



B. Tech – INFORMATION TECHNOLOGY

VTR UGE – 2025

CBCS CURRICULUM

Honors / Specialization / Minor

(With effect from 2025-26)

Department of Information Technology

School of Computing



Information Technology

VISION

To emerge as a centre of excellence in Information Technology that fosters competent professionals, advances cutting-edge research, and promotes innovation for societal development.

MISSION

M1: To strengthen outcome-based education aligned with current and frontier Information Technologies to develop competent professionals for industry and society.

M2: To promote interdisciplinary research and innovative practices for solving real-world challenges.

M3: To expand global academic partnerships and promote a diverse, inclusive ecosystem ensuring equitable participation.

M4: To foster ethical responsibility, leadership qualities, teamwork skills, and a strong commitment to lifelong learning among IT professionals.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs for IT)

After 3 to 5 years of professional accomplishment in the program, the graduates will be able to

PEO1: Apply fundamental knowledge in Information Technology, computing principles, and emerging digital technologies to design and develop innovative solutions for complex real-world problems.



PEO2: Demonstrate professional competence through interdisciplinary collaboration, research, and innovative practices to deliver sustainable and socially responsible IT solutions while exhibiting ethics, leadership, communication, and teamwork.

PEO3: Pursue successful careers in industry, entrepreneurship, higher education, and research through lifelong learning, global engagement, and continuous adaptation to evolving Information Technologies.

Knowledge and Attitude Profile (WK)

WK1 – Natural & Social Sciences: A systematic, theory-based understanding of the natural sciences applicable to the engineering discipline, paired with an foundational awareness of relevant social sciences.

WK2 – Mathematics & Computing: Conceptually-based mathematics, numerical analysis, data analysis, statistics, and formal aspects of computer and information science to support comprehensive modelling.

WK3 – Engineering Fundamentals: A systematic, theory-based formulation of core engineering fundamentals tailored specifically to the program's discipline.

WK4 – Engineering Specialist Knowledge: Advanced, specialized engineering knowledge that provides deep theoretical frameworks for the ultimate practice area.

WK5 – Engineering Design & Operations: Design-focused knowledge detailing efficient resource utilization, life-cycle performance, whole-life cost metrics, and environmental impacts.

WK6 – Engineering Practice: Practical comprehension of industry technology, operational safety, and execution methodologies within the respective practice domain.

WK7 – The Engineer & Society: Comprehensive knowledge regarding the role of engineering in society, focusing heavily on systemic sustainable development goals (SDGs) and public impact.

WK8 – Research Literature: Active engagement with selected knowledge found in current, peer-reviewed engineering research literature to fuel ongoing exploration.



WK9 – Ethics & Inclusive Conduct: Deep knowledge of professional ethics, accountability, and the operational norms of engineering practice. Includes an active awareness of diversity (gender, age, ethnicity, physical abilities) alongside mutual workplace respect.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The Engineer and The World: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO8. Individual and Collaborative Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.



PO9. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO10. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO11. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

On successful completion of the program, the graduates will be able to,

PSO1: Mathematical Concepts: Build a strong foundation to model and solve Information Technology problems through mathematical concepts, data structures, and algorithm design techniques.

PSO2: Software Development: Enhance technical proficiency to design and develop software applications using modern tools and emerging Information Technologies.

PSO2: Professional Competency: Transform technical knowledge into practical solutions through industry-oriented training and hands-on experience.

COURSE OUTCOMES (COs)

Abilities of the student are defined in terms of Course Outcomes (COs) as per Bloom's Taxonomy at the end of every course in the programme.



B. Tech – INFORMATION TECHNOLOGY

CURRICULUM

(CBCS)

Honors / Specialization / Minor

2025-2026

Credits required for regular students in various course categories for

B. Tech (IT)

The students shall earn 165 credits in various course categories given below for the award of degree of B.Tech (IT).

S. No	Course Category	Minimum Credits Required
1	Foundation Core Courses (FCC)	49
2	Programme Core Courses (PCC)	58
3	Programme Elective Courses (PEC)	21
4	Open Elective Courses (OEC)	9
5	Independent Learning Courses (ILC)	14
6	Industry / Higher Institute Learning Interaction(IHL)	2
7	Ability Enhancement Courses (AEC)	4
8	Skill Enhancement Courses (SEC)	4
9	Value Added Courses (VAC)	4
10	Mandatory Courses (If any)*	0
TOTAL CREDITS		165

Minimum credits required for regular students in various course categories for B.Tech Information Technology with minor

The students shall earn 165 credits in various course categories and additional 20 credits in the specialized tracks/ areas from other branches/ Schools by satisfying the prerequisite courses for the award of degree of B.Tech Information Technology with minor subject to the regulations.



Minimum credits required for regular students in various course categories for B.Tech Information Technology with Honors

The students shall earn 165 credits in various course categories and additional 20 credits in the specialized tracks / areas courses by satisfying the prerequisite courses for the award of degree of B.Tech Information Technology with Honors subject to the regulations.

Foundation Core Courses (FCC) (49 Credits)

Basic Science Courses (BSC) are foundational courses designed to impart essential scientific knowledge relevant to engineering. Engineering Science Courses (ESC) provide a foundational understanding of core engineering concepts drawn from multiple disciplines. Humanities and Social Sciences Courses (HSC) are intended to enhance the educational breath of engineering students.

L-Lecture, T-Tutorial, P-Practical, SL-Self Learning, C-credit

S. No	Course Code	Course Title	Category	L	T	P	SL	Credits
1	2510MA1001	Algebra and Calculus	BSC	3	1	0	3	4
2	2510PH1001	Physics	BSC	3	0	0	3	3
3	2510PH3001	Physics Laboratory	BSC	0	0	1	0	1
4	2510CH1001	Environmental Studies and Sustainability	BSC	2	0	0	2	2
5	2510CS1001	Problem Solving using C	ESC	3	0	0	3	3
6	2510CS3001	Problem Solving using C Laboratory	ESC	0	0	1	0	1
7	2510EC2001	Basic Electrical and Electronics Engineering	ESC	2	0	1	2	3
8	2510GE3001	Product Development Laboratory	ESC	0	0	2	0	2
9	2510EN2001	English for Global Careers - I	HSC	1	0	1	1	2
10	2510MA1002	Calculus and Transforms	BSC	3	1	0	3	4

S. No	Course Code	Course Title	Category	L	T	P	SL	Credits
11	2510CH1002	Chemistry	BSC	3	0	0	3	3
12	2510CH3001	Chemistry Laboratory	BSC	0	0	1	0	1
13	2510GE1001	Design Thinking	ESC	2	0	0	2	2
14	2510CS1002	Fundamentals of Data Structures	ESC	3	0	0	3	3
15	2510CS3002	Fundamentals of Data Structures Laboratory	ESC	0	0	1	0	1
16	2510GE1002	Introduction to Engineering	ESC	3	0	0	3	3
17	2510PH1002	Energy Science	ESC	2	0	0	2	2
18	2510MA1003	Discrete Mathematical Structures	BSC	3	0	0	3	3
19	2510MA1007	Probability, Statistics and Queuing Theory	BSC	3	0	0	3	3
20	2510GE1003	Universal Human Values	HSC	3	0	0	3	3
Total Credits								49
BSC – Basic Science Courses, ESC – Engineering Science Courses,				HSC – Humanities & Social Science Courses, M – Mandatory course AEC - Ability Enhancement Course				

Programme Core Courses (PCC) (58 Credits)

Programme Core Courses (PCC) for engineering students refer to a set of courses that are essential for a particular engineering discipline. It is designed to impart discipline-specific knowledge, technical competencies, and employability skills essential for professional growth and career readiness in the chosen field of study.

L-Lecture, T-Tutorial, P-Practical, SL-Self Learning, C-credit

S. No	Course Code	Course Title	L	T	P	SL	Credits
Theory Course							
1	2511IT1001	Advanced Data Structures	3	0	0	3	3
2	2511IT1002	Operating Systems	3	0	0	3	3
3	2511IT1003	Modern Computer Architecture	3	0	0	3	3
4	2511IT1004	Computer Networks	3	0	0	3	3
5	2511IT1005	Software Engineering and Practice	3	0	0	3	3
6	2511IT1006	Programming Using Java	3	0	0	3	3
7	2511IT1007	Database Management Systems	3	0	0	3	3
9	2511IT1008	Cryptography and Network Security	3	0	0	3	3
Integrated Course							
10	2511IT2001	Digital Electronics	2	0	2	2	3
11	2511IT2002	Design and Analysis of Algorithms	3	0	2	3	4
12	2511IT2005	Problem Solving and Testing using Java	1	0	4	1	3
13	2511IT2006	Embedded Systems and IoT	3	0	2	3	4
14	2511IT2007	Full Stack Application Development	1	0	4	1	3
15	2511IT2009	Artificial Intelligence	3	0	2	3	4
16	2511IT2010	Machine Learning	3	0	2	3	4
17	2511IT2011	Data Analytics and Visualization	2	0	2	2	3
Laboratory Course							

S. No	Course Code	Course Title	L	T	P	SL	Credits
18	2511IT3001	Advanced Data Structures Laboratory	0	0	2	0	1
19	2511IT3002	Computer Networks Laboratory	0	0	2	0	1
20	2511IT3003	Operating Systems Laboratory	0	0	2	0	1
21	2511IT3004	Competitive Coding Practice	0	0	2	0	1
22	2511IT3005	Programming using Java Laboratory	0	0	2	0	1
23	2511IT3006	Database Management Systems Laboratory	0	0	2	0	1
Total Credits							58

Programme Elective Courses (PEC) (21 Credits)

Programme Elective Courses (PEC) for engineering students typically refer to specialized courses offered within a Bachelor of Technology (B.Tech) Engineering program that allow students to choose subjects related to their specific major or specialization. PECs provide students with the flexibility to tailor their engineering education according to their career goals or passions while still covering core engineering principles.

L-Lecture, T-Tutorial, P-Practical, SL-Self Learning, C-credit

S. No	Course Code	Course Title	L	T	P	SL	Credits
Theory Courses							
1	2512IT1001	Optimization Techniques	3	0	0	3	3
2	2512IT1002	Modelling for Data Science	3	0	0	3	3
3	2512IT1003	High Performance Computing	3	0	0	3	3
4	2512IT1004	Edge Computing	3	0	0	3	3
5	2512IT1005	Information Coding Techniques	3	0	0	3	3

S. No	Course Code	Course Title	L	T	P	SL	Credits
6	2512IT1006	Distributed Computing	3	0	0	3	3
7	2512IT1007	Storage Technologies	2	0	0	2	2
8	2512IT1008	Digital Image Processing	3	0	0	3	3
9	2512IT1009	Cyber Security Policy, Law & Ethics	3	0	0	3	3
10	2512IT1010	Reinforcement Learning	3	0	0	3	3
11	2512IT2001	Deep Learning	3	0	2	3	4
12	2512IT2002	Natural Language Processing	3	0	2	3	4
13	2512IT2003	Computer Vision	3	0	2	3	4
14	2512IT2004	Ethical Hacking	3	0	2	3	4
15	2512IT2005	Block Chain Technologies	3	0	2	3	4
16	2512IT2006	Linux System Programming	3	0	2	3	4
17	2512IT2007	Linux Device Drivers	3	0	2	3	4
18	2512IT2008	Generative AI	3	0	2	3	4
19	2512IT2009	Virtualization Techniques	3	0	2	3	4
20	2512IT2010	Quantum Computing	3	0	2	3	4
21	2512IT2011	Robotic Process Automation	2	0	2	2	3
22	2512IT2012	IoT and Cloud Computing	3	0	2	3	4
23	2512IT2013	UI and UX Design	3	0	2	3	4
24	2512IT2014	Web Application Framework	3	0	2	3	4
25	2512IT2015	Virtual and Augmented Reality	3	0	2	3	4
26	2512IT2016	Cloud Security	3	0	2	3	4



S. No	Course Code	Course Title	L	T	P	SL	Credits
27	2512IT2017	Computer Graphics	2	0	2	2	3
28	2512IT2018	Web Analytics	2	0	2	2	3
29	2512IT2019	Software Testing and Automation	2	0	2	2	3
30	2512IT2020	Digital and Mobile Forensics	2	0	2	2	3
31	2512IT2021	Dev Ops	2	0	2	2	3
32	2512IT2022	Cognitive Computing	3	0	2	3	4
33	2512IT2023	Data Security and Privacy	3	0	2	3	4
34	2512IT2024	Information Security	3	0	2	3	4
35	2512IT2025	Introduction to FinTech	3	0	2	3	4
36	2512IT2026	Financial Accounting	3	0	2	3	4
37	2512IT2027	Principles of Compiler Design	2	0	2	2	3
38	2512IT2028	Big Data Analytics	2	0	2	2	3
39	2512IT2029	Artificial Intelligence Techniques	2	0	2	2	3
40	2512IT2030	Data Visualization	2	0	2	2	3
41	2512IT2031	Natural Language Processing	2	0	2	2	3
42	2512IT2032	Data Science	3	0	2	3	4
43	2512IT2033	Cyber Security	3	0	2	3	4
44	2512IT2034	Animation Engineering	3	0	2	3	4
45	2512IT2035	Game Design	3	0	2	3	4
46	2512IT2036	Data Engineering and Big Data Platforms	3	0	2	3	4
47	2512IT2037	Secure Coding	3	0	2	3	4



S. No	Course Code	Course Title	L	T	P	SL	Credits
48	2512IT2038	Blockchain Technology	3	0	2	3	4
49	2512IT2039	Forensics in Cyber Security	3	0	2	3	4
50	2512IT2040	Vulnerability Analysis and Penetration Testing	2	0	2	2	3
51	2512IT2041	3D Character Modelling	2	0	2	2	3
52	2512IT2042	Mobile Game Development Tools	2	0	2	2	3
53	2512IT2043	Story Telling	2	0	2	2	3
54	2512IT2044	IoT with Blockchain Technology	2	0	2	2	3
55	2512IT2045	Bitcoin and Cryptocurrencies	3	0	2	3	4
56	2512IT2046	Deep Learning Techniques	3	0	2	3	4
57	2512IT2047	Quantum Machine Learning	3	0	2	3	4
58	2512IT2048	Application Development and Maintenance	3	0	2	3	4
59	2512IT2049	Low code Development	3	0	2	3	4
60	2512IT2050	Robotics & Automation	3	0	2	3	4
61	2512IT2051	Industry Internet of Things	3	0	2	3	4
62	2512IT2052	Industrial Automation	3	0	2	3	4
63	2512IT2053	Business Intelligence	2	0	2	2	3
64	2512IT2054	Drone Technology	2	0	2	2	3
65	2512IT2055	Linux System Drivers	2	0	2	2	3
66	2512IT2056	Salesforce Ecosystem and Application Development	2	0	2	2	3
67	2512IT2057	Applied Programming Skills	2	0	2	2	3

S. No	Course Code	Course Title	L	T	P	SL	Credits
68	2512IT2058	Microprocessors and ARM Microcontrollers	3	0	2	3	4
69	2512IT2059	Foundations of Mainframe Computing	3	0	2	3	4
70	2512IT2060	Social Media Analytics	3	0	2	3	4
71	2512IT2061	Time Series and Forecasting	3	0	2	3	4
72	2512IT2062	Artificial Intelligence for Health Care	3	0	2	3	4
73	2512IT2063	Intelligent Agents	3	0	2	3	4
74	2512IT2064	Applied Coding Skills	3	0	2	3	4
75	2512IT2065	Digital Forensics	3	0	2	3	4

Open Elective Courses (OECs) (9 Credits)

Open Elective Courses (OECs) are subjects offered by other school programmes outside the student's major discipline. These courses enhance the academic experience, foster interdisciplinary learning, and contribute to the personal and professional development of students, preparing them to meet diverse challenges in their engineering careers.

Specifically, **Open Elective Courses offered by Information Technology for students of other schools** enable them to combine computing literacy with their primary major. Through this integration, students develop the versatile problem-solving abilities needed to succeed in today's tech-driven professional world.

L-Lecture, T-Tutorial, P-Practical, SL-Self Learning, C-Credit

S. No	Course Code	Course Title	L	T	P	SL	Credits
1	2513IT1001	Object Oriented Programming using Java	3	0	0	3	3
2	2513IT1002	Data Structures	3	0	0	3	3
3	2513IT1003	Operating Systems	3	0	0	3	3

S. No	Course Code	Course Title	L	T	P	SL	Credits
4	2513IT1004	Database Management Systems	3	0	0	3	3
5	2513IT1005	Computer Networks	3	0	0	3	3
6	2513IT1006	Data Analytics	3	0	0	3	3
7	2513IT1007	Software Development and Maintenance	3	0	0	3	3
8	2513IT1008	Salesforce Platform Essentials	3	0	0	3	3
9	2513IT1009	Linux on embedded systems	3	0	0	3	3
10	2513IT2001	Problem Solving and Testing using Python	1	0	4	1	3

Independent Learning Courses (ILC) (14 Credits)

Independent Learning Courses (ILCs) form an integral part of the B.Tech. Curriculum and are aimed at fostering self-directed learning among students. These courses provide opportunities to undertake projects, internships, or explore topics beyond the structured curriculum, thereby promoting critical thinking, innovation, and engagement with emerging technologies and interdisciplinary areas.

L-Lecture, T-Tutorial, P-Practical, SL-Self Learning, C-Credit

S. No	Course Code	Course Title	L	T	P	SL	Credits
1	2514IT5001	Community Service Project	0	0	2	-	1
2	2514IT6001	Minor Project	0	0	4	-	2
3	2514IT8001	Summer Internship	0	0	4	-	2
4	2514IT7001	Major Project	0	0	18	-	9



Industry / Higher Learning Institute (IHL)

Industry / Higher Learning Institute (IHL) courses are structured to bridge the gap between academic knowledge and its practical application in industry and international higher education institutions. These courses are intended to equip students with relevant skills through exposure to hands-on experiences, professional practices, and emerging technologies aligned with sectoral requirements.

L- Lecture, T- Tutorial, P- Practical, SL- Self Learning, C-Credit

S. No	Course Code	Course Title	L	T	P	SL	Credits
1	2515IT8001	Internship	-	-	-	-	2
2	2515IT8002	Industry Expert Lecture-1	-	-	-	-	1
3	2515IT8003	Industry Expert Lecture-2	-	-	-	-	1
4	2515IT8004	Higher Institute Learning Interaction-1	-	-	-	-	1
5	2515IT8005	Higher Institute Learning Interaction-2	-	-	-	-	1

Choose any combination totalling 2 credits

Ability Enhancement Courses (AEC)

Ability Enhancement Courses (AEC) are offered to augment students' skills and competencies beyond the core curriculum, thereby enriching their academic and professional development.

S. No	Course Code	Course Title	L	T	P	SL	Credits
1	2516EN2001	English for Global Careers - II	1	0	2	1	2
2	2516EN2002	Technical Communication	2	0	0	2	2
3	2516EN2003	Research & Academic Writing	2	0	0	2	2
4	2516EN2004	Professional Ethics	2	0	0	2	2



Skill Enhancement Courses (SEC)

Skill Enhancement Courses (SEC) are intended to equip the students with discipline specific practical skills that complement their core area of study. These courses focus on enhancing applied knowledge and professional competencies to improve employability and readiness for real-world challenges.

S. No	Course Code	Course Title	L	T	P	SL	Credits
1	2517EN3001	Professional Discourse and Fluency - I	0	0	2	0	1
2	2517GE3001	Cognitive Ability for Professional Development - I	0	0	2	0	1

Value Added Courses (VAC)

Value Added Courses (VAC) are supplementary courses aimed at enhancing students' practical skills, domain-specific knowledge, and employability beyond the scope of the core engineering curriculum.

L-Lecture, T-Tutorial, P-Practical, SL-Self Learning, C-Credit

S. No	Course Code	Course Title	L	T	P	SL	Credits
1	2518IT4001	Problem Solving and Programming using C++	1	0	0	1	1
1	2518IT4002	Networking Fundamentals and Security Essentials (CISCO)	1	0	0	1	1

Mandatory Courses

Mandatory Courses are introduced to support the students from varied academic backgrounds in adapting to the academic and professional expectations of Engineering and Society. These courses may be offered with or without credits; however, the credits earned shall not be considered for computing the CGPA but will be reflected in the grade sheet.

S. No	Course Code	Course Title	L	T	P	SL	Credits
1	2519BT1001	Biology for Engineers	1	0	0		M
2	2519GE1001	Engineers and Society	1	0	0		M
3	2519MG1001	Project Management and Finance	1	0	0		M
4	2519MG1002	Innovation and Entrepreneurship	1	0	0		M
5	2519SL1001	Constitution of India	1	0	0		M

MOOC based self-learning courses with or without credit transfer

Students must successfully complete the prescribed MOOC courses and submit the pass certificate to be eligible for credit transfer. The marks obtained will be converted to the corresponding letter grade and grade point as per the Institution's guidelines, and recorded accordingly by the department.

Track: Cloud Computing

S. No	Course Code	Course Name	L	T	P	C
1	2512IT1001	Cryptography and Network Security	3	0	0	3
2	2512IT1006	Distributed Computing	3	0	0	3
3	2512IT2009	Virtualization Techniques	2	0	2	3
4	2512IT2XXX	Network Fundamentals for Cloud	3	0	0	3
5	2512IT2XXX	Cloud Computing: Tools and Techniques*	3	0	2	4
6	2512IT2016	Cloud Security	3	0	0	3
7	2512IT2XXX	Cloud Infrastructure and Services	3	0	2	4
8	2512IT2XXX	IoT Deployment in Cloud	3	0	2	4



Track: Artificial Intelligence and Machine Learning

S. No	Course Code	Course Name	L	T	P	C
1	2512IT1001	Optimization Techniques	3	1	0	3
2	2512IT1010	Reinforcement Learning	3	1	0	3
3	2512IT2030	Data Visualization	3	0	2	4
4	2512IT2001	Deep Learning	3	1	2	4
5	2512IT2002	Natural Language Processing	3	0	2	4
6	2512IT2003	Computer Vision	3	0	2	4

Course Code & Name	2511IT1001- ADVANCED DATA STRUCTURES	Course Category	PC	L	T	P	C	Hrs / Week	Tot. Contact Hrs.	SL Hrs.*	Notional Hrs.
				3	0	0	3	3			

A. Preamble

This course introduces advanced data structures and algorithms for efficient storage, searching, indexing, and optimization of complex data. It covers advanced trees, heaps, hashing, graph algorithms, and string/spatial data structures used in real-world applications. The course emphasizes performance analysis and problem-solving using appropriate data organization techniques.

B. Pre-requisite Courses

2510CS1002 - Fundamentals of Data Structures

C. Course Outcome

Course Outcomes (CO)	At the end of this course, students will be able to:	RBT Level
CO1	Apply advanced data structures concepts of hashing, heaps, and Trees to solve complex computational problems.	K3 – Apply
CO2	Choose appropriate data structures to find solutions for searching, indexing, and optimization problems	K3 – Apply
CO3	Analyze the performance of given algorithm using time and space complexity measures.	K4 – Analyze
CO4	Examine graph, string, and spatial data structures to develop efficient solutions for given problems.	K4 – Analyze

D. Mapping of CO-POs, PSOs

Course Outcomes (CO)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2		1						1	2	2	1
CO2	3	3	3		1						1	2	3	2
CO3	3	2	2	2	1						2	3	2	1
CO4	3	3	2	2	1						1	2	3	1

E. Course Content

a) Topics	CO Coverage	Contact Hours
MODULE 1: HASHING AND INDEXING TECHNIQUES Introduction to hashing – Hash functions – Collision resolution techniques: Separate Chaining, Open Addressing: Linear Probing-Quadratic probing- Double hashing. Comparative analysis of hashing techniques based on time and space complexity: Load factor and rehashing- Perfect hashing- Extendible hashing- Applications of hashing. Case Study: Symbol Table Management / Password Authentication System.	CO1, CO2, CO3	9
MODULE 2: HEAPS AND PRIORITY QUEUES Introduction – Heap properties – Binary Heap-min-max heap – Heap operations, Priority Queue ADT. Advanced heaps: Binomial Heap, Performance analysis of Fibonacci Heap operations (Insert, Extract-Min, Decrease-Key, Merge) using amortized time and space complexity.	CO1, CO2, CO3	9

-Applications of heaps. Case Study: CPU Scheduling and Event Simulation System.		
MODULE 3: ADVANCED TREE STRUCTURES Introduction to advanced trees – Limitations of basic trees – Self-balancing trees: AVL Trees- Properties-operations, Red-Black Trees -properties-Operations, Splay Trees-Properties-Operations. Multiway search trees with Time and Space Complexity Evaluation: B-Trees, B+ Trees -structure-Operations Tries and Compressed Tries. Case Study: Dictionary Search Optimization using Trie and Compressed Trie	CO 1, CO3	9
MODULE 4: GRAPH ALGORITHMS Graph representations – Shortest path algorithms: Dijkstra's Algorithm, Bellman-Ford Algorithm. Minimum Spanning Trees: Prim's-Kruskal's Algorithms. Topological Sorting. Network flow Algorithms: Maximum Flow Basics - Ford-Fulkerson Method. Case Study: Transportation Network Optimization System.	CO3, CO4	9
MODULE 5: STRING AND SPATIAL DATA STRUCTURES Introduction to string matching- String data structures: Suffix Trees, Suffix Arrays. Pattern matching algorithms: Knuth-Morris-Pratt (KMP) Algorithm- Rabin-Karp Algorithm. Spatial data structures: Quad Trees, KD-Trees, R-Trees. Case Study: Text Search Engine / GIS (Geographic Information System).	CO3, CO4	9

F. Course Content and Lecture Schedule

Module Number	a) Topic	COs Covered	No of Periods
1	HASHING AND INDEXING TECHNIQUES	CO1, CO2, CO3	9
1.1	Course Orientation	-	1
1.2	Introduction to hashing – Hash functions	CO1	1
1.3	Collision resolution techniques-Separate Chaining,	CO2	1
1.4	Open Addressing: Linear Probing-	CO2	1
1.5	Quadratic probing- Double hashing.	CO2	1
1.6	Comparative analysis of hashing techniques based on time and space complexity: Load factor and rehashing-	CO3	1
1.7	Perfect hashing -Extendible hashing	CO3	2
1.8	Applications of hashing with examples	CO3	1
1.9	Case Study: Symbol Table Management / Password Authentication System.	CO3	1
2	HEAPS AND PRIORITY QUEUES	CO1, CO2, CO3	9
2.1	Introduction – Heap properties	CO1	1
2.2	Binary Heap-min and max heap operations	CO1	2
2.3	Priority Queue ADT.	CO2	1
2.4	Advanced heaps: Binomial Heap	CO2	1
2.5	Performance analysis of Fibonacci Heap operations (Insert, Extract-Min, Decrease-Key, Merge) using amortized time and space complexity.	CO3	2
2.6	Applications of heaps.	CO3	1
2.7	Case Study: CPU Scheduling and Event Simulation System	CO3	1

Module Number	a) Topic	COs Covered	No of Periods
3	ADVANCED TREE STRUCTURES	CO 1, CO3	9
3.1	Introduction to advanced trees – Limitations of basic trees	CO1	1
3.2	Self-balancing trees: AVL Trees- Properties-operations.	CO1	1
3.3	Red-Black Trees -properties-Operations,	CO1	1
3.4	Splay Trees- properties-Operations	CO1	1
3.5	Multiway search trees with Time and Space Complexity Evaluation -B-Trees,	CO3	1
3.6	B+ Trees -structure- Operations	CO3	1
3.7	Tries and Compressed Tries.	CO3	1
3.8	Case Study: Dictionary Search Optimization using Trie and Compressed Trie	CO3	2
4	GRAPH ALGORITHMS	CO3, CO4	9
4.1	Graph representations – Introductions	CO3	1
4.2	Shortest path algorithms: Dijkstra's Algorithm,	CO3	1
4.3	Bellman-Ford Algorithm.	CO3	1
4.4	Minimum Spanning Trees: Prim's.	CO3	1
4.5	Minimum Spanning Trees: Kruskal's Algorithms.	CO3	1
4.6	Topological Sorting.	CO4	1
4.7	Network flow Algorithms: Maximum Flow Basics -	CO4	1
4.8	Ford–Fulkerson Method.	CO4	1
4.9	Case Study: Transportation Network Optimization System.	CO4	1
5	STRING AND SPATIAL DATA STRUCTURES	CO2, CO4	9
5.1	Introduction to string matching, String data structures: Suffix Trees, Suffix Arrays.	CO2	1

Module Number	a) Topic	COs Covered	No of Periods
5.2	Pattern matching algorithms: Knuth–Morris–Pratt (KMP) Algorithm-	CO4	2
5.3	Rabin-Karp Algorithm	CO4	2
5.4	Spatial data structures: Quad Trees	CO4	1
5.5	KD-Trees,	CO4	1
5.6	R-Trees.	CO4	1
5.7	Case Study: Text Search Engine / GIS (Geographic Information System).	CO4	1

G. Other Features/Components Covered

Percentage of Course Content covering Syllabus of GATE / Other Examinations	75%	Percentage of Course Content covering Emerging Trends, Tools and Technology	25-35 %
---	-----	---	---------

H. Learning Resources (Text Books / Reference Books, Online Courses etc.,)

Learning Resources (Text Books / Reference Books, Online resources etc.,)	Text Books / Reference Books (IEEE Format)	Online resources (Preferably NPTEL or others)
	Text Book: 1. Michael T. Goodrich, Roberto Tamassia and Michael H. Goldwasser, <i>Data Structures and Algorithms in Java</i>, 6th Edition, Wiley India Pvt. Ltd., 2023. 2. Mark Allen Weiss, <i>Data</i>	1. Data Structure and Algorithms using Java, IIT Kharagpur https://nptel.ac.in/courses/106105225 2. Data Structures and Algorithms, IIT Delhi https://nptel.ac.in/courses/106102064



	<i>Structures and Algorithm Analysis in Java</i>, 3rd Edition, Pearson Education, 2017. Reference Book: 1. Sartaj Sahni, <i>Data Structures, Algorithms and Applications in Java</i>, 2nd Edition, Universities Press, 2018. 2. Robert Sedgewick and Kevin Wayne, <i>Algorithms</i>, 4th Edition, Addison-Wesley Professional, 2011. 3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, <i>Introduction to Algorithms</i>, 4th Edition, MIT Press, 2022.	
--	---	--

I. Course Learning Assessment

CO \ RBT	CIA-I					CIA-II					SEE				
	PART					PART					PART				
	A	B	C	D	Total (%)	A	B	C	D	Total (%)	A	B	C	D	Total (%)
CO1(K3)	2	4	14		40%	1	4			10%	1	2	7		20%
CO2(K3)	2	4	14		40%						1	4	7		24%
CO3(K4)	1	2		7	20%	2	2	14	7	50%	1	2	7		20%
CO4(K4)						2	4	14		40%	2	2	7	7	36%



J. Details of Self Learning (SL) Components/Activities for assigned SL Hrs.

S. No.	Component Name	No of Hrs.
SLC-1	Data Structures and Algorithms using Java https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012889695666700288926_shared/overview	10
SLC-2	Data Structures and Algorithms https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384203240484864010470_shared/overview	5
SLC-3	Introduction to Data Structures and Algorithms https://nptel.ac.in/courses/106102064	10
SLC-4	Data Structure and Algorithms using Java, IIT Kharagpur https://nptel.ac.in/courses/106105225	10
SLC-5	Data Structures and Algorithms Design https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs81	10

K. SDG Mapping and TRL Level (if applicable)

SDG: Sustainable Development Goal-9

TRL: Technology Validation in Laboratory 4

L. Course Design Details

Date of Revision	20.05.2026	BoS Number	43	Date of Approval of BoS	23-05-26
		Dr. A. PETER SOOSAI ANANDARAJ		DR. S P. CHOKKALINGAM	
Course Coordinator		Head of the Department		Dean of the School	

Course Code & Name	2511IT3001- ADVANCED DATA STRUCTURES LAB	Course Category	PC	L	T	P	C	Hrs / Week	Tot. Contact Hrs.	SL Hrs.*	Notional Hrs.
				0	0	2	1				

A. Preamble

This laboratory course provides practical exposure to the implementation and analysis of linear and non-linear data structures. It enables students to apply appropriate data structures and algorithms for solving computational problems efficiently through hands-on programming and real-world applications.

B. Pre-requisite Courses

2510CS3002 - Fundamentals of Data Structures Lab

C. Course Outcome

Course Outcomes (CO)	At the end of this course, students will be able to	RBT Level
CO1	Apply hashing techniques and heap for efficient implementation of ADT operations.	S3
CO2	Implement recursive algorithms for trees, graphs, and network flow problems using programming techniques.	S3
CO3	Design and implement different algorithms in various areas for efficient problem solving	S3

D. Mapping of CO-POs, PSOs

Course Outcomes (CO)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	1	1						1	2	2	1
CO2	3	3	2	1	1						1	2	2	1
CO3	3	3	2	2	1						2	3	2	1

E. Course Content

b) Lab Task	CO Coverage	Contact Hours
TASK 1: HASHING Develop a program to store k keys into an array of size n at the location computed using a hash function, $loc = key \% n$, where $k \leq n$ and k take values from [1 to m], $m > n$. To handle the collisions, use the following collision resolution techniques, a. Linear probing b. Quadratic probing c. Random probing d. Double hashing/rehashing	CO1	2
TASK 2: HEAP Develop and implement the following tasks Using Using Min Heap and Max Heap perform the following: i) Heap construction with insertion, deletion, and heapify operations. ii) Perform extract-min/extract-max and priority queue operations using heaps.	CO1	2

b) Lab Task	CO Coverage	Contact Hours
TASK 3: BINOMIAL HEAP Develop and implement the following tasks Using Binomial Heap perform the following: i) Implement creation, insertion, and merging of binomial trees in a Binomial Heap. ii) Implement union, find-min, extract-min, and deletion operations in Binomial Heap	CO1	2
TASK 4: AVL TREE Develop and implement the following tasks using Using AVL Tree perform the following: i) Construction of AVL Tree with insertion and deletion operations. ii) Self-balancing operations using LL, RR, LR, and RL rotations. iii) Analysis of height balancing.	CO2	2
TASK 4: RED-BLACK TREE Develop a program to implement Red-Black trees with insertion and deletion operation for the given input data as Strings.	CO2	2
TASK 5: B-TREE Develop a program to implement insertion, deletion, display and search operation in m-way B tree (i.e. a non-leaf node can have almost m children) for the given data as integers (Test the program for m=2, 4, 6).	CO2	2
TASK 6: TRIE Develop and implement the following tasks Using Trie perform the following: i) Construction of Trie with insertion and searching operations for words.	CO2	2

b) Lab Task	CO Coverage	Contact Hours
ii) Perform prefix matching, word deletion, and dictionary-based word searching operations.		
TASK 7: GRAPH ALGORITHMS Implement the following tasks using Graph Concept a) Find the Shortest Path using Dijkstra's and Bellman-Ford shortest path algorithms.	CO2	2
TASK 8: GRAPH ALGORITHMS Find Minimum Spanning Tree using Prim's and Kruskal's Algorithms.	CO2	2
TASK 9: NETWORK FLOW ALGORITHMS Implement Maximum Flow using Ford–Fulkerson Method.	CO2	2
TASK 10: STRING MATCHING ALGORITHM Implement a program to perform string matching using Knuth-Morris-Pratt algorithm and Rabin–Karp string matching algorithms.	CO3	2
TASK 11: SPATIAL DATA STRUCTURES Implement Quad Tree for spatial data representation and searching	CO3	2
Use case 1: Digital Certificate Verification System using Hashing Techniques Develop a Digital Certificate Verification System to store and verify certificate records using hashing techniques. Implement Linear Probing, Quadratic Probing, and Double Hashing to resolve collisions. Allow users to add certificate details and verify certificate authenticity using hash table search operations. Compare the performance of different collision resolution	CO1	2

b) Lab Task	CO Coverage	Contact Hours
techniques based on insertion and search efficiency.		
Use case 2: Smart Navigation System using Dijkstra's and Bellman–Ford Algorithms Design a transportation network application to determine the shortest path between locations in a city. Compare the performance of Dijkstra's and Bellman–Ford algorithms for weighted graphs with positive and negative edge weights	CO2	2
Use case 3: Disaster Management GIS using Quad Tree Create a GIS-based spatial searching system to store and retrieve geographical regions efficiently using Quad Trees. Simulate locating affected zones during flood or disaster management operations.	CO3	2

F. Other Features/Components Covered

Percentage of Course Content covering Syllabus of GATE / Other Examinations	65% - 70%	Percentage of Course Content covering Emerging Trends, Tools and Technology	25-35 %
---	-----------	---	---------

G. Learning Resources (Text Books / Reference Books, Online Courses etc.,)

Learning Resources (Text Books / Reference Books, Online resources etc.,)	Text Books / Reference Books (IEEE Format)	Online resources (Preferably NPTEL or others)
	Text Book: 1. Mark Allen Weiss, <i>Data Structures and Algorithm Analysis in Java</i> , 3rd Edition, Pearson Education, 2017. Reference Book: 1. Michael T. Goodrich, Roberto Tamassia and Michael H. Goldwasser, <i>Data Structures and Algorithms in Java</i> , 6th Edition, Wiley India Pvt. Ltd., 2023.	Online Resources: 1. Data Structure and Algorithms using Java, https://nptel.ac.in/courses/106105225

H. Course Learning Assessment

CO \ RBT	MODEL LAB (40 MARKS)					SEE LAB (60 MARKS)				
	PART					PART				
	A	B	C	D	Total (%)	A	B	C	D	Total (%)
CO1 (K3)	—	—	—	—	Any two CO's for 100%	—	—	—	—	Any two CO's for 100%
CO2 (K3)	—	—	—	—		—	—	—	—	
CO3 (K3)	—	—	—	—		—	—	—	—	
Total Marks	—	—	—	—	100%	—	—	—	—	100%



Assessment Pattern

- **Model Lab Examination:** 50 Marks
- **End Semester Lab Examination:** 50 Marks
- **Total:** 100 Marks

Suggested Part-wise Split-up

Model Lab Examination (50 Marks)

1. Avg mark for experiments 25

2. Model lab 20

Algorithm / Logic -5 Marks

Program Coding Compilation & Execution -10Marks

Viva-Voce -5 Marks

3. Attendance 5

End Semester Lab Examination (50 Marks)

- Part A – Program Writing (Algorithm/Logic): 10 Marks
- Part B – Program Coding: 20 Marks
- Part C – Compilation & Execution: 10 Marks
- Part D – Output Verification / Viva-Voce: 10 Marks

I. SDG Mapping and TRL Level (if applicable)

SDG: SDG 4 – Quality Education

SDG 9 – Industry, Innovation and Infrastructure

TRL: TRL 1, TRL 2, TRL 3, TRL 4

J. Course Design Details

The course is designed based on the principles of Outcome-Based Education (OBE), ensuring alignment between Course Outcomes (COs), laboratory practices, and assessment strategies. The content progresses from fundamental data structure concepts to advanced data structures and



algorithms, enabling students to develop efficient solutions for complex computational problems using trees, heaps, hashing, graphs, string matching, and spatial data structures.

Date of Revision	20.05.2026	BoS Number	43	Date of Approval of BoS	23.5.2026
		Dr. A. PETER SOOSAI ANANDARAJ		DR. S P. CHOKKALINGAM	
Course Coordinator		Head of the Department		Dean of the School	

Course Code & Name	2511IT1004 – COMPUTER NETWORKS	Course Category	PC	L	T	P	C	Hrs / Week	Tot. Contact Hrs.	SL Hrs.*	Notional Hrs.
				3	0	0	3	3	45	45	90

A. Preamble

This course is to provide students with an overview of computer networks. Enable them to apply networking concepts and protocols to construct efficient communication networks, analyze network performance, troubleshoot connectivity issues, and understand emerging trends in computer networking and Internet technologies.

B. Pre-requisite Courses

2510CS1001-Problem Solving Using C

C. Course Outcome

Course Outcomes (CO)	At the end of this course, students will be able to:	RBT Level
CO1	Apply the functions of layers in network architecture and network devices	K3
CO2	Analyze the various control mechanisms to ensure QoS in networks	K4
CO3	Make use of various protocols involved in different layers to confirm efficient data communication	K3
CO4	Construct networks using appropriate management techniques and effective addressing schemes	K3

D. Mapping of CO-POs, PSOs

Course Outcomes (CO)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2		3	-	-	-	-	-	-			
CO2	3	3		2	1	-	-	-	-	-	-		2	
CO3	3	2	2		2	-	-	-	-	-	-	2	2	2
CO4	2	3		2	2	-	-	-	-	-	-	2	3	2
	2.75	2.5	2	2	2	-	-	-	-	-	-	2	2.25	2

E. Course Content

a) Topics	CO Coverage	Contact Hours
MODULE 1: FUNDAMENTALS OF NETWORKS/ INTRODUCTION TO NETWORKS Types of Computer Networks-Network Topologies- - Network Architectures: OSI Reference Model-TCP/IP Suite, Transmission Media - Impairments, Switching Techniques, Network Performance Metrics, Design Issues - Network Devices.	CO1	10
MODULE 2: DATA LINK LAYER Data Link Layer : LLC sublayer - MAC sublayer and protocols - Error Control :Error Detection and Correction -Flow Control: Stop and Wait Protocol-Sliding Window- ARQ types -IEEE 802.3 Ethernet-IEEE-802.11 WLAN-Bluetooth	CO1, CO2	10
MODULE 3: NETWORK LAYER IP Addressing Methods-CLASSFULL:IPV4 addressing-CLASSLESS:IPV6	CO3, CO4	13

addressing-Subnetting-Supernetting-ICMP-IGMP-ARP-RARP-DHCP-Static and Default Routing — Unicast Routing Algorithms: Distance Vector Routing, Link State Routing, Path Vector Routing Protocols: — Protocols: RIP V1, RIP V2, OSPF, BGP, EIGRP - Multicasting Basics		
MODULE 4: TRANSPORT LAYER AND APPLICATION LAYER Transport Layer Protocols-Services-Port Numbers-UDP-TCP--SCTP-Flow Control - Congestion Control-Quality of Services(QOS) -WWW, HTTP/HTTPS, FTP/TFTP, TELNET/ SSH, DNS, SNMP, Electronic Mail: SMTP-SNMP-POP3-IMAP-MIME, Software Defined Networks: Open Flow Protocol, Architecture, Benefits and Challenges	CO2, CO3	12

F. Course Content and Lecture Schedule

Module Number	Topic	COs Covered	No of Periods
1	FUNDAMENTALS OF NETWORKS	CO1	10
1.1	History & Introduction	CO1	1
1.2	Types of Computer Networks	CO1	1
1.3	Network Topologies	CO1	1
1.4	Network Architectures: OSI Reference Model-TCP/IP Suite,	CO1	1
1.5	Transmission Media	CO1	1
1.6	Transmission Impairments	CO1	1
1.7	Switching Techniques,	CO1	1
1.8	Network Performance Metrics	CO1	1
1.9	Design Issues	CO1	1
1.10	Network Devices	CO1	1
2	DATA LINK LAYER	CO1, CO2	10
2.1	Data Link Layer : Introduction	CO1	1

Module Number	Topic	COs Covered	No of Periods
2.2	LLC sublayer - MAC sublayer	CO1	1
2.3	Error Detection - I	CO1	1
2.4	Error Detection - II	CO1	1
2.5	Error Correction	CO1	1
2.6	Flow Control: Stop and Wait Protocol-Sliding Window Protocol	CO1	1
2.7	ARQ types	CO2	1
2.8	IEEE 802.3 Ethernet	CO2	1
2.9	IEEE-802.11 WLAN	CO2	1
2.10	Bluetooth	CO2	1
3	NETWORK LAYER	CO3, CO4	13
3.1	IP Addressing Methods-CLASSFULL:IPV4 addressing	CO3	1
3.2	CLASSLESS:IPV6 addressing	CO3	1
3.3	Subnetting	CO3	1
3.4	Supernetting	CO3	1
3.5	ICMP-IGMP	CO3	1
3.6	ARP-RARP	CO3	1
3.7	DHCP	CO3	1
3.8	Static and Dynamic Routing	CO3	1
3.9	Unicast Routing Algorithms: Distance Vector Routing,	CO3	1
3.10	Link State Routing- OSPF	CO3	1
3.11	Path Vector Routing Protocols: RIP V1, RIP V2	CO3	1
3.12	BGP, EIGRP	CO3	1
3.13	Multicasting Basics	CO3	1
4	TRANSPORT LAYER AND APPLICATION LAYER	CO2, CO3	9
4.1	Transport Layer: Protocols-Services	CO3	1
4.2	Port Numbers-User Datagram Protocol	CO3	1

Module Number	Topic	COs Covered	No of Periods
4.3	Transmission Control Protocol--SCTP	CO3	1
4.4	Flow Control	CO3	1
4.5	Congestion Control Techniques - I	CO3	1
4.6	Congestion Control Techniques - II	CO3	1
4.7	Quality of Services(QOS)	CO2	1
4.8	Application Layer : WWW, HTTP/HTTPS	CO3	1
4.9	FTP/TFTP, TELNET/ SSH,	CO3	1
4.10	DNS, SNMP	CO3	1
4.11	Electronic Mail: SMTP-SNMP-POP3-IMAP-MIME,	CO3	1
4.12	Software Defined Networks: Open Flow Protocol, Architecture, Benefits and Challenges		

G. Other Features/Components Covered

Percentage of Course Content covering Syllabus of GATE / Other Examinations	65% - 70%	Percentage of Course Content covering Emerging Trends, Tools and Technology	30% - 35%
---	------------------	---	------------------

H. Learning Resources (Text Books / Reference Books, Online Courses etc.,)

Learning Resources (Text Books / Reference Books, Online resources etc.,)	Text Books / Reference Books (IEEE Format)	Online resources (Preferably NPTEL or others)
	Text Books: [1] Behrouz A. Foruzan, “Data Communication and Networking”, Fifth Edition, Science Engineering & Math Publications, 2013.	

	[2] Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011. Reference Books: [1] W. Stallings, “Data and Computer Communication”, Tenth Edition, Pearson Education, 2014. [2] Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks”, Fifth Edition, Prentice Hall, 2011 [3] Nader. F. Mir, “Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2010.	
--	---	--

I. Course Learning Assessment

CO \ RBT	CIA-I					CIA-II						SEE				
	PART					PART						PART				
	A	B	C	D	Total (%)	A	B	C	D	Total (%)	A	B	C	D	Total (%)	
CO1 (K3)	2	4	14		40%	1	4			10%	1	2	7		20%	
CO2 (K3)	2	4	14		40%						1	4	7		24%	
CO3 (K3)	1	2	–	7	20%	2	2	14	7	50%	1	2	7		20%	
CO4 (K4)	–	–	–		0%	2	4	14		40%	2	2	7	7	36%	

J. Details of Self Learning (SL) Components/Activities for assigned SL Hrs.

S. No.	Component Name	# of Hrs.	S. No.	Component Name	# of Hrs.
SLC-1	Network Types - case analysis of LAN, MAN, WAN	2	SLC-6	Routing Algorithms and Routing Protocols -Mini	6

S. No.	Component Name	# of Hrs.	S. No.	Component Name	# of Hrs.
	applications			case study on RIP, OSPF, and static routing	
SLC-2	Network Topologies and Transmission Media - Comparative analysis and chart preparation	3	SLC-7	Transport Layer Protocols (TCP & UDP) Packet flow observation and comparison exercise	6
SLC-3	IP Addressing and Subnetting- Practice problems using IPv4 and subnet calculations	5	SLC-8	Wireless Networks and Wi-Fi Standards- Self-learning presentation on IEEE 802.11 standards	6
SLC-4	OSI and TCP/IP Reference Models Layer-wise protocol identification activity using Packet Tracer	3	SLC-9	Network Security Fundamentals: Study of firewalls, VPNs, and common attacks	6
SLC-5	Ethernet and MAC Protocols Simulation-based learning using Packet Tracer/Wireshark	3	SLC-10	Emerging Trends in Networking (IoT, SDN, Cloud Networking)- Seminar preparation	5

K. SDG Mapping and TRL Level (if applicable)

SDG: SDG 4 – Quality Education

SDG 9 – Industry, Innovation and Infrastructure

TRL: TRL 1, TRL 2, TRL 3, TRL 4



L. Course Design Details

The course is designed based on the principles of Outcome-Based Education (OBE), ensuring alignment between Course Outcomes (COs), teaching–learning methods, and assessment strategies.

Date of Revision	20.05.2026	BoS Number	43	Date of Approval of BoS	23.5.2026
		Dr. A. PETER SOOSAI ANANDARAJ		DR. S P. CHOKKALINGAM	
Course Coordinator		Head of the Department		Dean of the School	

Course Code & Name	2511IT3002 – COMPUTER NETWORKS LAB	Course Category	PC	L	T	P	C	Hrs / Week	Tot. Contact Hrs.	SL Hrs.*	Notional Hrs.
				0	0	2	1	2	30	0	30

A. Preamble

This course is to provide students hands-on experience in understanding how data is transmitted, controlled, and managed to construct efficient communication networks. Analyze network performance for various protocols, security configuration and troubleshoot connectivity issues.

B. Pre-requisite Courses

Problem Solving Using C

C. Course Outcome

Course Outcomes (CO)	At the end of this course, students will be able to:	RBT Level
CO1	Configure basic LAN topologies, VLANs, wireless networks, and IPv6 addressing using networking tools and simulators. (S3)	S3
CO2	Apply routing techniques, subnetting methods, and routing protocols for efficient network communication. (S3)	S3
CO3	Analyze network traffic, MAC tables, and protocol behavior using packet analysis and troubleshooting tools. (S3)	S3
CO4	Develop and test client-server applications, remote login services, and network server configurations with appropriate security settings. (S3)	S3

D. Mapping of CO-POs, PSOs

Course Outcomes (CO)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	3	1	3						2	3	3	
CO2	3	3	2	2	3						2	3	3	
CO3	2	3	1	3	3						2	2	3	
CO4	3	2	3	2	3						2	2	3	3
	2.75	2.5	2.25	2	3						2	2.5	3	3

E. Course Content

b) Topics	CO Coverage	Contact Hours
Task 1:Configure basic LAN using Packet Tracer (star, bus, ring topologies).	CO1	2
Task 2: Using Hub-Switch Design LAN ,VLAN Configuration	CO1	2
Task 3: Frame Analysis Wireshark and Examine MAC table	CO3	2
Task 4:Static Routing, Dynamic Routing	CO2	2
Task 5: Subnetting	CO2	2
Task 6:Routing configuration using RIP and OSPF in Packet Tracer.	CO2	2
Task 7: Wireless Router Configuration	CO1	2
Task 8: Routing Table Update:IPV6 Addressing	CO1, CO2	2
Task 9: Socket programming using Python/C: Client-Server chat or file transfer.	CO4	2

Task 10: Security Configuration	CO4	2
Task 11: Implementation of Remote Login : TELNET/SSH	CO4	2
Task 12: Implementation of DNS	CO4	2
Task 13: Implementation of web server : HTTP/HTTPS	CO4	2
Task 14: Implementation of File server: FTP/TFTP	CO4	2
Task 15: Implementation of E-Mail using SMTP, POP3, IMAP	CO4	2
Use Case 1	CO1, CO2, CO3	2
Use Case 2	CO1, CO2, CO3	2

F. Other Features/Components Covered

Percentage of Course Content covering Syllabus of GATE / Other Examinations	85% - 90%	Percentage of Course Content covering Emerging Trends, Tools and Technology	80%
---	-----------	---	-----

G. Learning Resources (Text Books / Reference Books, Online Courses etc.,)

Learning Resources (Text Books / Reference Books, Online resources etc.,)	Text Books / Reference Books (IEEE Format)	Online resources (Preferably NPTEL or others)
	Text Books: [1]Behrouz A. Foruzan, “Data Communication and Networking”, Fifth Edition, Science Engineering & Math Publications, 2013. [2]Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers,	nptel.ac.in/courses/106106091 nptel.ac.in/courses/117105148 https://www.netacad.com/training/ccna-introduction-networks

	2011. Reference Books: [1] Cisco Certified Support Technician CCST Networking 100-150 Official Cert Guide , By Russ White, Published Dec 2, 2023 by Cisco Press. Part of the Official Cert Guide series. [2] Introduction to Networks Course Booklet (CCNAv7) By Cisco Networking Academy, Allan Johnson, Published Aug 13, 2020 by Cisco Press. Part of the Course Booklets series.	
--	---	--

H. Course Learning Assessment

CO \ RBT	MODEL LAB (40 MARKS)					SEE LAB (60 MARKS)				
	PART					PART				
	A	B	C	D	Total (%)	A	B	C	D	Total (%)
CO1 (K3)	—	—	—	—	Any two CO's for 100%	—	—	—	—	Any two CO's for 100%
CO2 (K3)	—	—	—	—		—	—	—	—	
CO3 (K3)	—	—	—	—		—	—	—	—	
Total Marks	—	—	—	—	100%	—	—	—	—	100%



Assessment Pattern

- **Model Lab Examination:** 50 Marks
- **End Semester Lab Examination:** 50 Marks
- **Total:** 100 Marks

Suggested Part-wise Split-up

Model Lab Examination (50 Marks)

4. Avg mark for experiments 25

5. Model lab 20

Algorithm / Logic -5 Marks

Program Coding Compilation & Execution -10Marks

Viva-Voce -5 Marks

6. Attendance 5

End Semester Lab Examination (50 Marks)

- Part A – Program Writing (Algorithm/Logic): 10 Marks
- Part B – Program Coding: 20 Marks
- Part C – Compilation & Execution: 10 Marks
- Part D – Output Verification / Viva-Voce: 10 Marks

I. SDG Mapping and TRL Level (if applicable)

SDG: SDG 4 – Quality Education

SDG 9 – Industry, Innovation and Infrastructure

TRL: TRL 1, TRL 2, TRL 3, TRL 4



J. Course Design Details

The course is designed based on the principles of Outcome-Based Education (OBE), ensuring alignment between Course Outcomes (Cos), teaching-learning methods, and assessment strategies.

Date of Revision	23.05.2026	BoS Number	43	Date of Approval of BoS	23.5.2026
		Dr. A. PETER SOOSAI ANANDARAJ		DR. S P. CHOKKALINGAM	
Course Coordinator		Head of the Department		Dean of the School	

Course Code & Name	2511IT2001- DIGITAL ELECTRONICS	Course Category	PC	L	T	P	C	Hrs / Week	Tot. Contact Hrs.	SL Hrs.*	Notional Hrs.
				2	-	2	3	4	60	30	90

A. Preamble

This course covers the fundamentals of digital electronics, including number systems, Boolean logic, and the design and analysis of combinational and sequential circuits. It also introduces HDL and programmable logic devices, enabling students to develop practical skills for solving real-world digital system problems.

B. Pre-requisite Courses

2510EC2001 - Basic Electrical and Electronics Engineering

C. Course Outcome

Course Outcomes (CO)	At the end of this course, students will be able to:	RBT Level
CO1	Build a efficient digital systems using Boolean Simplification Techniques	K3/S3
CO2	Design and simulate a combinational circuit using logic design principles for efficient real-time systems.	K4/S3
CO3	Analyze sequential circuit behavior, including state transitions and timing performance, through modeling and simulation in real-time	K4/S3
CO4	Investigate a CMOS-based VLSI circuits and Verilog modeling techniques for digital system implementation	K4/S3

D. Mapping of CO-POs, PSOs

Course Outcomes (CO)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	3	-	-	-	-	-	-	3	2	-
CO2	3	2	3	-	3	-	-	-	-	-	-	3	2	-
CO3	3	2	3	-	3	-	-	-	-	-	-	3	2	-
CO4	3	2	3	-	3	-	-	-	-	-	-	-	2	2

E. Course Content

a) Topics	CO Coverage	Contact Hours
MODULE 1: SIMPLIFICATION OF BOOLEAN EXPRESSIONS Introduction to Digital systems, Number systems, Machine Level Data representation, Boolean Algebra: Axiomatic Definition and Properties, Boolean Simplification: K-map Method–Tabulation Method - NAND and NOR Implementation	CO1	6
MODULE 2: COMBINATIONAL LOGIC Binary adder–subtractor, Decimal adder, Binary multiplier, Encoders, Decoders, Multiplexers and demultiplexers, Magnetic comparators, Code converter, Parity generator/Checker Circuits	CO1, CO2	8
MODULE 3: SEQUENTIAL LOGIC Basic latch - Flip-flops (SR - D - JK - T - Master-Slave) - Triggering of flip-flops -Counters - Design procedure - Ripple counters - BCD and Binary -	CO1, CO3	10

Synchronous counters - Registers - Shift registers - State Machine Design: Mealy and Moore Models-ASM Chart -Reduction of state and flow tables - Race-free state assignment – Hazards		
MODULE 4: VLSI DESIGN Introduction to VLSI design - Basic gate design - Digital VLSI design - Design of general Boolean circuits using CMOS gates - Verilog Concepts - Basic concepts - Modules & ports & Functions - Timing and delays - user defined primitives - Modelling Techniques in digital Circuits - Behavioral, Dataflow, Structural and Switch Level.	CO2, CO3, CO4	6
b) Lab Task	CO Coverage	Contact Hours
PART-A Task 1: Realization of Boolean expressions using K-map & implementation using Universal gates Tools: Digital Trainer Kit	CO1	2
Task 2: Design & implementation of Binary Adders & Binary Subtractors Tools: Digital Trainer Kit	CO1 & CO2	2
Task 3: Design & verification of Multiplexers and Demultiplexers Tools: Digital Trainer Kit	CO1 & CO2	2
Task 4: Design & implementation of Encoders and BCD to 7-Segment Display Tools: Digital Trainer Kit	CO1 & CO2	2
Task 5: Verification of Flip-Flop operations (SR, JK, D, T) Tools: Digital Trainer Kit	CO1 & CO3	2

Task 6: Design & implementation of Synchronous Counters Tools: Digital Trainer Kit	CO1 & CO3	2
Task 7: Design & implementation of Mod -N Counters Tools: Digital Trainer Kit	CO1 & CO3	2
Task 8: Design & verification of Shift Registers Tools: Digital Trainer Kit	CO1 & CO3	2
Task 9: Coding for Boolean Expression using HDL. Tools: Modelsim	CO1 & CO4	2
Task 10: Coding for Multiplexer using HDL. Tools: Modelsim	CO2 & CO4	2
Task 11: Coding for Binary Multiplier using HDL. Tools: Modelsim	CO2 & CO4	2
Task 12: Design a asynchronous counter using HDL. Tools: Modelsim	CO3 & CO4	2
PART-B		
<u>USE CASE / MINI PROJECT – 1</u> Develop a digital counter-based visitor monitoring system to automatically count and display the number of visitors entering and exiting a premises. The system should use digital electronics components and sequential logic circuits to maintain an accurate count, update the display in real time, and prevent counting errors during simultaneous entry and exit conditions.		
<u>USE CASE / MINI PROJECT – 2</u> Design a smart home security system using digital logic circuits to monitor unauthorized entry and provide alert indications. The system should detect intrusion conditions through sensors or switches, process the input using		
	CO1 , CO2, CO3 & CO4	6

digital electronic components, and generate appropriate alarm or indication signals for enhanced home security.

USE CASE / MINI PROJECT – 3

Design a digital clock using sequential circuits to display accurate time in hours, minutes, and seconds. The system should utilize counters, flip-flops, and display units to generate and control time sequences with proper synchronization and continuous real-time operation.

F. Course Content and Lecture Schedule

Module Number	Topic	COs Covered	No of Periods
1	Simplification of Boolean Expressions	CO1	8
1.1	Introduction to Digital systems, Number systems, Machine Level Data representation	CO1	1
1.2	Boolean Algebra: Axiomatic Definition and Properties,	CO1	1
1.3	Boolean Simplification: K-map Method	CO1	2
1.4	Tabulation Method	CO1	1
1.5	NAND and NOR Implementation	CO1	1
2	Combinational Logic	CO1 & CO2	8
2.1	Binary adder–subtractor	CO1 & CO2	1
2.2	Decimal adder, Binary multiplier,	CO1 & CO2	1
2.3	Encoders, Decoders,	CO1 & CO2	2
2.4	Multiplexers and demultiplexers,	CO1 & CO2	1
2.5	Magnetic comparators, Code converter,	CO1 & CO2	2

Module Number	Topic	COs Covered	No of Periods
2.6	Parity generator/Checker Circuits	CO1 & CO2	1
3	Sequential Logic	CO1 & CO3	10
3.1	Basic latch - Flip-flops (SR - D - JK - T - Master-Slave) Triggering of flip-flops	CO1 & CO3	2
3.2	Counters - Design procedure - Ripple counters	CO1 & CO3	1
3.3	BCD and Binary - Synchronous counters -	CO1 & CO3	2
3.4	Registers - Shift registers	CO1 & CO3	1
3.5	State Machine Design: Mealy and Moore Models – ASM Chart	CO1 & CO3	2
3.6	Reduction of state and flow tables Race-free state assignment	CO1 & CO3	1
3.7	Hazards	CO1 & CO3	1
4	VLSI Design	CO2, CO3 & CO4	8
4.1	Introduction to VLSI design - Basic gate design - Digital VLSI design - Design of general Boolean circuits using CMOS gates	CO2, CO3 & CO4	1
4.2	Verilog Concepts - Basic concepts - Modules & ports & Functions - Timing and delays - user defined primitives -	CO2, CO3 & CO4	1
4.3	Modelling Techniques in Combinational Circuits - Behavioral, Dataflow, Structural and Switch Level.	CO2, CO3 & CO4	2
4.4	Modelling Techniques in Sequential Circuits - Behavioral, Dataflow, Structural and Switch Level	CO2, CO3 & CO4	2



G. Other Features/Components Covered

Percentage of Course Content covering Syllabus of GATE / Other Examinations	60%-70%	Percentage of Course Content covering Emerging Trends, Tools and Technology	30%-40%
---	----------------	---	----------------

H. Learning Resources (Text Books / Reference Books, Online Courses etc.,)

Learning Resources (Text Books / Reference Books, Online resources etc.,)	Text Books / Reference Books (IEEE Format)	Online resources (Preferably NPTEL or others)
	Text Book-1: M. Morris Mano and Michael D. Ciletti, ‘Digital Design With an Introduction to the Verilog HDL’, Pearson , 5th Edition, 2018. Text Book-2: Samir Palnitkar , “Verilog HDL”, Second Edition, Pearson Education 2003 Reference Book: Stephen Brown, “Fundamentals of Digital Logic with Verilog”, McGraw Hill, 2007.	1. Digital Design with Verilog Instructor: Prof. Chandan Karfa, Prof. Aryabartta Sahu Institute: IIT Guwahati Duration: 8–12 Weeks Level: UG/PG (Core Course)

I. Course Learning Assessment

CO \ RBT	CIA-I					CIA-II					SEE				
	PART					PART					PART				
	A	B	C	D	Total I (%)	A	B	C	D	Total I (%)	A	B	C	D	Total (%)
CO1 (K3)	3	6	21	-	60%	-	-	-	-	-	2	2	7	-	10%
CO2 (K3)	2	4	14	-	0%	1	4	14	-	38%	1	4	7	-	20%
CO3 (K4)	-	-	-	-	-	3	4	7	7	42%	1	2	7	7	20%
CO4 (K4)	-	-	-	-	-	1	2	7	7	20%	1	2	7	7	50%

J. Details of Self Learning (SL) Components/Activities for assigned SL Hrs.

S. No.	Component Name	# of Hrs.	S. No.	Component Name	# of Hrs.
SLC-1	Study of number systems, Boolean algebra, and logic simplification techniques through reference materials	4	SLC-5	Design and verification of state machine models and sequential logic circuits	4
SLC-2	Practice problems on Karnaugh maps, tabulation methods, and logic gate implementations	4	SLC-6	Learning CMOS and basic VLSI design concepts through online resources and technical	3
SLC-3	Analysis and simulation of combinational logic circuits using digital simulation	5	SLC-7	Practice of Verilog coding and modeling techniques using open-	3
SLC-4	Self-study on sequential circuits, flip-flops, counters, and registers	5	SLC-8	Mini project development, testing, and report preparation based on digital	2



K. SDG Mapping and TRL Level (if applicable)

SDG: SDG 4 – Quality Education & SDG 9 – Industry, Innovation & Infrastructure

TRL: TRL 2–3 (Technology Concept & Proof of Concept)

L. Course Design Details

Date of Revision	20.05.2026	BoS Number	43	Date of Approval of BoS	23.5.2026
		Dr. A. PETER SOOSAI ANANDARAJ		DR. S P. CHOKKALINGAM	
Course Coordinator		Head of the Department		Dean of the School	

Course Code & Name	2511IT1007 / DATABASE MANAGEMENT SYSTEMS	Course Category	PC	L	T	P	C	Hrs / Week	Tot. Contact Hrs.	SL Hrs.*	Notional Hrs.
				3	0	0	3	3	45	45	90

A. Preamble

Databases are the backbone of all major applications today. Database Management Systems (DBMS) are fundamental to the development of modern data-driven applications across diverse domains such as enterprise systems, finance, and social platforms. This course provides a comprehensive foundation in relational data models, entity–relationship modeling, Structured Query Language (SQL), normalization, and database design methodologies. It also introduces contemporary trends, including NoSQL and lightweight databases, equipping learners with the skills required for scalable and efficient data management.

B. Pre-requisite Courses

2510CS1002 - Fundamentals of Data Structures

C. Course Objectives

The course aims to achieve the following objectives:

- To introduce the fundamental concepts of database systems and data modelling.
- To provide knowledge of relational database design, SQL, and normalization techniques.
- To familiarize students with transaction management, concurrency control, and recovery mechanisms.
- To expose students to modern database technologies such as NoSQL and graph databases.

D. Course Outcome

Course Outcomes (CO)	After successful completion of the course, students will be able to	RBT Level
CO1	Apply database concepts and data modelling techniques to develop conceptual and relational database designs for application requirements.	K3
CO2	Analyze database schemas and queries using appropriate constraints, normalization techniques, and SQL constructs.	K4
CO3	Use transaction processing and concurrency control mechanisms to ensure consistency and reliability in database systems	K3
CO4	Examine database storage mechanisms and modern database technologies to determine appropriate solutions for scalable data management applications.	K4

E. Mapping of CO-POs, PSOs

Course Outcomes (CO)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2										3		
CO2	3	3	2									2	3	
CO3	2			3	2							3		
CO4				2	3					2			2	3

F. Course Content

a) Topics	CO Coverage	Contact Hours
MODULE I: INTRODUCTION TO DATABASE SYSTEMS Purpose of Database Systems – Database Schema and Instances – Views of Data – Database Languages – Database System Architecture – Database Users and Database Administrator – Introduction to Distributed Databases – Data Models – Entity–Relationship (ER) Model – Fundamentals of Relational Databases – Mapping ER Diagrams to Relational Database Design.	CO1 CO2	9
MODULE II: RELATIONAL DATABASE DESIGN AND NORMALIZATION Keys and Constraints – Relational Algebra and Relational Calculus – SQL: Basic Operations, Queries, Joins, Nested Queries, Aggregate Functions, Views, and Indexing Concepts – Embedded SQL and PL/SQL: Functions, Procedures, and Triggers – Normalization: Functional Dependencies – First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce–Codd Normal Form (BCNF), Multivalued Dependencies (MVDs), and Join Dependencies (JDs) – Relational Database Schema Design: Database Schema Design for Real-World Applications (Case Study).	CO2 CO1	14
MODULE III: TRANSACTION AND CONCURRENCY Transaction Concepts: Transactions, Transaction States, and Schedules – Concurrency Control: Concurrent Execution, Serializability, Two-Phase Locking (2PL) Protocol, Timestamp-Ordering Protocol, Validation-Based Protocol, and Multiple Granularity – Deadlock: Deadlock Handling and Prevention, Wait-Die Scheme, and Wound-Wait Scheme – Recovery Management: Types of Failures – Recovery Techniques: Log-Based Recovery, Undo/Redo Operations, Checkpoints and Recovery Algorithms.	CO3 CO2	10
MODULE IV: STORAGE AND MODERN DATABASES Database Storage Fundamentals – Storage Hierarchy – RAID – Indexing	CO4 CO3	12

Techniques: Tree-Based Indexing (B-Tree and B+ Tree) – Hashing Techniques – Basics of Query Processing and Query Optimization – SQLite – Modern Databases: NoSQL Databases, Document Databases, and Graph Databases – CRUD Operations – Cloud Databases (DBaaS) – Case Study: Analyzing Scalable Modern Database Solutions for an E-Commerce Platform.		
--	--	--

G. Course Content and Lecture Schedule

Module Number	Topic	COs Covered	No of Periods
1	Purpose of Database Systems, File System vs. DBMS	CO1	1
1	Database Schema, Instances, and Views of Data	CO1	1
1	Database Languages (DDL, DML, DCL, TCL)	CO1	1
1	Database System Architecture (Three-Schema Architecture)	CO1	1
1	Database Users and Database Administrator (DBA)	CO1	1
1	Introduction to Distributed Databases and Data Models	CO1	1
1	Entity–Relationship (ER) Model: Entities, Attributes, Relationships, and Constraints	CO1	1
1	Fundamentals of Relational Databases: Relations, Tuples, Attributes, and Keys	CO1	1
1	Mapping ER Diagrams to Relational Database Design	CO1, CO2	1
2	Keys: Super Key, Candidate Key, Primary Key, Alternate Key, Composite Key, and Foreign Key	CO1, CO2	1
2	Integrity Constraints: Domain, Entity Integrity, and Referential Integrity Constraints	CO1, CO2	1
2	Relational Algebra: Selection, Projection, Union, Set Difference, Cartesian Product, and Rename	CO1, CO2	1
2	Relational Algebra: Join Operations, Division, and Relational Calculus	CO1, CO2	1

Module Number	Topic	COs Covered	No of Periods
2	SQL: DDL, DML, and Basic SQL Queries	CO2	1
2	SQL: Joins, Nested Queries, and Aggregate Functions	CO2	1
2	SQL: Views and Indexing Concepts	CO2	1
2	Embedded SQL and PL/SQL Fundamentals	CO2	1
2	PL/SQL: Functions and Procedures	CO2	1
2	PL/SQL: Triggers and Exception Handling	CO2	1
2	Functional Dependencies and First Normal Form (1NF)	CO1, CO2	1
2	Second Normal Form (2NF), Third Normal Form (3NF), and Boyce–Codd Normal Form (BCNF)	CO1, CO2	1
2	Multivalued Dependencies (MVDs), Join Dependencies (JDs), and Advanced Normalization	CO1, CO2	1
2	Relational Database Schema Design for Real-World Applications (Case Study)	CO1, CO2	1
3	Transaction Concepts: Transactions and ACID Properties	CO2, CO3	1
3	Transaction States and Transaction Schedules	CO2, CO3	1
3	Concurrent Execution and Serializability	CO3	1
3	Two-Phase Locking (2PL) Protocol and Multiple Granularity Locking	CO3	1
3	Timestamp-Ordering Protocol and Validation-Based Protocol	CO3	1
3	Deadlock: Deadlock Handling and Prevention	CO3	1
3	Wait-Die Scheme and Wound-Wait Scheme	CO3	1
3	Recovery Management: Types of Failures and Log-Based Recovery	CO3	1

Module Number	Topic	COs Covered	No of Periods
3	Undo/Redo Operations and Checkpoints	CO3	1
3	Recovery Algorithms and Case Study on Transaction Recovery	CO3	1
4	Database Storage Fundamentals	CO4	1
4	Storage Hierarchy and RAID	CO3, CO4	1
4	Tree-Based Indexing: B-Tree	CO4	1
4	Tree-Based Indexing: B+ Tree	CO4	1
4	Hashing Techniques and Indexing Comparison	CO4	1
4	Basics of Query Processing and Query Optimization	CO3, CO4	1
4	SQLite: Architecture, Features, and Applications	CO4	1
4	Modern Databases: NoSQL Databases and Data Models	CO4	1
4	Document Databases and CRUD Operations	CO4	1
4	Graph Databases and CRUD Operations	CO4	1
4	Cloud Databases (DBaaS): Concepts, Architecture, and Applications	CO3, CO4	1
4	Case Study: Analyzing Scalable Modern Database Solutions for an E-Commerce Platform	CO3, CO4	1

H. Other Features/Components Covered

Percentage of Course Content covering Syllabus of GATE / Other Examinations	90%	Percentage of Course Content covering Emerging Trends, Tools and Technology	75%
---	------------	---	------------

I. Learning Resources (Text Books / Reference Books, Online Courses etc.,)

Learning Resources (Text Books / Reference Books, Online resources etc.,)	Text Books / Reference Books	Online resources
	Text Book-1: Database System Concepts, Authors: Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill Education 7th Edition 2019 Text Book-2: Database Management Systems Authors: Raghu Ramakrishnan, Johannes Gehrke, McGraw-Hill Education, 4th Edition 2026 Reference Book: An Introduction to Database Systems, Author: C. J. Date, Publisher: Addison-Wesley / Pearson Education, Latest edition: Eighth (2006)	(Preferably NPTEL or others) 1. Data Base Management System Instructor: Partha Pratim Das & Samiran Chattopadhyay Institute: IIT Kharagpur Duration: 8–12 Weeks Level: UG/PG (Core Course) Other's • Oracle Live SQL for SQL and PL/SQL programming. • MySQL and PostgreSQL official documentation. • SQLite, MongoDB, and Neo4j official documentation. • W3Schools SQL Tutorial for beginners. • GeeksforGeeks DBMS tutorials and practice problems.

J. Course Learning Assessment

CO \ RBT	CIA-I(50 Marks)					CIA-II(50 Marks)					SEE(50 Marks)				
	PART					PART					PART				
	A	B	C	D	Total (%)	A	B	C	D	Total (%)	A	B	C	D	Total (%)
CO1(K3)	3	6	14		46%						1	4	7		24%
CO2(K4)	2	4	14	7	54%						1	2	7	7	36%

CO3(K3)						3	6	14		46%	1	2	7		20%
CO4(K4)						2	4	14	7	54%	2	2	7	7	34%

K. Details of Self Learning (SL) Components/Activities for assigned SL Hrs.

S. No.	Component Name	CO(s)	# of Hrs.
SLC-1	Study NPTEL/Course Era video lectures on Database Fundamentals, ER Modeling, Relational Model, and SQL	CO1, CO2	8
SLC-2	Practice SQL queries using MySQL/Oracle Live SQL/SQLite , including DDL, DML, joins, nested queries, and aggregate functions	CO2	12
SLC-3	Complete assignments on Relational Schema Design, and Normalization (up to BCNF)	CO1, CO2	8
SLC-4	Study Transaction Management, Concurrency Control, Deadlock Handling, and Recovery Techniques through Problem-Based Learning (PBL)	CO3	7
SLC-5	Hands-on practice with Modern Databases : MongoDB (CRUD Operations), Neo4j (Graph Database), and SQLite	CO3, CO4	10
Total		45 Hours	

L. SDG Mapping and TRL Level (if applicable)

SDG: 4- Quality Education

9- Industry, Innovation and Infrastructure

TRL: 1 - 4 (Basic Principles, Technology concepts, Experimental proof and Technology Validated in Laboratory)



M. Course Design Details

Date of Revision	23.05.2026	BoS Number	43	Date of Approval of BoS	23.05.2026
Course Coordinator		Head of the Department Dr. A. PETER SOOSAI ANANDARAJ		Dean of the School DR. S P. CHOKKALINGAM	

Course Code & Name	2511IT3006 - DATABASE MANAGEMENT SYSTEMS LAB	Course Category	PC	L	T	P	C	Hrs / Week	Tot. Contact Hrs.	SL Hrs.*	Notional Hrs.
				0	0	2	1	2	30	0	30

A. Preamble

The Database Management Systems Laboratory provides practical experience in database design, SQL and PL/SQL programming, and normalization techniques. Students develop database objects, execute queries, and manage relational databases effectively. The laboratory also introduces NoSQL databases, including document and graph databases. Through hands-on exercises and a mini project, students build efficient real-world database applications.

B. Pre-requisite Courses

2510CS3002 - Fundamentals of Data Structures Lab

C. Course objectives

The objectives of this course are to:

- Provide practical knowledge of conceptual and relational database design using Entity–Relationship (ER) modeling, normalization techniques, and SQL.
- Develop proficiency in SQL and PL/SQL programming for creating, manipulating, and managing database objects to support efficient data storage and retrieval.
- Enable students to design, implement, and evaluate real-world database applications using relational, document, and graph database technologies.

D. Course outcomes

Course Outcomes (CO)	At the end of this course, students will be able to	RBT Level
CO1	Construct Conceptual and Relational database schemas using ER diagrams, Normalization and SQL statements.	S3

Course Outcomes (CO)	At the end of this course, students will be able to	RBT Level
CO2	Develop database applications using SQL/PL SQL advanced features for efficient data manipulation and retrieval.	S3
CO3	Design database solutions using relational, document and graph databases for real-world applications.	S4

E. Mapping of CO-POs, PSOs

Course Outcomes (CO)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2		3						2	3	2	
CO2	3	3	3	2	3						3	3	3	2
CO3	2	3	3	3	3						2	3	3	3

F. Course Content

b) Lab Task	CO Coverage	Contact Hours
Task 1: Conceptual Database Design - Identify entities, attributes, and relationships. - Define relationship cardinalities. - Draw an Entity–Relationship (ER) diagram.	CO1/S3	2
Task 2: Relational Database Model Design - Convert an ER diagram into a relational database schema. - Write SQL Data Definition Language (DDL) and Data	CO1/S3	4

Manipulation Language (DML) statements. Define primary keys, foreign keys, and integrity constraints.		
Task 3: Basic SQL Queries - Retrieve data using SQL queries. - Apply operators, clauses, and built-in functions. - Use aggregate, string, and date functions.	CO2/S3	2
Task 4: Nested Queries - Write nested and correlated subqueries. - Develop complex SQL queries using subqueries.	CO1/S3	2
Task 5: Join Queries - Write SQL queries using different types of joins. - Develop equivalent and complex join queries.	CO2/S3	2
Task 6: Normalization - Apply functional dependencies. - Normalize database tables up to Boyce–Codd Normal Form (BCNF). - Determine the minimal cover and canonical cover.	CO2/S3	4
Task 7: PL/SQL Programming - Develop PL/SQL procedures and functions. - Implement control structures and loops in PL/SQL programs.	CO2/S3	2
Task 8: Triggers and Views - Create triggers for database events. - Create and manage simple and complex views.	CO3/S4	4
Task 9: MongoDB Operations Design document database using MongoDB and perform CRUD operations using Mongoose	CO3/S3	2
Task 10: Graph Database Operations Design graph database (Neo4j/GraphQL) and perform CRUD operations	CO3/S3	2

Task 11: Develop simple application	CO1, CO2, CO3/S4	4
Develop a simple database application and apply the concepts for the given real-world scenarios		

G. Other Features/Components Covered

Percentage of Course Content covering Syllabus of GATE / Other Examinations	90%	Percentage of Course Content covering Emerging Trends, Tools and Technology	75%
---	------------	---	------------

H. Learning Resources (Text Books / Reference Books, Online Courses etc.,)

Learning Resources (Text Books / Reference Books, Online resources etc.,)	Text Books / Reference Books	Online resources
	Text Book-1: Database System Concepts, Authors: Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill Education 7th Edition 2019 Text Book-2: Database Management Systems Authors: Raghu Ramakrishnan, Johannes Gehrke, McGraw-Hill Education, 4th Edition 2026 Reference Book: An Introduction to Database Systems, Author: C. J. Date, Publisher: Addison-Wesley / Pearson Education, Latest edition: Eighth (2006)	(Preferably NPTEL or others) 1. Data Base Management System Instructor: Partha Pratim Das & Samiran Chattopadhyay Institute: IIT Kharagpur Duration: 8–12 Weeks Level: UG/PG (Core Course) Other's - Oracle Live SQL for SQL and PL/SQL programming. - MySQL and PostgreSQL official documentation. - SQLite, MongoDB, and Neo4j official documentation. - W3Schools SQL Tutorial for beginners. - GeeksforGeeks DBMS tutorials and practice problems.

I. Course Learning Assessment

CO \ RBT	MODEL LAB (40 MARKS)					SEE LAB (60 MARKS)				
	PART					PART				
	A	B	C	D	Total (%)	A	B	C	D	Total (%)
CO1 (S3)	—	—	—	—	Any two CO's for 100%	—	—	—	—	Any two CO's for 100%
CO2 (S3)	—	—	—	—		—	—	—	—	
CO3 (S3)	—	—	—	—		—	—	—	—	
Total Marks	—	—	—	—	100%	—	—	—	—	100%

Assessment Pattern

- **Model Lab Examination:** 50 Marks
- **End Semester Lab Examination:** 50 Marks
- **Total:** 100 Marks

Suggested Part-wise Split-up

Model Lab Examination (50 Marks)

7. Avg mark for experiments 25

8. Model lab 20

Algorithm / Logic -5 Marks

Program Coding Compilation & Execution -10Marks

Viva-Voce -5 Marks

9. Attendance 5



End Semester Lab Examination (50 Marks)

- Part A – Program Writing (Algorithm/Logic): 10 Marks
- Part B – Program Coding: 20 Marks
- Part C – Compilation & Execution: 10 Marks
- Part D – Output Verification / Viva-Voce: 10 Marks

J. SDG Mapping and TRL Level (if applicable)

SDG: SDG 4 – Quality Education

SDG 9 – Industry, Innovation and Infrastructure

TRL: TRL 1- Basic Principles

TRL 2- Technology, Concepts

TRL 3- Experimental Proof

TRL 4 – Technology Validated in Laboratory

K. Course Design Details

The course is designed based on the principles of Outcome-Based Education (OBE), ensuring alignment between Course Outcomes (Cos), teaching–learning methods, and assessment strategies.

Date of Revision	20.05.2026	BoS Number	43	Date of Approval of BoS	23.5.2026
		Dr. A. PETER SOOSAI ANANDARAJ		DR. S P. CHOKKALINGAM	
Course Coordinator		Head of the Department		Dean of the School	

Course Code & Name	2511IT1006 – PROGRAMMING USING JAVA	Course Category	PC	L	T	P	C	Hrs / Week	Tot. Contact Hrs.	SL Hrs.*	Notional Hrs.
				3	0	0	3	3	45	45	90

A. Preamble

This course focuses on the fundamentals of Java programming, object-oriented concepts, and effective data handling techniques. It equips students with practical skills for developing structured and efficient software applications through modular coding practices, runtime management, and systematic testing methods.

B. Pre-requisite Courses

2510CS1001 - Problem Solving Using C

C. Course Outcome

Course Outcomes (CO)	At the end of this course, students will be able to:	RBT Level
CO1	Apply fundamental Java programming concepts to develop simple applications for real-world problems.	K3/S3
CO2	Use programming techniques to develop reliable and efficient Java applications.	K3/S3
CO3	Develop organized Java applications by applying appropriate programming concepts and language features	K3/S3
CO4	Analyze program behavior to ensure correctness and performance.	K4/S3

D. Mapping of CO-POs, PSOs

Course Outcomes (CO)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	2	-	-	-	-	-	-	-	-	2	2	-
CO2	2	2	2	-	2	-	-	-	-	-	-	-	2	-
CO3	2	3	3	-	3	-	-	-	-	-	2	-	2	-
CO4	2	2	3	2	3	-	-	-	-	-	-	-	2	-

E. Course Content

a) Topics	CO Coverage	Contact Hours
MODULE 1: FUNDAMENTALS OF JAVA PROGRAMMING Introduction to object-oriented programming - features of Java - JVM architecture – keywords, variables - data types - operators - control statements – command line arguments – compile-time errors – classes – objects – methods – constructors - method overloading - this keyword - static members - type casting - number-based problems.	CO1	10
MODULE 2: ARRAYS, PACKAGES AND INHERITANCE Arrays and multidimensional arrays - array-based problems - Java packages - built-in and user-defined packages - access specifiers (private, protected, default, public), Basics and forms of inheritance - super keyword - final keyword - method overriding - abstraction using abstract classes and interfaces	CO1, CO2	9
MODULE 3: EXCEPTION HANDLING, MULTITHREADING AND STRING Exception handling (hierarchy, types, try-catch/finally/throw/throws,	CO2, CO3	9

a) Topics	CO Coverage	Contact Hours
custom exceptions) - Thread concepts - thread life cycle - multithreaded programming - thread synchronization. - - string class - immutable strings - string handling methods - string-based problems - runtime errors.		
MODULE 4: COLLECTIONS AND DATABASE CONNECTIVITY Java.lang.Object - array of objects - java.lang.Arrays - collection framework (ArrayList, LinkedList, Vector, HashMap, TreeMap) - JDBC architecture - database connectivity - CRUD operations (insert, update, delete, select, join) - transaction management (commit, rollback) - debugging JDBC code.	CO3	9
MODULE 5: MODERN JAVA FEATURES, TESTING AND DEBUGGING Java 8 features: Lambda expressions - functional interfaces - method references - streams API - date and time API - collectors API - Debugging and bug fixing: logic errors - infinite loops - timeout errors - software testing life cycle - JUnit framework, annotations - Unit Testing.	CO3, CO4	8

F. Course Content and Lecture Schedule

Module Number	Topic	COs Covered	No of Periods
1	Fundamentals of Java Programming	CO1	10
1.1	Introduction to OOP	CO1	1
1.2	Features of Java, JVM	CO1	1
1.3	Keywords, Variables, Data Types	CO1	1
1.4	Operators	CO1	1
1.5	Control Statements	CO1	1

Module Number	Topic	COs Covered	No of Periods
1.6	Command Line Arguments, Compile Time Errors	CO1	1
1.7	Classes, Objects	CO1	1
1.8	Methods, Constructors	CO1	1
1.9	Method Overloading, this, Static	CO1	1
1.10	Type Casting, Number Problems	CO1	1
2	Arrays, Packages and Inheritance	CO1, CO2	9
2.1	Arrays, Multidimensional Arrays	CO1	1
2.2	Array Problems	CO1	1
2.3	Java Packages (Built-in)	CO1	1
2.4	User-defined Packages	CO1	1
2.5	Access Specifiers	CO1	1
2.6	Basics of Inheritance, Forms of Inheritance	CO2	1
2.7	Super, Final keyword	CO2	1
2.8	Method Overriding,	CO2	1
2.9	Abstract Class, Interfaces	CO2	1
3	Exception Handling , Multithreading and String	CO2, CO3	9
3.1	Exception Hierarchy	CO2	1
3.2	Types of Exceptions	CO2	1
3.3	Try-Catch, Finally, Throw, Throws	CO2	1
3.4	Custom Exceptions	CO2	1

Module Number	Topic	COs Covered	No of Periods
3.5	Thread Concepts, Life Cycle	CO3	1
3.6	Multithreading	CO3	1
3.7	Thread Synchronization	CO3	1
3.8	String Class, immutable strings and Methods	CO3	1
3.9	String Problems, Runtime Errors	CO3	1
4	Collections and Database Connectivity	CO3	9
4.1	Java.lang. Object, Arrays Utility	CO3	1
4.2	ArrayList, LinkedList	CO3	1
4.3	Vector	CO3	1
4.4	HashMap, TreeMap	CO3	1
4.5	JDBC Architecture, Database Connection	CO3	2
4.6	CRUD Operations	CO3	1
4.7	Join, Commit, Rollback	CO3	1
4.8	Debugging JDBC Code	CO3	1
5	Modern Java Features, Testing and Debugging	CO3, CO4	8
5.1	Lambda Expressions, Functional Interfaces	CO3	1
5.2	Method References, Streams API	CO3	1
5.3	Date-Time API, Collectors API	CO3	1
5.4	Debugging (Logic Errors)	CO4	1
5.5	Infinite Loop, Timeout Errors	CO4	1

Module Number	Topic	COs Covered	No of Periods
5.6	Software Testing Life Cycle	CO4	1
5.7	JUnit Framework, Annotations	CO4	1
5.8	Unit Testing	CO4	1

G. Other Features/Components Covered

Percentage of Course Content covering Syllabus of GATE / Other Examinations	20%	Percentage of Course Content covering Emerging Trends, Tools and Technology	25%
---	-----	---	-----

H. Learning Resources (Text Books / Reference Books, Online Courses etc.,)

Learning Resources (Text Books / Reference Books, Online resources etc.,)	Text Books / Reference Books (IEEE Format)	Online resources (Preferably NPTEL or others)
	Text Books: [1] H. Schildt, <i>Java: The Complete Reference</i> , 13th ed. New York, USA: McGraw-Hill Education, 2024. [2] C. S. Horstmann, <i>Core Java Volume I—Fundamentals</i> , 14th ed. Boston, USA: Pearson / Oracle Press, 2026. [3] J. Bloch, <i>Effective Java</i> , 3rd ed. Boston, USA: Addison-Wesley, 2018. [4] K. Sierra and B. Bates, <i>Head First Java</i> , 2nd ed. Sebastopol, USA: O'Reilly Media, 2005. [5] E. Balagurusamy, <i>Programming with</i>	1. Programming in Java: https://nptel.ac.in/courses/106105191 2. Java Programming Basics https://www.coursera.org/search?query=java%20programming%20basics 3. JDK 26 Documentation https://docs.oracle.com/javase

	<i>Java: A Primer</i>, 6th ed. New Delhi, India: McGraw-Hill Education, 2019. Reference Books: [6] P. Deitel and H. Deitel, <i>Java How to Program: Early Objects</i>, 11th ed. Boston, USA: Pearson, 2018. [7] B. Eckel, <i>Thinking in Java</i>, 4th ed. Upper Saddle River, USA: Prentice Hall, 2006. [8] C. S. Horstmann, <i>Core Java Volume II—Advanced Features</i>, 14th ed. Boston, USA: Pearson, 2026. [9] H. Schildt, <i>Java: A Beginner's Guide</i>, 8th ed. New York, USA: McGraw-Hill Education, 2022. [10] R. C. Martin, <i>Clean Code: A Handbook of Agile Software Craftsmanship</i>. Boston, USA: Prentice Hall, 2008. [11] B. Goetz et al., <i>Java Concurrency in Practice</i>. Boston, USA: Addison-Wesley, 2006. [12] Y. D. Liang, <i>Introduction to Java Programming</i>, 12th ed. Boston, USA: Pearson, 2020.	
--	---	--

I. Course Learning Assessment

Theory Course

COs \ RBT	CIA Test-1					CIA Test-II					SEE				
	PART					PART					PART				
	A	B	C	D	Total (%)	A	B	C	D	Total (%)	A	B	C	D	Total (%)
CO1 (K3)	3	6	14	-	46%	-	-	-	-	0%	2	2	7	-	22%
CO2 (K3)	2	4	14	7	54%	-	-	-	-	0%	1	4	7	-	24%
CO3 (K3)	-	-	-	-	0%	3	6	14	-	46%	1	4	7	-	24%
CO4 (K4)	-	-	-	-	0%	2	4	14	7	54%	1	-	7	7	30%

J. Details of Self Learning (SL) Components/Activities for assigned SL Hrs.

S. No.	Component Name	# of Hrs.
SLC-1	Programming in Java https://nptel.ac.in/courses/106105191	10
SLC-2	Multithreading in Java https://infyspringboard.onwingspan.com/web/en/app/toc/1ex_auth_01384205303214080010965_shared/overview	9
SLC-3	Introduction to Database and SQL https://nptel.ac.in/courses/106105175	8
SLC-4	JDBC Basics https://docs.oracle.com/javase/tutorial/jdbc/basics/	10
SLC-5	Lambda Expressions https://dev.java/learn/lambdas/	8

K. SDG Mapping and TRL Level (if applicable)

SDG: SDG 4 – Quality Education

SDG 9 – Industry, Innovation and Infrastructure

TRL: TRL 3 – Experimental Proof of Concept



L. Course Design Details

The course is designed based on the principles of Outcome-Based Education (OBE), ensuring alignment between Course Outcomes (COs), teaching–learning methods, and assessment strategies. The content progresses from fundamental programming concepts to advanced Java features, enabling students to build scalable and efficient applications.

Date of Revision	23.05.2026	BoS Number	43	Date of Approval of BoS	23.05.2026
Course Coordinator		Head of the Department Dr. A. PETER SOOSAI ANANDARAJ		Dean of the School DR. S P. CHOKKALINGAM	

Course Code & Name	2511IT3005 – PROGRAMMING USING JAVA LABORATORY	Course Category	PC	L	T	P	C	Hrs / Week	Tot. Contact Hrs.	SL Hrs.*	Notional Hrs.
				0	0	2	1	2	30	0	30

A. Preamble

This laboratory course provides hands-on experience in implementing object-oriented programming concepts using Java. It enables students to develop, test, and debug Java applications using collections, JDBC, and modern Java features.

B. Pre-requisite Courses

2510CS3001 Problem Solving using C Laboratory

C. Course Objectives

Learners are exposed to:

- Develop fundamental Java programming and object-oriented programming skills.
- Apply Java, JDBC, Collections, Java 8, and JUnit concepts to solve practical problems.
- Design and implement simple Java applications using effective programming and database techniques.

D. Course Outcomes

Course Outcomes (CO)	At the end of this course, students will be able to:	RBT Level
CO1	Develop programs to solve computational problems using appropriate programming techniques.	S3
CO2	Construct software applications using suitable programming constructs and software development tools.	S3
CO3	Execute database connectivity, software testing, and debugging techniques to develop reliable Java applications	S3

E. Correlation of COs with Program Outcomes and Programme Specific Outcomes

Course Outcomes (CO)	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	-	2	-	-	-	-	-	2	2	2	-
CO2	2	2	2	-	3	-	-	-	-	-	2	2	2	-
CO3	2	2	3	2	3	-	-	-	-	-	2	2	3	-

3- High; 2-Medium; 1-Low

F. Course Contents

b) Lab Task	CO Coverage	Contact Hours
Part A		
Task 1: Develop simple Java programs using operators, conditional, and looping statements.	CO1	2
Task 2: Implement object-oriented concepts to create Java programs using classes, objects, and access control.	CO1	2
Task 3: Construct Java programs utilizing constructors and arrays for problem solving.	CO1	2
Task 4: Demonstrate inheritance concepts by developing Java programs.	CO1	2
Task 5: Implement polymorphism concepts to develop Java programs using method overloading and method overriding.	CO1	2
Task 6: Demonstrate abstraction techniques by developing Java	CO1	2

programs using abstract classes and interfaces.		
Task 7: Execute exception handling mechanisms to manage runtime errors in Java programs.	CO2	2
Task 8: Utilize string handling methods to perform string manipulation operations in Java programs.	CO2	2
Task 9: Develop multithreading applications to illustrate thread creation and synchronization techniques.	CO2	2
Task 10: Construct Java programs to establish database connectivity and perform CRUD operations using JDBC.	CO3	2
Task 11: Employ collection framework concepts to manage data using List, Set, and Map in Java programs.	CO2	2
Task 12: Perform unit testing by developing and executing test cases using JUnit framework.	CO3	2
Task 13: Utilize functional programming features to create Java programs using lambda expressions.	CO3	2
Part B		
<u>USE CASE / MINI PROJECT – 1</u>		
Title: Student Result Management System		
Question:		
Design and implement a Java console-based Student Result Management System .		
The system should:		
- Accept student details such as Registration Number, Name, and Marks in multiple subjects - Calculate total marks, average, and grade - Store student records using appropriate Collection classes		
	CO1-CO3	4

- Display student results in a structured format
- Handle invalid inputs using **exception handling**

Input: Student details and marks entered through console

Output: Student result report with total, average, grade, and status

USE CASE / MINI PROJECT – 2

Title: Employee Skill Evaluation System using Java 8

Question:

Design and implement an **Employee Skill Evaluation System** using Java 8 features.

The system should:

- Store employee names and skill scores in a collection
- Use **Lambda Expressions** and **Streams** to:
 - Filter employees with skill score above a given threshold
 - Sort employees based on skill score
- Validate inputs and display appropriate messages for invalid data
- Create appropriate test cases.

Input: Employee details and skill scores

Output: Filtered and sorted employee skill evaluation report

USE CASE / MINI PROJECT – 3

Title: Stock Management System using JDBC

Question:

Design and implement an **Inventory Management System** using Java and JDBC.

The system should:

- Connect to a relational database using JDBC.
- Create a table to store product details (Product ID, Product Name, Quantity, Price).
- Perform CRUD operations on product records.
- Search products by name and generate a low-stock report.
- Handle database exceptions and invalid user inputs.

Input: Product details and user-selected operations.

Output: Updated inventory records and inventory status report.

USE CASE / MINI PROJECT – 4

Title: Bank Account Management System using JDBC

Question:

Design and implement a **Bank Account Management System** using Java and JDBC.

The system should:

- Connect to a database using JDBC.
- Store customer and account details.
- Perform deposit, withdrawal, balance enquiry, and account update operations.
- Maintain transaction records and handle invalid transactions using exception handling.

Input: Customer account details and banking transactions.

Output: Updated account information and transaction summary.

USE CASE / MINI PROJECT – 5

Title: Course Registration System using Java 8

Question:

Design and implement a **Course Registration System** using Java 8

features. The system should: • Store student and course details using collection classes. • Register and drop courses for students. • Use Lambda Expressions and Streams to: ◦ Filter students enrolled in a selected course. ◦ Sort students based on registration date or student name. • Validate registration details and display appropriate messages for invalid operations. • Create appropriate test cases. Input: Student details, course details, and registration information. Output: Course registration report with enrolled students and registration status.		
--	--	--

G. Other Features/Components Covered

Percentage of Course Content covering Syllabus of GATE / Other Examinations	20%	Percentage of Course Content covering Emerging Trends, Tools and Technology	25%
---	-----	---	-----

H. Learning Resources (Text Books / Reference Books, Online Courses etc.,)

Learning Resources (Text Books / Reference Books, Online resources etc.,)	Text Books / Reference Books (IEEE Format)	Online resources (Preferably NPTEL or others)
	Text Book: C. S. Horstmann, <i>Core Java Volume I—Fundamentals</i>, 14th ed. Boston, USA: Pearson, 2026.	1. Programming in Java (NPTEL) https://nptel.ac.in/courses/106105191 2. Oracle Java Documentation (JDK 26)



	Reference Book: 1. Y. D. Liang, <i>Introduction to Java Programming</i> , 12th ed. Boston, USA: Pearson, 2020.	https://docs.oracle.com/javase 3. Oracle Java Tutorials https://dev.java 4. JUnit 5 User Guide https://junit.org/junit5/docs/current/user-guide
--	---	--

I. Course Learning Assessment

CO \ RBT	MODEL LAB (40 MARKS)					SEE LAB (60 MARKS)				
	PART					PART				
	A	B	C	D	Total (%)	A	B	C	D	Total (%)
CO1 (K3)	—	—	—	—	Any two CO's for 100%	—	—	—	—	Any two CO's for 100%
CO2 (K3)	—	—	—	—		—	—	—	—	
CO3 (K3)	—	—	—	—		—	—	—	—	
Total Marks	—	—	—	—	100%	—	—	—	—	100%

Assessment Pattern

- **Model Lab Examination:** 50 Marks
- **End Semester Lab Examination:** 50 Marks
- **Total:** 100 Marks

Suggested Part-wise Split-up

Model Lab Examination (50 Marks)

10. Average mark for experiments - 25

11. Model lab 20

Algorithm / Logic -5 Marks



Program Coding Compilation & Execution -10Marks

Viva-Voce -5 Marks

12. Attendance 5

End Semester Lab Examination (50 Marks)

- Part A – Program Writing (Algorithm/Logic): 10 Marks
- Part B – Program Coding: 20 Marks
- Part C – Compilation & Execution: 10 Marks
- Part D – Output Verification / Viva-Voce: 10 Marks

J. SDG Mapping and TRL Level (if applicable)

SDG: SDG 4 – Quality Education

SDG 9 – Industry, Innovation and Infrastructure

TRL: TRL 3 – Experimental Proof of Concept

K. Course Design Details

The course is designed based on the principles of Outcome-Based Education (OBE), ensuring alignment between Course Outcomes (COs), laboratory exercises, and assessment strategies. The laboratory content progresses from fundamental Java programming and object-oriented concepts to advanced topics such as exception handling, multithreading, collections, database connectivity, unit testing, and modern Java features, enabling students to develop, test, and debug efficient Java applications for real-world software development.

Date of Revision	23.05.2026	BoS Number	43	Date of Approval of BoS	23.05.2026
Course Coordinator		Head of the Department Dr. A. PETER SOOSAI ANANDARAJ		Dean of the School DR. S P. CHOKKALINGAM	