers - Pointer as function arguments, Dynamic Memory Allocation Functions.			
Self-study	Investigate the applications of sparse matrices		
Text Book	Text Book 1: 2.1-2.4,3.9,5.1-5.63.15, 1.11.1-1.11.6		
MODULE-2	**STACKS AND QUEUES**	**25CSK32.2**	**9 Hours**
Stacks, Applications of Stacks: Recursion - Factorial, Fibonacci Sequence, Tower of Hanoi, Evaluation of Expressions, Multiple Stacks. Queues: Queue representation, Primitive operations, Circular queue, Priority queue, Double ended queue, Applications of queues.			
Case Study	Analyze the implementation of browser navigation (Back/Forward), call stack management		
Text Book	Text Book 1:7.1,7.3,7.4, Text Book 2: 4.5.1,4.5.3,4.5.4,4.5.6,5.1-5.4,6.4.1,6.4.3,6.4.4		
MODULE-3	**LINKED LISTS**	**25CSK32.3**	**9 Hours**
Introduction to Linked List, Representation of linked list in memory, Single Linked List, Doubly linked list, Header linked list, Linked representation of stack, Linked representation of queue, Circular linked list, , Operations on linked lists, Applications of Linked List – Polynomials Representation , Addition of two polynomials.			
Self Study	Explore the implementation of linked lists in real-world applications		
Text Book	Text Book 1: 6.1,6.2,6.4,6.5,6.8		
MODULE-4	**TREES**	**25CSK32.4**	**9 Hours**
Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees, Heaps. Binary Search Trees, Selection Trees, Forests, Balanced Trees, AVL Trees, Single rotation, Double rotation, Application of Trees - Evaluation of Expression			
Case Study	A college library stores thousands of books in alphabetical order. Suggest an appropriate tree data structure for organizing the records to enable fast searching, insertion, and deletion of books. Justify your choice by comparing it with other tree structures.		
Text Book	Text Book 1: 9.1, 9.3, 9.5, 9.7, Text Book 2: 10.1, 10.3, 10.5, 10.7		
MODULE-5	**GRAPHS, SORTING & HASHING**	**25CSK36.5, 25CSK36.6**	**9 Hours**
Definitions, Terminologies, Matrix and Adjacency List Representation Of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search. Sorting – Merge Sort, Quick Sort, Hashing: The symbol table, Hashing Functions, Collision Resolution Techniques.			
Case Study	A university maintains records of thousands of students that need to be sorted by USN and searched frequently. Compare the suitability of Bubble Sort, Insertion Sort, and Hashing for different operations, and justify the most efficient approach.		
Text Book	Text Book 1:13.1,13.2,13.3,8.1,8.2 & Text Book 2:10.1,10.2		

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Reema Thareja, Data Structures Using C. Oxford University Press, 3rd Edition, 2023. ISBN-13: 978-0199491689.
2. E. Balagurusamy, Data Structures Using C, 2nd Edition, McGraw Hill, 2025, ISBN: 978-9364443012.
3. Amol M. Jagtap and Ajit S. Mali, Data Structures using C: A Practical Approach for Beginners. Chapman & Hall/CRC Press (Taylor & Francis Group), 1st Edition, 2022. ISBN-13: 978-0367616311

Reference Books:

1. Douglas Baldwin, Greg Scragg, Introduction to Algorithms and Data Structures, 1st Edition, Cengage Learning, 2024, ISBN: 978-0357673560.
2. Bradley N. Miller, David L. Ranum, Roman Yasinovskyy, Problem Solving with Algorithms and Data Structures Using Python, Franklin, Beedle & Associates, 2024. ISBN-13: 978-9355426178.

Web links and Video Lectures (e-Resources):

- https://www.udemy.com/course/datastructurescncpp/
- https://www.coursera.org/specializations/data-structures-algorithms
- https://nptel.ac.in/courses/106102064

Activity-Based Learning (Suggested Activities in Class)

- Problem Solving Exercises
  - https://github.com/bollwarm/DataStructuresAlgorithms
  - https://www.hackerrank.com/domains/datastructures

DATA STRUCTURES LAB			
Course Code	**25CSLK32**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

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

25CSLK32.1	Apply the concepts of Arrays and Structures for programming and problem solving.
25CSLK32.2	Analyze the operational characteristics of stacks and queues for efficient data management.
25CSLK32.3	Implement linked list-based solutions for dynamic data organization and manipulation.
25CSLK32.4	Develop tree-based and searching solutions for efficient data storage, traversal, and retrieval.

No.	List of Programs	Hours	COs
	Prerequisite		
	• Basic C Programs (Arrays, User-Defined Functions, Structures, Pointers) • Basic Commands in Linux	2	NA
	PART-A		
1	Design, develop and implement a menu-driven program in C for the following array operations. • Creating an array of N Integer Elements • Display of array Elements with Suitable Headings • Inserting an Element (ELEM) at a given valid Position (POS) • Deleting an Element at a given valid Position (POS) • Exit. Support the program with functions for each of the above operations.	2	25CSLK32.1
2	Design, develop and implement a program in C to create a structure to store the name, account number and balance of 3 and store their information. a. Write a function to print the names of all the customers having balance less than MINIMUM_AMOUNT. b. Write a function to add BONUS_AMOUNT in the balance of all the customers having more than $1000 in their balance and then print the incremented value of their balance	2	25CSLK32.1
3	Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) • Push an Element on to Stack • Pop an Element from Stack • Demonstrate how Stack can be used to check Palindrome • Demonstrate Overflow and Underflow situations on Stack • Display the status of Stack • Exit Support the program with appropriate functions for each of the above operations	2	25CSLK32.2

4	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.	2	25CSLK32.2
5	Design, Develop and Implement a Program in C for the following Stack Application: Evaluation of Postfix expression with single digit operands and operators: +, -, *, /, %, ^.	2	25CSLK32.2
6	Design, Develop and Implement a Program in C for the following Stack Application: Solving Tower of Hanoi problem with n disks.	2	25CSLK32.2
PART-B			
7	Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above Operations.	2	25CSLK32.2
8	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Branch, Sem, Phone #. a. Create a SLL of N Students Data by using front insertion. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion / Deletion at End of SLL d. Perform Insertion / Deletion at Front of SLL (Demonstration of stack) e. Exit	2	25CSLK32.3
9	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Salary, Phone #. a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it. c. Perform Insertion and Deletion at End of DLL. d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit	2	25CSLK32.3
10	Using circular representation for a polynomial, design, develop, and execute a program in C to accept two polynomials, add them, and then print the resulting polynomial.	2	25CSLK32.3
11	Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers. a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit	2	25CSLK32.4
12	Demonstrate the Binary Search algorithm by first sorting the list of elements using any one of the standard sorting techniques. The program should accept a list of elements, sort them in ascending order, and then perform a Binary Search to find a	2	25CSLK32.4

	given target element. Display appropriate messages indicating whether the element was found and its position.		

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

- https://ds1-iiith.vlabs.ac.in/exp/poly-arithmetic/polynomial-arithmetic-linked-list/multiplication-of-polynomials.html
- https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
- https://visualgo.net/en/sorting
- https://ds1-iiith.vlabs.ac.in/exp/hash-tables/hash-tables/hash-tables-operations.html

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:
Reference Books:

1. Reema Thareja, Data Structures Using C. Oxford University Press, 3rd Edition, 2023. ISBN-13: 978-0199491689.
2. E. Balagurusamy, Data Structures Using C, 2nd Edition, McGraw Hill, 2025, ISBN: 978-9364443012.
3. Amol M. Jagtap and Ajit S. Mali, Data Structures using C: A Practical Approach for Beginners. Chapman & Hall/CRC Press (Taylor & Francis Group), 1st Edition, 2022. ISBN-13: 978-0367616311.

DIGITAL LOGIC AND COMPUTER ORGANIZATION			
Course Code	**25CSE33**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

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

25CSE33.1	Apply fundamental digital logic design concepts and techniques to solve problems in digital circuit design.
25CSE33.2	Analyze and implement combinational logic circuits and their real-time applications.
25CSE33.3	Design and simulate combinational and sequential logic circuits using Verilog HDL.
25CSE33.4	Evaluate sequential logic design techniques for real-world digital system implementation.
25CSE33.5	Discuss the computer organization concepts to determine the functional relationships and operational behavior of a computer system.
25CSE33.6	Examine the organization and operation of a computer system with respect to the performance of its processing, memory, and input-output components.

MODULE-1	**DIGITAL LOGIC ESSENTIALS**	**25CSE33.1**	**9 Hours**
Digital logic: Boolean function, K-Map simplification method, Don't-Care Conditions, NAND and NOR Implementation, Variable Entered K-MAP(VEM), Quine-McCluskey minimization technique. **Introduction to Verilog HDL:** data types, modeling styles, Operators.			
Case study	Create a secure lock system using a 4-digit binary passcode.		
Text Book	Textbook -1: Ch-3, 4.6		
MODULE-2	**COMBINATIONAL CIRCUITS**	**25CSE33.2, 25CSE33.4**	**9 Hours**
Combination logic circuits: Adders, Subtractors, Parallel Adder, Carry Look Ahead Adder, Adder-subtractor, Multiplexers, De-multiplexers, Decoders, encoder, Priority Encoders, Magnitude Comparator, Parity generator and checker, Verilog implementation of combinational circuit.			
Applications	Design a simple ALU capable of performing addition, subtraction, comparison, and parity check.		
Text Book	Textbook -1: Ch- 4		
MODULE-3	**APPLICATION OF SEQUENTIAL CIRCUITS**	**25CSE33.3, 25CSE33.4**	**9 Hours**
Types of Flip Flop, Conversion of Flip-flops, Shift Register, Types of Shift Registers, Universal Shift Register, Applications of Shift Register, Binary ripple counters, Synchronous binary counters, Design of a synchronous mod-n counters, Verilog implementation of Flip-flop, Shift registers and Counters.			
Case study	Design and Implementation of a Digital Sequence Detector Using Shift Registers and Flip-Flops.		
Text Book	Textbook 1 –Ch-5, 6		
MODULE-4	**COMPUTER ORGANIZATION AND DESIGN**	**25CSE33.5**	**9 Hours**
Instruction Codes, Computer Registers, Computer Instructions using RISC - V , Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input-Output and Interrupt, Design of basic computer.			
Applications	Design of a Binary Arithmetic Processing Unit (APU)		
Text Book	Textbook-2: Ch-2, 3		
MODULE-5	**REGISTER AND MEMORY ACCESS**	**25CSE33.6**	**9 Hours**
Registers: General Register Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC), Input-Output Interface, Asynchronous Data Transfer, Priority Interrupt. **Memory:** Memory Hierarchy, Cache Memory, Cache Replacement Techniques Direct Memory Access (DMA), Virtual Memory, Address translation, Input-Output Processor (IOP).			
Case study	Design and Analysis of Cache Mapping in a Mini CPU Architecture		

Text Book	Textbook-2: 4, 5

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Digital Design: with an Introduction to Verilog HDL, VHDL and System Verilog, M Morris Mano and Michael D. Ciletti, 6th Edition, 2018, Pearson Education, ISBN-978- 9353062019.
2. Computer Organization and Design: The Hardware/Software Interface: RISC-V Edition, David A. Patterson, John L. Hennessy, Morgan Kaufmann (Elsevier), 2nd Edition, 2024, ISBN: 978-0128203316

Reference Books:

1. Computer Arithmetic: Algorithms and Hardware Designs, Behrooz Parhami, Oxford University Press, 2nd Edition, 2023(reprint), ISBN-13: 978-0195328486
2. Digital Design and Computer Architecture, David Harris and Sarah Harris, Morgan Kaufmann (Elsevier), 3rd Edition, 2022, ISBN: 978-0128200643
3. Fundamentals of Digital Logic with Verilog Design, Stephen Brown and Zvonko Vranesic, McGraw-Hill Education, 3rd Edition, 2023, ISBN: 978-0073380544

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/117105080
- https://ocw.mit.edu/courses/6-004-computation-structures-spring-2017/
- https://www.coursera.org/learn/comparch
- https://www.edx.org/learn/design/the-hong-kong-university-of-science-and-technology-digital-design

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

- **Logic Puzzle Challenges**: Logic puzzles and challenges related to digital circuits. These can include tasks like designing specific logic gates or solving circuit problems. Puzzles can be individual or team-based.
- **Industry Case Studies**: Discussion on the challenges and solutions employed in various industries, such as aerospace, automotive, or consumer electronics.
- **Peer Teaching**: The students can be asked to teach and discuss specific topic or concept to their peers. This not only reinforces their own understanding but also encourages active engagement and collaboration.
- **Reflection and Discussion**: The students can be asked to present their learning of any topic with others. This will encourage students to reflect on their experiences and discuss what they learned. This promotes critical thinking and deeper understanding.

DIGITAL LOGIC LAB			
Course Code	**25CSL33**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours/Sem	**30**	**SEE Marks**	**50**
TW& SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

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

25CSL33.1	Apply principles of modular combinational logic design to construct and deploy combinational logic circuits.
25CSL33.2	Analyse sequential logic circuit requirements to synthesize efficient and reliable digital systems.
25CSL33.3	Implement combinational logic circuits by constructing and performing Verilog simulations effectively.
25CSL33.4	Develop sequential logic circuits through precise construction and Verilog simulation for functional verification.

No.	List of Experiments / Programs	Hours	COs
	Prerequisite		
	• Simple Boolean functions • Number conversions	2	NA
	PART-A		
1	Design and verify the Full Adder and Subtractor circuit using basic logic gates.	2	**25CSL33.1**
2	Design and verify the Parallel Adder/ Subtractor using IC 7483	2	**25CSL33.1**
3	Design and verify the 4-variable function using IC 74151(8:1MUX).	2	**25CSL33.1**
4	a) Design and implement the BCD to Gray code using NAND gates. b) Design and implement the Binary to excess-3 circuits using Gates (4 bit)	2	**25CSL33.1**
5	Implement and verify SISO, PIPO, SIPO, PISO, Left shift, Ring Counter and Johnson Counter using IC 7495.	2	**25CSL33.2**
6	Design and implement synchronous up Mod-N (N<8) Counter using JK flip flop.	2	**25CSL33.2**
	PART-B		
7	Write a Verilog code to simulate the following circuit: a) Adder and Subtractor b) Parallel adder	2	**25CSL33.3**
8	Write a Verilog code to simulate the following circuit: a) MUX b) De-MUX	2	**25CSL33.3**
9	Write a Verilog code to simulate the following circuit: a) Encoder b) Decoder	2	**25CSL33.3**
10	Write a Verilog code to simulate the following circuit: a) Magnitude comparator b) Code converter	2	**25CSL33.4**
11	Write a Verilog code to simulate the following circuit: a) Flip flops b) Shift Registers	2	**25CSL33.4**

12	Write a Verilog code to simulate the following circuit: a) Ring Counter and Johnson Counter b) Synchronous up and down counter	2	**25CSL33.4**

PART-C

Beyond Syllabus Virtual Lab Content

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

- **https://da-iitb.vlabs.ac.in/exp/washin-machine-control/**
- **https://da-iitb.vlabs.ac.in/exp/seat-belt-warning-system/**
- **https://da-iitb.vlabs.ac.in/exp/water-level-control/**
- **https://da-iitb.vlabs.ac.in/exp/cockpit-warning-light-control/**

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1. Electronics for Beginners: A Practical Guide to Components, Logic Circuits, and Digital Systems for Students and Hobbyists Kindle Edition 2025, ISBN: 979-8288621642
2. Verilog for Digital Design and Simulation: Definitive Reference, Richard Johnson,2025, ISBN: 661-0000839827

OPTIMIZATION TECHNIQUES			
Course Code	**25CSE34**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

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

25CSE34.1	Apply the concepts of operations research and linear programming to formulate optimization models and obtain graphical solutions for decision-making problems
25CSE34.2	Solve Linear Programming Problems using simplex methods to determine optimal solutions under different solution conditions.
25CSE34.3	Analyze transportation and assignment models to determine optimal resource allocation for real-world optimization problems
25CSE34.4	Examine project networks using CPM and PERT techniques for effective project planning and scheduling
25CSE34.5	Evaluate sequencing models for efficient job scheduling in manufacturing and service systems
25CSE34.6	Interpret game theory models to determine appropriate competitive strategies for decision-making problems

MODULE-1	**BASICS OF OPTIMIZATION TECHNIQUES**	**25CSE34.1**	**9 Hours**
Definition of Optimization and Operations Research, Characteristics of Operations Research, Scope of Operations Research, Applications of Operations Research (OR/OT), Objectives of Operations Research, Phases of OR/OT, Characteristics of a Good Model, Advantages of a Model, Limitations of a Model, Formulation of Linear Programming Problems, Graphical Method of Solution, Some Exceptional Cases.			
Case Study	A manufacturing company produces multiple products using limited raw materials and labor resources. Formulate the Linear Programming Problem and determine the optimal production plan using the graphical method to maximize profit		
Text Book	Text Book 1: 1.2, 1.3, 1.6, 1.10, 1.11, 1.12, 1.15, 1.16, 1.17, 2.6, 2.9, 2.10		
MODULE-2	**LINEAR PROGRAMMING-SIMPLEX METHOD**	**25CSE34.2**	**9 Hours**
Standard Form of an LP Problem, Simplex Algorithm (Maximization Case), Simplex Algorithm (Minimization Case)- Two Phase Method & Big-M Method, Some Complications and Their Resolution-Tie for Entering Basic Variable (Key Column) & Tie for Leaving Basic Variable (Key Row)- Degeneracy, Types of Linear Programming Solutions- Alternative Optimal Solutions, Unbounded Solution, Infeasible Solution.			
Case Study	A financial organization must allocate its available resources among different investment options under multiple constraints. Solve the optimization problem using the simplex method and analyze different solution conditions.		
Text Book	Text Book 2: 4.2, 4.3, 4.4, 4.5, 4.6		
MODULE-3	**TRANSPORTATION AND ASSIGNMENT PROBLEMS**	**25CSE34.3**	**9 Hours**
Transportation Models: Mathematical Model of Transportation Problem, The Transportation Algorithm, Methods of Finding Initial Solution- North-West Corner Method, Least Cost Method, Vogel's Approximation Method, Test for Optimality-Steps of MODI Method, Closed Loop in Transportation Table and its Properties, Variations in Transportation Problem-Unbalanced Supply and Demand, Maximization Transportation Problem. Assignment Models: Mathematical Model of Assignment Problem, Solution Methods of Assignment Problem- Hungarian Method, Variations of the Assignment Problem- Maximization Case, Travelling Salesman Problem.			
Case Study	A logistics company needs to transport products from multiple warehouses to customer locations while minimizing transportation cost. Determine the optimal transportation schedule and assign available resources efficiently using appropriate optimization techniques.		
Text Book	Text Book 2: 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 9.2, 9.3, 9.4, 9.5.		
MODULE-4	**NETWORK ANALYSIS IN PROJECT PLANNING (PERT and CPM)**	**25CSE34.4**	**9 Hours**

Basic Tools and Techniques of Project Management, Network Logic (Activity on Arrow Diagram), Numbering the Events (Fulkerson's Rule), Activity on Node, Merits and Demerits of AON Diagrams, Critical Path Method, Programme Evaluation and Review Technique (PERT), Distinction Between PERT and CPM.			
Case Study	A construction company is planning a project involving multiple interdependent activities. Develop the project network using CPM and PERT techniques, identify the critical path, and estimate the project completion time for effective project management.		
Text Book	Text Book 1: 14.6, 14.8, 14.9, 14.10, 14.11, 14.12, 14.13, 14.23		
MODULE-5	**SEQUENCING AND GAMES THEORY**	**25CSK34.5, 25CSK34.6**	**9 Hours**
Sequencing Problems: Notations, Terminology and Assumptions, Processing n Jobs Through Two Machines-Johnson's Procedure, Processing n Jobs Through Three Machines, Processing n Jobs Through m Machines, Processing Two Jobs Through m Machines. Games Theory: Characteristics of Games, Game Models, Definitions, Rules for Game Theory, Rule1: Look for Pure Strategy, Rule 2: Reduce by Dominance, Rule 3: Solve for a Mixed Strategy, Mixed Strategies (2x2 Games- Algebraic Method), Mixed Strategies (2xn or mx2 Games-Graphical Method).			
Case Study	A manufacturing organization processes multiple customer orders on different machines while competing with rival firms. Determine the optimal job sequence using sequencing techniques and interpret game theory models to identify suitable competitive strategies for decision-making.		
Text Book	Text Book 2: 21.2, 21.3, 21.4, 21.5, 21.6 Text Book 1: 9.11, 9.12, 9.13, 9.14, 9.15, 9.16, 9.17, 9.18, 9.19		

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	15
L5	**Evaluate**	5
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1) Prem Kumar Gupta, D S Hira, "Operations Research", S Chand and Company Limited, 7th edition Reprint 2023, ISBN: 978-81-219-0281-6.
2) J K Sharma " Operations Research Theory and Applications", Laxmi Publications, 6th edition 2025, ISBN: 978-93-85935-14-5

Reference Books:

1) Hamdy A. Taha, "Operations Research: An Introduction", Pearson, 10th Edition, Thirteenth Impression 2024, ISBN: 9352865278.
2) Frederick S. Hillier and Gerald J. Lieberman, "Introduction to operations research ", Mc Graw Hill, 12th Edition, 2025, ISBN: 978-9364444507.
3) Swarup Kanti, P K Gupta, Man Mohan, "Operations Research", Sultan Chand and Sons, 20th Revised Edition, 2022, ISBN: 93-5161-183-7.

Web links and Video Lectures (e-Resources): • https://nptel.ac.in/courses/111107128 • https://www.youtube.com/playlist?list=PLabr9RWfBcnqy9bzlLlp71FD7RjJHNiOg • https://www.youtube.com/watch?v=rrfFTdO2Z7I • https://www.youtube.com/watch?v=Tm2HhqMu5Jg • https://mcrhrdi.gov.in/splfc2-2022/week4/ProjectManagement%20-%20vilas%20shah.pdf
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Role Play • Problem Solving Exercises • Case Study Analysis • Activity-Based Learning • Team-Based Decision-Making Activity

SOFTWARE ENGINEERING AND PROJECT MANAGEMENT			
Course Code	**25CSK35**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

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

25CSK35.1	Apply appropriate software process models to solve real-world software engineering problems using the principles of the SDLC.
25CSK35.2	Analyze software requirements through requirement engineering, modelling, and agile management practices.
25CSK35.3	Design software systems using architectural, object-oriented, and user interface design principles.
25CSK35.4	Implement software testing strategies using appropriate testing techniques and tools to verify and validate software systems.
25CSK35.5	Examine software quality using object-oriented and web testing techniques and explore the security testing concepts.
25CSK35.6	Develop software project management plans by incorporating risk management, software configuration management, and maintenance practices.

MODULE-1	**INTRODUCTION TO SOFTWARE ENGINEERING AND PROCESS MODELS**	**25CSK35.1**	**9 Hours**

Introduction: Nature of software, Characteristics of good software, Software Engineering as a layered technology, Software process, project and product, Process models.

Process Models: Waterfall Model, Evolutionary models, Introduction to Agility - Agile process - Extreme Programming (XP) process - Principles of Agile software development - Agile frameworks and tools - Scrum - Kanban.

Case Study	A university is developing a Smart Campus Management System to automate student registration, attendance, fee payment, and library services. During development, stakeholders request new features such as mobile app and AI-based analytics. The development team must select an appropriate software process model to deliver a reliable, secure, and high-quality software product while accommodating changing requirements. • Identify the characteristics of good software required for this system. • Differentiate between the software process, project, and product. • Which software process model is most suitable for this project • Explain how Agile, Scrum, and Kanban can help manage changing requirements.
Text Book	Text Book 1: Chapter 1.1 to 1.4, 2.1 to 2.6 3.1 to 3.5 Text Book 2: Chapter 1, 2

MODULE-2	**REQUIREMENTS ENGINEERING**	**25CSK35.2**	**9 Hours**

Modelling Requirements: Software requirements- Types, Planning, Scope, Work Breakdown Structure, Milestones, Deliverables, Cost and estimates (human resources, time, costs), Requirement Engineering process, Requirement Elicitation, System modelling - Requirement Specification and Requirement Validation, Requirement Elicitation Techniques, Requirement Management in Agile

Applications	A college plans to automate its library operations using a Library Management System. • Identify and elicit functional and non-functional requirements from stakeholders. • Prepare a Software Requirements Specification (SRS) document. • Define the project scope, WBS, milestones, deliverables, and cost estimates. • Validate the requirements and describe how requirement changes will be managed during development
Text Book	Text Book 1: Chapter 7.1 to 7.6, 8.1 to 8.4 Text Book 2: Chapter 4.1,4.2

MODULE-3	SOFTWARE DESIGN	25CSK35.3	9 Hours
Software Design: Design Concepts and Principles - Abstraction, Refinement, Modularity, Cohesion, Coupling, Architectural design, Detailed Design Transaction and Transformation, Refactoring of designs, Object-Oriented Design, User Interface Design.			
Applications	An organization plans to develop an Online Shopping System for customers and administrators. • Design the software architecture and detailed design using abstraction, refinement, modularity, cohesion, and coupling principles. • Develop an object-oriented design by identifying classes, relationships, and interactions. • Design a user-friendly User Interface (UI) for product browsing, ordering, and payment. Review and refactor the design to improve maintainability, reusability, and performance.		
Text Book	Text Book 1: Chapter 9.1 to 9.4, 10.1 to 10.5,12.1 to 12.5 Text Book 2: Chapter 5,6,7.1 to 7.8, 9.1 to 9.3		
MODULE-4	**SOFTWARE VERIFICATION AND VALIDATION**	**25CSK35.4 25CSK35.5**	**9 Hours**
Verification and Validation: Software Testing -Testing fundamentals, test plan, test design, test execution, Reviews, inspections and auditing, White Box Testing, Black Box Testing, Regression Testing, Mutation Testing, Object-Oriented Testing and tools - JUnit, NUnit, Testing web-based systems and tool - Selenium, Overview: Security Testing			
Case Study	A bank has developed an Online Banking System that allows customers to register, log in, transfer funds, pay bills, and view account statements. Before deployment, the bank wants to ensure that the software is reliable, secure, and error-free. • Prepare a test plan and test cases. • Perform white-box, black-box, and regression testing. • Use JUnit/NUnit and Selenium for testing. • Conduct reviews and security testing to ensure software quality.		
Text Book	Text Book 1: Chapter 19.1 to 19.6,20.1 to 20.5 Text Book 2: Chapter 10		
MODULE-5	**SOFTWARE PROJECT MANAGEMENT**	**25CSK35.6**	**9 Hours**
Software Project Management: Risk management, RMMM plan, CASE tools, Agile project management, Software maintenance, Types of maintenance, Software Configuration Management - overview, SCM tools, Re-engineering, Reverse engineering, Software reuse, Overview: Sustainable and Green software			
Applications	Legacy System Modernization - Key Aspects to be Analyzed: • Maintenance type: Classify the maintenance activity involved (corrective, adaptive, perfective or preventive) in modernizing a legacy campus/enterprise application. • Configuration management: Identify how SCM tools track versions and changes during the re-engineering effort. • Re-engineering vs reverse engineering: Analyze the steps used to recover the design from legacy code and re-architect it for reuse.		
Text Book	Text Book 1: Chapter 22,23, 26.1 to 26.7,27.2 Text Book 3: Chapter 3,22,23,25		

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. R. S. Pressman and Bruce Maxim, Software Engineering: A Practitioner's Approach, 9th Edition, McGraw-Hill, 2023, ISBN-13: 978-9355325044
2. Rajib Mall, Fundamentals of Software Engineering, 5th Edition, PHI Learning Private Limited, 2018 (Reprint 2025), ISBN-13: 978-9388028028
3. Ian Sommerville, Software Engineering, Pearson Education Global, 10th Edition, 2016 (Reprint 2025), ISBN-13: 978-1292096131

Reference Books:

1. Robert K. Wysocki, Effective Project Management: Traditional, Agile, Extreme, Hybrid, 8th Edition, Wiley, 2022, ISBN-13: 978-1119868170
2. David Farley, Modern Software Engineering: Doing What Works to Build Better Software Faster, 1st Edition, Addison-Wesley Professional, 2021, ISBN-13: 978-0137314911
3. Bob Hughes, Mike Cotterell and Rajib Mall, Software Project Management, 7th Edition, McGraw-Hill Education, 2023, ISBN-13: 978-1260577952

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/learn/introduction-to-software-engineering
- https://www.edx.org/learn/software-engineering
- https://onlinecourses.nptel.ac.in/noc20_cs68/preview
- https://alison.com/course/project-management-s-fundamentals
- https://software-engineering-book.com/slides/
- https://www.atlassian.com/software/jira/guides (Jira for Agile project management)
- https://www.selenium.dev/documentation (Selenium testing documentation)
- https://learn.github.com/skills (GitHub Skills -- Git/GitHub hands-on)
- https://www.coursera.org/learn/version-control-with-git-and-github
- https://www.coursera.org/specializations/agile-scrum-mastery-csm-psm-certification

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

- Case studies / Case-lets on process models, project planning and quality assurance.
- Class presentations on Agile frameworks (Scrum, Kanban) and DevOps/testing tools (Jira, Selenium, JMeter).
- Hands-on exercises: preparing an SRS, drawing UML diagrams, writing JUnit/Selenium test scripts for a mini project.
- Maintain a GitHub portfolio of the mini-project (code, README, commit history) as a placement-ready artifact.
- Mock technical-interview rounds on SDLC, Agile, testing and system-design fundamentals covered in this course.

Ability Enhancement Course – III			
25CSE361	Exploratory Data Analysis	25CSE364	Microsoft Visio
25CSE362	Project Management with Git	25CSE365	Bio Inspired Design and Innovation (1-0-0-0)
25CSE363	Web Design Technologies		

EXPLORATORY DATA ANALYSIS			
Course Code	**25CSE361**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

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

25CSE361.1	Apply Python techniques for data creation, manipulation, and statistical analysis
25CSE361.2	Analyze datasets using Exploratory Data Analysis techniques.
25CSE361.3	Implement data visualization techniques to identify trends, patterns, and relationships.
25CSE361.4	Develop effective visualizations to interpret and communicate data insights.

No.	List of Programs	Hours	COs
	Prerequisite		
	Basic Python programs	2	NA
	PART-A		
1	Write a Python program to import the NumPy library and demonstrate the specified operations: 1. Create 1-D and 2-D arrays. 2. Compute aggregate functions such as sum () ,mean(), min ( ), and max ( ).	2	25CSE361.1
2	Import the Pandas Python library used in Exploratory Data Analysis and demonstrate the following operations 1. Create a DataFrame 2. Display the first five and last five records of the DataFrame 3. Display the data types of all columns	2	25CSE361.1
3	Import the Dataset using Pandas and perform data type conversions by converting attributes between string and numeric, string and Boolean, string and datetime, and datetime and integer.	2	25CSE361.1
4	Load a dataset and compute basic statistics such as mean, median, mode, standard deviation, minimum, maximum, and range for numerical attributes.	2	25CSE361.1
5	Identify and remove duplicate records from the Online Retail Dataset by performing the following operations: 1. Identify the number of duplicate records. 2. Remove duplicate records from the dataset. 3. Compare the dataset size before and after removing duplicates.	2	25CSE361.2
6	Load the Medical Appointment No Shows Dataset and perform the following operations: 1. Identify missing values. 2. Replace missing numerical values using mean and median. 3. Replace missing categorical values using mode and a constant value.	2	25CSE361.2
	PART-B		
7	• Create new attributes from existing features in the Student Performance Dataset by performing the following: • Generate a Total Marks attribute by adding marks obtained in different subjects. • Create a Result attribute indicating Pass or Fail based on the average marks. • Display the updated dataset.	2	25CSE361.2
8	• Analyze the Titanic Dataset by performing the following operations: • Count the number of passengers in each passenger class. • Find the frequency of male and female passengers.	2	25CSE361.3

	• Display the results using appropriate charts.		
9	• Analyze the relationships among the numerical attributes of the Housing Price Dataset by computing the correlation matrix. Based on the results: • Identify the pair of attributes with the strongest positive correlation. • Identify the pair of attributes with the strongest negative correlation. • Identify attribute pairs showing weak or negligible correlation.	2	25CSE361.3
10	Load a dataset and perform outlier detection using the IQR and Z-score methods. Remove the detected outliers and compare the results.	2	25CSE361.3
11	Implement Exploratory Data Analysis on the Diabetes Dataset using Matplotlib by creating: • Histograms • Probability distribution plots	2	25CSE361.4
12	Implement data visualization techniques using Seaborn on the Iris Dataset by creating scatter plots and correlation heatmaps. Interpret the patterns and relationships among the attributes.	2	25CSE361.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

- https://ids-amrt.vlabs.ac.in/exp/numpy-arrays-array-operations
- https://www.freecodecamp.org/learn/data-analysis-with-python/
- https://ids-amrt.vlabs.ac.in/exp/exploratory-data-analysis/simulation.html
- https://ids-amrt.vlabs.ac.in/exp/data-preprocessing/simulation.html
- https://www.kaggle.com/datasets/joniarroba/noshowappointments/code

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:
Reference Books:

1. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, Numpy, and Jupyter,3rd Edition, O'Reilly Media,2022,ISBN :978-1098104030.
2. VanderPlas, J. Python data science handbook: Essential tools for working with data (2nd ed.). O'Reilly Media. 2023, ISBN: 978-1098121228.

PROJECT MANAGEMENT WITH GIT			
Course Code	**25CSE362**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

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

25CSE362.1	Apply the fundamental concepts of Git to perform version control tasks.
25CSE362.2	Illustrate Git commands to create, manage and integrate branches.
25CSE362.3	Analyze collaborative development workflows using remote repositories.
25CSE362.4	Examine and manage repository history, versions, and code changes using Git.

No.	List of Programs	Hours	COs
	Prerequisite		
	• Basic Command Line Interface skills • Knowledge about file systems • A Github/ Gitlab account.	2	NA
	PART-A		
1	Create a new Git repository for a project, add a source file, and commit it with an appropriate message. Configure Git to ignore temporary files and log files using a.gitignore file and verify that ignored files are not tracked by Git.	2	25CSE362.1
2	A new feature needs to be developed separately from the main codebase. Create a branch named feature-branch, make and commit changes in that branch, then merge the completed feature into the main branch and display the commit history.	2	25CSE362.2
3	Modify an existing tracked file in your repository and examine the changes before staging them. Temporarily save the modifications, switch to another branch, return to the original branch, and restore the saved changes.	2	25CSE362.2
4	A remote repository has been updated with new commits while development is ongoing in your local branch. Fetch the latest changes from the remote repository, rebase your local branch onto the updated remote branch, resolve any merge conflicts that arise during the rebase process, and verify the commit history to ensure that the rebase has been completed successfully.	2	25CSE362.4
5	Connect a local Git repository to a remote repository hosted on GitHub, push the local commits to the remote repository, create a feature branch, raise a Pull Request, review and merge the Pull Request, and synchronize the changes with the local repository.	2	25CSE362.3
6	Clone an existing GitHub repository, verify the remote configuration, modify a file and commit the changes locally, then update the cloned repository with the latest changes available on the remote repository.	2	25CSE362.3
	PART-B		
7	Create an annotated tag named v1.0 for a specific commit, display the tag details, and verify that the tag has been created successfully.	2	25CSE362.4
8	Inspect the commit history of a Git repository and display the five most recent commits to analyze the sequence of changes made to the codebase.	2	25CSE362.4
9	A feature developed in one branch needs to be incorporated into another branch without merging the entire branch. Transfer to a selected range of commits from a	2	25CSE362.2

	source branch to the current branch using an appropriate Git operation and verify the changes.		
10	Given the commit ID of a previously recorded change, inspect the commit and display its details, including the author's information, commit date, commit message, and the changes introduced by that commit.	2	25CSE362.4
11	Analyze the repository by identifying commits made by a specific author within a given date range, generate contributor statistics, perform Git blame analysis on a source file, and examine the associated commit messages.	2	25CSE362.4
12	A commit introduced an incorrect modification to the codebase. Revert the changes introduced by the specified commit while preserving the repository history and verify the resulting commit log.	2	25CSE362.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

- https://www.atlassian.com/git/tutorials/advanced-overview/
- https://www.atlassian.com/git/tutorials/git-hooks/
- https://www.youtube.com/watch?v=qsTthZi23VE
- https://www.frontendtechlead.com/learn-git-advanced/
- https://www.youtube.com/watch?v=fcy9refAhz0
- https://www.datacamp.com/tutorial/git-reflog
- Git GUI using GitGUI /GitKraken/ SourceTree
- https://www.techsystemlab.com/en/blog/git-advanced-commands-rebase-cherry-pick-bisect
- https://docs.github.com/en/actions/
- https://www.datacamp.com/tutorial/git-bisect

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:
Reference Books:

1) Mariot Tsitoara, Beginning Git and GitHub: Version Control, Project Management and Teamwork for the New Developer, 2nd Edition, Apress, 2024. ISBN:978-1484293811
2) Anna Skoulikari, Learning Git: A Hands-On and Visual Guide to the Basics of Git, O'Reilly Media, 2023. ISBN: 978-1098133917
3) Raju Gandhi and Brian Murray, Github Actions in Action, Manning Publications, 2024.ISBN:978-1633437326

WEB DESIGN TECHNOLOGIES			
Course Code	**25CSE363**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours / Sem	**30**	**Exam Hours**	**03**

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

25CSE363.1	Analyze web page using HTML tags to create the structure and hierarchy of web pages.
25CSE363.2	Design visually appealing websites using advanced CSS with industry trends.
25CSE363.3	Develop dynamic web page using HTML and Jscript.
25CSE363.4	Evaluate dynamic web applications using JSON and RESTAPI to retrieve, process and display data effectively.

No.	List of Programs	Hours	COs
	Prerequisite		
	Basic understanding of graphics design principles, including colour, layout and typography.	2	NA
	PART-A		
1	Design a static login page that involves creating a simple and effective webpage that allows users to enter their credentials to access a secure area.	2	25CSE363.1
2	Design a class timetable using the colspan and rowspan attributes in HTML, which can help to create an organized and visually appealing layout. Create a simple class timetable for a week (Monday to Friday) and number of class sessions per day.	2	25CSE363.1
3	Design a user form with a variety of controls as a fundamental task in web development. Create a user form that includes at least six different types of controls: lists (select menus), text boxes, radio buttons, checkboxes, a drop-down menu and submit/reset buttons.	2	25CSE363.1
4	Design a web page with CSS to style - lists and tables, which can significantly enhance the visual appeal and readability of your content.	2	25CSE363.2
5	Design a web page using CSS to set background images for the entire page and individual elements, while controlling the repetition of the image using the background-repeat property, which can create an engaging and visually appealing design.	2	25CSE363.2
6	Design a web page using various selector forms with the assistance of CSS, which allows you to precisely target and style different elements within the webpage.	2	25CSE363.2
	PART-B		
7	Create a HTML page with a dropdown menu featuring a list of five countries and dynamically displaying their corresponding capitals using CSS to customize the font properties as a common web development task.	2	25CSE363.3
8	Create a HTML document enhanced with JavaScript to manage three short text paragraphs that gracefully return to their original location when moved, rather than being sent to the bottom using the z-index property.	2	25CSE363.3
9	Create a JavaScript code that generates an HTML page capable of taking a set of integer numbers and arranging them in descending order involves building both the HTML structure and the JavaScript functionality.	2	25CSE363.3

10	Design an HTML5 webpage for an e-learning platform that includes a course introduction video, an audio explanation for key concepts, and downloadable study materials.	2	25CSE363.3
11	Create a JSON document to store information about a Product Catalog. The JSON structure should include Product ID, Product Name, Category, Price, Quantity, and Manufacturer. Use JavaScript to parse the JSON data and display the product information in a well-formatted HTML table.	2	25CSE363.4
12	Develop a web application that fetches airline information from a REST API using JavaScript (fetch() method) and displays the airline number, airline name, destination, ticket price, date of journey and time of journey in a formatted HTML table.	2	25CSE363.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

- https://alison.com/topic/learn/133924/learning-outcomes
- https://html-iitd.vlabs.ac.in/exp/introduction-to-html/references.html
- https://html-iitd.vlabs.ac.in/
- https://www.w3schools.com/xml/
- https://www.w3schools.com/js/js_validation.asp
- https://www.w3schools.com/js/js_htmldom.asp

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:
Reference Books:

1) Robert W. Sebesta: Programming the World Wide Web, 8th Edition, 2020, Pearson Education, ISBN-13:978-9353946142, ISBN-10: 935394614X
2) M. Deitel, P.J. Deitel, A. B. Goldberg: Internet & World Wide Web How to Program, 5th Edition, Pearson education, 2021. ISBN-13: 9780137618279

MICROSOFT VISIO			
Course Code	**25CSE364**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

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

25CSE364.1	Apply Microsoft Visio tools, templates, and stencils to develop professional diagrams such as flowcharts, organizational charts, and network diagrams.
25CSE364.2	Analyze shapes, connectors, layouts, and formatting features to develop visually structured and technically accurate diagrams.
25CSE364.3	Evaluate business process and organizational diagrams by applying diagramming standards, themes, annotations, and layout techniques to improve clarity and visual communication.
25CSE364.4	Interpret Microsoft Visio export, collaboration, and data integration features for effective sharing and presentation of professional diagrams using external applications.

No.	List of Programs	Hours	COs
	Prerequisite		
	• Basic Soft Engineering Diagramming Concepts. • Familiarity with Microsoft Office.	2	NA
	PART-A		
1	Draw a new Visio diagram using a Basic Flowchart template and explore different stencils.	2	25CSE364.1
2	Compute the Visio workspace by enabling rulers, gridlines, guides, and Shape Search.	2	25CSE364.1
3	Analyze the use of standard shapes, dynamic connectors, and alignment tools to organize a process diagram in Microsoft Visio.	2	25CSE364.2
4	Examine grouping, object arrangement, formatting styles, and themes to organize and enhance the visual structure of a Visio diagram.	2	25CSE364.2
5	Organize a workflow diagram for a University Admission Process by categorizing activities and applying appropriate Visio diagramming features.	2	25CSE364.2
6	Inspect the use of text, callouts, annotations, and formatting techniques to improve the readability and organization of a Visio diagram.	2	25CSE364.2
	PART-B		
7	Evaluate and develop a Cross-Functional Business Process Diagram.	2	25CSE364.3
8	Assess an organizational chart by applying appropriate employee information, layout options, and formatting features in Microsoft Visio.	2	25CSE364.3
9	Validate a network diagram representing computers, routers, and switches by applying suitable Visio templates and diagramming standards.	2	25CSE364.3
10	Assess the export features of Microsoft Visio by publishing a completed diagram in PDF and image formats for effective distribution and presentation.	2	25CSE364.4
11	Validate collaboration methods by sharing and managing a Microsoft Visio diagram using OneDrive or SharePoint.	2	25CSE364.4
12	Justify the use of the Data Visualizer feature to integrate Excel data with Microsoft Visio for developing data-driven diagrams.	2	25CSE364.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

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

- https://se-iitkgp.vlabs.ac.in/exp/modeling-data-flow/simulation.html
- https://se-iitkgp.vlabs.ac.in/exp/uml-class-sequence/simulation.html
- https://drawio-app.com/sequence-diagrams
- https://drawio-app.com/blog/use-draw-io-for-your-electrical-diagrams

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1) David Parker and David J. Parker, Visualize Complex Processes with Microsoft Visio, Packt Publishing, First Edition, 2023, ISBN: 9781837631926.
2) George M. Taranto, Microsoft Visio User Guide 2025: A Practical Manual for Network Mapping, Process Flow Optimization, and Database Visualization, Independently Published, 2025, ISBN: **979-**8283546209.

BIO INSPIRED DESIGN AND INNOVATION			
Course Code	**25CSE365**	**Credits**	**03**
L:T:P:S	**1:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**50**
TW & SL / Sem	**15**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

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

25CSE365.1	Understand the fundamentals and significance of bio-inspired design and engineering.
25CSE365.2	Apply biomaterials and bio-inspired healthcare systems for engineering applications.
25CSE365.3	Analyze bio-inspired optimization techniques to solve sustainable engineering and environmental management problems.
25CSE365.4	Apply bio-inspired AI innovations in manufacturing, automation, materials, and sustainable product development.

MODULE-1	**BIO-INSPIRED DESIGN AND ENGINEERING**	**25XYZ365.1**	**3 Hours**
Bio-Inspired Engineering and design, History, Need for Bio-Inspired Designs. Bio inspired Additive manufacturing techniques, (self-healing, self-assembly).			
Self-study	Investigate the Challenges of Bio inspired design, Compare with traditional areas of science and engineering		
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16		
MODULE-2	**BIO MATERIALS AND BIO HEALTHCARE DESIGN**	**25XYZ365.2**	**3 Hours**
Biomaterials, Design of Forms- (Hexagonal unit cells, Intrinsic disorder, anisotropy), Bio- Mechanics, Applications of Biomaterials and Bio systems in Health care design (Human Prosthetics, Parasitic, Wasp Inspired Needle)			
Case Study	Investigate Bio-Compatible and health care applications.		
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15		
MODULE-3	**BIO SUSTAINABLE DEVELOPMENT**	**25XYZ365.3**	**3Hours**
Innovations in Energy (Termite mound inspired shopping malls), Innovations in Resource-Air purification, filtration), Dew water collection systems, water purification, desalination.			
Case Study	Explore the Bio inspired environmental constructions and development.		
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10		
MODULE-4	**BIO-OPTIMISATION TECHNIQUES**	**25XYZ365.3**	**3 Hours**
No Free Lunch Theorem, Bat Algorithm, Flower Pollination Algorithm, Genetic Algorithm, Ant Colony Optimisation (ACO), Swam Intelligence- Particle Swam Optimisation (PSO).			
Self-study	Scrutinize the Different types of Optimization techniques, genetic research.		
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7		
MODULE-5	**Applications of Bio-Inspired AI Innovations**	**25XYZ365.4**	**3 Hours**
Bio-inspired innovations in AI Integrated automotive systems, automation and robotics, AI-driven Bio materials discovery and manufacturing, AI Driven predictive modeling, digital twins, and sustainable product design for addressing environmental and industrial challenges.			
Case Study	Survey on Bio inspired Innovations, design, applications and case studies of the same.		
Text Book	Text Book 2: 12.1 to 12.10		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		**Marks Distribution**		
		Test (s)	**AAT1**	**AAT2**
		25	**15**	**10**
L1	**Remember**	5	-	-
L2	**Understand**	5	5	-
L3	**Apply**	10	5	5
L4	**Analyze**	5	5	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 Learning Resources:

Text Books:

1) Helena Hashemi Farzaneh, Udo Lindemann, "A Practical Guide to Bio-inspired Design", Springer Vieweg, 1st edition 2019, ISBN-10: 366257683X, ISBN-13: 978-3662576830.
2) Torben A. Lenau, Akhlesh Lakhtakia," Biologically Inspired Design: A Primer (Synthesis Lectures on Engineering, Science, and Technology)", Publisher: Morgan & Claypool Publishers, 2021, ISBN-10:1636390471, ISBN-13: 978-1636390475

Reference Books:

1) French M, "Invention and evolution: Design in nature and engineering", Publisher: Cambridge University Press, 2020, ISBN-13: 978-1108492263.
2) Pan L., Pang S., Song T. and Gong F. eds, "Bio-Inspired Computing: Theories and Applications", 15th International Conference, BIC-TA 2020, Qingdao, China, October 23-25, 2021, Revised Selected Papers (Vol. 1363). Springer Nature, 2021, ISBN: 978-981-16-1820-1.

Web links and Video Lectures (e-Resources)

- https://onlinecourses.nptel.ac.in/noc22_ge24/preview
- https://biodesign.berkeley.edu/bioinspired-design-course/
- https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design20Workshop%20Report_2232327_October%202022_Final.508.pdf

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

- Bio Materials printing using 3D Printing
- Flipped class room
- Organizing Group wise discussions on sub topics
- Student presentations

COMMUNITY PROJECT USING INNOVATION AND DESIGN THINKING			
Course Code	**25CPD37**	**Credits**	**02**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**--**	**SEE Marks**	**50**
TW & SL / Sem	**30**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

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

25CPD37.1	Identify environmental issues and their impact on ecosystems, natural resources, and sustainable development.
25CPD37.2	Evaluate environmental conditions using data obtained through field surveys, case studies, environmental audits, and related investigations
25CPD37.3	Develop skills in project planning, field survey, data collection, implementation, documentation and reporting
25CPD37.4	Formulate feasible environmental problem statements and solutions considering practical constraints and sustainability aspects

Community Project using Innovation and Design Thinking helps students to understand community problems, develop innovative solutions, and create sustainable positive impact through a structured problem-solving approach. Rapid urbanization, population growth, environmental concerns, energy demand, water scarcity, waste management, transportation issues and rural development challenges have created practical problems affecting communities and public welfare. This course aims to integrate technical knowledge, field exposure and societal engagement so that students identify real community issues, frame problem statements and attempt appropriate, feasible and sustainable engineering responses.

Methods for project identification: Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

Restrictions and professional conduct:

Community / Societal Projects shall remain academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation.

CIE Assessment Pattern (50 Marks)

RBT Levels		Periodical Reviews and Evaluation
		50
L1	Remember	-
L2	Understand	05
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

SEE Assessment Pattern (50 Marks)

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

Suggested Learning Resources:

Textbooks:

1. Phadke, N. D. Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2. Garg, N. R. Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.
3. Gupta, A. and P. Singh. Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4. Wilson, G. Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books:

1. NPTEL courses on Project-Based Learning and Social Innovation.
2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: https://sdgs.un.org
4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):

1. NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
2. NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
3. Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): https://vlab.co.in
4. Geological Survey of India (GSI) – Maps, reports, and publications: https://www.gsi.gov.in
5. YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments).
6. American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

NATIONAL SERVICE SCHEME			
Course Code	**25NSS30, 24NSS40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:

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

25NSSX0.1	Understand the importance of his / her responsibilities towards society.
25NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
25NSSX0.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.
25NSSX0.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Semester/ Course Code	CONTENT	COs	HOURS
3RD 25NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Developing Sustainable Water management system for rural areas and implementationapproaches. 4. Setting of the information imparting club for women leading to contribution in social and economic issues. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.	25NSS30.1, 25NSS30.2, 25NSS30.3, 25NSS30.4	30
4TH 25NSS40	1. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 2. Contribution to any national level initiative of Government of India. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 3. Spreading public awareness under rural outreach programs. (minimum 5 programs). 4. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 5. Govt. school Rejuvenation and helping them to achieve good infrastructure.	25NSS40.1, 25NSS40.2, 25NSS40.3, 25NSS40.4	30

CIE Assessment Pattern (50 Marks – Activity based)

CIE component for every semester	Marks
Presentation – 1 : Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and Principal.
- At last report should be evaluated by the NSS officer of the Institute.
- Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
  - Lecture session by NSS Officer
  - Students Presentation on Topics
  - Presentation - 1, Selection of topic, PHASE – 1
  - Commencement of activity and its progress - PHASE – 2
  - Execution of Activity
  - Case study-based Assessment, Individual performance
  - Sector/ Team wise study and its consolidation
  - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, IndianAgriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

3.	Developing SustainableWater management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams /College campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
1.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

3.	Spreading public awareness under ruraloutreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Organize National integration and socialharmony events / Workshops / Seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Govt. school Rejuvenation andhelping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION AND SPORTS			
Course Code	**25PED30, 25PED40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:

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

25PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
25PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
25PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
25PEDX0.4	Understand the roles and responsibilities of organization and administration of sports and games

Semester	CONTENT	COs	HOURS
3RD 25PED30	**Module 1: Orientation** A. Lifestyle B. Food & Nutrition C. Health & Wellness D. Pre-Fitness test.	25PED30.1 25PED30.2 25PED30.3 25PED30.4	30
	Module 2: General Fitness & Components of Fitness A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash		
	Module 3: **Specific games (Any one to be selected by the student)** 1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.		
4TH 25PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games	25PED40.1 25PED40.2 25PED40.3 25PED40.4	30
	Module 2: Specific Games (Anyone to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground.		
	Module 3: Role of Organization and administration		

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

YOGA			
Course Code	**25YOG30, 25YOG40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

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

25YOGX0.1	Understanding the origin, history, aim and objectives of Yoga
25YOGX0.2	Become familiar with an authentic foundation of Yogic practices
25YOGX0.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
25YOGX0.4	Use the teachings of Patanjali in daily life.

Semester / Course Code	CONTENT	COs	HOURS
3rd 25YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 1. Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Kapalabhati:** Revision of Kapalabhati -40strokes/min 3rounds **Different types of Asanas with Brief introduction and importance:** 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	25YOG30.1, 25YOG30.2, 25YOG30.3, 25YOG30.4	30
4TH 25YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Different types of Asanas with Brief introduction and importance:** 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana 5. Balancing: Sheershasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	25YOG40.1, 25YOG40.2, 25YOG40.3, 25YOG40.4	30

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
2. Tiwari, O P: Asana Why and How
3. Ajitkumar: Yoga Pravesha (Kannada)
4. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
5. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
6. Nagendra H R: The art and science of Pranayama
7. Tiruka: Shatkriyegalu (Kannada)
8. Iyengar B K S: Yoga Pradipika (Kannada)
9. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- https://youtu.be/KB-TYlgd1wE
- https://youtu.be/aa-TG0Wg1Ls

MUSIC			
Course Code	**25MUS30, 25MUS40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

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

25MUSX0.1	Identify and understand the origins and evolution of the Indian music system and its fundamental concepts
25MUSX0.2	Analyse and practice various types of compositions in Carnatic music and relate to different musical traditions
25MUSX0.3	Demonstrate knowledge of major composers and their contributions to Indian classical music
25MUSX0.4	Classify and understand various musical instruments and their construction

Mapping of Course Outcomes to Program Outcomes:

Semester / Course Code	CONTENT	COs	HOURS
3rd 25MUS30	**Origin of Indian Music** - Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Taya, Raga, Tala, and Mla. Study of the fundamental concepts that form the foundation of Carnatic music. **Compositions in Carnatic Music** - Introduction to types of compositions including Geethe, Jathi, Swara, Swarajathi, Varna, Krithi, and Thillana. Understanding of notation systems and their application in musical compositions. **Composers and Their Contributions** - Biography and musical contributions of Purandaradasa (founder of Carnatic music pedagogy), Thyagaraja (prolific composer and saint), and Mysoro Vasudevacharya. Study of their impact on Indian classical music traditions. **Abhyasa Gana - Practical Training**- Singing of Sarale Varase exercises and notation writing. Introduction to Suladi Sapthatala. Singing of 2 Geethe in Malahiri. Foundation for practical music experience.	25MUS30.1, 25MUS30.2, 25MUS30.3, 25MUS30.4	30 Hrs
4TH 25MUS40	**Classification of Musical Instruments** - Classification and construction of string instruments (Veena, Sitar), wind instruments (Flute, Shehnai), percussion instruments (Mridangam, Tabla), and Idiophones (Ghana Vaadya - Gongs, Cymbals). Examples and characteristics of each class of instruments. **Abhyasa Gana - Practical Training**- Continuation of singing exercises including Sarale Varase at varying speeds. Complete notation writing for Sarale Varase and Suladi Sapthatala in Mayamalavagowla Raga. Singing of 2 additional Geethe in Malahiri, one Jathi Swara, and one Krithi in a Mela raga. Advanced practical music training.	25MUS40.1, 25MUS40.2, 25MUS40.3, 25MUS40.4	30 Hrs

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Singing/Playing learnt in the semester and internal tests (MCQ type)

CIE	Marks
Avg of Test 1 and Test 2	20
Practical test on: a. Recite one Sarale Varase mentioned by the examiner in three speeds. b. Sing/Play the Geethe in Malahari. c. Singing/Playing Jathi Swara/Krithi.	30
Total	**50**

Textbooks:

1. Vidushi Vasantha Madhavi, "Theory of Music", Prism Publication, 2007.
2. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana - Vol.1 (English), Shreenivaas Prakaashana, 2018.

References:

1. Lakshminarayana Subramiam, Viji Subramaniam, "Classical Music of India: A Practical Guide", Tranqueber 2018.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=ihFDT8ZBPxE
- https://www.youtube.com/watch?v=4XXl5tTXa0I
- https://www.youtube.com/watch?v=n-60gfzGa1E
- https://www.youtube.com/watch?v=Vv_K7J7gx6M
- https://www.youtube.com/watch?v=BovAAPumYUo
- https://www.youtube.com/watch?v=F_aWPATb8V4
- https://www.youtube.com/watch?v=DPPCRWA3hXo
- https://www.youtube.com/watch?v=TuP00NK9eTM
- https://www.youtube.com/watch?v=LlolyBzZtdg

BASIC APPLIED MATHEMATICS - I
(Common for All Branches)

Course Code	**25DMAT31**	**Credits**	**0**
L:T:P:S	**0:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50**
Total Hours /Sem	**30**	**Exam Hours**	**--**

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

25DMAT31.1	Understand the concepts of elementary transformations to the rank of a matrix, and apply the consistency and solutions of systems of linear equations
25DMAT31.2	Apply eigenvalues and eigenvectors of square matrices for matrix diagonalization, and compute the powers of matrices for engineering and computational applications
25DMAT31.3	Analyze curves represented in Cartesian, polar coordinate systems, determine tangents, angles between polar curves, and derive pedal equations for scientific modeling.
25DMAT31.4	Apply techniques of partial differentiation, chain rule, Euler's theorem for homogeneous functions, Jacobians of functions to solve multivariable engineering problems
25DMAT31.5	Analyze the motion of particles using velocity and acceleration vectors, and evaluate gradient and directional derivatives to interpret rates of change in scalar fields.
25DMAT31.6	Apply vector differential operators—gradient, divergence, and curl—to investigate scalar and vector fields

MODULE-1	**LINEAR ALGEBRA - 1**	**25DMAT31.1**	**3 Hours**
Elementary transformations, Reduction of the given matrix to echelon form, Rank of a Matrix, Consistency of a system of linear equations, Solution of a system of non-homogeneous linear equations.			
Self-study	Rank of a matrix by normal form, Solution of a system of homogeneous linear equations		
Text Book	Text Book 1: 2.7, 28.6, Text Book 2: 7.3, 7.4		
MODULE-2	**LINEAR ALGEBRA - 2**	**25DMAT31.2**	**3 Hours**
Linear transform, Eigen values and Eigen vectors of a square matrix, Diagonalization of a square matrix and Power of matrices using Diagonalization.			
Self-study	Reduction of quadratic expression to canonical form.		
Text Book	Text Book 1: 2.11, 2.13, Text Book 2: 7.9, 8.1.		
MODULE-3	**DIFFERENTIAL CALCULUS**	**25DMAT31.3**	**3 Hours**
Importance of cartesian and polar coordinate systems, Angle between the radius vector and tangent to a polar curve, angle between two polar curves, Pedal equation of a polar curve.			
Self-study	Radius of curvature in cartesian, parametric, polar forms		
Text Book	Text Book 1: 4.4, 4.7, 4.8		
MODULE-4	**MULTIVARIABLE CALCULUS**	**25DMAT31.4**	**3 Hours**
Introduction to partial differentiation, total differentiation, chain rule, Euler's theorem for Homogeneous functions, Jacobians, Extreme values of the functions with two variables.			
Self-study	Basic problems on partial differentiation		
Text Book	Text Book 1: 5.4, 5.7		
MODULE-5	**VECTOR CALCULUS**	**25DMAT31.5** **25DMAT31.6**	**3 Hours**
Velocity and Acceleration of a particle, Gradient of scalar function, directional derivative, Divergence and Curl of vector functions, Solenoidal and Irrotational vector fields.			
Self-study	Vector identities		
Text Book	Text Book 1: 8.3, 8.5, 8.7, 8.18 Text Book 2: 9.7, 9.8, 9.9		

CIE Assessment Pattern (50 Marks – Theory) –

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

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://youtu.be/IUV0_Nj4d1s?si=eO3s7keCbCO1_jcz
- https://youtu.be/VzUcs7aiqgg?si=YLtTUGr4Xp88KGY3
- https://youtu.be/LDBnS4c7YbA?si=udUOdJ-u0ZxFmBAW
- https://youtu.be/palSdK9P-ns?si=7A8_VSxEI4lGvksB
- https://youtu.be/Bw5yEqwMjQU?si=jzbklZmVev1w8K2S
- https://youtu.be/LBqdGn1r_fQ?si=DWcAIiFnosT7zikY
- https://youtu.be/N5YCGOyTSuU?si=Wsf75V5fkUpfVVxr
- https://youtu.be/gd1FYn86P0c?si=7drzBEqVFSv6sQeZ
- https://youtu.be/cSj82GG6MX4?si=4QN1DFXEqaJoUBn7
- https://youtu.be/0c3yq9btr3A?si=jIoz8eu5TgV7mh8G
- https://youtu.be/PhfbEr2btGQ?si=HVK1uk65oHph0t8G

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

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

Fourth Semester Syllabus

DISCRETE MATHEMATICS AND GRAPH THEORY (Common for AIML & CSE)			
Course Code	**25MAC41**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

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

25MAC41.1	Apply propositional logic to construct truth tables and analyze the validity of logical statements using logical connectives.
25MAC41.2	Analyze function composition, inverse functions, and apply the Pigeonhole Principle to solve counting and existence problems in engineering.
25MAC41.3	Apply the Principle of Inclusion and Exclusion and its generalizations to solve counting and combinatorial problems encountered in engineering.
25MAC41.4	Analyze graph structures by determining graph isomorphism, identifying subgraphs, and interpreting the structural properties of graphs.
25MAC41.5	Apply the concepts of rooted trees, binary trees, spanning trees, network flows, and Kruskal's algorithm to solve optimization and network design problems.
25MAC41.6	Analyze planar graphs and their different representations to solve graph-theoretic problems in engineering, computer science, communication networks, and circuit design.

MODULE-1	**MATHEMATICAL LOGIC**	**25MAC41.1**	**9 Hours**
Basic Connectives and Truth Tables, Tautology and Contradiction, Logic Equivalence, The Laws of Logic, Converse, Inverse and Contra positive, Logical Implication, Rules of Inference. Introduction to quantifiers.			
Self-study	NAND, NOR connectives problems		
Text Book	Text Book 1: 2.1, 2.2, 2.3. 2.4, 2.5.		
MODULE-2	**RELATIONS AND FUNCTIONS**	**25MAC41.2**	**9 Hours**
Cartesian Products and Relations, One-to-One and onto functions. The Pigeon hole principle, Function Composition and Inverse Functions. Properties of Relations, Equivalence Relations and Partitions. Partial orders, Hasse diagram.			
Self-study	Introduction and operations on set theory.		
Text Book	Text Book 1: 5.1, 5.2, 5.3, 5.5, 5.6, 7.1, 7.3, 7.4.		
MODULE-3	**THE PRINCIPLE OF INCLUSION AND EXCLUSION**	**25MAC41.3**	**9 Hours**
The principle of Inclusion and Exclusion, Generalizations of the principle, Derangements, nothing is in its right place, Rook Polynomials. Recurrence relations: First order linear recurrence relation, the second order linear homogeneous recurrence relation with constant coefficients.			
Self-study	Permutations and combinations		
Text Book	Text Book 1: 8.1, 8.2, 8.3, 8.4, 10.1, 10.2.		
MODULE-4	**GRAPH THEORY**	**25MAC41.4**	**9 Hours**
Introduction, Basic definition, Application of graphs, finite, infinite and bipartite graphs, incidence and degree, isolated vertex, pendant vertex and null graph. Isomorphism of graphs. Introduction to sub-graphs, walks, paths, circuits and cycles.			
Self-study	Graph coloring, chromatic polynomials.		
Text Book	Text Book 1: 11.1, 11.2, 11.3, 11.4, Text Book 2: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9.		
MODULE-5	**CONNECTIVITY AND PLANARITY**	**25MAC41.5 25MAC41.6**	**9 Hours**
Eulers graphs, Hamiltonian paths, circuits and cycles, Rooted and Binary trees, spanning trees, Network flows, Kruskal algorithm, Vertex connectivity, edge connectivity, cut set and cut vertices, fundamental circuits. Planar graphs, Different representation of a planar graph			
Self-study	Directed graphs, Huffman code		
Text Book	Text Book 1: 11.5, 12.1, 12.2, 12.3, Text Book 2: 3.1, 3.5, 4.1, 4.2, 4.3, 4.4, 5.2, 5.4, 5.6		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	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	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1) Ralph P. Grimaldi, Discrete and Combinatorial Mathematics-an applied introduction, Pearson Education, Fifth Edition, 2019, ISBN: 9789353433055.
2) Narsingh Deo, Graph Theory with Application to Engineering and Computer Science, Dover Publications Inc., First Edition, 2016, ISBN: 978-0486807935.

Reference Books:

1) Basavaraj S. Anami and Venkanna S. Madalli, Discrete Mathematics – A Concept based approach, Universities Press, 2016, ISBN: 9788173719998
2) Kenneth H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, McGraw Hill Education, Seventh Edition, 2017, ISBN: 9780070681880
3) D.S. Malik and M.K. Sen, Discrete Mathematical Structures: Theory and Applications, Thomson, 2004. ISBN: 9780619212858
4) Thomas Koshy, Discrete Mathematics with Applications, Elsevier, First Edition 2005, ISBN: 9788181478870.

Web links and Video Lectures (e-Resources):

- https://youtu.be/O4Qf0SQKkZw?si=1r9joVe2-rP04fCH
- https://youtu.be/Hbyj6vEi7fY?si=_GaCjUHBNdV2MArP
- https://youtu.be/7hLvm_4DNqs?si=viYHH_fZDZQ9Fmdw
- https://youtu.be/7hLvm_4DNqs?si=viYHH_fZDZQ9Fmdw
- https://youtu.be/6Z_eengdMVE?si=-ZlPy2xl18oMUwfR
- https://youtu.be/fwSiTaCs8KM?si=wpZcCEG-pNDuIPkS
- https://youtu.be/iHC1ZdLdKjw?si=tuN-6pLqhMWPN4Mb
- https://youtu.be/auvGQCoYdu4?si=3ELSyG5g-475AN1_
- https://youtu.be/GLHWih_RB38?si=FuoNQAzNR2IlYpU0

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

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

OBJECT ORIENTED PROGRAMMING USING JAVA			
Course Code	**25CSK42**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

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

25CSK42.1	Model the real-world entities using Object Oriented Programming concepts.
25CSK42.2	Identify the importance of inheritance and interface concepts and apply to model relationships
25CSK42.3	Analyze the importance of file handling and string handling operations
25CSK42.4	Apply the concept of Exception handling and Multithreading in concurrent programming
25CSK42.5	Develop applications using collections framework for managing user defined types
25CSK42.6	Solve the real-world problems using Object Oriented concepts and collection Framework in Java

MODULE-1	**INTRODUCTION TO JAVA**	**25CSK42.1**	**9 Hours**
The Java Language, Java Development Kit (JDK); Java Buzzwords, Byte Code, JVM, JRE and Java environment, Data types, variables and Arrays, Operators, Control statement, command line Arguments, Object Oriented concepts, Classes, Objects and Methods, Access specifiers, Method Overloading, Constructor, Implicit this.			
Case Study	JavaDoc report generation		
Text Book	Text Book 1: Part 1 Chapter 1 to 7		
MODULE-2	**INHERITANCE AND INTERFACING**	**25CSK42.2**	**9 Hours**
Inheritance, Method Overriding, Annotations, Static members, Inner Classes, Abstract Classes, Final members and classes, The Object Class, Interfaces, Package Fundamentals, Reflections			
Case Study	Real world scenario and application of interface and abstract classes		
Text Book	Text Book 1: Part 1 Chapter 8 ,9,12		
MODULE-3	**STRING MANIPULATION AND FILE HANDLING**	**25CSK42.3**	**9 Hours**
String Constructors, Length Operations, Character Extraction, Comparison, Searching, Modifying, String Buffer, StringBuilder, Basic file I/O: File Input Stream, File Output Stream, File Reader, File Writer			
Case Study	Serialization of java objects		
Text Book	Text Book 1: Part 2 Chapter 16, Part 1 Chapter 13		
MODULE-4	**EXCEPTION HANDLING AND MULTI-THREADING**	**25CSK42.4**	**9 Hours**
Exception handling: Fundamentals, Types, Using try, catch, throw, throws, finally, multiple catch, User Defined Exceptions, Thread Concept, Java Thread Model, The main method, Creating Threads, Daemon Threads, Thread Pool, Thread Priorities, Synchronization, join.			
Case Study	Solving Java based UI hanging due to deadlock issues		
Text Book	Text Book 1: Part 1 Chapter 10, 11		
MODULE-5	**COLLECTION FRAMEWORK**	**25CSK42.5&25CSK42.6**	**9 Hours**
Collections Overview, Collection Interfaces, Set, List, Map, Queue, Collection Classes, Generics, Type Wrappers, accessing a collection using an Iterator, Sorting collections, equals ().			
Case Study	Lambda expressions in Java		
Text Book	Text Book 1: Part 1 Chapter 14		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Test (s)	AAT1	AAT2
		25	10	15
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	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 Book:

1. Herbert Schildt, "Java: The Complete Reference", 13th Edition, McGraw-Hill, 2025. ISBN: 978-9355326478

Reference Books:

1. Kathy Sierra, Bert Bates & Trisha Gee, Head First Java, 3rd Edition, O'Reilly Media, 2022. ISBN-13: 9781491910771, ISBN-10: 1491910771.
2. Y. Daniel Liang, Introduction to Java Programming and Data Structures, Comprehensive Version, 13th Edition, Pearson, 2023. ISBN-13: 9780138092832.
3. Herbert Schildt & Danny Coward, Java: The Complete Reference, 13th Edition, McGraw-Hill Education, 2024. ISBN-13: 9781265058432.
4. Cay S. Horstmann, Core Java, Volume I: Fundamentals, 13th Edition, Pearson, 2025. ISBN-13: 9789367130735.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=bm0OyhwFDuY&list=PLsyeobzWxl7pe_IiTfNyr55kwJPWbgxB5
- https://www.youtube.com/watch?v=CFD9EFcNZTQ
- https://www.youtube.com/watch?v=r59xYe3Vyks&list=PLS1QulWo1RIbfTjQvTdj8Y6yyq4R7g-Al

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

- Hands-on with coding platforms like Codetantra.

OBJECT ORIENTED PROGRAMMING USING JAVA LAB			
Course Code	**25CSLK42**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

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

25CSLK42.1	Understand the real world applications using Object Oriented Programming concepts.
25CSLK42.2	Develop applications using String concept in Java.
25CSLK42.3	Apply the concept of Multithreading and exception handling in java programming
25CSLK42.4	Solve the real world problems using Object Oriented concepts and collection framework in Java.

No.	List of Programs	Hours	COs
	Prerequisite Programs / Demo		
	Expected Prior Knowledge and Skills: Proficiency in C programming language, basic program design concepts (e.g, pseudo code)..	2	NA
	PART-A		
1	Create a Java program for the following task: 1. Define a class named Book with four attributes: • title (String) • author (String) • isbn (int) • price (double) 2. Provide a constructor that initializes all four attributes when a Book object is created. 3. In the main method, create two Book objects using the constructor. Print the details of each Book object in a clear, well formatted manner.	2	25CSLK42.1
2	A courier company must calculate the volume of shipping cartons that come in different shapes and require optional padding. Create a Java class Box and a driver program that meet the following requirements: **Constructor Overloading** • Box () → creates a default carton of 1 cm × 1 cm × 1 cm. • Box (double side) → creates a cube-shaped carton whose three edges are all side cm. • Box (double length, double breadth, double height) → creates a rectangular carton with the given dimensions in centimetres. **Method Overloading (all named** volume**)** • double volume () → returns the carton's raw volume in cm^3. • double volume (double scaleFactor) → returns the volume after being multiplied by scaleFactor (e.g., 1.05 for 5 % padding). • static double volume (double l, double b, double h) → static helper that calculates the volume of any block without creating a Box object. **In a driver class (BoxDemo):** • Construct one object with each constructor. • Display the dimensions of every box. • Demonstrate each overloaded volume method, clearly labelling the output.	2	25CSLK42.1
3	Design and implement a Java program to demonstrate both **multilevel inheritance** and **hierarchical inheritance**. 1. Create a base class Person with attributes name and age.	2	25CSLK42.1

	2. Derive a class Employee from Person with an additional field empId 3. From Employee, derive two separate classes: o Manager with an additional field department o Clerk with an additional field typingSpeed		
4	Write a Java program that models different kinds of musical instruments and shows runtime (dynamic) polymorphism through method overriding. 1. **Base class** • Create an abstract class Instrument containing a method void playNote(). 2. **Subclasses (hierarchical inheritance)** • Piano overrides playNote() to print "Piano: C-E-G chord". • Guitar overrides playNote() to print "Guitar: Strum on E minor". • Flute overrides playNote() to print "Flute: Sustained A note". 3. **Driver code** (OrchestraDemo) • Declare an Instrument [] array that holds one object of each subclass. • Iterate through the array and invoke playNote() on every element. • Show that the correct subclass version executes at runtime, proving dynamic dispatch.	2	25CSLK42.1
5	Design and develop Java program to compute area and perimeter for different shapes using abstract classes and interfaces.	2	25CSLK42.1
6	Create a class in Java called "Calculator" which contains the following: 1. A static method called powerInt(int num1, int num2) that accepts two integers and returns num1 to the power of num2 (num1 power num2). 2. A static method called powerDouble(double num1,int num2) that accepts one double and one integer and returns num1 to the power of num2 (num1 power num2). 3. Call your method from another class without instantiating the class (i.e. call it like Calculator.powerInt(12,10) since your methods are defined to be static). Hint: Use Math.pow(double,double) to calculate the power.	2	25CSLK42.1
PART-B			
7	Develop a simple Java program to find the longest substring without repeating characters in a given string. Accept the input string through command-line arguments. If no command-line argument is provided, accept the input interactively using the Scanner class. Display the longest substring and its length.	2	25CSLK42.2
8	Design and Develop a simple Java program to • Instantiate a StringBuffer with the text "Hello". • Append " World", insert "Java " after the first space, and then delete the word "World". • After each operation, print the buffer content and its current capacity.	2	25CSLK42.2
9	Develop a Program to take care of Number Format Exception if user enters values other than integer for calculating average marks of 2 students. The name of the students and marks in 3 subjects are taken from the user while executing the program. • In the same Program write your own Exception classes to take care of Negative values and values out of range (i.e. other than in the range of 0-100) • Include finally to output the statement "Program terminated".	2	25CSLK42.3
10	Design and implement a Java program to solve the classic Producer-Consumer problem with a fixed-size shared buffer. Program must include Producer threads that add items and Consumer threads that remove items. Crucially, producers should wait if the buffer is full, and consumers should wait if its empty, ensuring proper synchronization using **synchronized, wait (), and notifyAll()**.	2	25CSLK42.3
11	Create a Student Attendance Management System using a **HashMap**Collection type. Perform the following operations: Add the key-value pair.	2	25CSLK42.4

	Retrieve the value associated with a given key Check whether a particular key/value exist. replace a value associated with a given key in the HashMap		
12	Write a Java program that creates a new **ArrayList<Integer>**, adds several exam marks, and then performs the following operations: 1. **Add all elements** of another List<Integer> to the original ArrayList. 2. **Copy** the ArrayList to a plain int [] array. 3. **Reverse** the contents of the ArrayList. 4. **Extract** a **sub-list** (e.g., marks from index 2 to index 5). 5. **Sort** the ArrayList in ascending order. 6. **Clone** the ArrayList into another ArrayList<Integer>.	2	25CSLK42.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

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

- https://java-iitd.vlabs.ac.in/exp/method-overloading
- https://java-iitd.vlabs.ac.in/exp/inheritance
- https://java-iitd.vlabs.ac.in/exp/exceptions
- https://java-iitd.vlabs.ac.in/exp/threading
- https://java-iitd.vlabs.ac.in/exp/collections

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	**20**
L1	**Remember**	**-**	**-**
L2	**Understand**	10	5
L3	**Apply**	10	5
L4	**Analyze**	10	10
L5	**Evaluate**	**-**	-
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.Y. Daniel Liang, "Introduction to Java Programming and Data Structures", 13th Edition, Pearson Education, 2023, ISBN: 978-0138092832.

2. Herbert Schildt and Danny Coward, "Java: The Complete Reference", 13th Edition, McGraw-Hill Education, 2025, ISBN: 978-9355326478.

3. Kathy Sierra, Bert Bates, and Trisha Gee, "Head First Java", 3rd Edition, O'Reilly Media, 2022, ISBN: 978-1491910771.

OPERATING SYSTEMS			
Course Code	**25CSK43**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

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

25CSK43.1	Understand the concept of processes and services offered by an operating system.
25CSK43.2	Apply Inter-Process Communication mechanisms and delve into the intricacies of CPU scheduling algorithms.
25CSK43.3	Use hardware and software solutions to the critical-section problem and evaluate multiple mechanisms for managing deadlock situations.
25CSK43.4	Analyze various approaches to memory management.
25CSK43.5	Examine the organization of secondary storage management.
25CSK43.6	Conduct Linux Operating System case study.

MODULE-1	**OPERATING SYSTEM CONCEPTS**	**25CSK43.1**	**9 Hours**
Basic Operating Systems: Definition, Operating System Structure, Operating System Operations- Dual-Mode. System Structure –Operating System Services, System Calls - Types of Operating System Structure, Microkernel's, Hybrid Systems – Mac OS X, iOS, Android, Process - Process Concept, Process States, PCB, Scheduling Queues, Schedulers, Context Switch.			
Case Study	Investigate the Challenges in designing the Linux operating system from different viewpoints.		
Text Book	Text Book 1: Chapter 1-1.1,1.4, Chapter 2-2.1,2.3,2.8, Chapter 3-3.1 Text Book 2: Chapter 2 – 2.2, 2.3, 2.5, 2.6		
MODULE-2	**PROCESS MANAGEMENT**	**25CSK43.2**	**9 Hours**
Process Operations –Operation on Process; Inter-Process Communication – Shared Memory System, Message Passing System, Thread Overview. CPU Scheduling: Basic Concepts, CPU- I/O Burst Cycle; CPU Scheduler – Pre-emptive Scheduling, Dispatcher; Scheduling Criteria; Scheduling Algorithms – FCFS, SJF, Round-Robin, Priority.			
Case Study	Investigate the various scheduling algorithms used in Linux operating systems Various Thread library implementation.		
Text Book	Text Book 1: Chapter 3-3.2-3.6Chapter4- 4.1,4.2,4.3,4.4,4.6, Chapter5-5.1-5.3 Text Book 2: Chapter3: 3.1- 3.3		
MODULE-3	**PROCESS SYNCHRONIZATION AND CONCURRENCY**	**25CSK43.3**	**9 Hours**
Process Synchronization: Background; The Critical Section Problem; Peterson's Solution; Mutex Locks; Semaphores, Classical Problems of Synchronization – The Reader-Writer Problem, Dining-Philosopher Problem, Starvation. Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock Detection and Recovery.			
Self-study	Explore the need for synchronization in various Linux kernel data structures.		
Text Book	Text Book 1: Chapter 6-561-6.6, Chapter 7-7.1, Chapter 8-8.1-8.8		
MODULE-4	**MEMORY MANAGEMENT**	**25CSK43.4**	**9 Hours**
Memory Management – Swapping, Logical versus Physical Address Space, Contiguous Allocation, Paging - Basic Method, Hardware Support, Protection; Structure of Page Table-Hierarchical, Segmentation – Basic Method, Segmentation Hardware. Virtual Memory: Demand Paging; Page Replacement – Basics, Algorithms - FIFO, Optimal, LRU, Thrashing – Causes of Thrashing.			
Self-study	Scrutinize the Different types of Optimization techniques in managing virtual memory.		
Text Book	Text Book 1: Chapter 9: 9.1 – 9.5 Chapter 10: 10.1, 10.2, 10.4, 10.6		
MODULE-5	**FILE SYSTEM MANAGEMENT**	**25CSK43.5, 25CSK43.6**	**9 Hours**
File-System Interface: File Structure, Access methods – Sequential Access, Direct Access, Other Access Methods Implementation: Directory Implementation – Linear List, Hash Table, Allocation Methods – Contiguous Allocation, Linked Allocation, Indexed Allocation.			

Mass Storage Structures: Overview, Disk Structure, Disk Scheduling –FCFS, SSTF, SCAN, CSCAN, LOOK.	
Self-study	For developing two programs that need to share data in real time without using files or databases, specify which IPC mechanism is available in Linux, and which would be most efficient for real-time communication between processes.
Text Book	Text Book 1: Chapter 14:14.1,14.3,14.4,14.5 Chapter 20: 20.1-20.9 Text Book 2: 2.2

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	**Remember**	-	-	-
L2	**Understand**	10	-	-
L3	**Apply**	5	10	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**	20
L3	**Apply**	10
L4	**Analyze**	10
L5	**Evaluate**	10
L6	**Create**	--

Suggested Learning Resources:

Text Books:

1) Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons, Inc., 10th Edition, 2021, ISBN: 978-1-119-80037-8
2) W. Richard Stevens, Bill Fenner, and Andrew M. Rudoff, UNIX Network Programming, Volume 1: The Sockets Networking API, 3rd Edition, Addison-Wesley Professional, 2003. ISBN-13: 978-0131411555.

Reference Books:

1) Willian Stallings, Operating Systems: Internals and design principals, Pearson, 9th Edition, 2021, ISBN:978-0134670959.
2) Richard Fox, Linux with operating system concepts, CRC Press, 2nd edition, 2021, ISBN:978-0367554958.
3) Sri Manikanta palakollu, Practical System Programming with C: Pragmatic Example Application in Linux and Unix based Operating System, Apress, 1st Edition, 2021, ISBN: 978-148426320.
4) Raghavan Thirumalai, Linux Kernel Programming, Packt Publishing, 2nd edition, 2021, ISBN: 978-1801079518.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc24_cs108/preview
- https://www.youtube.com/watch?v=mXw9ruZaxzQ
- https://www.coursera.org/courses?query=operating%20system
- https://www.geeksforgeeks.org/operating-systems/operating-systems/
- https://www.tutorialspoint.com/operating_system/index.htm
- https://www.studytonight.com/operating-system/
- https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O

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

- Organizing Group wise discussions on issues
- Data Driven Case studies
- Cross Platform Comparative Learning

LINUX OPERATING SYSTEM LAB			
Course Code	**25CSL43**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

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

25CSL43.1	Apply Linux basic and file related commands, System Calls and implement CPU Scheduling algorithms.
25CSL43.2	Analyze solutions for process synchronization, deadlock avoidance, and prevention in a specified scenario.
25CSL43.3	Evaluate different methods of memory allocation and page replacement strategies.
25CSL43.4	Implement disk scheduling algorithms based on a provided process description.

No.	List of Programs	Hours	COs
	Prerequisite		
	• Proficiency in programming languages like C is essential for operating system development since many OS components are typically written in C language.	2	NA
	PART-A		
1	Execute the basic Linux commands for directory management, file management, and system information retrieval. • Directory related Commands – pwd, mkdir, rmdir, cd, ls • File related Commands – touch, cat, cp, mv, rm, cmp, chmod, wc, grep • System and Utility Commands– echo, clear, who, cal, date, bc, man, uname, uptime.	2	25CSL43.1
2	Write a C program to demonstrate the use of fork(), exec(), and wait() system calls by creating a child process, executing a Linux command in the child process, displaying the Process IDs of the parent and child processes, and synchronizing the execution of both processes.	2	25CSL43.1
3	Develop a program to model FCFS and non-preemptive SJF CPU scheduling algorithm.	2	25CSL43.1
4	Create a C program to simulate the Priority and round-robin scheduling algorithm.	2	25CSL43.1
5	Implement a C program by creating two unrelated processes for sharing the resource for demonstrating Shared Memory concept.	2	25CSL43.2
6	Implement a C program to depict the Producer-Consumer problem using semaphores.	2	25CSL43.2
	PART-B		
7	Implement a C program to depict the Dining Philosopher's problem concept.	2	25CSL43.2
8	Develop a program for simulating the Banker's Algorithm to prevent deadlock avoidance.	2	25CSL43.2
9	Implement a program to emulate first fit and best fit contiguous memory allocation. And simulate paging table implementation and determining the actual physical address in memory.	2	25CSL43.3
10	Create a program to execute the FIFO, LRU and Optimal page replacement algorithm.	2	25CSL43.3
11	Implement a program for simulating the F C F S and SCAN disk scheduling algorithm.	2	25CSL43.4
12	Implement a program for simulating the S S T F a n d LOOK disk scheduling algorithm.	2	25CSL43.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

- https://naim30.github.io/OS-virtual-lab/
- https://os.edu.distrinet-research.be/
- https://os.edu.distrinet-research.be/
- https://pdos.csail.mit.edu/6.1810/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	15	10
L4	Analyze	10	5
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:
Reference Books:

1) Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons, Inc., 10th Edition, 2021, ISBN: 978-1-119-80037-8.
2) Michael Kerrisk, The Linux Programming Interface: A Linux and UNIX System Programming Handbook, No Starch Press, 2024, ISBN-13: 978-1718500402
3) Andrew S. Tanenbaum and Herbert Bos, Modern Operating Systems, Pearson, 5th Edition, 2024, ISBN-13: 978-9361595134

DATABASE MANAGEMENT SYSTEMS			
Course Code	**25CSK44**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

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

25CSK44.1	Apply relational database concepts, database design principles, relational algebra and SQL to develop database applications
25CSK44.2	Analyze query processing, indexing techniques, and database programming methods for efficient data retrieval and performance optimization
25CSK44.3	Design relational database schemas and data models based on database management principles and application requirements
25CSK44.4	Implement database solutions using relational database management systems and SQL for effective data storage, manipulation, and retrieval
25CSK44.5	Evaluate normalization, transaction processing, concurrency control, and recovery techniques to ensure reliable and consistent database management
25CSK44.6	Create database applications using modern relational and NoSQL database technologies to address real-world data management requirements

MODULE-1	**DATABASE FUNDAMENTALS AND DATABASE DESIGN**	**25CSK44.1, 25CSK44.2**	**9 Hours**
Database Concepts: Definitions, Characteristics, Advantages of DBMS, Three-schema architecture, Data Abstraction & Independence, DBMS Components: Database Designers, Administrators, Users. Entity-Relationship Model: Entity types, attributes, keys (super key, primary, candidate), Relationship types, structural constraints, Reduction of ER schema to relational schema, Relational Model Concepts: Schema, Tuples, Domains, Keys, Integrity Constraints: Entity, Referential.			
Self-Study	Explore different real-world databases (e.g., railway reservation systems, hospital management systems) and identify the advantages of DBMS over traditional file systems.		
Text Book	Text Book 1: 1.1,1.2, 1.3, 1.4, 1.6, 2.2, 2.4, 3.3, 3.4, 3.5, 5.1, 5.2		
MODULE-2	**RELATIONAL DATABASES AND SQL**	**25CSK44.2,25CSK44.3**	**9 Hours**
Relational Algebra: Select, Project, Join, Union, Intersection, Difference, Rename, Division. SQL Basics: DDL: Create, Drop, Alter, Truncate; DML: Insert, Delete, Update; SQL Clauses: Where, Order By, Group By; Constraints: Not Null, Unique, Primary, Foreign Key; Aggregate functions: SUM, AVG, COUNT, MIN, MAX.			
Case Study	Consider three related tables representing entities and their associations. Design relational algebra queries to: Retrieve records that meet specific conditions. Identify records not associated with certain data (using difference). Write SQL statements to: Create tables and define their structures (DDL). Insert sample data (DML). Retrieve and summarize data using SELECT with various clauses (WHERE, GROUP BY, ORDER BY).		
Text Book	Text Book 1: 8.1, 8.2, 8.3, 6.1, 6.2, 6.3, 6.4.4 to 2.15		
MODULE-3	**QUERY PROCESSING & INDEXING**	**25CSK44.3,25CSK44.4**	**9 Hours**
Advanced SQL: Union, Intersect and Except; Nested Queries; Correlated Queries; Joins; Query Optimization , Introduction to Views; Triggers; Dynamic SQL, ODBC/JDBC. Indexing: Tree Structured Indexing: Indexed sequential access method, B+ Trees, Format of a node, Search, Insert, Delete, Duplicates, Hash based indexing: Static Hashing, Extendible Hashing, Linear Hashing			
Self-study	Explore different types of joins (inner, outer, left, right, natural) by creating simple tables and writing example queries to understand how results differ.		
Text Book	Text Book 2: 3.5, 3.8,4.2,14.1 to 14.7		
MODULE-4	**NORMAL FORMS & TRANSACTION PROCESSING**	**25CSK44.4, 25CSK44.5**	**9 Hours**

Normalization: Functional Dependencies; Normal Forms: 1NF, 2NF, 3NF, BCNF; Transaction Management: ACID Properties; Distributed Transactions, Schedules: Recoverability, Serializability; Concurrency Control: 2PL-Two-Phase Locking, Timestamp based & Optimistic Concurrency; Database Recovery concepts.			
Case Study	Start with a large unnormalized relation containing redundant and repeating groups. Identify all functional dependencies. Normalize the relation step by step to achieve 3NF or BCNF, clearly explaining the design decisions.		
Text Book	Text Book 1: 20.1, 20.3, 20.4, 20.5, 21.1, 21.2, 21.4, 22.1		
MODULE-5	**NoSQL & MODERN DATABASE SYSTEMS**	**25CSK44.5, 25CSK44.6**	**9 Hours**
NoSQL: Introduction to NoSQL: Need, Features, ACID vs BASE, CAP Theorem; Types: Key-Value, Document, Column, Graph. Modern Database Systems: Cassandra DB: Architecture, Data Centers and Racks, Gossip Protocol, Snitches vs Nodes, Replication, Read/Write Operations, Caching, Compaction, Tombstones. Mongo DB: Overview.			
Self-study	Compare different NoSQL database types: Key-Value, Document, Column, Graph, focusing on their data models and use cases.		
Text Book	Text Book 1: 24.1 - 24.6, Text Book 3: 6.1, 6.2, 6.3, 6.5, 6.7, 6.15,6.16, 6.17, 9.1, 9.2		

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 8th Edition, Pearson / Addison-Wesley, 2025, ISBN-13: 978-0133970777
2. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, 7th Edition, Tata McGraw-Hill, 2024, ISBN-13: 978-9390727506
3. Jeff Carpenter and Eben Hewitt, Cassandra: The Definitive Guide, 2nd Edition, O'Reilly Media, 2020, ISBN-13: 978-1492097143

Reference Books:

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw-Hill, 2022 (Reprint), ISBN-13: 978-0072465631.

Web links and Video Lectures (e-Resources)

- https://onlinecourses.nptel.ac.in/noc23_cs79/preview
- https://www.youtube.com/watch?v=DRSog3SA4-Y&list=PLIwC9bZ0rmjSkm1VRJROX4vP2YMIf4Ebh
- https://www.youtube.com/watch?v=f1oV46r69YM
- https://dev.mysql.com/doc/workbench/en/ (MySQL Workbench -- ER modelling)
- https://dbdiagram.io/ (Quick ER-diagramming tool used in industry)
- https://university.mongodb.com/ (MongoDB University -- free NoSQL courses)

• https://cassandra.apache.org/doc/latest/ (Apache Cassandra documentation) • https://aws.amazon.com/rds/ and https://aws.amazon.com/dynamodb/ (Managed cloud databases used in industry)
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Qualitative Assessment -- Explore a live database application. • Case Study -- Designing a relational database for a given scenario. • Qualitative Assessment -- Explore a live database application. • Case Study -- Designing a relational database for a given scenario. • Mock technical-interview rounds on SQL query writing, normalization and transactions -- common database rounds in placement drives.Mock technical-interview rounds on SQL query writing, normalization and transactions -- common database rounds in placement drives.

DATABASE MANAGEMENT SYSTEMS LAB			
Course Code	**25CSLK44**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

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

25CSLK44.1	Apply relational database design principles, DDL, DML, integrity constraints and normalization techniques for database applications
25CSLK44.2	Analyze SQL queries using relational operators, aggregate functions, joins and subqueries for data retrieval and manipulation.
25CSLK44.3	Evaluate database programming techniques using views, triggers and JDBC/ODBC connectivity for database-driven applications.
25CSLK44.4	Create database applications using relational and NoSQL database technologies for modern data management solutions.

No.	List of Programs	Hours	COs
	Prerequisite		
	Demonstration on installation and configuration of an RDBMS platform (MySQL / PostgreSQL / Oracle) and a NoSQL platform (MongoDB Compass / Cassandra), and an overview of SQL client tools and ER-modeling tools used in industry (MySQL Workbench, google drawing).	2	NA
	PART-A		
1	Identify the possible entities, attributes and relationships for a given real-world case study (e.g., Online Food Delivery / Hospital Management System) and design an ER/EER diagram using an industry ER-modeling tool such as MySQL Workbench or google drawing; map the diagram to a relational schema.	2	25CSLK44.1
2	Demonstrate various DDL and DML commands to create, modify, and manipulate a Student Database, applying appropriate primary key, foreign key, unique, check, not null and default constraints while creating tables.	2	25CSLK44.1
3	Demonstrate the use of various SQL operators (arithmetic, comparison, logical and special operators such as BETWEEN, IN, LIKE) on a Library Management database.	2	25CSLK44.2
4	Apply aggregate functions along with GROUP BY, HAVING, and ORDER BY clauses on a Sales/Library database to summarize and rank data.	2	25CSLK44.2
5	Demonstrate the use of nested and correlated subqueries to retrieve details of all customers who have ordered more than a given number of items, from an Order Database.	2	25CSLK44.2
6	Start with a large unnormalized relation containing redundant and repeating groups (e.g., an e-commerce order table): identify all functional dependencies and normalize the relation step by step to achieve 3NF, BCNF and 4NF, clearly explaining the design decisions and any controlled denormalization trade-off for read performance.	2	25CSLK44.1
	PART-B		
7	Analyze various types of joins (inner, outer, left, right, self and cross joins) to perform multi-table queries relating to Student and Course tables enrolled in each course.	2	25CSLK44.2
8	Create/replace a single-table view and a multi-table view, update and drop views for the given relations; compare tables and views and demonstrate an update-through-view scenario.	2	25CSLK44.3

9	Create and drop triggers for various events such as insert, update and delete transactions (e.g., maintaining an audit log on a BOOK table); demonstrate a trigger that enforces a business rule.	2	25CSLK44.3
10	Develop a Python application to connect to a database using ODBC, perform CRUD (Create, Read, Update, Delete) operations and integrate JSON data handling for data serialization, storage, retrieval and API-style data exchange, simulating a real-world backend application.	2	25CSLK44.3
11	Design and implement a relation using Cassandra and perform basic CRUD operations within the Cassandra database.	2	25CSLK44.4
12	Demonstrate creating and dropping a database/collection in MongoDB and perform basic CRUD operations using JavaScript/Python query syntax.	2	25CSLK44.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

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

- https://vlab.iitr.ac.in/assets/explorelabs/Database%20management%20system%20lab/labs/index.html
- https://www.programiz.com/sql/online-compiler
- https://www.db-fiddle.com/
- https://leetcode.com/problemset/database/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	5
L4	Analyze	15	5
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 8th Edition, Pearson / Addison-Wesley, 2025, ISBN-13: 978-0133970777.
2. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, 7th Edition, Tata McGraw-Hill, 2024, ISBN-13: 978-9390727506.
3. Jeff Carpenter and Eben Hewitt, Cassandra: The Definitive Guide, 2nd Edition, O'Reilly Media, 2020, ISBN-13: 978-1492097143.
4. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw-Hill, 2023 (Reprint), 0ISBN-13: 978-0072465631.

Professional Elective Course-I			
25CSE451	Knowledge Engineering	25CSE454	Computer Graphics and Animation
25CSE452	Introduction to Cloud Computing and Virtualization	25CSE455	Fundamentals of Information Security
25CSE453	Software Testing	25CSE456	Theory of Computation

KNOWLEDGE ENGINEERING			
Course Code	**25CSE451**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

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

25CSE451.1	Apply knowledge representation and uncertainty reasoning techniques to solve intelligent system problems.
25CSE451.2	Analyze knowledge engineering methodologies and reasoning approaches for intelligent decision-making.
25CSE451.3	Design ontology models for semantic knowledge representation and knowledge structuring.
25CSE451.4	Implement knowledge graphs and rule-based inference mechanisms using RDF, SPARQL, Neo4j, and ontologies.
25CSE451.5	Develop rule-based inference mechanisms and ontological reasoning for knowledge-based problem solving.
25CSE451.6	Evaluate machine learning techniques for rule induction and knowledge discovery in intelligent systems.

MODULE-1	**Knowledge Representation and Reasoning under Uncertainty**	**25CSE451.1**	**9 Hours**
Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods – Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering.			
Case Study	Building a small health assistant chatbot. When someone types "I have fever and cough," the chatbot should guess what illness it might be—like flu or cold. But since it's not sure, it shows different chances, like "70% flu, 30% cold." If the person adds "loss of smell," the chatbot changes its guess. This helps you learn how systems handle incomplete or uncertain information.		
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.6, 2.5, 2.6		
MODULE-2	**Knowledge Engineering Methodologies and Design Approaches**	**25CSE451.2**	**9 Hours**
Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.			
Applications	Designing a simple career helper for students. It asks questions like "Do you enjoy coding?" or "Are you good at maths?" and then suggests a suitable career like engineer or designer. Even if the student skips a few questions, the system still gives suggestions. This helps you learn how smart systems are designed step by step using logical thinking.		
Text Book	Text Book 1: 3.1, 3.3, 3.4		
MODULE-3	**Ontology Modeling and Semantic Knowledge Structuring**	**25CSE451.3, 25CSE451.4**	**9 Hours**
Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation, Knowledge Representation and Knowledge-Based Agents, Knowledge Graph Fundamentals, Introduction to Protégé ,Neo4J, Constraint Satisfaction Problems			
Case Study	Create a mini knowledge model of a grocery store. You list items like Milk, Apple, and Bread. Then, you group them under categories like Dairy or Fruits. You also add details like price or expiry date. This case helps you understand how to organize information so that computers can understand and use it.		
Text Book	Text Book 1: 5.2, 5.3, 5.5–5.10, 6.1–6.4. Text Book 2 : 7.1–7.2, 7.1, 7.6 , 6.1–6.3		

MODULE-4	Rule-Based Inference and Ontological Reasoning	25CSE451.4, 25CSE451.5	9 Hours
Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.			
Applications	Design a smart light system for your home. The rule is simple: if it's dark and someone enters the room, the light should turn on. If no one is there for 10 minutes, it turns off. You also think of what happens if the motion sensor doesn't work. This teaches you how computers use rules to make decisions.		
Text Book	Text Book 1: 7.1–7.6		
MODULE-5	**Machine Learning for Rule Induction and Knowledge Discovery**	**25CSE451.5, 25CSE451.6**	**9 Hours**
Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning, Introduction to Explainable AI modules			
Applications	Make a small tool to predict if a student will pass or fail. For example, if a student has more than 80% attendance and good marks, it says "Pass." Later, it improves its rules by learning from other student results. This helps you understand how machines can learn from data and improve over time.		
Text Book	Text Book 1: 8.1, 8.3, 8.4, 9.1, 9.2, 9.4, 9.10. Text Book 2: 19.3		

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Tecuci, G., Marcu, D., Boicu, M., and Schum, D. A., Knowledge Engineering: Building Cognitive Assistants for Evidence-Based Reasoning, Cambridge University Press, 2016.
2) Russell, S. and Norvig, P., Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021

Reference Books:

1) Sharma, A., Kautish, S., Agrawal, P., Madaan, V., Gupta, C., and Nanda, S., Knowledge Engineering for Modern Information Systems: Methods, Models and Tools, De Gruyter, 2022.
2) Corcho, O., Hollink, L., Kutz, O., Troquard, N., and Ekaputra, F. J. (Eds.), Knowledge Engineering and Knowledge Management: 23rd International Conference, EKAW 2022, Bolzano, Italy, September 26–29, 2022, Proceedings, Springer, 2022.
3) Allen, B. P., Stork, L., and Groth, P., Knowledge Engineering Using Large Language Models, Transactions on Graph Data and Knowledge (TGDK), 2023.
4) Allen, B. P., Ilievski, F., and Joshi, S., Identifying and Consolidating Knowledge Engineering Requirements, arXiv Preprint, 2023

Web links and Video Lectures (e-Resources): • https://nptel.ac.in/courses/106106140 • https://www.youtube.com/watch?v=l0PZhqmTwfM&list=PL6DEHvciXKeUx4P32B3hKMK1t6mC8RhsW • https://www.youtube.com/watch?v=HZGCoVF3YvM • https://www.youtube.com/watch?v=cIyBZ15Q65I
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning ● Self-study to explore Knowledge graphs and ontologies ● Case Studies /Caselets ● Problem Solving Exercises

INTRODUCTION TO CLOUD COMPUTING AND VIRTUALIZATION			
Course Code	**25CSE452**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

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

25CSE452.1	Apply Virtualization, Cloud models and Services to address real-world scalability and performance challenges.
25CSE452.2	Analyze the fundamental concepts, architectures, and service models that form the basis of cloud computing for selecting appropriate cloud solutions.
25CSE452.3	Design cloud migration strategies and scalable cloud-based solutions using PaaS, DBaaS, microservices.
25CSE452.4	Develop cloud applications by integrating cloud platforms, services, and microservice-based architectures.
25CSE452.5	Evaluate cloud environments using cost optimization tools, resource management techniques, and cost-saving strategies to improve efficiency.
25CSE452.6	Interpret cloud cost metrics to implement cost-saving strategies in cloud environments

MODULE-1	**Introduction to Cloud Computing**	**25CSE452.1**	**9 Hours**
Definition of Cloud Computing, Historical Evolution, Key Benefits and Advantages, Cloud Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models (Public, Private, Hybrid, Community), and an Overview of Leading Cloud Providers such as AWS, Azure, Google Cloud, and others.			
Case Study	Case Studies: Real-world examples of cloud adoption 1. Netflix 2. Airbnb		
Text Book	Text Book 1: Chapters: 1, 2,5,6		
MODULE-2	**Cloud Infrastructure and Virtualization**	**25CSE452.2**	**9 Hours**
Virtualization Technologies and Concepts, Hypervisors and Virtual Machines (VMs), Containers and Containerization Tools (Docker, Kubernetes), IaaS Providers, Cloud-Based Virtual Resource Management, Scalability, and Elasticity. Cloud Security.			
Case Study	• Case Studies: Real-world examples of cloud adoption • Case Study on Zen Hypervisor for Cloud Governance and Cost Efficiency"		
Text Book	Text Book 1: Chapters: 4,5,8,14		
MODULE-3	**Cloud Services and Platform as a Service (PaaS)**	**25CSE452.3**	**9 Hours**
Overview of Platform as a Service (PaaS), Leading PaaS Providers (e.g., Heroku, Google App Engine), Building, Deploying, and Scaling Cloud Applications, Introduction to Database as a Service (DBaaS), Microservices Architecture, and Serverless Computing. Autoscaling and Load balancing.			
Case Study	Case Studies: Building and Deploying Web Applications in the Cloud E-Commerce Website Migration to AWS - Scenario: Serverless Web App on Google Cloud Platform - Scenario		
Text Book	Text Book 1: Chapters: 5 ,8, 10, 11		
MODULE-4	**Cloud Cost Management and Optimization**	**25CSE452.4 25CSE452.6**	**9 Hours**
Cloud Cost Management – Understanding Cost Structures, Comparing Total Cost of Ownership (TCO) with Cloud Expenses, Significance of Cost Optimization, Tracking and Analyzing Cloud Costs through Billing and Allocation, Utilizing Cost Dashboards and Reports, Identifying Key Cost Drivers and Anomalies, Implementing Cost Optimization Strategies such as Rightsizing of VMs, Storage, and Databases, and Exploring Cloud Cost Management Tools (e.g., AWS Cost Explorer, Azure Cost Management).			
Self-study	1. Cloud Cost Management: Understanding Cost Structures in Modern Enterprises 2. Exploring Cloud Cost Management Tools: AWS Cost Explorer vs Azure Cost Management		

Text Book	Text Book 1: Chapters: 2,8,14		
MODULE-5	**Cloud Migration and Management**	**25CSE452.5**	**9 Hours**
Cloud Migration Strategies – Rehosting, Refactoring, and Rearchitecting; Planning and Executing Cloud Migrations; Cost Optimization in Cloud Environments; Cloud Governance and Management Tools; Cloud Service Management Platforms (e.g., AWS Management Console, Azure Portal); and Emerging Trends and Innovations in Cloud Computing.			
Case Study	Survey on Bio inspired Innovations, design, applications and case studies of the same. **1.** Dropbox's Migration to AWS **2.** Netflix's Cloud Adoption with AWS		
Text Book	Text Book 1: Chapters: 8,10,11,14,15		

CIE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Erl, T., Mahmood, Z., & Puttini, R. (2023). Cloud computing: Concepts, technology & architecture (2nd ed.). Pearson. ISBN-13: 9780138044242.

Reference Books:

1) Wang, Y., & Lee, W.. Cost Optimization in Cloud Computing: A Survey. IEEE Access, 7, 2019, ISBN: 90498 90515.
2) Mastthew Portnoy and David K,, Virtualization Essentials, Wiley, 2016, ISBN: 1119267722
3) Buyya, R., Broberg, J., & Goscinski, A. (Eds.). Cloud computing: Principles and paradigms. Wiley. 2011, ISBN: 978-0-470-88799-8 [1, 2, 3, 4]

Web links and Video Lectures (e-Resources):

- https://restpublisher.com/wp-content/uploads/2025/08/Cloud-Computing-and-Virtualization.pdf
- https://www.cse.iitb.ac.in/~cs695/slides_pdf/01-intro.pdf
- https://www.researchgate.net/publication/376396234_Virtualization_in_Cloud_Computing_Transforming_Infrastructure_and_Enhancing_Efficiency
- https://www.cse.iitb.ac.in/~convergence/workshops/Intro_to_Virtualization.pdf
- https://www.studocu.com/in/document/cvr-college-of-engineering/computer-science-and-engineering/comprehensive-study-guide-on-virtualization-in-cloud-computing/125520212

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

- Case Studies
- Project Based Learning
- Problem solving exercises

SOFTWARE TESTING			
Course Code	**25CSE453**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL /Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

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

25CSE453.1	Apply the fundamental concepts and principles of software testing to ensure software quality.
25CSE453.2	Analyze various software testing approaches and their applications in different testing scenarios.
25CSE453.3	Design structural test cases to achieve effective test coverage and defect detection.
25CSE453.4	Develop test cases for software applications by evaluating the appropriate testing approach.
25CSE453.5	Implement software test automation for web applications using appropriate automation tools.
25CSE453.6	Evaluate Selenium UI test automation framework for web application testing.

MODULE-1	**Foundations of Software Testing**	**25CSE453.1**	**9 Hours**
Introduction, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V- model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing			
Self Study	Compare the testing activities performed in the V-Model and Agile software development methodologies.		
Text Book	Textbook 1: Ch1		
MODULE-2	**Functional Testing**	**25CSE453.2**	**9 Hours**
Boundary Value Testing - Boundary value analysis, Robustness testing, Worst-case testing, Special Value Testing, Examples, Random Testing, Guidelines. **Equivalence Class Testing** - Equivalence classes, Equivalence test cases for the triangle problem, NextDate function, and the commission problem, Guidelines and observations, **Decision Table Based Testing** - Decision tables, Test cases for the triangle problem, NextDate function, and the commission problem, Guidelines and observations.			
Self Study	Identify boundary values for form validation, password policies, and input field constraints.		
Text Book	Textbook 1: Ch. 5, 6, 7		
MODULE-3	**Structural Testing**	**25CSE453.3**	**9 Hours**
Structural Testing: Overview, Statement testing, Program testing, Condition testing, **Path testing** - DD paths, Test coverage metrics, Basis path testing, guidelines and observations, **Dataflow testing**: Definition-Use testing, Slice-based testing, Guidelines and observations			
Self Study	Construct Control Flow Graphs for simple programs and identify independent paths for Basis Path Testing.		
Text Book	Textbook 1: Ch 9,10		
MODULE-4	**Integration and System Testing**	**25CSE453.4**	**9 Hours**
Levels of Testing: Traditional view of testing levels, Alternative life-cycle models, The SATM system, Separating integration and system testing. **Integration Testing:** A closer look at the SATM system, Decomposition-based, call graph-based, Path based integrations			
Self Study	Study the role of test drivers, stubs, mocks, and simulators in integration testing and identify scenarios where each is used.		
Text Book	Textbook 1: Ch. 12 & 13.1,13.2,13.3,13.4		
MODULE-5	**Test Automation and Tools**	**25CSE453.5, 25CSE453.6**	**9 Hours**
Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.			

Self Study	Explore different Selenium automation frameworks such as Data-Driven, Keyword-Driven, Hybrid, Page Object Model (POM), and Behavior-Driven Development (BDD).
Text Book	Text Book 2: Chapter 1.1,1.2,1.3, Chapter 3

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 5th Edition, Auerbach Publications, 2021, ISBN-13: 978-0367358495.
2. Boni Garcia, Hands-On Selenium WebDriver with Java :A Deep Dive into the Development of End-to-End Tests,O'REILLY,2022, ISBN:9781098110000

Reference Books:

1. Saeed Parsa, Software Testing Automation: Testability Evaluation, Refactoring, Test Data Generation and Fault Localization, Springer, 2023. ISBN: 9783031220562
2. Arnon Axelrod, Complete Guide to Test Automation: Techniques, Practices, and Patterns for Building and Maintaining Effective Software Test Automation, Apress, 2023. ISBN: 9781484299562.
3. Ajay Kumar Jena, Automation Testing with Selenium and JUnit, BPB Publications, 2023. ISBN: 9789355516596.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106/105/106105150/
- https://onlinecourses.nptel.ac.in/noc19_cs71/preview
- https://www.selenium.dev/documentation/webdriver/
- https://www.selenium.dev/documentation/test_practices/

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

- Problem Solving Exercises
- Case study /Case Lets
- Project Based Learning

COMPUTER GRAPHICS AND ANIMATION			
Course Code	**25CSE454**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

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

25CSE454.1	Understand the concepts of computer graphics, display systems, coordinate representations, OpenGL and graphics algorithms
25CSE454.2	Apply geometric transformations, viewing techniques and clipping methods for computer graphics applications
25CSE454.3	Analyze two-dimensional and three-dimensional transformation, viewing and projection techniques for graphics applications
25CSE454.4	Design computer graphics techniques for visualization, rendering and graphical object representation
25CSE454.5	Evaluate computer animation sequences using animation methods, motion specifications, key-frame systems and character animation techniques
25CSE454.6	Interpret computer animation solutions using advanced animation techniques

MODULE-1	**INTRODUCTION TO COMPUTER GRAPHICS AND GRAPHICS PRIMITIVES**	**25CSE454.1**	**9 Hours**
Introduction to Computer Graphics and Applications, Video Display Devices, Raster-Scan and Random-Scan Systems, Graphics Workstations and Viewing Systems, Input and Output Devices, Coordinate Representations, Graphics Functions, Introduction to OpenGL, Coordinate Reference Frames, Graphics Output Primitives, Attributes of Graphics Primitives, Color and Grayscale, Line Drawing Algorithms (DDA and Bresenham), Circle Generation using Midpoint Algorithm, Ellipse Generation Algorithm.			
Applications	1. Apply Bresenham's line algorithm for drawing in a mobile sketching application and compare its efficiency with DDA. 2. Apply DDA, Bresenham, and Midpoint Circle algorithms in CAD software for drawing geometric shapes.		
Text Book	Text Book 2: Ch 1.1 and 1.2 Text Book 1: Ch 1, 2, 3, 4, 5.		
MODULE-2	**TWO-DIMENSIONAL GEOMETRIC TRANSFORMATIONS**	**25CSE454.2**	**9 Hours**
Coordinate Reference Frames, Fill-Area Primitives, Polygon Fill Areas, General Scan-Line Polygon-Fill Algorithm, Scan-Line Fill of Convex Polygons, Basic Two-Dimensional Geometric Transformations, Matrix Representations and Homogeneous Coordinates, Two-Dimensional Composite Transformations, Other Two-Dimensional Transformations, Transformations between Two-Dimensional Coordinate Systems.			
Applications	1. A 2D animation software is being developed to simulate a walking character in a digital game or animation system. The character's movement includes translation (forward motion), rotation (body orientation) and scaling to create a realistic walking cycle. 2. Apply composite transformations (translation, rotation and scaling) to achieve smooth and realistic animation of objects in computer graphics applications.		
Text Book	Text Book 1: Ch 3, 5, 6.		
MODULE-3	**TWO-DIMENSIONAL VIEWING**	**25CSE454.2 25CSE454.3**	**9 Hours**
The Two-Dimensional Viewing Pipeline, The Clipping Window, Normalization and Viewport Transformations, Clipping Algorithms: Cohen–Sutherland Line Clipping, Liang–Barsky Line Clipping and Sutherland–Hodgman Polygon Clipping, Two-Dimensional Point Clipping, Two-Dimensional Line Clipping, Polygon Fill-Area Clipping, Curve Clipping, Text Clipping and handling of clipping edge cases (lines parallel to clipping boundaries, coincident lines, partially visible polygons and boundary conditions).			

Applications	1. Design a CAD system where large and complex shapes need to be clipped to a selected viewport. 2. Apply polygon clipping techniques to extract only the visible portion of the object within the viewing window and discuss the challenges in handling complex and irregular shapes.		
Text Book	Text Book 1: Ch 9		
MODULE-4	**THREE-DIMENSIONAL TRANSFORMATIONS AND VIEWING**	**25CSE454.3 25CSE454.4**	**9 Hours**
Three-Dimensional Translation, Rotation and Scaling, Composite Three-Dimensional Transformations, Affine Transformations, Transformations between Three-Dimensional Coordinate Systems, Three-Dimensional Viewing Pipeline, Projection Transformations, Orthogonal, Oblique and Perspective Projections, Viewport Transformation, Three-Dimensional Clipping Algorithms			
Applications	1. Modern AR/VR applications require realistic 3D visualization of virtual environments. 2. Discuss the use of parallel and perspective projections in 3D graphics and their suitability for immersive applications such as gaming, simulation and virtual reality systems.		
Text Book	Text Book 1: Ch 8, 9.		
MODULE-5	**COMPUTER ANIMATION**	**25CSE454.5 25CSE454.6**	**9 Hours**
Raster Methods for Computer Animation, Design of Animation Sequences, Traditional Animation Techniques, General Computer Animation Functions, Key-Frame Systems, Motion Specifications, Character Animation, Periodic Motions, Curve Interpolation (Bezier and B-Spline Curves), Skeletal Animation, Inverse Kinematics (IK), Motion Capture Techniques and Applications.			
Self-study	1. Design a metro train animation system that simulates train movement along a predefined path using key-frame animation techniques. The system should model smooth motion between frames and ensure realistic animation of moving objects in a virtual environment. 2. Discuss the challenges in real-time animation such as processing speed, smooth motion generation and synchronization of frames.		
Text Book	Text Book 1: Ch 11.		

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Donald Hearn, M. Pauline Baker, Warren Carithers, Computer Graphics with OpenGL, 4th Edition, Pearson, 2025, ISBN: 978-93-325-1871-1.
2) V. Scott Gordon and John L. Clevenger, Computer Graphics Programming in OpenGL with C++, 3rd Edition, Mercury Learning and Information, 2024, ISBN-13: 978-1501522598, ISBN-10: 1501522590.

Reference Books:

1) Matt Pharr, Wenzel Jakob, and Greg Humphreys, Physically Based Rendering: From Theory to Implementation, 4th Edition, The MIT Press, 2023, ISBN: 978-0262048026.
2) Tomas Akenine-Möller, Eric Haines, and Naty Hoffman, Real-Time Rendering, 5th Edition, A K Peters/CRC Press (Taylor & Francis Group), 2025, ISBN: 978-1032725888.
3) John Kessenich, Graham Sellers, and Dave Shreiner, OpenGL Programming Guide: The Official Guide to Learning OpenGL (Version 4.6 with SPIR-V), 9th Edition, Addison-Wesley Professional, 2022, ISBN: 978-0136802082.

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu
- https://nptel.ac.in/courses/106106090
- https://www.tutorialspoint.com
- https://www.siggraph.org
- https://www.khanacademy.org
- https://learnopengl.com
- https://www.coursera.org
- https://cseweb.ucsd.edu
- https://cse18-iiith.vlabs.ac.in/

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

- Case studies/Case lets
- Practical orientation on Design Thinking, Creativity & Innovation
- Participatory & Industry-integrated learning
- Practical activities / problem solving exercises
- Participation in Seminars/ Workshop

FUNDAMENTALS OF INFORMATION SECURITY			
Course Code	**25CSE455**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

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

25CSE455.1	Apply the principles of information security, security services, mechanisms, standards, and common cyber threats to demonstrate an understanding of secure information systems in organizational environments.
25CSE455.2	Use security planning, governance models, policies, standards and frameworks for establishing organizational information security practices.
25CSE455.3	Analyze asset classification, asset valuation techniques, threat profiling and vulnerability assessment methods to identify security weaknesses in information systems.
25CSE455.4	Identify risk management processes, incident response mechanisms, digital forensics and contingency planning approaches for maintaining business continuity.
25CSE455.5	Choose security implementation principles, SDLC concepts and maintenance models to ensure effective deployment and management of information security systems.
25CSE455.6	Evaluate information security issues and recommend suitable security measures for real-world organizational scenarios and cyber incidents.

MODULE-1	**INTRODUCTION**	**25CSE455.1**	**9 Hours**

Computer Security, Components of Information System, Security in organization, Need for information security, Threats and attacks, 12 categories of threats, Challenges of information security, OSI security architecture, security services, mechanisms and standards, Real world Security Breach – case studies.

Case Study	SolarWinds Supply Chain Attack (2020) – Analyze how attackers compromised the software update process, identify the security weaknesses, and evaluate its impact on confidentiality, integrity, and availability.
Text Book	Text Book 1: Chapter 1. Text Book 2: Chapter 1, Chapter 2.

MODULE-2	**SECURITY MANAGEMENT & POLICY**	**25CSE455.2**	**9 Hours**

Introduction, Security Planning & Governance; Policy, Defining user policy, Standards and practices; Security Blue print, Models, and Frame work;

Self-study	NIST Cybersecurity Framework (CSF) 2.0 – Students study the framework's governance, protection, detection, response, and recovery functions and analyze its role in establishing organizational information security practices.
Text Book	Text Book 1: Chapter 10. Text Book 2: Chapter 3

MODULE-3	**ASSET VALUATION & VULNERABILITY ASSESSMENT**	**25CSE455.3**	**9 Hours**

Asset Types & Classification- Hardware, Software, Data, Physical; Asset Valuation Models- Qualitative & Quantitative; Threat Identification & Profiling- External and Internal, Vulnerability Assessment Techniques- Automated scanning, Manual penetration testing, Vulnerability scanning, Penetration testing, Prioritization frame work and CVSS.

Applications	Attack Surface Mapping of a Small Organization Students identify and classify organizational assets, analyze potential attack entry points, and prioritize vulnerabilities to improve security posture.
Text Book	Text Book 3: Chapter 2,3, 4,5

MODULE-4	**RISK, INCIDENTRESPONSE & CONTINGENCY PLAN**	**25CSE455.4**	**9 Hours**

Risk management-Introduction, Framework, Process, Treatment/Response, Risk calculation, Managing Risk, Alternative Risk Management; Contingency Planning, Incident Response, Digital Forensics, Disaster Recovery, Business Continuity, Crisis management.

Case Study	Colonial Pipeline Ransomware Attack (2021) – Analyze the impact of ransomware on critical infrastructure and evaluate risk management, incident response, disaster recovery, and business continuity strategies.
Text Book	Text Book 2: Chapter 4 & 5

MODULE-5	IMPLEMENTATION & MAINTENANCE	25CSE455.5, 25CSE455.6	9 Hours

Introduction, SDLC, Project Management, Technical & Nontechnical aspects of implementation; Information security maintenance & its models, physical security.

Applications	Secure SDLC for an Online Student Management System Students integrate security requirements, controls, and maintenance activities across all phases of the Software Development Life Cycle to ensure secure system implementation and operation.
Text Book	Text Book 2: Chapter 11 & 12

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) William Easttom, "Computer Security Fundamentals", 5th Edition, Pearson IT Certification, ISBN-13: 978-0137984787, Dec 2022.
2) Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security", 7th Edition, Cengage Learning, ISBN-13: 978-0357506431, 2021.
3) Ron Eddings, MJ Kaufmann, "Attack Surface Management: Strategies and Techniques for Safeguarding Your Digital Assets, O'Reilly Media, ISBN-13: 978-1098165086, 2025.

Reference Books:

1) William Stallings, Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson Education, ISBN-13: 978-9357059718, 2023.
2) Jason Andress, "The Basics of Information Security", 4th Edition, Elsevier, ISBN-13: 978-0443182280, 2023.
3) Thomas A. Johnson, "Cybersecurity Fundamentals", 4th Edition, CRC Press, ISBN-13: 978-1032664576, 2024.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=0vvUkancccU
- nptel.ac.in/courses/106106129
- Information Security Fundamentals | Coursera
- What is Information Security? - GeeksforGeeks
- https://www.youtube.com/watch?v=l1Dl_czYpJI&t=27s
- https://www.youtube.com/watch?v=q0uUpf7w93A&list=PLIwjtbLyaFQ6q4NtpZ3UTLYURR2BSn7IL

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

- Organizing Group wise discussions on issues
- Class Presentations
- Case Studies/Case lets
- Practical activities / problem solving exercises

THEORY OF COMPUTATION			
Course Code	**25CSE456**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

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

25CSE456.1	Apply finite automata and formal language concepts for language recognition and finite state system modeling.
25CSE456.2	Analyze regular expressions, finite automata, and pumping lemma techniques to construct and verify regular languages.
25CSE456.3	Design context-free grammars and pushdown automata for language recognition and parsing.
25CSE456.4	Implement Turing Machines to recognize languages and relationship with Linear Bounded Automata and Type-0 Grammars.
25CSE456.5	Evaluate computable functions and Turing-computable models to determine their computational properties.
25CSE456.6	Interpret the capabilities and limitations of computational models in solving formal language and computability problems.

MODULE-1	**AUTOMATA AND FORMAL LANGUAGES**	**25CSE456.1**	**9 Hours**
Definition, Description of a Finite Automaton; Transition Systems; Properties of Transition Functions; Acceptability of a String by a Finite Automaton; Nondeterministic Finite State Machines; The Equivalence of DFA and NDFA; Mealy and Moore Models; Minimization of Finite Automata. FORMAL LANGUAGES: Definitions and Examples; Chomsky Classification of Languages; Languages and Their Relation; Recursive and Recursively Enumerable Sets; Operations on Languages; Languages and Automata.			
Self-study	Investigate the Applications of Finite Automata in Everyday Computing Systems.		
Text Book	Textbook 1:11.1-11.4, Textbook 2: Chapter 1.5-1.6,2.2-2.9,3.7-3.8		
MODULE-2	**REGULAR SETS AND GRAMMARS**	**25CSE456.2**	**9 Hours**
Regular Expressions; Finite Automata and Regular Expressions: Transition System Containing A-moves, NDFAs with A-moves and Regular Expressions, Conversion of Nondeterministic Systems to Deterministic Systems, Algebraic Method Using Arden's Theorem, Construction of Finite Automata Equivalent to a Regular Expression, Equivalence of Two Finite Automata, Equivalence of Two Regular Expressions; Pumping Lemma for Regular Sets; Application of Pumping Lemma; Closure Properties of Regular Sets.			
Case Study	Analyze the implementation of regular expression engines in programming languages or search engines to understand how they efficiently match patterns in text data		
Text Book	Textbook 1: Chapter 3,4, Textbook 2: 3.2–3.6		
MODULE-3	**CONTEXT-FREE LANGUAGES & PUSHDOWN AUTOMATA**	**25CSE456.3**	**9 Hours**
CFL and Derivation Trees; Ambiguity in Context-free Grammars, Simplification of Context-free Grammars, Normal Forms for Context-free Grammars. PUSHDOWN AUTOMATA(PDA): Basic Definitions, Acceptance by PDA, Pushdown Automata and Context-free Languages, Parsing and Pushdown Automata.			
Case Study	Explore applications of pushdown automata in syntax analysis stages of compilers and interpreters, where they are used to recognize and parse context-free grammars.		
Text Book	Textbook 1: Chapter 5, 6.1 to 6.3, 7.1.-7.4		
MODULE-4	**TURING MACHINES & LINEAR BOUNDED AUTOMATA**	**25CSE456.4**	**9 Hours**
Turing Machine Model; Representation of Turing Machines; Language Acceptability by Turing Machines; Design of Turing Machines; Description of Turing Machines; Techniques for TM Construction; Variants of Turing Machines; The Model of Linear Bounded Automaton; Turing Machines and Type 0 Grammars; Linear Bounded Automata and Languages.			
Self-study	Solve practice problems and exercises to reinforce concepts such as designing Turing machines and their relationship with type 0 grammars		
Text Book	Textbook11: 9.1.-9.3,10.1-10.5		
MODULE-5	**COMPUTABILITY THEORY ESSENTIALS**	**25CSE456.5 25CSE456.6**	**9 Hours**

Introduction and Basic Concepts; Primitive Recursive Functions; Recursive Functions; Partial Recursive Functions and Turing Machines: Computability, A Turing Model for Computation, Turing-computable Functions, Construction of the Turing Machine that Can Compute the Zero Function Z, Construction of the Turing Machine for Computing the Successor Function, Construction of the Turing Machine for Computing the Projection Ui m, Construction of the Turing Machine that Can Perform Composition, Recursion, Minimization.	
Case Study	Investigate real-world examples of computable functions used in algorithmic decision-making or problem-solving tasks, and analyze their efficiency and limitations.
Text Book	Textbook 1: Chapter 13, Textbook 2: Chapter 6.2-6.3,8.2-8.4

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1. Peter Linz & Susan H. Rodger, An Introduction to Formal Languages and Automata, 7th Edition, Jones & Bartlett Learning, 2022 (ISBN 978-1-284-23160-1)
2. Pallavi Vijay Chavan, Ashish Jadhav, *Automata Theory and Formal Languages*, 1st Edition, Academic Press (Elsevier), 2023, ISBN-13: 9780323917841.

Reference Books:

1. Michael Sipser, *Introduction to the Theory of Computation*. Cengage Learning, 3rd Edition (Reprint), 2021. ISBN-13: **978-8131518472**.
2. K. R. Chowdhary, Theory of Computation: Automata, Formal Languages, Computation and Complexity, Springer, 2025.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106104028
- https://ocw.mit.edu/courses/18-404j-theory-of-computation-fall-2020/
- https://ocw.mit.edu/courses/18-404j-theory-of-computation-fall-2020/resources/lecture-videos/
- https://ocw.mit.edu/courses/18-404j-theory-of-computation-fall-2020/resources/lecture-notes/

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

- Problem Solving Exercises
- Grammar Construction Challenge
- Turing Machine Simulation

Ability Enhancement Course – IV			
25CSE461	Data Visualization	25CSE464	UI / UX Design
25CSE462	IoT Programming	25CSE465	Programming in C++
25CSE463	Automated Software Testing		

DATA VISUALIZATION			
Course Code	**25CSE461**	**Credits**	**50**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

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

25CSE461.1	Apply Python libraries such as Pandas, Matplotlib, and Seaborn to explore datasets and create basic data visualizations.
25CSE461.2	Analyze datasets using exploratory data analysis, data preprocessing techniques, correlation analysis, and Principal Component Analysis (PCA).
25CSE461.3	Develop interactive visualizations in Tableau using charts, maps, filters, calculated fields, and parameters.
25CSE461.4	Create interactive dashboards and data stories in Tableau to communicate meaningful insights from real-world datasets.

No.	List of Programs	Hours	COs
	Prerequisite		
	Python Programming Concepts Exploratory Data Analysis using Python	2	NA
	PART-A		
1	Load the Titanic dataset using Pandas and perform Exploratory Data Analysis (EDA) by displaying dataset information, summary statistics, missing values, and data types.	2	25CSE461.1
2	Create line, bar, scatter, histogram, and pie charts using Matplotlib to visualize customer demographics and spending patterns.	2	25CSE461.1
3	Visualize data using histogram, box plot, violin plot, count plot, and heatmap with Seaborn to analyze the distribution of medical attributes.	2	25CSE461.2
4	Implement bivariate analysis using scatter plots, pair plots, and correlation heatmaps to identify relationships among housing features.	2	25CSE461.2
5	Implement data preprocessing by handling missing values, removing duplicate records, detecting outliers, and visualizing the cleaned dataset.	2	25CSE461.2
6	Apply Principal Component Analysis (PCA) to reduce dimensionality and visualize high-dimensional data using Plotly.	2	25CSE461.2
	PART-B		
7	Import the Sample Superstore dataset into Tableau and create basic visualizations including bar chart, line chart, pie chart, tree map, and packed bubble chart.	2	25CSE461.3
8	Apply filters, sorting, grouping, hierarchies, calculated fields, and parameters to analyze business data.	2	25CSE461.3

9	Create geographical visualizations using symbol maps, filled maps, and custom geographic roles to analyze regional sales.	2	25CSE461.3
10	Design an interactive dashboard using multiple worksheets, filters, actions, containers, and legends.	2	25CSE461.4
11	Create a Tableau Story using dashboards to present business insights and data-driven decisions.	2	25CSE461.4
12	Develop a comprehensive interactive dashboard using a real-world dataset of your choice and present key analytical insights.	2	25CSE461.4

PART-C

Beyond Syllabus Virtual Lab Content(4 Hours)

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

- https://www.kaggle.com/learn/data-visualization
- https://ids-amrt.vlabs.ac.in/exp/data-visualisation-matplotlib/
- https://colab.research.google.com/github/jakevdp/PythonDataScienceHandbook/blob/master/notebooks/04.14-Visualization-With-Seaborn.ipynb
- https://www.tableau.com/products/public

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	10	5
L5	Evaluate	5	-
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) Nathan Yau, Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics, 2nd Edition, Wiley, 2024, ISBN: 978-1-394-21486-0
2) Desireé Abbott, Everyday Data Visualization: Design Effective Charts and Dashboards, 1st Edition, Manning Publications, 2024, ISBN-13: 978-1633438408
3) Seema Acharya, Mastering Data Visualization using Tableau, 1st Edition, Wiley India, 2024, ISBN: 978-9357462952

IOT PROGRAMMING			
Course Code	**25CSE463**	**Credits**	**50**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

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

25CSE463.1	Understand the fundamentals, architecture, and functionalities of various single-board embedded platforms used in IoT applications.
25CSE463.2	Apply Arduino programming and interfacing techniques to connect IoT devices and peripheral modules.
25CSE463.3	Analyse the performance and functionality of Arduino-based IoT systems by integrating sensors, actuators, and communication modules.
25CSE463.4	Evaluate the performance, reliability, and effectiveness of Arduino-based IoT applications by testing and validating sensor interfacing and system functionality.

No.	List of Programs	Hours	COs
	Prerequisite		
	Basic knowledge of C programming, Digital Electronics, Microprocessors and Microcontrollers, Embedded Systems, and IoT fundamentals.	2	NA
	PART-A		
1	Interface an LED/Buzzer with Arduino/Raspberry Pi and write a program to turn the LED ON (or activate the buzzer) for 1 second, followed by a 2-second OFF period, and repeat the process continuously.	2	25CSE463.1
2	Interface a digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to activate an LED upon object or light detection.	2	25CSE463.1
3	Interface a smoke sensor with Arduino/Raspberry Pi and write a program to detect smoke and trigger an alarm based on the sensor output.	2	25CSE463.1
4	Interface a DHT11 temperature and humidity sensor with Arduino/Raspberry Pi and write a program to acquire and display real-time temperature and humidity data.	2	25CSE463.2
5	Interface a TCS3200 colour sensor with Arduino/Raspberry Pi and write a program to detect and display the colour of an object.	2	25CSE463.2
6	Interface a Bluetooth module with Arduino/Raspberry Pi and write a program to control the ON/OFF state of an LED based on commands received from a smartphone via Bluetooth.	2	25CSE463.2
	PART-B		
7	Interface an ultrasonic sensor with Arduino/Raspberry Pi and write a program to measure and display the distance of an object using ultrasonic sensing.	2	25CSE463.3

8	Interface a float sensor with Arduino/Raspberry Pi and write a program to monitor the water level in an overhead tank and provide an LED indication when an overflow condition is detected.	2	25CSE463.3
9	Interface an ADXL335 accelerometer with Arduino/Raspberry Pi and write a program to measure acceleration along multiple axes and display the detected orientation on the Serial Monitor.	2	25CSE463.3
10	Develop an Arduino/Raspberry Pi application that interfaces an ultrasonic sensor and three LEDs (Red, Green, and White) to implement gesture-based sequential LED control.	2	25CSE463.4
11	Interface a soil moisture sensor with Arduino/Raspberry Pi and implement a program to measure, monitor, and display soil moisture levels.	2	25CSE463.4
12	Interface a temperature and humidity sensor with Arduino/Raspberry Pi and implement a program to acquire and upload real-time sensor data to a cloud platform.	2	25CSE463.4

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

- https://iot-amrt.vlabs.ac.in/exp/interface-led-pi/
- https://iot-amrt.vlabs.ac.in/exp/dht11-sensor-pi/
- https://www.geeksforgeeks.org/edittext-widget-in-android-using-java-with-examples/
- https://iot-amrt.vlabs.ac.in/exp/interface-push-sensor-pi/

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	5
L3	Apply	15
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:
Reference Books:

1) Surya Durbha and Jyoti Joglekar, Internet of Things, 1st Edition, Oxford University Press, 2021, ISBN-13: 978-0190121099.
2) Pramod R. Gunjal, Internet of Things: Theory to Practice, 1st Edition, CRC Press, 2024, ISBN-13: 978-1032251684.

AUTOMATED SOFTWARE TESTING			
Course Code	**25CSE462**	**Credits**	**50**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

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

25CSE462.1	Apply Tricentis Tosca features to perform functional testing and identify UI objects for web applications.
25CSE462.2	Analyze test automation using Tosca operations and reusable test cases.
25CSE462.3	Implement data-driven testing, synchronization, and reusable automation components using Tosca.
25CSE462.4	Develop automated test solutions using conditional statements, exception handling, and recovery mechanisms.

No.	List of Programs	Hours	COs
	Prerequisite		
	Basics of Software Testing , Basics of web applications and GUI elements	2	
	PART-A		
1	Install Tricentis Tosca and become familiar with the Tosca environment, Tosca Commander, Tosca Executor, XScan, and Test Repository.	2	25CSE462.1
2	Perform Functional Acceptance Testing (FAT) of a web application using Tosca.	2	25CSE462.1
3	Create reusable modules using Tosca XScan and identify UI objects using different identification methods: By properties, By Anchor, By image and By Index	2	25CSE462.1
4	Perform data manipulation using Tosca Buffer Operations and Process Operations.	2	25CSE462.2
5	Automate user interactions using following Operations. • Window maximize • Window minimize • Window close • Find Minimum • Find Maximum • Calculate Average	2	25CSE462.2
6	Create reusable test cases using Tosca Test Case Design, Test Data Management, Mapping, and Templates.	2	25CSE462.2
	PART-B		
7	Perform data-driven testing in Tosca by reading multiple sets of input data from an Excel spreadsheet. • Read user data from Excel • Perform login or form-fill for each row • Validate results dynamically	2	25CSE462.3
8	Automate the shopping cart functionality of an e-commerce web application using Tosca. • Search for an item	2	25CSE462.3

	• Add item to cart • Validate price and item count in cart		
9	Implement synchronization mechanisms to improve the reliability of automated test execution. Apply the following • Wait On • Default Settings • Static Wait, Timeout • TBox Wait and Sf Wait for Busy Indicator	2	25CSE462.3
10	Create reusable automation components using Test Step Blocks and Libraries. • Create a Reusable Test Step Block for Login/Logout • Creating and Using Libraries.	2	25CSE462.3

11	Implement conditional statements in automated testing
	• Automate login.
	• Create conditional logic to:
	  ○ Verify successful login.
	  ○ Navigate to Dashboard if login succeeds.
	  ○ Display error validation if login fails.
	• Create conditions for:
	  ○ Empty username
	  ○ Empty password
	  ○ Invalid credentials
	  ○ Valid credentials
		2	25CSE462.4

12	Implement the following exception handling and recovery Scenarios: • Execute login with valid credentials. • Execute login with invalid credentials. • Handle missing UI controls. • Handle application timeout. • Configure recovery and retry mechanisms. • Capture screenshots on failure. • Generate execution report.	2	25CSE462.4

PART-C

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

- https://academy.tricentis.com/resources/tosca-demo-in-action
- https://www.tricentis.com/software-testing-tool-trial-demo/trial-tosca
- https://docs.tricentis.com/tosca-2025.1/en-us/content/resources/webhelp/cover_web.htm
- https://docs.tricentis.com/tosca-2025.1/en-us/content/first_steps/get_started.htm

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	10	5
L5	Evaluate	5	-
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. Paul C. Jorgensen, “Software Testing: A Craftsman's Approach”, Publisher: Auerbach Publications, 2021,4th Edition ISBN: 9781466560680
2. Aditya Garg, “Software Testing with Tricentis Tosca”, Publisher: BPB Publications, 2021 ISBN: 9789389898869
3. Tricentis, “TOSCA Automation Tool – Official Documentation” Publisher: Tricentis GmbH (Online Resource)

UI UX Design			
Course Code	**25CSE464**	**Credits**	**01**
L: T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

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

25CSE464.1	Apply UI UX design principles, Laws of UX, usability guidelines, accessibility standards, and user-centered design concepts.
25CSE464.2	Analyze design thinking methodologies to identify user needs, define problems, and develop user-centered design solutions.
25CSE464.3	Design wireframes, user flows, and interactive prototypes using industry-standard UI UX design tools.
25CSE464.4	Evaluate digital interfaces using usability testing, heuristic evaluation, assessment of reusable UI components, and responsive design practices.

No.	List of Programs	Hours	COs
	Prerequisite		
	Basic knowledge of computer applications and familiarity with graphical user interfaces (GUI).	2	NA
	PART-A		
1	Compare the user interfaces of two mobile or web applications and prepare an evaluation report highlighting usability issues and design improvements.	2	25CSE464.1
2	Evaluate the user experience of a messaging application by analyzing user flows, interaction patterns, and notification mechanisms. Prepare a UX evaluation report.	2	25CSE464.1
3	Develop personas, customer journey maps, and a low-fidelity prototype for a given problem using the Design Thinking approach.	2	25CSE464.2
4	Evaluate a UPI application by analyzing user flow, interface consistency, trust indicators, and usability. Prepare a case study report.	2	25CSE464.2
5	Evaluate an application using UX metrics such as Task Completion Time, Task Success Rate, and Net Promoter Score (NPS). Interpret the results and recommend design improvements.	2	25CSE464.2
6	Develop a responsive webpage using HTML and CSS Flexbox for multiple screen sizes.	2	25CSE464.2
	PART-B		
7	Develop a design system in Figma using reusable components, typography, color styles, and grids.	2	25CSE464.3
8	Create low-fidelity wireframes in Figma for a mobile or desktop application and evaluate them for usability.	2	25CSE464.3
9	Develop a high-fidelity user interface in Figma by applying typography, color schemes, spacing, and visual hierarchy.	2	25CSE464.3
10	Design interface layouts in Figma using typography, iconography, color, and spacing principles. Evaluate the layouts for consistency and usability.	2	25CSE464.3
11	Develop reusable UI components in Figma using Auto Layout and component variants. Evaluate the components for consistency, scalability, and usability.	2	25CSE464.4
12	Develop an interactive prototype for a Smart Campus mobile application in Figma, conduct usability testing, and prepare a report with design improvement recommendations.	2	25CSE464.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

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

- https://www.figma.com/resource-library/ux-validation
- https://www.figma.com/resource-library/usability-testing
- https://ux-ui-design-fundamentals-usability-and-visual-principle-145d1b.gitlab.io/labs/240122.913_Lab_User_Experience_Analysis_and_Heuristic_Evaluation/240122.913_Lab_User_Experience_Analysis_and_Heuristic_Evaluation.md.html

- https://ux-ui-design-fundamentals-usability-and-visual-principle-145d1b.gitlab.io

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Text Books:

1. Fabio Staiano, Designing and Prototyping Interfaces with Figma, Packt Publishing, 2022. ISBN: 978-1801819693
2. Joel Marsh, UX for Beginners: A Crash Course in 100 Short Lessons, O'Reilly Media, 2022. ISBN: 978-1491912681

Reference Books:

1. Jon Yablonski, Laws of UX: Using Psychology to Design Better Products and Services, 2nd Edition, O'Reilly Media, 2024. ISBN: 978-1098146854
2. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Toolbox, Wiley, 2024. ISBN: 9781394252488

PROGRAMMING IN C++			
Course Code	**25CSE465**	**Credits**	**50**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

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

25CSE465.1	Understand the concepts of classes and objects by implementing programs using appropriate access specifiers, constructors, and destructors.
25CSE465.2	Apply object-oriented programming concepts by developing programs using inline functions, friend functions, generic pointers, this pointer, and dynamic memory allocation.
25CSE465.3	Analyze object-oriented design by implementing programs using inheritance, virtual functions, and polymorphism.
25CSE465.4	Evaluate robust C++ applications by implementing file I/O operations, exception handling, and generic templates.

No.	List of Programs	Hours	COs
	Prerequisite		
	Basic knowledge of the C programming language. Understanding of algorithms, flowcharts, functions, arrays, and pointers.	2	NA
	PART-A		
1	Write a C++ program using a Student class to store student information and display the details using appropriate member functions.	2	25CSE465.1
2	Write a C++ program to use scope resolution operator. Display the various values of the same variables declared at different scope levels. Write a C++ program to demonstrate Access Specifiers public, private and protected	2	25CSE465.1
3	Write a C++ program to demonstrate default, parameterized and copy constructors, along with the destructor.	2	25CSE465.1
4	Write a C++ program to find the largest of three numbers using inline function. Write a C++ program to demonstrate friend function	2	25CSE465.2
5	Write a C++ program to demonstrate the usage of Generic pointers Write a C++ program to demonstrate the usage of this pointer	2	25CSE465.2
6	Write a C++ program to demonstrate dynamic memory allocation and deallocation using new and delete operators	2	25CSE465.2
	PART-B		
7	Write a C++ program to demonstrate Single, Multiple, Multilevel and Hierarchical Inheritance.	2	25CSE465.3
8	Write a C++ program to demonstrate virtual function and Pure virtual function	2	25CSE465.3
9	Write a C++ program that demonstrates function overloading, operator overloading and overriding	2	25CSE465.3
10	Write a C++ program to create a text file, check file created or not, if created it will write some text into the file and then read the text from the file.	2	25CSE465.4
11	Write a C++ program to demonstrate usage of try, catch and throw to handle exception	2	25CSE465.4
12	Write a program to create a generic template for adding two integers and two float values and make use of the template to perform addition.	2	25CSE465.4

PART-C

Beyond Syllabus Virtual Lab Content

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

- https://practice.geeksforgeeks.org/
- https://oop-amrt.vlabs.ac.in/exp/association-relationship/index.html
- https://www.onlinegdb.com/
- https://www.programiz.com/cpp-programming/online-compiler/

CIE Assessment Pattern (50 Marks – Lab)

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

SEE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1. E. Balagurusamy, "Object Oriented Programming with C++", 9th Edition, McGraw Hill Education (India) Pvt. Ltd., 2026, ISBN: 978-9364445016.
2. Herbert Schildt, *C++: The Complete Reference*, 4th Edition, McGraw Hill Education, 2017, ISBN-13: 978-0070532465.

ENVIRONMENTAL SCIENCE PROJECT			
Course Code	**25EPP47**	**Credits**	**02**
L:T:P:S	**0:0:2:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**-**	**SEE Marks**	**50**
TW & SL / Sem	**60**	**Total Marks**	**100**
Total Hours /Sem	**60**	**Exam Hours**	**03**

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

25EPP47.1	Identify environmental issues and their impact on ecosystems, natural resources, and sustainable development.
25EPP47.2	Evaluate environmental conditions using data obtained through field surveys, case studies, environmental audits, and related investigations
25EPP47.3	Develop skills in project planning, field survey, data collection, implementation, documentation and reporting
25EPP47.4	Design sustainable solutions to mitigate identified environmental problems using scientific and engineering principles.

The Environmental Science Project is a practical, applied-learning course that builds students' environmental awareness and responsibility. It focuses on real issues such as climate change, pollution, biodiversity, resource use, soil erosion, and thermal comfort, using field surveys, case studies, data collection, audits, and analysis to develop feasible and sustainable solutions. Students are encouraged to propose feasible, sustainable, and technically sound solutions based on scientific principles and engineering practices.

The project may be undertaken **individually or in groups of up to four students**, including interdisciplinary teams wherever appropriate. Student performance shall be evaluated based on the prescribed project assessment rubrics.

Methods for project identification: Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

Restrictions and professional conduct:

Environmental Science Projects should be academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation.

CIE Assessment Pattern (50 Marks)

RBT Levels		Periodical Reviews and Evaluation
		50
L1	**Remember**	**-**
L2	**Understand**	**05**
L3	**Apply**	**15**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**10**

SEE Assessment Pattern (50 Marks)

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

Suggested Learning Resources:

Textbooks:

1. Phadke, N. D. Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2. Garg, N. R. Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.

3. Gupta, A. and P. Singh. Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4. Wilson, G. Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books:

1. NPTEL courses on Project-Based Learning and Social Innovation.
2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: https://sdgs.un.org
4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):

1. NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
2. NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
3. Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): https://vlab.co.in
4. Geological Survey of India (GSI) – Maps, reports, and publications: https://www.gsi.gov.in
5. YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments). 6. American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

NATIONAL SERVICE SCHEME			
Course Code	**25NSS30, 24NSS40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:

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

25NSSX0.1	Understand the importance of his / her responsibilities towards society.
25NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
25NSSX0.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.
25NSSX0.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Semester/ Course Code	CONTENT	COs	HOURS
3RD 25NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Developing Sustainable Water management system for rural areas and implementationapproaches. 4. Setting of the information imparting club for women leading to contribution in social and economic issues. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.	25NSS30.1, 25NSS30.2, 25NSS30.3, 25NSS30.4	30
4TH 25NSS40	1. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 2. Contribution to any national level initiative of Government of India. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 3. Spreading public awareness under rural outreach programs. (minimum 5 programs). 4. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 5. Govt. school Rejuvenation and helping them to achieve good infrastructure.	25NSS40.1, 25NSS40.2, 25NSS40.3, 25NSS40.4	30

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and Principal.
- At last report should be evaluated by the NSS officer of the Institute.
- Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
    - Lecture session by NSS Officer
    - Students Presentation on Topics
    - Presentation - 1, Selection of topic, PHASE – 1
    - Commencement of activity and its progress - PHASE – 2
    - Execution of Activity
    - Case study-based Assessment, Individual performance
    - Sector/ Team wise study and its consolidation
    - Video based seminar for 10 minutes by each student at the end of semester withReport.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, IndianAgriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govtorganization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted byindividual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

3.	Developing SustainableWater management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/properconsultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams /College campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
1.	Helping local schools toachieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

3.	Spreading public awareness under ruraloutreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Organize National integration and socialharmony events / Workshops / Seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/prope r consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/prope r consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION AND SPORTS			
Course Code	**25PED30, 25PED40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:

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

25PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
25PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
25PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
25PEDX0.4	Understand the roles and responsibilities of organization and administration of sports and games

Semester	CONTENT	COs	HOURS
3RD 25PED30	**Module 1: Orientation** A. Lifestyle B. Food & Nutrition C. Health & Wellness D. Pre-Fitness test. **Module 2: General Fitness & Components of Fitness** A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash **Module 3:** **Specific games (Any one to be selected by the student)** 1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.	25PED30.1, 25PED30.2,25PED30.3, 25PED30.4	30
4TH 25PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games **Module 2: Specific Games (Anyone to be selected by the student)** A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground. **Module 3: Role of Organization and administration**	25PED40.1, 25PED40.2,25PED40.3,25PED40.4	30

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

YOGA			
Course Code	**25YOG30, 25YOG40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours /	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x**
Total Hours /Sem	**30**	**Exam Hours**	**02**

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

25YOGX	Understanding the origin, history, aim and objectives of Yoga
25YOGX	Become familiar with an authentic foundation of Yogic practices
25YOGX	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat Kriyas
25YOGX	Use the teachings of Patanjali in daily life.

Semester / Course Code	CONTENT	COs	HOURS
3rd 25YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 1. Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Kapalabhati:** Revision of Kapalabhati -40strokes/min 3rounds **Different types of Asanas with Brief introduction and importance:** 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	25YOG30.1, 25YOG30.2, 25YOG30.3, 25YOG30.4	30
4TH 25YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Different types of Asanas with Brief introduction and importance:** 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana 5. Balancing: Sheershasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	25YOG40.1, 25YOG40.2, 25YOG40.3, 25YOG40.4	30

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
2. Tiwari, O P: Asana Why and How
3. Ajitkumar: Yoga Pravesha (Kannada)
4. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
5. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
6. Nagendra H R: The art and science of Pranayama
7. Tiruka: Shatkriyegalu (Kannada)
8. Iyengar B K S: Yoga Pradipika (Kannada)
9. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- https://youtu.be/KB-TYlgd1wE
- https://youtu.be/aa-TG0Wg1Ls

MUSIC			
Course Code	**25MUS30, 25MUS40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours /	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

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

25MUSX0.1	Identify and understand the origins and evolution of the Indian music system and its fundamental concepts
25MUSX0.2	Analyse and practice various types of compositions in Carnatic music and relate to different musical traditions
25MUSX0.3	Demonstrate knowledge of major composers and their contributions to Indian classical music
25MUSX0.4	Classify and understand various musical instruments and their construction

Mapping of Course Outcomes to Program Outcomes:

Semester / Course Code	CONTENT	COs	HOURS
3rd 25MUS30	**Origin of Indian Music** - Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Taya, Raga, Tala, and Mla. Study of the fundamental concepts that form the foundation of Carnatic music. **Compositions in Carnatic Music** - Introduction to types of compositions including Geethe, Jathi, Swara, Swarajathi, Varna, Krithi, and Thillana. Understanding of notation systems and their application in musical compositions. **Composers and Their Contributions** - Biography and musical contributions of Purandaradasa (founder of Carnatic music pedagogy), Thyagaraja (prolific composer and saint), and Mysoro Vasudevacharya. Study of their impact on Indian classical music traditions. **Abhyasa Gana - Practical Training**- Singing of Sarale Varase exercises and notation writing. Introduction to Suladi Sapthatala. Singing of 2 Geethe in Malahiri. Foundation for practical music experience.	25MUS30.1, 25MUS30.2, 25MUS30.3, 25MUS30.4	30
4TH 25MUS40	**Classification of Musical Instruments** - Classification and construction of string instruments (Veena, Sitar), wind instruments (Flute, Shehnai), percussion instruments (Mridangam, Tabla), and Idiophones (Ghana Vaadya - Gongs, Cymbals). Examples and characteristics of each class of instruments. **Abhyasa Gana - Practical Training**- Continuation of singing exercises including Sarale Varase at varying speeds. Complete notation writing for Sarale Varase and Suladi Sapthatala in Mayamalavagowla Raga. Singing of 2 additional Geethe in Malahiri, one Jathi Swara, and one Krithi in a Mela raga. Advanced practical music training.	25MUS40.1, 25MUS40.2, 25MUS40.3, 25MUS40.4	30

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Singing/Playing learnt in the semester and internal tests (MCQ type)

CIE	Marks
Avg of Test 1 and Test 2	20
Practical test on: a. Recite one Sarale Varase mentioned by the examiner in three speeds. b. Sing/Play the Geethe in Malahari. c. Singing/Playing Jathi Swara/Krithi.	30
Total	**50**

Textbooks:

1. Vidushi Vasantha Madhavi, "Theory of Music", Prism Publication, 2007.
2. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana - Vol.1 (English), Shreenivaas Prakaashana, 2018.

References:

1. Lakshminarayana Subramiam, Viji Subramaniam, "Classical Music of India: A Practical Guide", Tranqueber 2018.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=ihFDT8ZBPxE
- https://www.youtube.com/watch?v=4XXl5tTXa0I
- https://www.youtube.com/watch?v=n-60gfzGa1E
- https://www.youtube.com/watch?v=Vv_K7J7gx6M
- https://www.youtube.com/watch?v=BovAAPumYUo
- https://www.youtube.com/watch?v=F_aWPATb8V4
- https://www.youtube.com/watch?v=DPPCRWA3hXo
- https://www.youtube.com/watch?v=TuP00NK9eTM
- https://www.youtube.com/watch?v=LlolyBzZtdg

BASIC APPLIED MATHEMATICS - II
(Common for All Branches)

Course Code	**25DMAT41**	**Credits**	**0**
L:T:P:S	**0:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50**
Total Hours /Sem	**30**	**Exam Hours**	**--**

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

25DMAT41.1	Understand the least squares method to fit linear, quadratic, and exponential curves to experimental data.
25DMAT41.2	Solve first-order and first-degree differential equations and interpret their solutions in engineering and scientific applications.
25DMAT41.3	Analyze higher-order linear differential equations solutions encountered in engineering systems.
25DMAT41.4	Apply the double and triple integrals concepts to compute the areas and volumes of engineering domains.
25DMAT41.5	Analyze the Laplace transforms and apply their properties to simplify mathematical models of engineering systems.
25DMAT41.6	Apply Laplace transform techniques to solve linear differential equations arising in the engineering applications.

MODULE-1	**STATISTICAL ANALYSIS**	**25DMAT41.1**	**3 Hours**
Fitting of the linear curves, quadratic curves and exponential curves by least square method. Correlation, Coefficient of correlation and Lines of Regression.			
Self-study	Fitting of the geometric curves.		
Text Book	Text Book 1: 24.5, 25.12, 25.13, 25.14		
MODULE-2	**ORDINARY DIFFERENTIAL EQUATIONS**	**25DMAT41.2, 25DMAT41.3**	**3 Hours**
Solution of first order and first-degree differential equations – Exact differential equations. Solution of second and higher order homogeneous and non-homogeneous (e^{ax}, $\sin ax$, $\cos ax$) linear differential equations.			
Self-study	Solution of first order linear differential equations		
Text Book	Text Book 1: 11.11, 11.12, 13.5		
MODULE-3	**INTEGRAL CALCULUS**	**25DMAT41.4**	**3 Hours**
Evaluation of double integrals, evaluation of double integrals by change of order of integration, double integrals in polar coordinates, Area enclosed by plane curves, Evaluation of triple integrals.			
Self-study	Evaluation of double integrals over the region of integration.		
Text Book	Text Book 1: 7.1, 7.2, 7.3.		
MODULE-4	**LAPLACE TRANSFORMS**	**25DMAT41.5**	**3 Hours**
Definition and Laplace transform of simple functions, Properties of Laplace transforms -Shifting property problems, Laplace transform of Periodic functions problems.			
Self-study	Laplace transform of elementary functions		
Text Book	Text Book 1: 21.3, 21.4, 21.5, Text Book 2: 6.1.		
MODULE-5	**INVERSE LAPLACE TRANSFORMS**	**25DMAT41.6**	**3 Hours**
Inverse Laplace Transform by partial fractions and completing square forms. Solution of linear differential equations using Laplace Transform techniques.			
Self-study	Inverse Laplace transform of simple functions		
Text Book	Text Book 1: 21.12, 21.15, Text Book 2: 6.4.		

CIE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, I 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2 ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, I 9780273719236
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition, 2 ISBN: 9780070634190
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, I 9789352533831
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Editi 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://youtu.be/SaNDPSk1UVM?si=FRxMnRi1btCUIscK
- https://youtu.be/HxrLu-qRJKc?si=pKc9XOCllBx-H4Wp
- https://youtu.be/ma1QmE1SH3I?si=Hoo3_cjiIds203os
- https://youtu.be/TKBXey91Gc4?si=JjZfQvJxdxN8I6YQ
- https://youtu.be/1THkFmuIPXM?si=pc9VvmZ-9cQe_Wr_
- https://youtu.be/m7jH0jfRf2I?si=OOEWttfQhieJ9wih
- https://youtu.be/qFnoRfZknBY?si=BeMrhMF3LML4hBGa
- https://youtu.be/n9XP6pljtw8?si=3gU-XKgt5JIZe9LE

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

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

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 knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems

Problem Analysis: Identify, formulate, review research literature and analyse complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

Design/Development of Solutions: Design creative solutions for complex engineering problems and design/ develop systems/ components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)

Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)

Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams

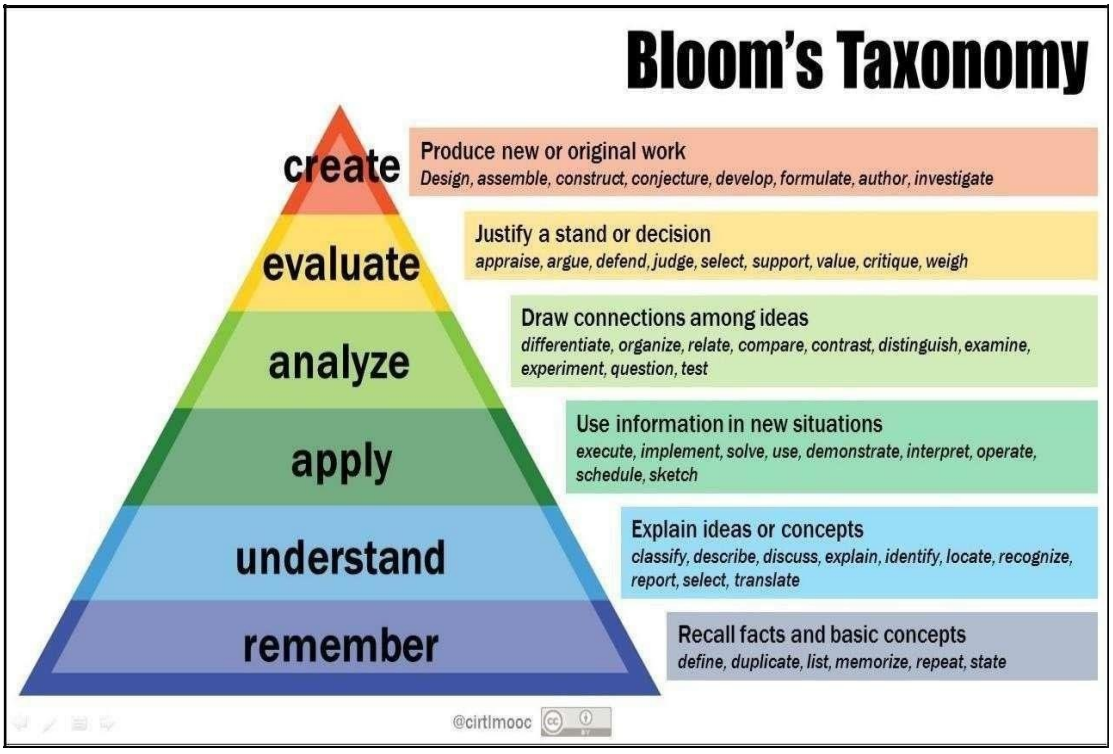
Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective language, and learning differences

Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments

Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

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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