



**VIDYAVARDHINI'S COLLEGE OF ENGINEERING AND
TECHNOLOGY, VASAI-401202**

(Autonomous Institute Affiliated to University of Mumbai)

(NAAC & NBA Accredited)

F.Y. M. Tech Curriculum Structure and Syllabus
(Choice Based Credit Grading System)



Prepared by: Board of Studies (Department of Computer Engineering)

Approved by: Academic Council of VCET, Vasai(w)

(Effective from Academic year 2026-27)

Signed by

Chairman: BOS

Chairman: Academic Council

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Preamble

Vidyavardhini's College of Engineering and Technology (VCET), Vasai, with autonomous status effective from the Academic Year 2026–27, offers a forward-looking curriculum for the Master of Technology (M.Tech.) in Computer Engineering designed to meet industry standards, emerging technological trends, and national priorities. The autonomous status enables the institute to develop a flexible, industry-relevant, and continuously evolving academic framework.

Quality enhancement in technical education has become essential to meet the growing expectations of industry, research organizations, and society. With rapid advancements in computing technologies and digital transformation across all sectors, postgraduate programs in Computer Engineering must focus on innovation, research, analytical skills, and professional excellence. In this context, Vidyavardhini's College of Engineering and Technology, an autonomous institute affiliated to University of Mumbai, has developed a modern and flexible curriculum for the Master of Technology (M.Tech.) in Computer Engineering.

The curriculum is framed on the principles of Outcome-Based Education (OBE), ensuring that students acquire strong domain knowledge, technical proficiency, research aptitude, leadership qualities, and problem-solving skills. Clearly defined Course Outcomes (COs), Program Outcomes (POs), and Program Specific Outcomes (PSOs) facilitate effective teaching-learning processes and continuous academic improvement.

The implementation of the Choice Based Credit and Grading System (CBCS) promotes learner-centric education by providing flexibility, multidisciplinary learning opportunities, and continuous evaluation. The curriculum integrates advanced laboratories, project-based learning, seminars, and dissertation work to strengthen practical exposure, research competence, innovation, and self-learning abilities among students. Credits are assigned based on the learner's effort and time invested in the teaching-learning process. Each semester follows a 15-week academic schedule, wherein 13 weeks are allocated for curriculum delivery and the remaining 2 weeks are utilized for revision, guest lectures, industry interaction, and coverage of advanced topics beyond the syllabus. The total credit requirement of the program is 68 credits, with emphasis not only on knowledge acquisition but also on skill development, professional attitude, ethics, and lifelong learning.

The program also focuses on developing communication skills, teamwork, leadership qualities, and entrepreneurial abilities necessary for addressing real-world engineering challenges. The curriculum structure is aligned with the recommendations of All India Council for Technical Education and the academic guidelines of University of Mumbai.

The present curriculum for the Master of Technology (M.Tech.) in Computer Engineering shall be implemented from the Academic Year 2026–27.

Chairman

Board of Studies

Department of Computer Engineering

Vision of The Institute

- To be a premier institution of technical education, aiming at becoming a valuable resource for industry and society.

Mission of The Institute

1. To provide technologically inspiring environment for learning.
2. To promote creativity, innovation and professional activities.
3. To inculcate ethical and moral values.
4. To cater personal, professional and societal needs through quality education.

Vision of The Department

- To evolve as a center of excellence in the field of Computer Engineering to cater to industrial and societal needs.

Mission of The Department

1. To provide quality technical education with the aid of modern resources.
2. To inculcate creative thinking through innovative ideas and project development.
3. To encourage Life-long learning, leadership skills, entrepreneur skills with ethical & moral values.

Program Outcomes (PO)

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

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

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

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

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

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

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

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

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

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

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

Program Specific Outcomes (PSO)

1. Analyze problems and design applications of database, networking, security, web technology, cloud computing, machine learning using mathematical skills and computational tools
2. Develop computer-based systems to provide solutions for organizational, societal problems by working in multidisciplinary teams and pursue a career in IT industry

Program Educational Objectives (PEO)

1. To facilitate learners with a sound foundation in the mathematical, scientific and engineering fundamentals to accomplish professional excellence and succeed in higher studies in computer engineering domain.
 2. To enable learners to use modern tools effectively to solve real life problems in the field of computer engineering.
 3. To equip learners with extensive education necessary to understand the impact of computer technology in a global and social context.
 4. To inculcate professional and ethical attitude, leadership qualities, commitment to societal responsibilities and prepare the learners for life-long learning to built up a successful career in Computer Engineering.
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Knowledge and Attitude Profiles (WK)

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

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

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

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

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

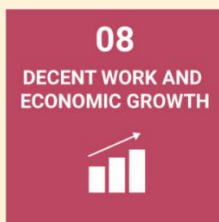
WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

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

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

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

Sustainable Development Goals (SDG)



Program Structure for First Year MTech Computer Engineering
Vidyavardhini's College of Engineering and Technology, Vasai Road
With effect from Academic year 2026-27

Sr. No	Course Code	Course Name	Teaching Scheme			Total Credits	Evaluation Scheme								
			L	T	P		IA- I	IA-II	IAT-I + IAT-II (AVG)	CIAT	ESE	Exam duration in hrs.	CIAL	PR / OR Exam	Total
SEM - I															
1	VMTechCEC101	Advanced Algorithm	3			3	20	20	20	20	60	3		100	
2	VMTechCEC102	Advance Computer Network and Design	3			3	20	20	20	20	60	3		100	
3	VMTechCEDLOC 1	Department Level Optional Course-1	3			3	20	20	20	20	60	3		100	
4	VMTechCEDLOC 2	Department Level Optional Course-2	3			3	20	20	20	20	60	3		100	
5	VMTechILOC1	Institute Level Optional Course-1	3			3	20	20	20	20	60	3		100	
6	VMTechCEL101	Computational Laboratory-1			2	1							25	25	50
7	VMTechCE102	Skill Based Lab-1			4	2							50	50	100
			5	0	2	18								650	

L: Lecture, T: Theory, P: Practical, IA: Internal Assessment, CIAT: Continuous Internal Assessment Theory, CIAL: Continuous Internal Assessment Lab, ESE: End Semester Evaluation, OR: Oral, PR: Practical

Course Code	Department Level Optional Course-1	Course Code	Institute Level Optional Course-I
VMTechCEDLOC1	<ol style="list-style-type: none"> AI in Cybersecurity Database Systems: Design and Implementation Computational Intelligence Modern Operating System 	VMTechILOC1	<ol style="list-style-type: none"> Product Lifecycle Management Reliability Engineering Management Information System Design of Experiments Operation Research Cyber Security and Laws Disaster Management & Mitigation Measures Energy Audit and Management Development Engineering
	Department Level Optional Course-1		
VMTechCEDLOC2	<ol style="list-style-type: none"> High Performance Computing Reinforcement Learning Internet of Everything Web Application Security 		

Program Structure for First Year MTech Computer Engineering
Vidyavardhini's College of Engineering and Technology, Vasai Road
With effect from Academic year 2026-27

Sr. No	Course Code	Course Name	Teaching Scheme			Total Credits	Evaluation Scheme								
			L	T	P		IA- I	IA-II	IAT-I + IAT-II (AVG)	CIAT	ESE	Exam duration in hrs.	CIAL	PR / OR Exam	Total
SEM - II															
1	VMTechCEC201	Cloud Computing and Services	3			3	20	20	20	20	60	3		100	
2	VMTechCEC202	Statistics and Exploratory Data Analytics	3			3	20	20	20	20	60	3		100	
3	VMTechCEDLOC3	Department Level Optional Course-3	3			3	20	20	20	20	60	3		100	
4	VMTechCEDLOC4	Department Level Optional Course-4	3			3	20	20	20	20	60	3		100	
5	VMTechILOC2	Institute Level Optional Course-2	3			3	20	20	20	20	60	3		100	
6	VMTechCEL201	Computational Laboratory-2			2	1							25	25	50
7	VMTechCEL202	Skill Based Lab-2			4	2							50	50	100
			5	0	2	18								650	

L: Lecture, T: Theory, P: Practical, IA: Internal Assessment, CIAT: Continuous Internal Assessment Theory, CIAL: Continuous Internal Assessment Lab, ESE: End Semester Evaluation, OR: Oral, PR: Practical

Course Code	Department Level Optional Course-3	Course Code	Institute Level Optional Course-2
VMTechCEDLOC3	1. Applied Natural Language Processing 2. Data Storage & Retrieval 3. Advance Soft Computing 4. Ethical Hacking and Digital Forensics	VMTechILOC2	1. Project Management 2. Finance Management 3. Entrepreneurship Development and Management 4. Human Resource Management 5. Professional Ethics and CSR 6. Research Methodology 7. IPR and Patenting 8. Digital Business Management 9. Environmental Management
	Department Level Optional Course-4		
VMTechCEDLOC4	1. Blockchain Technology & Applications 2. Generative AI 3. Design Thinking 4. Text, Web and Social Media Analytics		

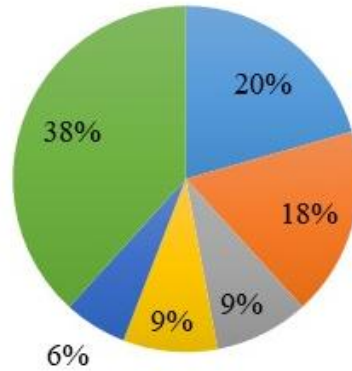
Program Structure for First Year MTech Computer Engineering
Vidyavardhini's College of Engineering and Technology, Vasai Road
With effect from Academic year 2026-27

Sr. No	Course Code	Course Name	Teaching Scheme			Total Credits	Evaluation Scheme								
			L	T	P		IA- I	IA-II	IAT-I + IAT-II (AVG)	CIAT	ESE	Exam duration in hrs.	CIAL	PR / OR Exam	Total
SEM - III															
1	VMTechCEMP301	Major Project: Dissertation – I			20	10							50	50	100
2	VMTechCEOCC301	Online Credit Course- I				3									
3	VMTechCEOCC302	Online Credit Course- II				3									
			0	0	1	16									100

Program Structure for First Year MTech Computer Engineering
Vidyavardhini's College of Engineering and Technology, Vasai Road
With effect from Academic year 2026-27

Sr. No	Course Code	Course Name	Teaching Scheme			Total Credits	Evaluation Scheme								
			L	T	P		IA- I	IA-II	IAT-I + IAT-II (AVG)	CIAT	ESE	Exam duration in hrs.	CIAL	PR / OR Exam	Total
SEM - IV															
1	VMTechCEMP301	Major Project: Dissertation –II			32	16							100	100	200
			0	0	1	16									200

**Credit Distribution of M.Tech Computer Engineering
Vidyavardhini's College of Engineering and Technology, Vasai Road
With effect from Academic year 2026-27**



- Core Courses
- Department Level Optional Courses
- Institute Level Optional Courses
- Online MOOC
- Skill Based Lab
- Project Based Learning

Program	F. Y. M. Tech Computer Engineering								
Course	Advanced Algorithm						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEC101	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Engineering Mathematics, Data Structures. Algorithms

Course Objectives:

1. To analyze algorithms in terms of their time and space complexity for efficient problem solving.
2. To develop skills in problem formulation and designing effective algorithmic solutions.
3. To gain knowledge of various applied algorithms and their practical significance.
4. To understand algorithms with applications in geometric modeling, graphics, and robotics.
5. To explore algorithmic concepts relevant to vision, computer animation, and real-world systems.
6. To cultivate the ability to select and implement appropriate algorithms for specific domains.

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Analyze various algorithms and evaluate their practical applications with respect to time and space complexity.
 CO2. Apply advanced design and analysis techniques to solve computational problems effectively.
 CO3. Apply various advanced data structures to solve computing problems.
 CO4. Explain and implement major graph algorithms along with their theoretical analyses.
 CO5. Analyze and apply linear programming techniques and string matching algorithms in solving optimization problems
 CO6. Design and evaluate algorithmic solutions for real-world problems using appropriate strategies and tools.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Fundamentals of Algorithms: Introduction to Algorithms, analyzing algorithms (Big Oh, small Oh, Omega, small Omega, Theta, Tilde), Growth of Functions, Recurrences, the substitution method, the recursion-tree method, the master method, Complexity of Recursive algorithms, Proving Techniques. Amortized Analysis (Aggregate, Accounting and Potential Method) Self-Learning: Case studies on amortized analysis in dynamic arrays and stacks	6	CO1
2	Dynamic Programming and Linear Programming: Elements of dynamic programming, Matrix-chain multiplication, Weighted Job Scheduling Algorithm, Graphical Method, Simplex Method, Standard and slack forms, Formulating problems as linear programs. Self-Learning: Applications of Linear Programming in resource allocation	6	CO2
3	Advanced Data Structures: Top-Down Splay Tree, Skew Heaps, Fibonacci Heaps, van Emde Boas Trees, AA-Trees, Treaps, Data Structures for Disjoint Sets. Self-Learning: Comparison of balanced tree structures	6	CO3
4	Graph Algorithms: Single-Source Shortest Paths-The Bellman-Ford algorithm, Dijkstra' s algorithm, Difference constraints and shortest paths ,All-Pairs Shortest Paths-The Floyd- Warshall algorithm, Maximum Flow-Flow networks, The Ford-Fulkerson method, Maximum bipartite matching Self-Learning: Graph traversal techniques in social networks	6	CO4

5	Computational Geometry: Line-segment properties, determining whether any pair of segments intersects, Finding the convex hull, Finding the closest pair of points Self-Learning: Applications of convex hull in image processing	6	CO5
6	Parallel & Applied Algorithms Integer Factorization Algorithms, Zero-Knowledge Proofs String Matching Algorithms: The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm, Longest common subsequence Parallel Algorithm: Mesh Algorithm and its applications Probabilistic Algorithm: Game Theoretic Techniques Randomized Algorithms: Monte Carlo and Las Vegas. Self-Learning: String matching applications in plagiarism detection	6	CO6

Learning Resources

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, PHI, India Second Edition, February 2010.
2. H. S. Wilf, “Algorithms and complexity”, Prentice hall, Summer 1994.
3. Horowitz, Sahani and Rajsekar, “Fundamentals of Computer Algorithms”, Galgotia, January 2008.

Reference Books:

1. “The Design and Analysis of Computer Algorithms” by Aho, Hopcroft, Ullman, 1974.
2. “Algorithm Design” by Kleinberg and Tardos, 16 March 2005.
3. “Data Structures and Algorithm Analysis in C” by Mark Allen Weiss, Pearson, September 1996.

Online Resources:

1. <https://www.geeksforgeeks.org/difference-between-big-o-notations-and-tilde/>
2. <https://www.tutorialspoint.com/Amortized-Analysis>

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (AA)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	3	2	2	1		1	1	1	1	2	3
CO2	3	2	3	2	2	1		1	1	1	1	3	2
CO3	3	2	3	2	2	1		1	1	1	1	2	3
CO4	3	2	3	3	2	1		1	1	1	1	2	3
CO5	2	3	3	3	2	1		1	1	1	1	3	2
CO6	3	2	3	2	2	1		1	1	1	1	2	3

Program	F. Y. M. Tech Computer Engineering								
Course	Advance Computer Network and Design						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEC102	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Computer Network, Security

Course Objectives:

1. To understand advanced internetworking concepts including congestion control, QoS, and resource allocation.
2. To understand routing principles and industry-standard routing protocols for IPv4 and IPv6 and high-availability routing design..
3. To understand IPv6 design, addressing, transition mechanisms, and related protocols.
4. To Develop skills in enterprise network design using top-down methodology , and design best practices for campus, data center, wireless, and WAN/VPN.
5. To understand fundamentals of ad hoc wireless networks including MAC, routing, and transport protocols and their constraints.
6. To understand Software-Defined Networking (SDN), OpenFlow, and Network Function Virtualization and their role in modern programmable networks.

Course Outcomes:

After successful completion of the course, the learner will be able to:

CO1. Analyze congestion-control and queuing mechanisms (FIFO, fair queuing, RED, DECbit) and describe TCP congestion-control algorithms, with examples.

CO2. Analyze the appropriate QoS mechanisms (Integrated Services/RSVP, Differentiated Services: EF/AF) for given application requirements and traffic profiles. .

CO3. Configure basic IPv4/IPv6 routing on network simulators/emulators using RIP, OSPF, EIGRP, and BGP, and justify protocol selection for a given topology.

CO4. Design a multi-layer enterprise network (access, distribution, core) that meets capacity, redundancy, and security requirements, and produce a written design document using PPDIIO.

CO5. Compare ad hoc MAC and routing protocols (MACA variants, DSDV, DSR, AODV, ZRP) and evaluate their suitability for a stated mobile scenario using simulation results.

CO6. Demonstrate basic SDN concepts by deploying a controller and programming simple OpenFlow flow rules or NFV functions in a lab environment and reporting performance observations.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Congestion control and resource allocation: issues of resource allocation, queuing disciplines such as FIFO and Fair Queuing, TCP congestion control using Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery. Congestion-avoidance mechanisms: Random Early Detection, Explicit Congestion Notification, CoDel, PIE, and Quality of Service with application requirements, Integrated Services overview, Differentiated Services (EF, AF), and QUIC transport overview.	6	CO1
2	IPv4 routing principles, Routing Information Protocol (conceptual overview), EIGRP, OSPF for IPv4 and IPv6, Border Gateway Protocol, high availability routing, open-source routing platforms, routing automation basics, and BGP security using RPKI and filtering practices.	6	CO2
3	IPv4 deficiencies, IPv6 addressing, multicast, anycast, ICMPv6, Neighbour Discovery, IPv6 routing, IPv6 protocols, SLAAC and DHCPv6, IPv6 privacy extensions, IPv6 security mechanisms, and IPv6 transition and tunneling techniques.	6	CO3

4	Designing network topology and solutions using the top-down approach, PPDIIO, network design layers including access, distribution, and core/backbone layers, access layer design, backbone network design, enterprise LAN design, campus design best practices, virtualization and data center design, leaf-spine concepts, wireless LAN design, WAN and VPN design, network observability and telemetry, and resilience testing with failover validation.	6	CO4
5	MAC protocols for ad hoc wireless networks including MACA/W and MACA/PR, routing protocols for ad hoc wireless networks including DSDV, DSR, AODV, and ZRP, transport layer ATCP, 6LoWPAN, RPL basics, energy-aware routing, and security in ad hoc and IoT wireless networks.	6	CO5
6	Introduction to Software Defined Networking, control and data planes, SDN controllers, OpenFlow basics, controller programmability, policy-based automation, intent-based networking, Network Function Virtualization concepts, and service chaining overview.	6	CO6

Learning Resources

Text Books:

1. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, Elsevier, Fourth Edition.
2. Philip M. Miller, TCP / IP: The Ultimate Protocol Guide Applications, Access and Data Security - Vol 2, Wiley
3. Pete Loshin, IPv6: Theory, Protocols and Practice, Morgan Kaufmann, 2nd Edition, 2004
4. Anthony Bruno, Steve Jordan, Official Cert Guide: CCDA, Cisco Press,
5. C. Siva Ram Murthy, B.S. Manoj, Ad Hoc Wireless Networks: Architectures and, Prentice Hall, 2004.
6. Thomas D Nadeau and Ken Grey, Software Defined Networking, O'Reilly, 2013
7. James F. Kurose & Keith W. Ross , Computer Networking: A Top-Down Approach, 8th ed., Pearson.
8. Larry L. Peterson & Bruce S. Davie, Computer Networks: A Systems Approach, 6th ed., Morgan Kaufmann.
9. Andrew S. Tanenbaum & David J. Wetherall, Computer Networks, 5th ed., Pearson.
10. Silvia Hagen , IPv6 Essentials, 3rd ed., O'Reilly.
11. Ilya Grigorik, High Performance Browser Networking, O'Reilly
12. Jason Edelman, Scott S. Lowe, Matt Oswalt , Network Programmability and Automation, O'Reilly.
13. Software Defined Networks: A Comprehensive Approach — Paul Goransson, Chuck Black, Timothy Culver (2nd ed.).

Reference Books:

1. William Stallings, High-Speed Networks and Internets, Pearson Education, 2nd Edition, 2002.
2. James F. Kurose, Keith W. Ross, —Computer Networking, A Top-Down Approach Featuring the Internet, Third Edition, Addison Wesley, 2004.
3. Pujolle, Software Networks: Virtualization, SDN, 5G, Security, Wiley,
4. Gary A. Donahue , Network Warrior , O'Reilly.
5. Eric Chou, Mastering Python Networking / Network Automation with Python.

Online Courses:

1. Computer Networks and Internet Protocol (IIT Kharagpur) <https://nptel.ac.in/courses/106105183>
2. Advanced Computer Networks (IIT Indore / IIT Gandhinagar) <https://nptel.ac.in/courses/106106243>
3. Advanced Computer Networks (recent offering on Swayam-NPTEL) https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs60
4. Computer Networks and Internet Protocols (Swayam / NPTEL preview/archives)
5. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs35 Specialized/Topic lectures (NPTEL video lectures on SDN and IoT topics)
6. <http://www.digimat.in/nptel/courses/video/106105166/L33.html>

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 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- The options should be of comparable difficulty level and should test similar learning outcomes.
- Internal choice may be provided within each question, ensuring both options cover the same module.
- Students will attempt all questions.

CO-PO-PSO Mapping (ACND)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	1	1	1	-	2
CO2	2	3	2	2	-	-	-	-	1	1	1	-	2
CO3	3	2	2	2	-	-	-	-	1	1	1	-	2
CO4	2	2	2	2	-	-	-	-	1	1	1	-	2
CO5	1	1	1	2	-	-	-	-	1	1	1	-	2
CO6	2	1	1	1	-	-	-	-	1	1	1	-	2

Program	F. Y. M. Tech Computer Engineering								
Course	AI in Cyber Security						Semester	I	
Code	Credits	Teaching Scheme (Hrs./Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEDLOC11	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Basic knowledge of computer networks, operating systems, programming, and fundamentals of artificial intelligence or machine learning.

Course Objectives:

1. To understand fundamental concepts of cyber security, cyber threats, and attack mechanisms.
2. To learn the role of artificial intelligence in enhancing cyber security systems.
3. To apply machine learning techniques for intrusion detection and cyber threat analysis.
4. To analyze malware, phishing, and malicious activities using deep learning approaches.
5. To explore AI-based network security, cloud security, and IoT security applications.
6. To understand advanced and emerging trends in AI-driven cyber security including ethical and privacy aspects

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Illustrate the fundamental concepts of cyber security, cyber threats, attack taxonomy, and the role of artificial intelligence in security systems.
- CO2. Apply supervised and unsupervised machine learning algorithms for intrusion detection, anomaly detection, and cyber threat intelligence.
- CO3. Analyze malware, phishing, and malicious behaviors using deep learning models such as ANN, CNN, RNN/LSTM, and NLP techniques.
- CO4. Apply AI-based techniques for network traffic analysis, SIEM systems, cloud security, and IoT threat detection.
- CO5. Apply advanced AI security techniques and privacy-preserving mechanisms for secure cyber defense systems.
- CO6. Analyze emerging research trends, ethical challenges, and real-world applications of AI in cyber security domains.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Foundations of Cyber Security and Artificial Intelligence Fundamentals of Cyber Security and Threat Analysis: Advanced Concepts in Cyber Security, Cyber Threat Landscape and Attack Taxonomy, Security Analytics and Risk Assessment (Decision Trees, Bayesian Networks) Artificial Intelligence for Cyber Security: Fundamentals of Artificial Intelligence and Machine Learning, Intelligent Agents and Autonomous Security Systems, Rule-based Security Models, Uncertainty Handling in Security Systems (Fuzzy Logic Systems)	6	CO1
2	Machine Learning for Cyber Threat Intelligence Security Analytics and Threat Detection: Security Data Acquisition and Preprocessing, Feature Engineering for Security Analytics, Intrusion Detection and Prevention Systems (IDS/IPS) using Support Vector Machine (SVM) and Random Forest Algorithms AI-based Threat Intelligence: Anomaly and Threat Detection (K-Nearest Neighbors (KNN), Naïve Bayes Classifiers), Cyber Threat Intelligence using AI Techniques, Unsupervised Threat Analysis (K-Means, DBSCAN Clustering Algorithms)	6	CO2
3	Deep Learning for Malware and Phishing Detection AI-based Malware and Threat Detection: AI-based Malware Analysis, Static and Dynamic Malware Classification using Artificial Neural Networks (ANN) and Convolutional Neural Networks (CNN), Behavioral Analysis of Malicious Activities using Recurrent Neural Networks (RNN/LSTM) NLP Applications in Cyber Security: Phishing, Spam, and Fake Website Detection using Natural Language Processing (NLP) Techniques, Text Feature	6	CO3

	Extraction (TF-IDF and Word Embeddings), Cyber Threat Detection using Transformer-based NLP Models		
4	<p>AI-driven Network Security Analytics AI for Network Threat Detection and Monitoring: AI for Network Traffic Analysis using Principal Component Analysis (PCA) and Autoencoders, Detection of DDoS, Botnet, and Zero-Day Attacks using Isolation Forest and Ensemble Learning Techniques, Predictive and Real-Time Threat Monitoring using Machine Learning Models AI in Security Operations, Cloud and IoT Security: Security Information and Event Management (SIEM) using AI-based Analytics, Sequential Attack Pattern Detection using Hidden Markov Models (HMM), AI-based Threat Detection for Cloud and IoT Security Environments, Intelligent Event Correlation and Security Analytics using Ensemble Learning Algorithms</p>	6	CO4
5	<p>Advanced Topics in AI Security Intelligent and Autonomous Security Systems: Adversarial Machine Learning using Generative Adversarial Networks (GAN), Explainable AI (XAI) for Security Systems using Explainable AI Models, Reinforcement Learning for Autonomous Defense using Deep Reinforcement Learning Techniques Secure and Privacy-Preserving AI: AI-assisted Penetration Testing and Vulnerability Assessment, Privacy-Preserving AI using Federated Learning Techniques, Secure Data Sharing and Model Training using Differential Privacy Methods, Advanced AI-based Security Frameworks and Defense Mechanisms</p>	6	CO5
6	<p>Research Trends, Case Studies, and Applications AI Applications and Intelligent Secure Systems: AI Applications in Banking, Healthcare, Smart Cities, and Industrial Security, Blockchain and AI for Secure Systems, AI-based Fraud Detection and Threat Intelligence Systems Ethical and Emerging Trends in AI Security: Ethical, Legal, and Privacy Challenges in AI Security, Explainable and Trustworthy AI in Cyber Defense, Recent Research Trends: Generative AI, Autonomous Security Systems, Zero Trust Security, Quantum-safe Security</p>	6	CO6

Learning Resources

Text Books:

1. Clarence Chio, David Freeman. Machine Learning and Security: Protecting Systems with Data and Algorithms, O'Reilly, 2018.
2. Mark Stamp, Corrado Aaron Visaggio, Francesco Mercaldo, Fabio Di Troia. Artificial Intelligence for Cybersecurity. Springer Nature Switzerland AG, 2022

Reference Books:

1. B. Gupta, D. P. Agrawal, Haoxiang Wang. Artificial Intelligence for Cybersecurity: Techniques, Applications and Research Issues. Springer, 2023
2. [Mark Stamp](#), [Martin Jureček](#). Machine Learning, Deep Learning and AI for Cybersecurity. Springer, 2025
3. Emmanuel Tsukerman. Machine Learning for Cybersecurity Cookbook, O'Reilly, 2019.

Online Courses:

1. AI for IoT and Cyber Security- IIT Indore (Prof. Somnath Dey), Swayam NPTEL, <https://elearn.nptel.ac.in/product-page/ai-for-iot-and-cyber-security>
2. AI for Cybersecurity – (Darius Bufeana), Coursera, <https://www.coursera.org/learn/ai-for-cybersecurity>

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (AICS)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	1	-	-	1	-	-	2	2	1
CO2	2	3	2	2	3	-	-	-	-	-	2	3	2
CO3	2	3	2	3	3	-	-	-	-	-	2	3	2
CO4	2	3	3	2	3	1	-	-	-	-	2	3	3
CO5	2	3	2	2	3	1	-	2	-	-	3	2	2
CO6	2	2	-	1	2	-	2	3	-	1	3	2	2

Program	F. Y. M. Tech Computer Engineering								
Course	Database Systems: Design and Implementation						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEDLOC12	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites: Basic knowledge of Database Management System.

Course Objectives:

1. To introduce principles and foundations of distributed database.
2. To impart knowledge of query processing and optimization.
3. To introduce the concept of document-oriented database.
4. Understand the usage of advanced data models for real life application.
5. To create awareness about potential security threats to a database and mechanisms to handle it.
6. To apply advanced databases in real-world applications.

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Design distributed databases using fragmentation, allocation, replication, and transparency concepts.
- CO2. Analyze query processing, decomposition, localization, and optimization techniques in distributed databases.
- CO3. Analyze object-oriented and document-oriented database systems.
- CO4. Apply temporal and spatial data models for real-world applications.
- CO5. Implement database security techniques including authentication, authorization, auditing, and access control mechanisms.
- CO6. Apply advanced database technologies for different applications.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	<p>Introduction: Centralized versus non centralized Databases, Homogeneous and Heterogeneous DDBMS and their comparison, Distributed database design: Concept, Objective of Data Distribution Data Fragmentation, The allocation of fragment, Concepts of replication servers, Transparencies in Distributed Database Design. Self-Learning: Case study on centralized and distributed database systems</p>	6	CO1
2	<p>Query Processing and Optimization: Query Processing Problem, Objectives of Query Processing, Complexity of Relational Algebra Operations, Layers of Query Processing, Query Decomposition and Data Localization: Query Decomposition Localization of Distributed Data. Self-Learning: Case study for query optimization techniques in distributed databases</p>	6	CO2
3	<p>Document oriented database Object Oriented Database: Need of object-oriented database, Impedance matching problem between OO languages and Relational databases, Case study db4O. Document Oriented Database: Need of Document Oriented database, difference between Document Oriented Database and Traditional database, Types of encoding XML, JSON, BSON, Representation XML, Json Objects. Case study on doc oriented based such a MongoDB Self-Learning: Case study on modern document-oriented databases.</p>	6	CO3
4	<p>Advanced data models: Temporal data models, Aspects of valid time, Bitemporal time and bi-temporal time with examples of each. Spatial model: Types of spatial data models - Raster, Vector and Image</p>	6	CO4

	Self-Learning: Practice valid time and bi-temporal data representation.		
5	Data Security Introduction to Database Security Issues: Authentication and authorization, Database auditing, Discretionary Access Control Based on Granting and Revoking Privileges, Mandatory Access Control and Role-Based Access Control for Multilevel Security Introduction to Statistical Database Security Self-Learning: Practice SQL privilege management using GRANT and REVOKE.	6	CO5
6	Advance Databases: AI-enabled Database Systems , Mobile databases, NoSQL, Native XML databases (NXD), Document oriented databases, Graph database Federated Databases: Architecture, Development task, System operation Self-Learning: Study of AI-enabled database systems and applications.	6	CO6

Learning Resources

Text Books:

1. Elmasri&Navathe, —Fundamentals of Database Systems| IV edition. PEARSON Education.
2. Korth, Silberschatzsudarshan, —Database systems, concepts| 5th edition McGraw Hill
3. Sibaram Prasad Panda, —Relational, NoSQL, and Artificial Intelligence-Integrated Database Architectures|, Deep Science Publishing, 2025.
4. M. Tamer Ozsu , Patrick Valduriez, —Principles of Distributed Databases|, Pearson Education India

Reference Books:

1. Chhanda Ray, —Distributed Database Systems|, Pearson Education India.
2. Hector Garcia-Molina, Jeffery D. Ullman, Jennifer Widom, —Database system Implementation|
3. Thomas M.Connolly Carolyn Begg, Database Systems: A practical Approach to Design, Implementation and Management, 4/e.
4. Elisa Bertino, Barbara Catania & Gian Piero Zarri, —Intelligent Database Systems|, Addison Wesley.

Online Courses:

1. [Neo4j GraphAcademy](#)
Specialized learning for graph databases and graph data modeling.
2. [IBM SkillsBuild – Artificial Intelligence Fundamentals](#)
Useful for understanding AI-enabled database applications and intelligent systems.

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.

- d. Internal choice may be provided within each question, ensuring both options cover the same module.
e. Students will attempt all questions.

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	2	2	1	1	1	1	-	-	3	2
CO2	2	3	2	3	2	1	1	1	1	-	-	3	2
CO3	2	2	3	2	2	1	1	1	1	-	-	3	3
CO4	2	2	3	2	3	1	1	1	1	-	-	2	3
CO5	2	2	2	3	3	1	1	1	1	-	-	1	2
CO6	2	2	3	2	3	1	1	1	1	2	2	3	

Program	F. Y. M. Tech Computer Engineering								
Course	Computational Intelligence						Semester	I	
Code	Credits	Teaching Scheme (Hrs./Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEDLOC13	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Basic knowledge of Artificial Intelligence, probability, optimization techniques, and programming fundamentals.

Course Objectives:

1. To understand the paradigms and applications of Computational Intelligence.
2. To learn artificial neural networks and support vector machine models.
3. To study fuzzy systems and fuzzy inference mechanisms.
4. To explore optimization techniques using genetic algorithms and swarm intelligence.
5. To understand artificial immune systems and bio-inspired intelligent systems.
6. To apply computational intelligence techniques for solving real-world engineering problems.

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Illustrate the paradigms, techniques, and applications of Computational Intelligence.
 CO2. Apply Artificial Neural Networks and Support Vector Machines for classification and learning problems.
 CO3. Analyze fuzzy systems, fuzzy relations, and fuzzy inference mechanisms for intelligent decision-making.
 CO4. Apply optimization techniques using Genetic Algorithms and Swarm Intelligence methods.
 CO5. Illustrate Artificial Immune System models and algorithms for intelligent problem-solving.
 CO6. Analyze real-world applications of Computational Intelligence in optimization, path finding, and pattern recognition.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction to Computational Intelligence Introduction to Computational Intelligence, Paradigms of Computational Intelligence, Difference between Artificial Intelligence and Computational Intelligence, Approaches to Computational Intelligence, Synergies of Computational Intelligence Techniques, Applications of Computational Intelligence, Grand Challenges of Computational Intelligence.	6	CO1
2	Artificial Neural Networks and Support Vector Machine Basic Models of ANN: Neural Network Architecture, McCulloch-Pitts (MP) Neuron, Linear Separability, Activation Functions, Types of Learning. Learning Rules: Hebbian Rule, Perceptron Rule, Delta Rule, Winner-Take-All Learning. Supervised Neural Networks: Perceptron Networks – SDPTA, SCPTA, MCPTA, Adaline Networks. Support Vector Machine: Binary SVM, Hyperplane Concept, Applications of SVM in Classification Problems.	6	CO2
3	Fuzzy Systems Fuzzy Sets: Definition, Operations, Properties, Relations, Characteristics, Membership Functions. Fuzzy Logic and Inference: Fuzzification, Defuzzification, Fuzzy Rules and Reasoning, Fuzzy Inference Systems. Applications of Fuzzy Systems: Intelligent control systems and decision-making applications.	6	CO3
4	Optimization using Genetic Algorithms and Swarm Intelligence Genetic Algorithms: Selection, Encoding Techniques, Crossover, Mutation, Fitness Function, Applications of Genetic Algorithms. Swarm Intelligence: Particle Swarm Optimization (PSO), Guaranteed Convergence PSO, Social-Based PSO, Binary PSO, Hybrid PSO Algorithms.	6	CO4

	Ant Colony Optimization: Simple Ant Colony Optimization Algorithm and Path Optimization.		
5	Artificial Immune System Natural Immune System: Classical View, Antibodies and Antigens. Artificial Immune Models: Artificial Immune System Algorithm, Classical View Models, Clonal Selection Algorithm (CLONALG), Applications of Artificial Immune Systems. Bio-inspired Intelligent Systems and Adaptive Learning Concepts.	6	CO5
6	Applications of Computational Intelligence Character Recognition using ANN, Genetic Algorithms in Game Playing, Color Recipe Prediction using Single MLP Approach, Ant Algorithm and Swarm Intelligence for Travelling Salesman Problem (TSP), Intelligent Best Path Finding Techniques, Engineering and Industrial Applications of Computational Intelligence.	6	CO6

Learning Resources**Text Books:**

1. S. N. Sivanandam and S. N. Deepa, *Principles of Soft Computing*, Wiley India.
2. Andries P. Engelbrecht, *Computational Intelligence: An Introduction*, Wiley.
3. Rajasekaran and Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms*, PHI.
4. David E. Goldberg, *Genetic Algorithms in Search, Optimization and Machine Learning*, Pearson.

Reference Books:

1. George J. Klir and Bo Yuan, *Fuzzy Sets and Fuzzy Logic: Theory and Applications*, PHI.
2. James A. Freeman and David M. Skapura, *Neural Networks: Algorithms, Applications and Programming Techniques*, Pearson.
3. Xin-She Yang, *Nature-Inspired Optimization Algorithms*, Elsevier.
4. Eberhart, Simpson and Dobbins, *Computational Intelligence PC Tools*, Academic Press.
5. Christopher Bishop, *Pattern Recognition and Machine Learning*, Springer.

Online Courses:

1. Soft Computing – NPTEL, <https://nptel.ac.in/>
2. Computational Intelligence – Coursera, <https://www.coursera.org/>
3. Artificial Intelligence and Soft Computing – Swayam NPTEL, <https://onlinecourses.nptel.ac.in/>

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.

- c. The options should be of comparable difficulty level and should test similar learning outcomes.
 d. Internal choice may be provided within each question, ensuring both options cover the same module.
 e. Students will attempt all questions.

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	3	1	1	1	1	1	1	2	3
CO2	3	3	3	1	3	1	-	-	1	-	-	2	3
CO3	3	3	2	3	3	1	-	-	1	-	-	3	3
CO4	3	3	3	2	3	1	-	-	1	1	-	2	3
CO5	3	3	2	1	3	1	-	-	1	-	-	2	3
CO6	3	3	3	3	3	3	1	1	2	1	3	2	2

Program	M. Tech Computer Engineering								
Course	Modern Operating System						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEDLOC14	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Basic Operating System concepts

Course Objectives:

1. To learn the architectural and design issues related to Operating System.
2. To learn distributed systems and Real time operating system.
3. To get a thorough knowledge of database operating systems and cloud operating System.

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Apply the principles and concepts in analyzing and designing Operating System.
 CO2. Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system.
 CO3. Apply the fault handling concepts in distributed operating system.
 CO4. Analyze the performance and reliability of real time Operating Systems.
 CO5. Analyze the performance and reliability of database Operating Systems.
 CO6. Analyze the performance and reliability of mobile Operating Systems.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Types of Operating Systems. Architectures and design issues of Network Operating Systems, Distributed Operating Systems, Middleware, Real-Time Systems, and Database Operating Systems. Introduction to processes, concurrent processes, critical section problems, formal memory models, weak consistency issues, modern concurrency primitives, and concurrency debugging tools	6	CO1
2	Scheduling: issues in load distributing, components of load distributing algorithms, stability, performance comparison, selecting a suitable load sharing algorithm, adaptive load-aware scheduling, and cloud/container scheduling basics. Synchronization: physical and logical clocks, NTP and PTP concepts. Distributed Mutual Exclusion: introduction, classification overview, and key mutual exclusion algorithms. Distributed Deadlock: introduction, deadlock handling strategies, detection issues and resolution, control organizations, centralized, distributed, and hierarchical algorithms. Scheduling considerations for microservice-based distributed systems.	6	CO2
3	Agreement Protocol: system model, classification overview, Byzantine Agreement Problem, and Raft consensus overview. Fault Recovery: concepts, classification of failures, backward error recovery, recovery in concurrent systems, consistent checkpoints, synchronous and asynchronous check pointing and recovery. Fault tolerance: issues, atomic actions and committing, commit protocols, non-blocking commit protocols, voting protocols, dynamic voting concepts, fault injection principles, and observability using tracing and metrics.	6	CO3
4	Types of real-time tasks: timing constraints, modeling timing constraints, task characteristics, clock-driven scheduling, hybrid schedulers, event-driven scheduling, EDF scheduling, Rate Monotonic Algorithm, multicore real-time scheduling, partitioned and global approaches, mixed-criticality scheduling basics, resource sharing, priority inversion, PIP, PCP, HLP, scheduling real-time tasks in distributed systems, and	6	CO4

	Time-Sensitive Networking overview.		
5	Concurrency control in database systems: problems of concurrency control, serializability theory, distributed database systems, lock-based, timestamp-based, optimistic, and replication-based concurrency control algorithms, multi-version concurrency control, distributed transaction models including two-phase commit and sagas, and consistency models in geo-distributed databases.	6	CO5
6	Case studies of Distributed Operating Systems: Mach and Amoeba (key concepts). Real-Time Operating Systems: UNIX as RTOS and Windows as RTOS. Mobile OS concepts, mobile OS security and sandboxing, Cloud OS concepts, cloud-native operating system primitives including containers, namespaces and cgroups, and serverless execution environment basics.	6	CO6

Learning Resources**Text Books:**

1. Mukesh Singhal, Niranjan G. Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems" MC Graw Hill education.
2. Rajib Mall, —Real-Time Systems: Theory and Practice, Pearson education.
3. Anthony Williams, C++ Concurrency in Action, 2nd ed.
4. Kleppmann, M. — Designing Data-Intensive Applications, 1st Edition, O'Reilly Media.
5. Liu, J. W. S. — Real-Time Systems, 1st Edition (or latest), Pearson / Prentice Hall.
6. Özsu, M. T. & Valduriez, P. — Principles of Distributed Database Systems, 4th Edition, Springer
7. Burns, A. & Wellings, A. — Real-Time Systems Design and Analysis, 4th Edition, Wiley (for RTOS aspects);
8. Hightower, K., Burns, B., & Beda, J. — Kubernetes: Up & Running, 2nd Edition, O'Reilly Media

Reference Books:

1. Andrew S. Tanenbaum, "Modern Systems Principles and Paradigms". PHI.
2. Pradeep K. Sinha, "Distributed Operating System-Concepts and design", PHI.
3. Andrew S. Tanenbaum, "Distributed Operating System", Pearson Education.
4. Jane W. S. Liu, —Real Time Systems, Pearson education. (edition)

Online Courses:

1. Distributed Systems (NPTEL) https://onlinecourses.nptel.ac.in/noc21_cs87/
2. Advanced Distributed Systems https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs80

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.

- vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (MOS)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	1	-	-	-	1	1	1	-	2
CO2	2	2	2	2	1	-	-	-	1	1	1	-	2
CO3	2	2	2	2	1	-	-	-	1	1	1	-	2
CO4	2	2	2	2	1	-	-	-	1	1	1	-	2
CO5	1	1	1	2	1	-	-	-	1	1	1	-	2
CO6	2	1	1	1	1	-	-	-	1	1	1	-	2

Program	F. Y. M. Tech Computer Engineering								
Course	High Performance Computing						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme			Laboratory Examination Scheme	
VMTechCEDLOC21	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Computer Architecture, Operating System, Cloud Computing

Course Objectives:

1. Introduce the fundamental concepts of high-performance computing (HPC) architecture and parallel computing.
2. Provide foundations for developing, analyzing, and implementing parallel algorithms using parallelization paradigms like MPI, OpenMP, OpenCL, and CUDA.
3. Introduce range of activities associated with HPC in Cloud

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO.1 Understand parallel and pipeline processing approaches
- CO2. Design a parallel algorithm to solve computational problems and identify issues in parallel programming.
- CO3. Analyze the performance of parallel computing systems for clusters in terms of execution time, total parallel overhead, speedup.
- CO4. Develop efficient and high-performance parallel algorithms using OpenMP and message passing paradigm
- CO5. Develop high-performance parallel programming using OpenCL and CUDA framework
- CO6. Perform the range of activities associated with High Performance Computing in Cloud Computing

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction to Parallel Computing: Parallelism (What, Why, Applications), Levels of parallelism(instruction, transaction, task, thread, memory, function) Classification Models: Architectural Schemes ((Flynn's, Shore's, Feng's, Handler's) Memory Access: Distributed Memory, Shared Memory, Hybrid Distributed Shared Memory Parallel Architecture: Pipeline Architecture: Arithmetic pipelines, Floating Point, Array Processor Self-Learning: Multicore and Manycore processor architecture	6	CO1
2	Parallel Programming Platform and Algorithm Design: Parallel Programming Platform: Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models. Self-Learning: Scalability analysis of parallel algorithms	6	CO2
3	Performance Measures: Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law, Performance Bottlenecks, The Karp Flatt Metric. Self-Learning: Case studies on bottlenecks in high-performance computing systems	6	CO3

4	<p>HPC Programming: OpenMP and MPI HPC Programming: OpenMP Introduction: Threads, Share memory Architecture, Multi-core processors and Hyperthreading, Fork and join model. OpenMP directives: #pragma omp parallel, Hello world with openMP, #pragma omp for, #pragma omp for schedule. Serial vs Parallel PI program. HPC Programming: MPI Introduction: Processes, Multiprocessor programming model, Distributed system programming model, Inter-process communication using message passing: Asynchronous and Synchronous MPI Programming: Hello world problem, mpi_initMPI_sendMPI_Recv, Synchronisation: MPI_Barrier Hybrid (MPI + OpenMP) programming, Hardware requirement, Threads inside Processes, Hybrid Matrix multiplication Self-Learning: Message passing vs Share memory communication: Advantages and disadvantage</p>	6	CO4
5	<p>Parallel programming using accelerators: An Overview of GPGPUs, Introduction to CUDA, Introduction to Heterogeneous Computing using OpenCL, An Overview of OpenCL API, Heterogeneous Programming in OpenCL. Modern GPUs and accelerators: NVIDIA A100, H100, H200, Blackwell (B100/B200); AMD Instinct MI300; Intel Data Center GPU Max; Google TPU Self-Learning: Role of GPU in Deep Learning (case study)</p>	6	CO5
6	<p>High Performance Computing in the Cloud: Virtualization and Containerization, Parallel Computing Frameworks, Scaling, HPC in the Cloud Use Cases. Self-Learning: Security challenges in cloud-based HPC systems</p>	6	CO6

Learning Resources

Text Books:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, Pearson Education, Second Edition, 2007.
2. “CUDA Programming: A Developer” Guide to Parallel Computing with GPUs”, by Shane cook
3. M. R. Bhujade, —Parallel Computing, 2nd edition, New Age International Publishers, 2009.
4. Kai Hwang, Naresh Jotwani, —Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill, Second Edition, 2010.
5. Georg Hager, Gerhard Wellein, Chapman “ Introduction to High Performance Computing for Scientists and Engineers” Hall.CRC Computational Science Series,2011.

Reference Books:

1. Michael J. Quinn, —Parallel Programming in C with MPI and OpenMPI, McGraw-Hill International Editions, Computer Science Series, 2008.
2. Kai Hwang, Zhiwei, “ Scalable Parallel Computing: Technology,Architecture,Programming”,McGraw-Hill Education,1998
3. Laurence T. Yang, Minyi Guo, “ High Performance Computing: Paradigms and Infrastructure” , by willey, 2006.

Online Resources:

1. <https://nptel.ac.in/courses/112105293>
2. <https://archive.nptel.ac.in/courses/128/106/128106014/>

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- The question paper shall consist of six questions, carrying 10 marks each.
 - Question No. 1 shall be set from CO1.
 - Question No. 2 shall be set from CO2.
 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- The options should be of comparable difficulty level and should test similar learning outcomes.
- Internal choice may be provided within each question, ensuring both options cover the same module.
- Students will attempt all questions.

CO-PO-PSO Mapping (HPC)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	2			2	2	2	1	3	2
CO2	2	2	3	1	2			2	2	2	1	3	2
CO3	2	3	2	1	2			2	2	2	1	3	3
CO4	2	2	3	1	3			2	2	2	1	3	2
CO5	2	2	3	1	3			2	2	2	1	3	2
CO6	3	2	1	1	2			2	2	2	1	3	2

Program	F. Y. M. Tech Computer Engineering								
Course	Reinforcement Learning						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechXXEDLOC22	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Probability distributions and expected values, Linear algebra and vector operations (e.g., inner products), Fundamentals of Machine Learning, Basics of Neural Networks.

Course Objectives:

1. To understand the mathematical foundations and fundamental paradigms of Reinforcement Learning.
2. To provide knowledge of reinforcement learning algorithms for sequential decision-making problems.
3. To understand dynamic programming and temporal-difference learning methods used in reinforcement learning.
4. To provide knowledge on model-free and model-based reinforcement learning techniques.
5. To analyze deep reinforcement learning architectures and policy optimization methods.
6. To inculcate the ability to design intelligent systems using reinforcement learning for real-world applications

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Explain the fundamental concepts of Reinforcement Learning, Markov Decision Processes, and value functions.
 CO2. Apply bandit algorithms and Bellman equations to solve reinforcement learning problems.
 CO3. Analyze dynamic programming and temporal-difference learning techniques for policy optimization.
 CO4. Apply model-free and model-based reinforcement learning algorithms in stochastic environments.
 CO5. Analyze deep reinforcement learning methods and exploration strategies for complex decision-making problems
 CO6. Design reinforcement learning-based intelligent systems for real-world applications.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction to Reinforcement Learning: Introduction, history, characteristics, and applications of Reinforcement Learning. Components of RL: agent, environment, states, actions, rewards, and policies. Markov Property, Markov Chains, Markov Reward Processes (MRP), Markov Decision Processes (MDPs), returns, discount factor, value functions, and optimal value functions. Self-Learning: Applications of Reinforcement Learning in modern AI systems	6	CO1
2	Bandit Problems and Markov Decision Processes: Multi-Armed Bandit Problems, exploration vs exploitation, ϵ -greedy methods, Upper Confidence Bound (UCB), Thompson Sampling, Gradient Bandit Algorithms. Bellman Expectation Equation and Bellman Optimality Equation. Self-Learning: Contextual Bandit algorithms for recommendation systems	6	CO2
3	Dynamic Programming and Temporal Difference Learning: Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Generalized Policy Iteration. Monte Carlo Prediction and Control, Temporal Difference Learning, TD(0), SARSA, Q-Learning, comparison of SARSA and Q-Learning. Self-Learning: Comparison of Monte Carlo and Temporal Difference methods	6	CO3
4	Model-Free and Model-Based Reinforcement Learning: On-policy and Off-policy learning, Eligibility Traces and TD(λ), Function Approximation in RL, Least Squares Methods, Fitted Q Iteration, Planning and Learning, Dyna-	6	CO4

	Q Architecture, Introduction to Partially Observable Markov Decision Processes (POMDPs). Self-Learning: Model-based RL in robotic navigation systems		
5	Deep Reinforcement Learning: Introduction to Deep Reinforcement Learning, Neural Networks for RL, Deep Q-Networks (DQN), Experience Replay, Target Networks, Policy Gradient Methods, REINFORCE Algorithm, Actor-Critic Methods, Advantage Actor Critic (A2C), Proximal Policy Optimization (PPO), Hierarchical Reinforcement Learning. Self-Learning: Recent advancements in Deep Reinforcement Learning	6	CO5
6	Applications of Reinforcement Learning: Reinforcement Learning in Robotics, Autonomous Systems, Game Playing, Recommendation Systems, Finance, Healthcare, Industrial Automation, Resource Allocation, Smart Grid Optimization, and Network Routing. Self-Learning: Design of an RL-based solution for a real-world application	6	CO6

Learning Resources**Text Books:**

1. R. Sutton and A. Barto, “Reinforcement Learning: An Introduction”, MIT Press, 2018.
2. Maxim Lapan, “Deep Reinforcement Learning Hands-On”, Packt Publishing, 2018.
3. Phil Winder, Reinforcement Learning Industrial Applications with Intelligent Agents, O’Reilly
4. Dr Engr SM Farrukh Akhtar, Practical Reinforcement Learning, Packt Publishing, 2017.

Reference Books:

1. Csaba Szepesvári, Algorithms for Reinforcement Learning, Morgan & Claypool Publishers, 2010.
2. Dimitri P. Bertsekas, Reinforcement Learning and Optimal Control, Athena Scientific, 2019
3. S. Ravichandiran, Hands-on Reinforcement Learning with Python: Master reinforcement and deep reinforcement learning using OpenAI Gym and TensorFlow, Packt Publishing, 2018.
4. N. Buduma, N. Locascio, Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, O’Reilly
5. G. Ciaburro, Keras Reinforcement Learning Projects, Packt Publishing, 2018.
6. C. Aggarwal, Neural Networks and Deep Learning: A Textbook, Springer, 978-3-031-29641-3, 2023

Online Courses:

1. Reinforcement Learning, Prof. Balaraman Ravindran, IIT Madras, NPTEL, https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs81

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.

- iv. Question No. 4 shall be set from CO4.
 v. Question No. 5 shall be set from CO5.
 vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
 c. The options should be of comparable difficulty level and should test similar learning outcomes.
 d. Internal choice may be provided within each question, ensuring both options cover the same module.
 e. Students will attempt all questions.

CO-PO-PSO Mapping (RL)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	–	–	1	–	–	–	–	–	2	2	–
CO2	3	3	1	1	2	–	–	–	–	–	2	3	1
CO3	3	3	2	2	2	–	–	–	–	–	2	3	1
CO4	3	3	2	2	3	–	–	1	–	–	3	3	2
CO5	3	3	2	2	3	1	–	1	–	–	3	3	2
CO6	3	3	3	2	3	2	1	2	2	2	3	3	3

Program	F. Y. M. Tech Computer Engineering								
Course	Internet of Everything						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEDLOC23	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Internet of Things (IoT), Embedded Systems, Computer Networks, Wireless Communication, Microprocessors and Microcontrollers, Cloud Computing, Cyber Security, Data Communication and Networking, Sensors and Instrumentation

Course Objectives:

1. Understand the evolution from Internet to Internet of Everything (IoE).
2. Analyze architectures and enabling technologies of IoE systems.
3. Explore communication protocols and interoperability in heterogeneous networks.
4. Apply edge, fog, and cloud computing concepts for intelligent systems.
5. Examine security, privacy, and trust mechanisms in IoE environments.
6. Study industrial and emerging applications of IoE technologies.

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1.** Understand the fundamentals, architecture, and evolution of Internet of Everything systems.
CO2. Analyze communication technologies and interoperability mechanisms in IoE environments.
CO3. Apply edge, fog, and cloud computing concepts for intelligent data processing systems.
CO4. Evaluate security, privacy, and trust management techniques in IoE ecosystems.
CO5. Design IoE-based solutions for industrial and smart application domains.
CO6. Explore future trends and emerging technologies in Internet of Everything systems.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction to Internet of Everything 1.1 Evolution from Internet to IoT and IoE 1.2 Difference between IoT and IoE 1.3 Convergence of People, Process, Data and Things 1.4 Characteristics and architecture of IoE systems 1.5 Cyber Physical Systems (CPS) 1.6 Smart sensors and intelligent devices 1.7 Distributed intelligent environments 1.8 Enabling technologies for IoE 1.9 Challenges: scalability, interoperability, latency Self-Learning: Real-world IoE ecosystems and smart environments	6	CO1
2	Communication Technologies and Interoperability 2.1 Wireless technologies: Wi-Fi 6, BLE, ZigBee, Thread 2.2 LPWAN technologies: LoRaWAN, NB-IoT, 5G systems 2.3 Communication protocols: MQTT, CoAP, HTTP/HTTPS, AMQP, DDS 2.4 Middleware and API-based communication systems 2.5 Interoperability challenges in heterogeneous networks 2.6 Digital twins and semantic interoperability 2.7 Gateway architectures 2.8 Software Defined Networking (SDN) in IoE Self-Learning: Protocol comparison for IoE applications	6	CO2
3	Edge Computing, Cloud Integration and AI in IoE 3.1 Edge computing and fog computing architectures 3.2 Resource allocation in edge systems 3.3 Cloud computing platforms for IoE	6	CO3

	<p>3.4 Distributed storage systems and data lakes</p> <p>3.5 Virtualization and containerization (Docker, Kubernetes concepts)</p> <p>3.6 Artificial Intelligence and Machine Learning in IoE</p> <p>3.7 TinyML for embedded intelligence</p> <p>3.8 Predictive maintenance and automation</p> <p>3.9 Real-time analytics and visualization</p> <p>Self-Learning: AI-powered IoT edge devices</p>		
4	<p>Security, Privacy and Trust Management in IoE</p> <p>4.1 Security challenges in IoE ecosystems</p> <p>4.2 Device vulnerabilities and network attacks</p> <p>4.3 Authentication and authorization mechanisms</p> <p>4.4 Cryptographic protocols for secure communication</p> <p>4.5 Secure boot and firmware protection</p> <p>4.6 Blockchain applications in IoE security</p> <p>4.7 Data privacy regulations and ethics</p> <p>4.8 Intrusion detection systems</p> <p>4.9 Fault-tolerant and resilient architectures</p> <p>Self-Learning: Blockchain-based IoE security models</p>	6	CO4
5	<p>Industrial and Smart Applications of IoE</p> <p>5.1 Smart homes and smart cities</p> <p>5.2 Intelligent transportation systems and connected vehicles</p> <p>5.3 Industrial Internet of Everything and Industry 4.0</p> <p>5.4 Smart manufacturing and automation</p> <p>5.5 Healthcare, telemedicine and wearable systems</p> <p>5.6 Smart agriculture and environmental monitoring</p> <p>5.7 Autonomous robotics and surveillance systems</p> <p>5.8 Energy-efficient and sustainable IoE ecosystems</p> <p>Self-Learning: Real-world smart city deployments</p>	6	CO5
6	<p>Future Trends and Advanced IoE Systems</p> <p>6.1 Internet of Bio-Nano Things</p> <p>6.2 Quantum communication in connected systems</p> <p>6.3 6G-enabled intelligent ecosystems</p> <p>6.4 Metaverse and immersive connectivity</p> <p>6.5 Green and sustainable IoE architectures</p> <p>6.6 Digital transformation using IoE</p> <p>6.7 Autonomous intelligent systems</p> <p>6.8 Emerging research challenges</p> <p>6.9 Case studies of large-scale IoE deployments</p> <p>Self-Learning: Future of hyper-connected intelligent systems</p>	6	CO6

Learning Resources

Text Books:

1. Rajkumar Buyya, *Internet of Things: Principles and Paradigms*, Morgan Kaufmann
2. Vijay Madiseti & Arshdeep Bahga, *Internet of Things*, VPT Publications
3. Daniel Minoli, *Building the Internet of Things with IPv6 and MIPv6*, Wiley

Reference Books:

1. Walteneus Dargie & Christian Poellabauer, *Fundamentals of IoT*
2. George Reese, *Cloud Application Architectures*
3. Security and Privacy in IoT Systems, IEEE Publications

Online Courses:

1. NPTEL – Internet of Things (IIT Kharagpur)
2. Coursera – IoT and Cloud Computing Specialization
3. edX – IoT Systems and Industrial Applications

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- The question paper shall consist of six questions, carrying 10 marks each.
 - Question No. 1 shall be set from CO1.
 - Question No. 2 shall be set from CO2.
 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- The options should be of comparable difficulty level and should test similar learning outcomes.
- Internal choice may be provided within each question, ensuring both options cover the same module.
- Students will attempt all questions.

CO-PO-PSO Mapping (IOE)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	3	-	-	-	-	-	-	2	3
CO2	3	3	3	2	3	-	-	-	-	2	-	3	3
CO3	3	3	3	3	3	2	-	-	-	2	2	3	3
CO4	3	3	3	3	3	3	2	-	-	2	2	3	3
CO5	3	3	3	3	3	2	2	-	-	2	2	3	3
CO6	3	3	3	3	3	3	2	2	2	2	2	3	3

Program	F. Y. M. Tech Computer Engineering								
Course	Web Application Security						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEDLOC24	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Introduction to Information and Network Security, Basics of Operating Systems and Web Technologies, Fundamentals of Cryptography

Course Objectives:

1. To understand security principles involved in modern web and cloud-based applications.
2. To analyze browser security mechanisms and client-side vulnerabilities.
3. To identify and mitigate web application vulnerabilities using secure development practices.
4. To apply modern tools and techniques for secure web application testing.
5. To design secure and scalable web applications using industry standards.
6. To explore emerging trends in application security including cloud and container security.

Course Outcomes:

After successful completion of the course, the learner will be able to:

CO1. Analyze the security requirements and threats associated with modern web applications.

CO2. Evaluate browser security mechanisms and client-side attack vectors.

CO3. Identify and mitigate vulnerabilities in web applications using secure coding practices.

CO4. Apply modern security testing tools and techniques for application security assessment.

CO5. Design secure web applications considering authentication, authorization and data protection mechanisms.

CO6. Interpret emerging application security concepts including cloud-native and container security.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Web Application Security Fundamentals Introduction to Web Applications, History of Web Applications, Interface and Structure, Benefits and Drawbacks of Web Applications, Web Application vs Cloud Application, Security Fundamentals, Input Validation, Attack Surface Reduction, Rules of Thumb, Classifying and Prioritizing Threats, Secure Coding Practices for Modern Web Applications Self-Learning: Cookies, Access Control	6	CO1
2	Browser Security Principles Origin Policy, Exceptions to Same-Origin Policy, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), Reflected XSS, HTML Injection, HTTP Security Headers, Browser Sandboxing, Domain Relaxation, Content Security Policy (CSP), Browser Security in Single Page Applications (SPA) Self-Learning: HTTPS, HTTP Proxies	6	CO2
3	Web Application Vulnerabilities Understanding Vulnerabilities in Traditional Client-Server and Web Applications, Client State Manipulation, Cookie-based Attacks, SQL Injection, Cross-domain Attacks (XSS/XSRF/XSSI), HTTP Header Injection, SSL Vulnerabilities and Testing, Session Vulnerabilities and Testing, Cross-site Request Forgery, API Security Vulnerabilities, OWASP Top 10 Overview Self-Learning: SSH Tunneling, Cleaning Traces, Cleaning Event Logs, Advanced Phishing Attacks	6	CO3
4	Web Application Mitigations HTTP Request and Response, Rendering and Events, HTML Image Tags and Security Issues, JavaScript Timing Attacks, Port Scanning, Remote Scripting, Running Remote Code, Frames and Iframes, Browser Sandbox, Same-Origin Policy, Library Import, Domain Relaxation, Secure REST API Development,	6	CO4

	Token-based Authentication Mechanisms Self-Learning: Nikto, OWASP ZAP		
5	Secure Website Design Architecture and Design Issues for Web Applications, Deployment Considerations, Input Validation, Authentication, Authorization, Configuration Management, Sensitive Data Protection, Session Management, Cryptography, Parameter Manipulation, Exception Management, Auditing and Logging, Design Guidelines, Forms and Validation, Technical Implementation, Cloud-native Application Security Basics Self-Learning: Wapiti, SQL Map	6	CO5
6	Cutting Edge Web Application Security Clickjacking, DNS Rebinding, Flash Security, Java Applet Security, Single Sign-On Security, IPv6 Impact on Web Security, Zero Trust Security Concepts, Security in Containerized Applications and Microservices Self-Learning: Open-source Security Assessment Tools from OWASP	6	CO6

Learning Resources**Text Books:**

1. Sullivan, Bryan, and Vincent Liu. Web Application Security, A Beginner's Guide. McGraw Hill Professional, 2011.
2. Stuttard, Dafydd, and Marcus Pinto. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws. John Wiley Sons, 2011

Reference Books:

1. O'Reilly Web Security Privacy and Commerce 2nd Edition 2011
2. Professional Pen Testing for Web application, Andres andreu, wrox press
3. Carlos Serrao, Vicente Aguilera, Fabio Cerullo, "Web Application Security" Springer; 1st Edition.

Online Courses:

1. Systems and Usable Security – IIT Indore (Prof. Neminath Hubballi), NPTEL IIT Indore, https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs68

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (WAS)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	2	-	2	-	-	-	2	3
CO2	3	3	2	3	3	2	-	2	-	-	-	2	3
CO3	3	3	3	3	3	2	2	2	-	-	-	2	3
CO4	2	3	2	3	3	2	-	2	2	-	-	2	3
CO5	3	3	2	2	2	2	-	2	-	-	-	2	3
CO6	3	3	2	3	3	2	-	2	-	-	-	2	3

Program		F. Y. M. Tech Computer Engineering							
Course		Product Life Cycle Management					Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme			Laboratory Examination Scheme	
VMTech ILOC11	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Computer-Aided Design (CAD) tools product design and development processes, computer and database management skills

Course Objectives:

1. To familiarize the students with the need, benefits and components of PLM.
2. To acquaint students with Product Data Management & PLM strategies.
3. To give insights into new product development program and guidelines for designing and developing a product.
4. To familiarize the students with Virtual Product Development

Course Outcomes:

After successful completion of the course, the learner will be able to:

CO1. Understand the concepts, phases, strategies, and applications of Product Lifecycle Management (PLM)

CO2. Apply product design and development approaches, concurrent engineering principles, NPD strategies, and Design for X techniques in product development processes.

CO3. Explain the concepts, components, importance, implementation needs, and challenges of Product Data Management (PDM) systems.

CO4. Analyze the use of virtual product development tools in component design, machining, and manufacturing processes.

CO5. Analyze environmental strategies, sustainable development concepts, and life cycle considerations in product design.

CO6. Analyze the frameworks, phases, applications, limitations, and cost analysis models of Life Cycle Assessment (LCA) and Life Cycle Cost Analysis (LCCA).

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	<p>Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM</p> <p>Self-Learning: Cloud-based PLM systems, Role of Artificial Intelligence and IoT in PLM</p>	6	CO1
2	<p>Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process</p> <p>Self-Learning: Role of innovation and creativity in product design, Reverse engineering in product development</p>	6	CO2

3	<p>Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation</p> <p>Self-Learning: Bill of Materials (BOM) management, Cybersecurity and data protection in PDM</p>	6	CO3
4	<p>Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies</p> <p>Self-Learning: Virtual Reality (VR) and Augmented Reality (AR) in product visualization</p>	6	CO4
5	<p>Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design</p> <p>Self-Learning: Green engineering and eco-innovation, Role of sustainability in modern industries</p>	6	CO5
6	<p>Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis</p> <p>Self-Learning: Product Life Cycle Inventory (LCI) analysis, Software tools used for LCA such as GaBi and SimaPro</p>	6	CO6

Learning Resources

Text Books:

1. John Stark – Product Lifecycle Management: 21st Century Paradigm for Product Realisation
2. Karl T. Ulrich and Steven D. Eppinger – Product Design and Development

Reference Books:

1. John Stark. -Product Lifecycle Management: Paradigm for 21st Century Product Realisationl, Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, —Product Design for the environment-A life cycle approachl, Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, ImmonenAnselmie, —Product Life Cycle Managementl, Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, —Product Lifecycle Management: Driving the next generation of lean thinkingl, Tata McGraw Hill, 2006, ISBN: 0070636265

Online Courses:

1. <https://www.coursera.org/learn/what-is-product-lifecycle-management>
2. <https://www.udemy.com/course/the-complete-product-management-course>

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (PLCM)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	1	1	-	-	-	1	2	2	1
CO2	2	2	3	1	2	2	-	1	-	1	2	2	2
CO3	2	2	1	-	2	1	-	-	-	1	2	2	1
CO4	2	3	2	2	3	1	-	-	-	-	2	3	1
CO5	2	3	2	1	1	3	-	-	-	1	2	1	2
CO6	2	3	2	2	1	3	-	-	-	2	2	1	2

Program	F. Y. M. Tech Computer Engineering								
Course	Reliability Engineering						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech ILOC12	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Basic knowledge of Engineering Mathematics, Probability and Statistics, Random Variables and Probability Distributions, Basic concepts of Engineering Systems, and introductory understanding of quality control and statistical analysis.

Course Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Apply probability distributions and statistical measures to solve reliability engineering problems.
 CO2. Apply reliability concepts and hazard models to determine reliability parameters of engineering systems.
 CO3. Analyze the reliability of series, parallel, mixed and k-out-of-n system configurations using reliability block diagrams.
 CO4. Apply redundancy techniques and reliability analysis methods to improve system reliability.
 CO5. Apply maintainability and availability concepts for effective maintenance planning and system performance improvement.
 CO6. Perform Failure Mode, Effects and Criticality Analysis (FMECA) and fault tree analysis for reliability assessment of engineering systems.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson distributions, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Standard Deviation, Variance. Numerical problems on probability distributions, applications in reliability engineering.	6	CO1
2	Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Time Dependent Failure Rate, Weibull Distribution, Exponential Distribution. Distribution functions and reliability analysis.	6	CO2
3	System Reliability: System Configurations: Series configuration, Parallel configuration, Mixed configuration, k-out-of-n structure, Complex systems, Reliability block diagrams	6	CO3
4	Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies, Markov analysis, System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method, comparative analysis of redundancy techniques.	6	CO4
5	Maintainability and Availability: System downtime, Design for Maintainability, Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement,	6	CO5

	Availability concepts, Preventive maintenance, Predictive maintenance, industrial maintenance examples.		
6	Failure Mode Effects and critical Analysis: severity analysis, criticality analysis, FMECA examples, fault tree construction, basic symbols, development of functional reliability block diagram, fault tree analysis, event tree analysis, industrial case studies, practical fault tree examples.	6	CO6

Learning Resources**Text Books:**

1. Reliability Engineering by E. Balagurusamy – Covers probability theory, hazard models, system reliability, redundancy techniques and FMEA.
2. Reliability Engineering by Kailash C. Kapur and Michael Pecht – Useful for reliability concepts, maintainability, Weibull analysis and fault tree analysis.
3. Reliability Engineering: Probabilistic Models and Maintenance Methods by Joel Nachlas – Good reference for probabilistic models, maintenance methods and reliability analysis.
4. Reliability Engineering and Risk Analysis: A Practical Guide by Mohammad Modarres – Covers risk analysis, reliability methods, probability distributions and system reliability.
5. Applied Reliability and Quality by Balbir S. Dhillon – Includes quality assurance, reliability functions, FMEA and statistical methods

Reference Books:

1. L.S. Srinath, —Reliability Engineering, Affiliated East-West Press (P) Ltd., 1985.
2. Charles E. Ebeling, —Reliability and Maintainability Engineering, Tata McGraw Hill.
3. B.S. Dhillon, C. Singh, —Engineering Reliability, John Wiley & Sons, 1980.
4. P.D.T. Conon, —Practical Reliability Engg., John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, —Reliability in Engineering Design, John Wiley & Sons.
6. Murray R. Spiegel, —Probability and Statistics, Tata McGraw-Hill Publishing Co. Ltd.

Online Courses:

1. **Introduction to Reliability Engineering (IIT Kharagpur)**
https://onlinecourses.nptel.ac.in/noc25_ge19/preview
2. **Statistical Learning for Reliability Analysis – NPTEL/SWAYAM**
https://onlinecourses.nptel.ac.in/noc24_cs107/preview
3. **Failure Analysis and Prevention – NPTEL**
<https://onlinecourses-archive.nptel.ac.in/noc18-me29/course>

Assessment:**Internal Assessment for 20 marks:**

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

CO-PO-PSO Mapping (RM)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	-	2
CO2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO3	3	2	2	-	-	-	-	-	-	-	2	-	2
CO4	3	2	2	-	-	-	-	-	-	-	2	-	2
CO5	2	2	-	-	-	-	-	-	-	-	2	-	2
CO6	2	2	-	-	-	-	-	-	-	-	2	-	2

Program	F. Y. M. Tech Computer Engineering								
Course	Management Information System					Semester	I		
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechILOC13	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Database Management System, Basics of Computer Fundamentals

Course Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Course Outcomes:

After successful completion of the course, the learner will be able to:

CO1. Identify the impact of information systems on an organization

CO2. Use tools and technologies to access database information for improving business performance and decision making

CO3. Identify the threats to information systems and apply security controls for IS

CO4. Identify use of social computing for business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce.

CO5. Use technologies that underlie pervasive computing, providing examples of how businesses can utilize each

CO6. Identify the Transaction Processing, Functional Area Information and ERP system for enterprise-wide knowledge management

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS. Self-Learning: Case studies on IT-enabled organizations	6	CO1
2	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results Self-Learning: Case studies on Big Data analytics in business decision making	6	CO2
3	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls Self-Learning: Cryptography and secure communication techniques	6	CO3
4	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce. Self-Learning: Role of AI and chatbots in CRM and E-commerce systems	6	CO4

5	Computer Networks: Wired and Wireless technology, Pervasive computing, Cloud computing model. Self-Learning: Case studies on cloud-based enterprise applications	6	CO5
6	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models. Self-Learning: Emerging trends in Information Systems development and automation	6	CO6

Learning Resources**Reference Books:**

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- The question paper shall consist of six questions, carrying 10 marks each.
 - Question No. 1 shall be set from CO1.
 - Question No. 2 shall be set from CO2.
 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- The options should be of comparable difficulty level and should test similar learning outcomes.
- Internal choice may be provided within each question, ensuring both options cover the same module.
- Students will attempt all questions.

CO-PO-PSO Mapping (MIS)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1		1			2	2	2	2	1	2
CO2	3	2	1		1			2	2	2	2	2	2
CO3	3	2	1		1			2	2	2	2	2	2
CO4	3	2	1		1			2	2	2	2	2	3
CO5	3	2	1		1			2	2	2	2	2	2
CO6	3	2	1		1			2	2	2	2	2	2

Program	F. Y. M. Tech Computer Engineering								
Course	Design of Experiments						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme			Laboratory Examination Scheme	
VMTechILOC14	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Basic knowledge of Probability and Statistics, Engineering Mathematics, Statistical Quality Control, hypothesis testing, regression analysis, and fundamentals of data analysis.

Course Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Apply principles of experimental design and response surface methodology for engineering applications.
 CO2. Apply regression models and hypothesis testing techniques for analysis of experimental data.
 CO3. Apply two-level factorial design methods for analyzing engineering experiments.
 CO4. Apply fractional factorial design techniques for process optimization and industrial applications.
 CO5. Apply response surface methods for optimization of engineering systems and processes.
 CO6. Apply Taguchi methods and signal-to-noise ratio analysis for robust product and process design.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction 1 Strategy of Experimentation 2 Typical Applications of Experimental Design 3 Guidelines for Designing Experiments 4 Response Surface Methodology 5 Industrial applications of DOE.	6	CO1
2	Fitting Regression Models 1. Linear Regression Models 2. Estimation of the Parameters in Linear Regression Models 3. Hypothesis Testing in Multiple Regression 4. Confidence Intervals in Multiple Regression 5. Prediction of new response observation 6. Regression model diagnostics 7. Testing for lack of fit 8. Applications of regression models in engineering systems.	6	CO2
3	Two-Level Factorial Designs 1. The 2^2 Design 2. The General 2^{k-p} Design 3. A Single Replicate of the 2^k Design 4. The Addition of Center Points to the 2^k Design, 5. Blocking in the 2^k Factorial Design 6. Industrial case studies on factorial design.	6	CO3
4	Two-Level Fractional Factorial Designs 1. The One-Half Fraction of the 2^k Design 2. The General 2^{k-p} Fractional Factorial Design 3. Resolution III, IV and V Designs 4. Fractional Factorial Split-Plot Designs 5. applications of fractional factorial design in process optimization.	6	CO4

5	Response Surface Methods and Designs <ol style="list-style-type: none"> 1. Introduction to Response Surface Methodology 2. The Method of Steepest Ascent 3. Analysis of a Second-Order Response Surface 4. Experimental Designs for Fitting Response Surfaces 5. optimization applications using response surface methodology. 	6	CO5
6	Taguchi Approach <ol style="list-style-type: none"> 1. Crossed Array Designs and Signal-to-Noise Ratios 2. Analysis Methods 3. Robust design examples 4. industrial robust design case studies 	6	CO6

Learning Resources**Text Books:**

1. Design and Analysis of Experiments by Douglas C. Montgomery, Wiley India.
2. Statistics for Experimenters by George E. P. Box, William G. Hunter and J. Stuart Hunter, Wiley Publications.
3. Experimental Design by William G. Cochran and Gertrude M. Cox, Wiley India.
4. Design of Experiments Using The Taguchi Approach by Ranjit K. Roy, Wiley Publications.
5. Applied Design of Experiments and Taguchi Methods by Ravi Bhardwaj, PHI Learning.

Reference Books:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Online Courses:

1. [NPTEL – Design and Analysis of Experiments](#)
2. [NPTEL Course Archive – Design and Analysis of Experiments](#)
3. [NPTEL – DOE Video Lectures and Study Materials](#)

Assessment:**Internal Assessment for 20 marks:****Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

CO-PO-PSO Mapping (DOE)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	-	2
CO2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO3	3	2	2	-	-	-	-	-	-	-	2	-	2
CO4	3	2	2	-	-	-	-	-	-	-	2	-	2
CO5	2	2	-	-	-	-	-	-	-	-	2	-	2
CO6	2	2	-	-	-	-	-	-	-	-	2	-	2

Program	F. Y. M. Tech Computer Engineering								
Course	Operation Research						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechILOC15	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Basic knowledge of Engineering Mathematics, Probability and Statistics, Matrix Algebra, Optimization Techniques, and fundamentals of mathematical modeling.

Course Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Course Outcomes:

- CO1. Apply linear programming techniques and optimization methods to solve engineering decision-making problems.
 CO2. Apply queuing models for analysis and improvement of service and operational systems.
 CO3. Apply simulation techniques and Monte Carlo methods for modeling industrial and engineering systems.
 CO4. Apply dynamic programming methods for solving multistage optimization problems.
 CO5. Apply game theory concepts and strategic decision-making methods to competitive situations.
 1. CO6. Apply inventory models for effective inventory control and supply chain management.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction to Operations Research, Structure of Mathematical Models, Limitations of Operations Research, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical Method, Simplex Method, Big M Method, Two Phase Method, Duality, Transportation Problem, Northwest Corner Rule, Least Cost Method, Vogel's Approximation Method, MODI Method, Assignment Problem, Hungarian Method, Travelling Salesman Problem, applications of Operations Research in decision making. Self-Study Topics: Applications of Linear Programming in industries.	6	CO1
2	Queing Model: Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population models, applications of queuing models. Self-Study Topics: Queuing applications in banking and hospital systems.	6	CO2
3	Simulation Introduction to Simulation, Methodology of Simulation, Basic Concepts, Simulation Procedure, Applications of Simulation, Monte-Carlo Method, Monte-Carlo Simulation, Advantages and Limitations of Simulation, industrial applications of simulation. Self-Study Topics: Simulation applications in manufacturing systems.	6	CO3
4	Dynamic Programming Characteristics of Dynamic Programming, Priority Management, Employment Smoothing, Capital Budgeting, Stage Coach Problem, Shortest Path Problem, Cargo Loading Problem, Reliability Problems, applications of dynamic programming in optimization Self-Study Topics : Shortest path applications in navigation systems.	6	CO4
5	Game Theory: Competitive games, rectangular games, saddle point, minimax and maximin methods, optimal strategies, value of the game, dominance principle, mixed strategy	6	CO5

	for 2×2 games, applications of game theory in business decision making. applications of game theory in business decision making.		
6	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model, inventory control applications in supply chain management. Self-Study Topics: Inventory applications in retail management.	6	CO6

Learning Resources**Text Books:**

1. Operations Research: An Introduction – Hamdy A. Taha – Covers linear programming, transportation, queuing theory, simulation and inventory models.
2. Introduction to Operations Research – Frederick S. Hillier and Gerald J. Lieberman – Standard textbook for Operations Research with strong conceptual explanations and applications.
3. Operations Research: Applications and Algorithms – Wayne L. Winston – Useful for optimization methods, integer programming, simulation and game theory.
4. Operations Research – Kanti Swarup, P. K. Gupta and Man Mohan – Syllabus-oriented book widely used in Indian universities.
5. Introduction to Operations Research – Operations Research Society Reference – Reference material for OR concepts and applications.

Reference Books:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

Online Courses:

1. [NPTEL – Operations Research \(IIT Roorkee\)](#)
2. [NPTEL – Introduction to Operations Research \(IIT Madras\)](#)
3. [NPTEL Course Portal – Operations Research](#)
4. [Free Video Lectures – Operations Research](#)

Assessment:**Internal Assessment for 20 marks:**

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

CO-PO-PSO Mapping (OR)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	-	2
CO2	3	3	-	-	-	-	-	-	-	-	2	-	2
CO3	3	3	2	-	-	-	-	-	-	-	2	-	2
CO4	3	3	2	-	-	-	-	-	-	-	2	-	2
CO5	2	3	2	-	-	-	-	-	-	-	2	-	2
CO6	2	3	2	-	-	-	-	-	-	-	2	-	2

Program	F. Y. M. Tech Computer Engineering								
Course	Cyber security and laws						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechILOC16	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Fundamentals of computer networks, operating systems, database systems, cryptography basics, and programming concepts.

Course Objectives:

1. To understand cyber security concepts, threats, vulnerabilities, and attack mechanisms
2. To provide knowledge of network, system, and application security techniques.
3. To understand cryptographic techniques and secure communication methods.
4. To impart knowledge of cyber laws, IT Act provisions, and digital evidence handling.
5. To understand digital forensics and incident response mechanisms.
6. To explore emerging trends and research areas in cyber security.

Course Outcomes:

After successful completion of the course, the learner will be able to:

CO1. Understand the fundamentals of cybercrime, cybercriminal activities, and the impact of cyber threats on individuals and organizations.

CO2. Analyze different cyber offences, attack techniques, and security challenges related to networks, cloud systems, and mobile devices.

CO3. Apply cyber security tools and techniques to identify common cyber attacks such as phishing, malware, SQL injection, and identity theft.

CO4. Analyze legal, ethical, and privacy issues associated with cyberspace, e-commerce, and cyber laws.

CO5. Apply provisions of the Indian IT Act and cyber law procedures for handling cybercrime and digital evidence.

CO6. Apply information security standards and compliance frameworks for maintaining organizational security and regulatory requirements.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction to Cybercrime: Cybercrime definition and origin of cybercrime, cybercriminals and motives, classification of cybercrime, cybercrime in India, profile and types of cybercriminals, impact of cybercrime on society and organizations.	6	CO1
2	Cyber Offences & Cyber Security : Criminal planning and attack methods, social engineering, cyber stalking, cyber café and cybercrimes, botnets and attack vectors, cloud computing security, mobile and wireless device security, authentication and organizational security measures for mobile devices.	6	CO2
3	Tools and Methods Used in Cybercrime : Phishing, password cracking, keyloggers and spyware, viruses and worms, steganography, DoS and DDoS attacks, SQL injection, buffer overflow, attacks on wireless networks, phishing techniques, identity theft	6	CO3
4	Cyber Law and Cyberspace : Concept of cyberspace, e-commerce and cyber law, security and intellectual property aspects in cyber law, privacy and ethical issues, legal framework for electronic data interchange, electronic banking, need for Indian cyber law.	6	CO4
5	Indian IT Act : Cybercrime and criminal justice, penalties and adjudication under IT Act 2000, IT Act 2008 amendments, appeals under IT Act, digital evidence basics, cyber law enforcement agencies and procedures.	6	CO5

6	Information Security Standards & Compliance : Information security standards and compliance frameworks including SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI-DSS, basics of security auditing and compliance management.	6	CO6
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Learning Resources**Text Books:**

1. William Stallings, “Cryptography and Network Security: Principles and Practice”, Pearson Education, 8th Edition.
2. Nina Godbole and Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley India Pvt. Ltd., 3rd Edition.
3. William Stallings and Lawrie Brown, “Computer Security: Principles and Practice”, Pearson Education, 4th Edition.
4. Nilakshi Jain, “Digital Forensics”, Wiley India Pvt. Ltd., 1st Edition.
5. Pavan Duggal, “Cyber Law: Indian Perspective”, Saakshar Law Publications, Latest Edition

Reference Books:

1. William Stallings, “Network Security Essentials: Applications and Standards”, Pearson Education, 6th Edition.
2. Charles J. Brooks, Christopher Grow, Philip Craig and Donald Short, “Cybersecurity Essentials”, Wiley Publications, 1st Edition.
3. Bill Nelson, Amelia Phillips and Christopher Steuart, “Guide to Computer Forensics and Investigations”, Cengage Learning, 6th Edition.
4. Thomas R. Peltier, “Information Security Policies, Procedures, and Standards”, Auerbach Publications, 1st Edition.
5. John Sammons, “The Basics of Digital Forensics”, Syngress Publications, 2nd Edition.

Online Courses:

1. [NPTEL Cyber Security Course](#)
2. [CERT-In Official Website](#)
3. [OWASP Foundation](#)

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered.

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, research paper reviews, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

Question No. 1 shall be set from CO1.

Question No. 2 shall be set from CO2.

Question No. 3 shall be set from CO3.

Question No. 4 shall be set from CO4.

Question No. 5 shall be set from CO5.

Question No. 6 shall be set from CO6.

b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.

c. The options should be of comparable difficulty level and should test similar learning outcomes.

d. Internal choice may be provided within each question, ensuring both options cover the same module.

e. Students will attempt all questions.

CO-PO-PSO Mapping (CSL)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	2	2	2	2	-	2	2	-
CO2	2	3	-	2	2	-	2	2	2	-	-	3	2
CO3	2	2	2	-	3	-	2	2	2	-	-	3	2
CO4	2	3	-	-	-	2	3	2	2	-	-	2	2
CO5	2	2	-	-	2	3	3	2	2	-	-	2	2
CO6	2	-	2	-	2	2	-	2	2	-	-	3	3

Program	F. Y. M. Tech Computer Engineering								
Course	Disaster Management and Mitigation Measures						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme			Laboratory Examination Scheme	
VMTechILOC17	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Illustrate scenario of disaster and its effects in India
 CO2. Compare Manmade and Natural disasters and their extent and possible effects on the economy
 CO3. Outline the Government Policies, acts and administration
 CO4. Employ the knowledge of Institutional Framework for Disaster Management in India
 CO5. Apply the knowledge of Financing and Relief Measures
 CO6. Utilize the knowledge of preventive and mitigation measures to know the simple do's and don'ts in disasters

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction to Disaster Management Concept and definition of disaster , Hazard, vulnerability, risk, capacity, and resilience, Types of disasters: Natural disasters, Man-made disasters. Disaster management cycle, Disaster preparedness and response, Role of engineers in disaster management.	6	CO1
2	Natural Disasters Earthquakes: Causes and effects , Seismic zones, Earthquake-resistant structures Floods: Causes, impacts, and flood control measures Cyclones and storms: Forecasting and mitigation Landslides and avalanches Droughts and heat waves Tsunami and coastal disasters	6	CO2
3	Man-Made Disasters and Technological: Industrial disasters Chemical and nuclear hazards Fire hazards and explosion control Transportation accidents Biological disasters and pandemics Cyber threats and infrastructure failures	6	CO3
4	Disaster Risk Reduction and Mitigation Risk assessment and vulnerability analysis Structural mitigation measures Non-structural mitigation measures Early warning systems GIS and remote sensing in disaster management Smart technologies and IoT applications Community-based disaster management	6	CO4

5	Disaster Preparedness, Response, and Recovery Disaster preparedness planning Emergency operation centers Incident response system Search, rescue, evacuation, and relief operations Post-disaster rehabilitation and reconstruction Psychological and social impacts of disasters Role of NGOs and government agencies	6	CO5
6	Policies, Frameworks, and Case Studies National Disaster Management Authority (NDMA) Disaster Management Act Sendai Framework for Disaster Risk Reduction Sustainable Development Goals (SDGs) and disaster resilience Case studies: <ul style="list-style-type: none"> • Bhuj Earthquake • Kerala Floods • Bhopal Gas Tragedy • COVID-19 Pandemic 	6	CO6

Reference Books:

1. Disaster Management by Harsh K. Gupta
2. Disaster Management: An Appraisal of Institutional Mechanisms in India by O.S. Dagur
3. Introduction to International Disaster Management by Damon Coppola
4. Disaster Management Handbook by Jack Pinkowski
5. Disaster Management & Rehabilitation by Rajdeep Dasgupta
6. Natural Hazards and Disaster Management by R.B. Singh

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (DMMM)													
Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2					1	1	1	1	1	1	1
CO2	2	3					1	1	1	1	1	1	1
CO3	2	3					1	1	1	1	1	1	1
CO4	2	2					1	1	1	1	1	1	1
CO5	2	2					1	1	1	1	1	1	1
CO6	2	2					1	1	1	1	1	1	1

Program	F. Y. M. Tech Computer Engineering								
Course	Energy Audit and Management						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechILOC18	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Basic knowledge of Engineering Mathematics, Basic Electrical Engineering, Fundamentals of Thermodynamics, Heat Transfer, Fluid Mechanics, and introductory concepts of Electrical Machines and Power Systems.

Course Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course Outcomes:

After successful completion of the course, the learner will be able to:

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Energy Scenario : Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act 2001 and its Features, Basics of Energy and its various forms, Material and Energy Balance, applications of energy conservation in daily life and industries.	6	CO1
2	Energy Audit Principles: Definition of Energy Audit, need for energy audit, types of energy audit, energy management approach, understanding energy costs, benchmarking, energy performance, matching energy use to requirement, maximizing system efficiency, optimizing energy inputs, fuel and energy substitution, monitoring and targeting, energy audit instruments, data analysis, financial analysis techniques (Payback period, NPV, ROI, IRR), basic case studies of energy audit.	6	CO2
3	Energy Management and Energy Conservation in Electrical System: Electricity billing, load management and maximum demand control, power factor improvement, energy efficient equipment and appliances, star ratings, lighting system efficiency occupancy sensors, daylight integration, intelligent controllers, energy conservation in motors, pumps, drives, induction motors, retrofitting, soft starters, variable speed drives, energy efficiency applications in electrical systems.	6	CO3
4	Energy Management in Thermal Systems: Thermal loads overview, steam distribution system, steam losses, steam leakages, steam trapping, condensate recovery, flash steam recovery, boilers and furnaces efficiency, waste heat recovery, insulation types and applications, HVAC system basics, COP, refrigeration and AC performance, energy saving opportunities in HVAC, thermal energy efficiency applications.	6	CO4

5	Energy Performance Assessment: On-site performance evaluation techniques, motors and VFD case studies, pumps, HVAC system calculations, lighting system ILER method, financial analysis techniques, basic energy performance evaluation case studies.	6	CO5
6	Energy Conservation in Buildings: Energy Conservation Building Codes (ECBC), Green Buildings, LEED rating system, renewable energy sources applications, energy-efficient building design concepts and sustainable construction practices.	6	CO6

Learning Resources**Text Books:**

1. Energy Management and Conservation – **Barney L. Capehart, Wayne C. Turner, William J. Kennedy**
2. Handbook of Energy Audit and Management – **Y P Abbi and Shashank Jain**
3. Energy Management Principles – **Craig B. Smith**
4. Energy Management – **W. R. Murphy and G. McKay**
5. Energy Efficiency and Management – **Dr. S. C. Tripathy**
6. Guide to Energy Management – **Albert Thumann, William J. Younger, Terry Niehus**

Reference Books:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Online Courses:

1. Energy Conservation and Waste Heat Recovery https://onlinecourses.nptel.ac.in/noc25_me167/preview
2. Engineering Thermodynamics (Base for Energy Concepts) https://onlinecourses.nptel.ac.in/noc18_ch03/

Assessment:**Internal Assessment for 20 marks:**

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	2	-	-	-	2	-	2
CO2	3	3	2	-	2	-	2	-	-	-	2	-	2
CO3	3	3	2	-	2	-	2	-	-	-	2	-	2
CO4	3	3	2	-	2	-	2	-	-	-	2	-	2
CO5	3	3	2	2	2	-	2	-	-	-	2	-	2
CO6	3	3	2	2	2	-	3	-	-	-	2	-	2

Program	F. Y. M. Tech Computer Engineering								
Course	Development Engineering						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechILOC19	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:**Course Objectives:**

1. To understand the concepts, characteristics, scope, and challenges of rural development and rural society in India.
2. To apply the principles and structure of Panchayati Raj Institutions and decentralized governance in rural development.
3. To apply rural development planning processes, initiatives, and implementation strategies at national, state, regional, and local levels.
4. To analyze the role of the 73rd Constitutional Amendment in strengthening local self-governance and participatory rural planning.
5. To analyze the significance of science, technology, human values, and sustainable practices in rural development and planning.

To apply ethical principles and professional values in rural development, planning, research, and community-oriented activities.

Course Outcomes:

After successful completion of the course, the learner will be able to:

CO1. Understand the concepts, scope, characteristics, and challenges of rural development and rural society in India.

CO2. Apply the principles of Panchayati Raj and decentralized governance for rural development and community participation.

CO3. Apply rural development planning processes, initiatives, and implementation strategies at national, state, regional, and local levels.

CO4. Analyze the impact of the 73rd Constitutional Amendment and decentralized planning mechanisms on rural governance and development.

CO5. Analyze the role of science, technology, and human values in sustainable rural development and planning practices.

CO6. Apply ethical principles and professional values in rural development, planning, research, and community-oriented activities.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction to Rural Development: Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development. Roots of Rural Development in India; Rural reconstruction and Sarvodaya programme before independence; impact of voluntary effort and Sarvodaya Movement on rural development. Constitutional direction, directive principles; Panchayati Raj; planning of villages and community development; National extension services.	6	CO1
2	Post-Independence Rural Development: Balwant Rai Mehta Committee; Three-tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee; linkage between Panchayati Raj, participation and rural development.	6	CO2
3	Rural Development Initiatives in Five Year Plans: Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface; integrated approach and local plans; Development initiatives	6	CO3

	and their convergence; Special component plan and sub-plan for the weaker sections; Micro-level planning; Data base for local planning; Need for decentralized planning; Sustainable rural development.		
4	73rd Amendment Scenario / 73rd Constitution Amendment Act: Including 29 subjects, devolution of powers, functions and finance; Panchayati Raj institutions – organizational linkages; Recent changes in rural local planning; Gram Sabha – revitalized Panchayati Raj; institutionalization; resource mapping; resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	6	CO4
5	Values and Science and Technology: Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of values; Psychological values – integrated personality; mental health; Social values – the modern search for a good society; justice, democracy, rule of law, values in Indian constitution. Aesthetic values – perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; culture; relativity; Relative and absolute values. Human values – humanism and human values; human rights; human values in freedom, creativity, love and wisdom	6	CO5
6	Ethics: Causes of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics. Professional ethics; Ethics in planning profession, research and education	6	CO6

Learning Resources**Text Books:**

1. Rural Local Governance and Development, *Rural Local Governance and Development: Theories and Practices of Panchayati Raj Institutions in India*, Routledge, 1st Edition.
2. Panchayati Raj & Rural Development: Policy, Practice & Implication, Blue Rose Publishers, 1st Edition.
3. Rural Development and Panchayati Raj Institutions, Agri Horti Press, 1st Edition.
4. Panchayati Raj Institutions and Rural Development, Rawat Publications, 1st Edition.

Rural Development in New Dimensions: Corporate Social Responsibility and Panchayati Raj, Global Vision Publishing House, 1st Edition.

Reference Books:

1. Rural Local Governance and Development, Routledge Publications.
2. Panchayati Raj & Rural Development: Policy, Practice & Implication, Blue Rose Publishers.
3. Panchayati Raj Institutions and Rural Development, Rawat Publications.
4. Rural Development and Panchayati Raj Institutions, Agri Horti Press.
5. Rural Development in New Dimensions: Corporate Social Responsibility and Panchayati Raj, Global Vision Publishing House.

Online Courses:

1. [NPTEL – Rural Development](#)
2. [SWAYAM – Rural Development and Panchayati Raj Courses](#)
3. [IGNOU Online Courses – Rural Development](#)
4. [e-PG Pathshala – Rural Development](#)
5. [Coursera – Sustainable Development Courses](#)

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (DE)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	–	–	–	3	–	–	–	–	–	1	2
CO2	2	2	2	–	–	3	2	2	2	–	–	1	3
CO3	2	3	3	–	–	3	–	2	2	2	–	2	3
CO4	2	3	2	2	–	3	2	–	2	–	–	2	2
CO5	2	2	2	–	2	3	3	–	2	–	2	3	2
CO6	–	–	–	–	–	2	3	2	2	–	2	1	3

Program	F. Y. M. Tech Computer Engineering								
Course	Computational Laboratory I						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEL101	1	L	T	P	CIA		ESE	CIAL	OR
					IAT	CIAT			
		--	--	2	--	--	--	25	25

Lab Objectives:

- To analyze the algorithms using space and time complexity.
- To acquire knowledge of various applied algorithms.
- To understand algorithms that have applications in areas such as geometric modelling, graphics, robotics, vision, computer animation, etc.
- To understand the advanced internetworking concepts
- To understand the working of the routing devices
- To understand the advanced networks and their designing

Lab Outcomes:

After successful completion of the course, the learner will be able to:

LO1: Apply dynamic programming and linear programming techniques to solve optimization problems LO2. Design and implement graph algorithms such as Bellman-Ford and Floyd-Warshall for shortest path problems.

LO3. Implement and string matching algorithms including Naïve String Matching and Rabin-Karp algorithms.

LO4: Implement advanced internetworking concepts such as congestion control, QoS, and resource allocation, socket communication

LO5: Implement routing algorithms to understand the functioning of routing devices

LO6: Implement the concepts to measure performance and functioning of advanced networks

Lab Prerequisite:

Students should have basic knowledge of C/C++ concepts, Data Structures, Analysis of Algorithms, Python programming, Familiarity with time and space Complexity, networking concepts, socket programming

List of laboratory experiments: (Any Ten Experiments)

Sr. No.	Name of the Experiment	Hours	LO Mapping
1	Implement Matrix chain multiplication.	02	LO1
2	Implement Linear Programming Simplex method.	02	LO1
3	Implement Single-Source Shortest Paths-The Bellman-Ford algorithm.	02	LO2
4	Implement All-Pairs Shortest Paths-The Floyd-Warshall algorithm.	02	LO2
5	Implement Naïve String matching algorithm.	02	LO3
6	Implement Rabin Karp algorithm.	02	LO3
7	Implement and compare FIFO and Fair Queuing algorithms.	02	LO4
8	Implement Distance Vector Routing using Bellman-Ford algorithm.	02	LO5
9	Implement IPv6 socket communication.	02	LO4
10	Implement a simple network monitoring concept with failover detection.	02	LO6
11	Simulate AODV routing in ad hoc wireless networks.	02	LO5
12	Simulate SDN flow rule matching and forwarding.	02	LO6

Sr No	List of Assignments / Tutorials	Hrs	LO Mapping
01	Dynamic Programming: Matrix Chain Multiplication		LO1
02	Linear Programming		LO1

03	Graph Algorithms	02	LO2
04	Parallel & Applied Algorithms		LO3
05	Internetworking		LO4
06	Routing		LO5
07	Ad hoc wireless networks		LO6
08	Software Defined Networking		LO6

Assessment :

Continuous Internal Assessment-Lab (CIAL): CIAL shall consist of at least 10 practicals based on the above list. Also, the CIAL Journal must include at least 6 assignments.

CIAL Marks: 25 Marks (Total marks) = 15 Marks (Average marks of Experiments) +10 Marks (At least 2 LMs of 5 marks each)

LO-PO-PSO Mapping (CC I)

Lab Outcomes (LO)	Program Outcomes (PO)												PSO1	PSO2
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11			
LO1	3	-	-	-	2	-	-	2	2	2	2	3	2	
LO2	3	2	2	-	3	-	-	2	2	2	2	3	3	
LO3	3	2	-	2	3	-	-	-	2	-	2	3	2	
LO4	2	3	2	3	3	-	-	-	2	-	2	3	2	
LO5	2	2	-	2	3	-	-	-	2	-	2	2	2	
LO6	2	3	3	2	3	2	-	2	2	2	3	3	3	

Program	F. Y. M. Tech. Computer Engineering								
Course	Skill Based Lab						Semester	I	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme			Laboratory Examination Scheme	
VMTechC ESBL102	1	L	T	P	CIA		ESE	CIAL	OR
					IAT	CIA T			
		--	--	2	--	--	--	50	50
Lab Objectives: To be framed as per the DLOC offered									
Lab Outcomes: To be framed as per the DLOC offered									
Detail Content: Skill Based Lab I shall include activity/ Case study/ project-based learning like Mini-project in engineering domains related to the specialization or interdisciplinary domains, product design application software development, idea proposal and validation.									
Assessment :									
Continuous Internal Assessment-Lab (CIAL): CIAL shall consist of continuous assessment based on activities, case studies, mini-projects, product design, software development, idea proposal and validation related to the specialization or interdisciplinary domains as per the defined Lab Outcomes (DLOCs). Students shall perform at least 10 skill-based practical activities/tasks. The CIAL Journal must also include at least 6 assignments covering implementation, analysis, design, and validation aspects.									
CIAL Marks: 25 Marks (Total Marks) = Average Marks of Practicals/Activities/Mini-Project Work									

Progra m	F. Y. M. Tech Computer Engineering								
Course	Cloud Computing & Services						Semester	II	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEC201	3	L	T	P	CIA (40)		ESE	CI AL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites:

Cloud Computing models, Virtualization, Primary and Secondary services offered by the cloud.

Course Objectives:

1. To understand cloud computing, virtualization, and service-oriented architectures.
2. To analyze mobile cloud computing architectures and deployment models.
3. To evaluate computation and data offloading techniques in mobile cloud environments.
4. To design energy-efficient and sustainable mobile cloud solutions.
5. To examine resource allocation, security, and business models in cloud ecosystems.
6. To develop mobile cloud applications using emerging technologies and research trends..

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Explain cloud computing architectures, virtualization technologies, and cloud service models
 CO2. Analyze mobile cloud computing frameworks, architectures, and deployment challenges.
 CO3. Evaluate different offloading and resource management techniques in mobile cloud environment.
 CO4. Design energy-efficient and green mobile cloud computing solutions for sustainable systems.
 CO5. Select appropriate cloud resources, security mechanisms, and business models for mobile cloud applications.
 CO6. Develop mobile cloud-based applications for real-world domains using modern cloud platforms and tools

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Advanced Cloud Computing and Virtualization: Advanced Cloud Computing and Virtualization Evolution of Cloud Computing, Characteristics and Architecture of Cloud Systems, Service Models (IaaS, PaaS, SaaS, FaaS), Deployment Models, Virtualization Concepts, Hypervisors, Containerization using Docker and Kubernetes, Virtual Machine Migration, Edge and Fog Computing, Cloud Infrastructure Management, Challenges in Cloud Adoption. Self-Learning: Comparative study of AWS, Microsoft Azure, and Google Cloud Platform.	6	CO1
2	Mobile Cloud Computing Architecture and Frameworks: Introduction to Mobile Cloud Computing (MCC), Need and Evolution, MCC Architecture, Characteristics, Advantages and Challenges, Mobile Cloud Service Models, Context-aware Computing, Mobile as Consumer/Provider/Broker, Cloud Storage for Mobile Systems, Security and Privacy Issues in MCC, Mobile Cloud Platforms and Middleware Self-Learning: Study of modern mobile cloud frameworks and APIs	6	CO2
3	Computation and Data Offloading Techniques: Introduction to Offloading, Types and Topologies of Offloading, Computation vs Data Offloading, Adaptive Offloading Strategies, Cloud Path Selection, Opportunistic Communication, Multi-cloud	6	CO3

	<p>Offloading, Edge-assisted Offloading, Performance Analysis Metrics, Latency-aware Offloading, AI-assisted Offloading Techniques. Offloading Frameworks: CloneCloud, MAUI, ThinkAir, Cuckoo, Weblet</p> <p>Self-Learning: Comparative analysis of offloading frameworks</p>		
4	<p>Green Mobile Cloud Computing and Sustainable Systems : Green Computing Fundamentals, Energy-efficient Mobile Cloud Systems, Resource Optimization Techniques, Computational Offloading for Energy Saving, Sustainable Data Centers, Energy-aware Resource Provisioning, Green IoT Integration, Carbon-aware Cloud Infrastructure, Green Location Sensing, Challenges in Sustainable Computing.</p> <p>Self-Learning: Industry initiatives and policies for sustainable cloud computing..</p>	6	CO4
5	<p>Resource Allocation, Security and Business Models : Resource Allocation Techniques: Static, Dynamic and Adaptive Models, Load Balancing, QoS-aware Allocation, SLA Management, Security Challenges in Mobile Cloud Computing, Authentication and Access Control, Privacy Preservation, Blockchain-enabled Cloud Security, Mobile Cloud Business Models, Pricing Models, Cloud Economics, Social Mobile Cloud Models.</p> <p>Self-Learning: Cloud-based startup business case studies</p>	6	CO5
6	<p>Applications and Emerging Trends in Mobile Cloud Computing: Mobile Cloud Applications in Healthcare, Smart Cities, IoT, Vehicular Networks, Biometric Systems, Mobile Learning, Augmented Reality and Cloud Gaming, Cloud Streaming Applications, AI-enabled Mobile Cloud Applications, Cross-cloud Communication, Elastic Mobile Applications, Future Trends in Mobile Edge Intelligence</p> <p>Self-Learning: Research paper review on emerging MCC applications</p>	6	CO6

Learning Resources

Text Books:

1. Rajkumar Buyya and Satish Narayana Srirama, “Mobile Cloud Computing”, Elsevier Publications.
2. Rajkumar Buyya, James Broberg and Andrzej Goscinski, “Cloud Computing: Principles and Paradigms”, Wiley Publications.
3. Kai Hwang, Geoffrey C. Fox and Jack G. Dongarra, “Distributed and Cloud Computing”, Morgan Kaufmann Publications.
4. Barrie Sosinsky, “Cloud Computing Bible”, Wiley India Publications.
5. Meikang Qiu, “Mobile Cloud Computing: Foundations and Service Models”, CRC Press.

Reference Books:

1. Tim Mather, Subra Kumaraswamy and Shahed Latif, “Cloud Security and Privacy”, O’Reilly Publications.
2. Nigel Poulton, “Docker Deep Dive”, Leanpub Publications.
3. Marko Lukša, “Kubernetes in Action”, Manning Publications.
4. Rajkumar Buyya and Satish Narayana Srirama, “Fog and Edge Computing: Principles and Paradigms”, Wiley Publications.
5. Ying-Dar Lin and Yuan-Cheng Lai, “Mobile Edge Computing”, CRC Press.
6. Saurabh Kumar Garg and Rajkumar Buyya, “Green Cloud Computing”, Wiley Publications.

Online Courses:

1. Prof. Soumya Kanti Ghosh, “Cloud Computing”, NPTEL, IIT Kharagpur,
<https://nptel.ac.in/courses/106105167>

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (CCS)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	3	2	-	-	2	-	-	-	-	-	2	3	2
CO2	3	3	-	2	2	-	-	-	-	-	2	3	2
CO3	2	3	2	2	3	-	-	-	-	-	2	3	2
CO4	2	2	3	2	2	3	-	-	-	-	2	2	3
CO5	2	2	2	-	3	2	2	-	-	2	2	3	2
CO6	2	2	3	2	3	2	-	2	2	2	3	3	3

Program	F. Y. M. Tech Computer Engineering								
Course	Statistics and Exploratory Data Analytics						Semester	II	
Code	Credits	Teaching Scheme(Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech CEC202	3	L	T	P	CIA (40)		ESE	CIA	PR/OR
					IAT	CIAT		L	
		3	--	--	20	20	60	--	--
Course Prerequisites:									
Course Objectives:									
<ol style="list-style-type: none"> To introduce the fundamental concepts of statistics, exploratory data analysis, and the data science process. To develop understanding of probability theory, statistical distributions, sampling methods, and hypothesis testing techniques. To familiarize learners with regression analysis and predictive statistical modeling techniques for data analysis. To introduce analysis of variance (ANOVA), covariance, and statistical comparison techniques for evaluating group differences. To explain dimensionality reduction and multivariate analysis techniques for identifying patterns and relationships in data. To develop knowledge of model validation, performance evaluation metrics, and information visualization techniques for effective data interpretation and communication 									
Course Outcomes:									
After successful completion of the course, the learner will be able to:									
CO1. Apply statistical and exploratory data analysis techniques in the data science process for analyzing datasets.									
CO2. Apply probability concepts, statistical distributions, sampling methods, and hypothesis testing techniques for data interpretation and decision-making.									
CO3. Apply regression analysis and predictive statistical techniques including linear and logistic regression to solve real-world data analysis problems and interpret model outcomes									
CO4. Use analysis of variance (ANOVA), covariance, F-test, and proportion testing techniques to compare groups, evaluate statistical significance, and identify Type I and Type II errors.									
CO5. Apply dimensionality reduction, multivariate analysis, and exploratory data analysis techniques to identify patterns, relationships, and trends in high-dimensional datasets									
CO6. Apply performance metrics, validation techniques, ROC-AUC analysis, and information visualization techniques for predictive model analysis and data communication..									
Syllabus									
Unit No.	Description							Hrs.	CO Mapping
1	Introduction to Statistics and Data Science: 1.1: Data science process, types of data, structured and unstructured data, data collection methods, data preprocessing, handling missing values, noise reduction, outlier detection, exploratory data analysis process, ethical issues in data science 1.2: Descriptive Statistics: Measures of central tendency (mean, median, mode), measures of dispersion (range, variance, standard deviation, interquartile range), skewness and kurtosis, correlation and covariance 1.3: Data Visualization for EDA: Histograms, boxplots, scatterplots, bar charts, pie charts, heatmaps, pair plots, correlation matrices, visual interpretation of data distributions and relationships Self-Learning: Self-Learning: Applications of exploratory data analysis in healthcare, finance, and social media analytics, open government data portals and public datasets							6	CO1

2	<p>Probability and Statistical Foundations</p> <p>2.1: Probability Theory: Basic probability concepts, conditional probability, Bayes theorem, random variables, discrete and continuous probability distributions</p> <p>2.2: Statistical Distributions and Sampling: Binomial distribution, Poisson distribution, normal distribution, sampling techniques, sampling distribution, central limit theorem</p> <p>2.3: Statistical Inference: Confidence intervals, hypothesis testing, p-values, Type I and Type II errors, one-sample and two-sample tests, introduction to statistical significance in data analysis</p> <p>Self-Learning: Significance of Bayes theorem in predictive analytics, importance of sampling methods in data analysis</p>	6	CO2
3	<p>Regression Analysis and Predictive Statistics</p> <p>3.1: Correlation and Regression: Correlation analysis, simple linear regression, multiple linear regression, regression assumptions, residual plots, outliers and influence points.</p> <p>3.2: Statistical Tests in Regression: F-test and t-test for simple and multiple linear regression, coefficient of determination (R^2), adjusted R^2, introduction to cost function and error minimization</p> <p>3.3: Logistic Regression: Binary classification, logistic regression model, multiple logistic regression, interpretation of coefficients, odds ratio, introduction to classification problems.</p> <p>Self-Learning: Concepts of multicollinearity and model complexity, impact of outliers on predictive models, comparison between linear and logistic regression approaches</p>	6	CO3
4	<p>Analysis of Variance and Statistical Comparison</p> <p>4.1: Analysis of Variance (ANOVA): One-way ANOVA, F-test for ANOVA, evaluating group differences, assumptions of ANOVA, relationship between ANOVA and regression.</p> <p>4.2: Advanced ANOVA Models: Two-way ANOVA, analysis of covariance (ANCOVA), multiple comparison issues, post-hoc analysis techniques</p> <p>4.3: Analysis for Proportions: One-sample and two-sample tests for proportions, confidence intervals for proportions, significance tests for differences in proportions, effect size measures.</p> <p>Self-Learning: Comparison between ANOVA and t-test, assumptions and limitations of ANOVA models, interpretation of statistical significance and confidence intervals in research studies.</p>	6	CO4
5	<p>Advanced Exploratory Data Analysis and Dimensionality Reduction</p> <p>5.1: Multivariate Data Analysis: Multivariate visualization techniques, covariance structure, feature relationships, feature scaling and normalization</p> <p>5.2: Dimensionality Reduction Techniques: Principal Component Analysis (PCA), singular value decomposition (SVD), interpretation of principal components, applying PCA to new data</p> <p>5.3: Introduction to Unsupervised Learning: Clustering concepts, supervised vs unsupervised learning, applications of dimensionality reduction in EDA and predictive analytics.</p> <p>Self-Learning: Challenges in analyzing high-dimensional data, comparison of PCA and clustering techniques</p>	6	CO5

6	<p>Model Evaluation and Data Communication</p> <p>6.1 Experimental Setup and Validation: Training, validation and test datasets, holdout method, cross-validation, bootstrap method.</p> <p>6.2 Performance Evaluation Metrics: Accuracy, precision, recall, F1-score, ROC curve, area under ROC curve (AUC), regression loss functions.</p> <p>6.3 Data Communication and Visualization: Effective information visualization, visual encoding, dashboards, storytelling with data, visualizing time-series data, interpretation and communication of analytical results.</p> <p>Self-Learning: Bias-variance tradeoff in predictive modeling, interpretation of confusion matrix and ROC curve, challenges in evaluating imbalanced datasets, principles of effective data storytelling and visual communication in analytics reports</p>	6	CO6
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Learning Resources

Text Books:

1. Davy Cielen, Meysman, Mohamed Ali, —Introducing Data Science, Dreamtech Press.
2. Gupta and Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, Tenth Edition (2000).
3. Agarwal B.L. : Basic Statistics, New Age International Ltd
4. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer.
5. Kevin P. Murphy, —Machine Learning a Probabilistic Perspective, The MIT Press.
6. Dean Abbott, —Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Wiley, 2014
7. Andy Field, Jeremy Miles and Zoe Field, Discovering Statistics Using R, SAGE Publications Ltd

Reference Books:

1. Teetor, P. (2011). R cookbook. Sebastopol, CA: O'Reilly. ISBN 9780596809157
2. Chang, W. (2013). R graphics cookbook. Sebastopol, CA: O'Reilly. ISBN 9781449316952
3. Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly Media
4. Seema Acharya and Subhashini Chellappan, —Big Data and Analytics, Wiley
5. Grewal P. S, Methods of Statistical Analysis, Sterling Publishers, 1990

Online Courses:

1. Data sets for Machine Learning algorithms: <https://www.kaggle.com/datasets>
2. <https://towardsdatascience.com/machine-learning/home>
3. https://onlinecourses.nptel.ac.in/noc21_cs85/preview
4. <https://www.openintro.org/stat/>

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (SEDA)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO1 1	PS O1	PSO 2
CO1	2	3	1	2	2	-	1	1	1	-	2	1	2
CO2	2	2	1	1	2	-	1	1	1	-	2	1	2
CO3	2	2	1	1	2	-	1	1	1	-	2	1	2
CO4	2	1	1	1	2	-	1	1	1	-	2	1	2
CO5	2	1	1	1	2	-	1	1	1	-	2	1	2
CO6	2	1	1	1	2	-	1	1	1	-	2	1	2

Program		F. Y. M. Tech Computer Engineering							
Course	Applied Natural Language Processing					Semester	II		
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech CEDLO C31	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--
Course Prerequisites: Knowledge of Data Structures and Algorithms, Theory of Computation and Automata, Probability and Statistics, and Python Programming with basic Machine Learning concepts.									
Course Objectives: <ol style="list-style-type: none"> To understand the fundamentals and challenges of Natural Language Processing (NLP). To analyze lexical, syntactic, and semantic processing techniques in NLP. To study probabilistic and statistical approaches for language modelling and tagging. To explore discourse analysis, pragmatics, and lexical resources used in NLP systems. To apply NLP techniques for information retrieval, text analytics, and machine translation applications To design intelligent NLP-based applications using modern tools and deep learning approaches. 									
Course Outcomes: After successful completion of the course, the learner will be able to: <ul style="list-style-type: none"> CO1. Explain the fundamentals, architecture, and challenges of Natural Language Processing systems CO2. Analyze word-level and syntactic processing techniques using statistical and probabilistic models. CO3. Apply semantic and pragmatic analysis techniques for language understanding. CO4. Evaluate different NLP models and lexical resources for real-world language processing tasks. CO5. Design NLP solutions for applications such as information retrieval, text classification, and machine translation. CO6. Develop intelligent NLP applications using modern frameworks, machine learning, and deep learning techniques 									
Syllabus									
Unit No.	Description	Hrs.	CO Mapping						
1	Introduction to Natural Language Processing: Introduction to NLP, Evolution and Challenges of NLP, Language Modeling: Grammar-based and Statistical Approaches, Regular Expressions, Finite State Automata, Morphological Analysis, Lexical Processing, Tokenization, Stemming and Lemmatization, Spelling Error Detection and Correction, Minimum Edit Distance Self-Learning: Study of NLP libraries such as NLTK and SpaCy.	6	CO1						
2	Word Level and Statistical Analysis: N-gram Language Models, Smoothing Techniques, Interpolation and Backoff Models, Word Classes and POS Tagging, Rule-based Tagging, Stochastic Tagging, Transformation-based Tagging, Hidden Markov Models, Maximum Entropy Models, Named Entity Recognition (NER), Word Embeddings and Vector Representations. Self-Learning: Implementation of Word2Vec and GloVe models.	6	CO2						
3	Syntactic and Parsing Techniques: Context Free Grammars (CFG), Dependency Grammar, Parse Trees, Treebanks, Grammar Normal Forms, Syntactic Parsing, Ambiguity Resolution, Dynamic Programming Parsing, Shallow Parsing, Probabilistic CFG, CYK Parsing Algorithm, Lexicalized CFGs, Feature	6	CO3						

	Structures and Unification. Self-Learning: Comparative study of constituency and dependency parsing		
4	Semantic Analysis and Pragmatics: Semantic Representation, First Order Logic, Description Logics, Syntax-driven Semantic Analysis, Semantic Attachments, Word Sense Disambiguation, Thematic Roles, Semantic Similarity, Pragmatics in NLP, Selectional Restrictions, Distributional Semantics, Contextual Word Representation Models. Self-Learning: Study of BERT and Transformer-based semantic models.	6	CO4
5	Discourse Analysis and NLP Resources: Discourse Processing, Anaphora Resolution, Coreference Resolution, Centering Theory, Lexical Resources and Corpora: WordNet, PropBank, FrameNet, Penn Treebank, Brown Corpus, British National Corpus, Porter Stemmer, Lemmatizers, NLP Annotation Techniques, Corpus Creation and Evaluation Metrics. Self-Learning: Building custom datasets and annotation tools for NLP.	6	CO5
6	Applications and Emerging Trends in NLP: Applications of NLP: Machine Translation, Information Retrieval, Information Extraction, Text Categorization, Text Summarization, Sentiment Analysis, Conversational AI and Chatbots, Speech Interfaces, Question Answering Systems, Deep Learning in NLP, Large Language Models (LLMs), Ethical Issues in NLP and Responsible AI. Self-Learning: Research review on Generative AI and Large Language Models.	6	CO6

Learning Resources**Text Books:**

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Pearson Education.
2. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, O’Reilly Media.
3. Christopher D. Manning and Hinrich Schütze, “Foundations of Statistical Natural Language Processing”, MIT Press.
4. Jacob Eisenstein, “Introduction to Natural Language Processing”, MIT Press.
5. Delip Rao and Brian McMahan, “Natural Language Processing with PyTorch”, O’Reilly Media.
6. C.C. Chan and K.T. Chau, “*Modern Electric Vehicle Technology*,” Oxford University Press.

Reference Books:

1. Breck Baldwin, “Language Processing with Java and LingPipe Cookbook”, Atlantic Publisher.
2. Richard M. Reese, “Natural Language Processing with Java”, O’Reilly Media.
3. Nitin Indurkha and Fred J. Damerau, “Handbook of Natural Language Processing”, Chapman and Hall/CRC Press.
4. Tanveer Siddiqui and U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press.
5. Alexander Clark, Chris Fox and Shalom Lappin, “The Handbook of Computational Linguistics and Natural Language Processing”, Wiley-Blackwell.

Online Courses:

1. Prof. Pushpak Bhattacharyya, “Natural Language Processing”, NPTEL, IIT Bombay, <https://nptel.ac.in/courses/106101007>
2. Prof. Mausam, “Natural Language Processing”, NPTEL, IIT Delhi, <https://nptel.ac.in/courses/106102220>

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (ANLP)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO1 1	PS O1	PSO 2
CO1	3	2	-	-	2	-	-	-	-	-	2	3	2
CO2	3	3	-	2	3	-	-	-	-	-	2	3	2
CO3	2	3	2	2	3	-	-	-	-	-	2	3	2
CO4	2	3	2	3	3	-	-	-	-	-	2	3	2
CO5	2	2	3	2	3	2	-	2	2	2	2	3	3
CO6	2	3	3	2	3	2	2	2	2	2	3	3	3

Program		F. Y. M. Tech Computer Engineering							
Course		Data Storage and Retrieval				Semester	II		
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech CEDLOC32	3	L	T	P	CIA (40)		ESE	CI	PR/OR
					IAT	CIAT		AL	
		3	--	--	20	20	60	--	--

Course Prerequisites:

Fundamentals of database systems, data structures, computer networks, operating systems, and file organization concepts..

Course Objectives:

1. To understand modern data storage architectures and storage technologies.
2. To study data retrieval mechanisms and indexing techniques.
3. To understand distributed and cloud-based storage systems.
4. To provide knowledge of data backup, recovery, and fault tolerance mechanisms.
5. To understand big data storage and NoSQL database systems.
6. To explore emerging trends and research areas in data storage and retrieval systems.

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Understand data storage architectures and storage management techniques.
- CO2. Apply indexing and retrieval mechanisms for efficient data access.
- CO3. Analyze distributed and cloud storage systems for scalable data management.
- CO4. Apply backup, recovery, and fault tolerance techniques in storage systems.
- CO5. Analyze NoSQL and big data storage technologies for large-scale applications.
- CO6. Apply emerging trends and research challenges in data storage and retrieval systems.

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	Introduction to Data Storage Systems: Fundamentals of Data Storage, Storage Architectures, Direct Attached Storage (DAS), Network Attached Storage (NAS), Storage Area Network (SAN), RAID Levels, Storage Virtualization, Storage Management Concepts. Self-Learning: Case studies on enterprise storage architectures.	6	CO1
2	Data Retrieval and Indexing Techniques: File Organization Methods, Sequential and Indexed File Organization, B-Tree and B+ Tree Indexing, Hashing Techniques, Query Processing and Optimization, Information Retrieval Basics, Search Algorithms. Self-Learning: Applications of indexing in search engines and databases.	6	CO2
3	Distributed and Cloud Storage Systems: Distributed File Systems, Google File System (GFS), Hadoop Distributed File System (HDFS), Cloud Storage Architectures, Data Replication, Consistency Models, Object Storage Systems. Self-Learning: Comparative study of AWS S3, Azure Blob Storage, and Google Cloud Storage.	6	CO3
4	Backup, Recovery, and Fault Tolerance: Data Backup Techniques, Recovery Mechanisms, Disaster Recovery Planning, Fault Tolerance, Data Redundancy, Replication Strategies, Snapshots, Business Continuity Concepts. Self-Learning: Industrial backup and disaster recovery tools.	6	CO4

5	<p>Big Data and NoSQL Storage: Introduction to Big Data Storage, NoSQL Databases, Key-Value Stores, Column-Oriented Databases, Document Databases, CAP Theorem, Data Warehousing, Data Lakes.</p> <p>Self-Learning: Applications of MongoDB, Cassandra, and HBase.</p>	6	CO5
6	<p>Emerging Trends in Data Storage and Retrieval: AI in Storage Management, Storage Security, Blockchain-based Storage, Edge Storage, Green Data Centers, Data Compression Techniques, Research Trends and Case Studies.</p> <p>Self-Learning: Research papers on modern storage optimization techniques.</p>	6	CO6

Learning Resources

Text Books:

1. EMC Education Services, “Information Storage and Management”, Wiley Publications, 2nd Edition.
2. Silberschatz, Korth and Sudarshan, “Database System Concepts”, McGraw-Hill Education, 7th Edition.
3. Tom White, “Hadoop: The Definitive Guide”, O’Reilly Media, 4th Edition.
4. Prabhakar S. Deshpande, “SQL and NoSQL Databases”, Wiley India Pvt. Ltd., 1st Edition.
5. Jiawei Han, Micheline Kamber and Jian Pei, “Data Mining: Concepts and Techniques”, Morgan Kaufmann Publishers, 3rd Edition.

Reference Books:

1. Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, McGraw-Hill Education, 3rd Edition.
2. Alex Petrov, “Database Internals”, O’Reilly Media, 1st Edition.
3. Ian H. Witten, Alistair Moffat and Timothy C. Bell, “Managing Gigabytes”, Morgan Kaufmann Publishers, 2nd Edition.
4. Martin Kleppmann, “Designing Data-Intensive Applications”, O’Reilly Media, 1st Edition.
5. George Reese, “Cloud Application Architectures”, O’Reilly Media, 1st Edition.

Online Courses:

1. [NPTEL Database Management Systems](#)
2. [Coursera Big Data Specialization](#)
3. [MongoDB University](#)

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered.

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, research paper reviews, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- i. Question No. 1 shall be set from CO1.
- ii. Question No. 2 shall be set from CO2.

- iii. Question No. 3 shall be set from CO3.
- iv. Question No. 4 shall be set from CO4.
- v. Question No. 5 shall be set from CO5.
- vi. Question No. 6 shall be set from CO6.

b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.

c. The options should be of comparable difficulty level and should test similar learning outcomes.

d. Internal choice may be provided within each question, ensuring both options cover the same module.

e. Students will attempt all questions.

CO-PO-PSO Mapping (DSR)

Course Outcomes(CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2
CO1	3	2	-	-	2	-	2	2	2	-	2	2	-
CO2	3	3	2	2	3	-	2	2	2	-	2	3	2
CO3	3	3	2	2	3	2	2	2	2	-	2	3	2
CO4	3	3	2	2	3	2	2	2	2	-	2	2	2
CO5	3	3	2	2	3	-	2	2	2	-	3	2	2
CO6	2	3	2	3	2	-	2	2	2	-	3	3	3

Program		F. Y. M. Tech Computer Engineering							
Course		Advanced Soft Computing					Semester	II	
Code	Credits	Teaching Scheme (Hrs./Week)			Theory Examination Scheme		Laboratory	Examination Scheme	
VMTech CEDLO C33	3	L	T	P	CIA (40)		ESE	CI A L	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--
Course Prerequisites: Basic mathematics, soft computing, Computational intelligence.									
Course Objectives: <ol style="list-style-type: none"> To introduce the fundamental concepts and characteristics of Soft Computing techniques. To develop understanding of fuzzy logic, fuzzy inference systems, and rough set theory for intelligent decision-making. To explain the principles and learning mechanisms of supervised and unsupervised neural networks. To familiarize students with hybrid intelligent systems integrating fuzzy logic, neural networks, and genetic algorithms. To introduce the fundamentals and architectures of deep learning techniques for computational intelligence applications. To apply Soft Computing techniques for solving real-world engineering and industrial problems through case studies and applications. 									
Course Outcomes: After successful completion of the course, the learner will be able to: CO1. Describe the concepts, characteristics, and constituents of Soft Computing techniques and distinguish them from Hard Computing approaches. CO2. Apply fuzzy logic principles, fuzzy inference systems, and rough set concepts to solve decision-making and control problems. CO3. Analyze the learning process and implementation of supervised neural network models such as Back Propagation and Radial Basis Function networks. CO4. Examine unsupervised neural network models including Self-Organizing Maps, Learning Vector Quantization, and Adaptive Resonance Theory. CO5. Apply hybrid intelligent systems and deep learning architectures for solving complex computational problems. CO6. Develop soft computing-based solutions for real-world applications using Neuro-Fuzzy and intelligent system approaches.									
Syllabus									
Unit No.	Description	Hrs.	CO Mapping						
1	Introduction Differentiate Hard and Soft Computing, Soft Computing Constituents, Neuro-Fuzzy and Soft Computing Characteristics, Advantages and Limitations of Soft Computing, Applications of Soft Computing in Engineering, Overview of Artificial Intelligence and Computational Intelligence	6	CO1						
2	Fuzzy Logic & Rough Set Theory Fuzzy Relations and Fuzzy Rules, Generalized Modus Ponens, Defuzzification and its Types, Fuzzy Inference Systems, Design of Fuzzy Controller, Introduction to Rough Sets, Membership Functions and Fuzzification Methods, Linguistic Variables and Approximate Reasoning	6	CO2						

3	Supervised Network Error Back Propagation Training Algorithm, Radial Basis Function, Multilayer Perceptron (MLP), Gradient Descent Learning Rule, Performance Evaluation of Neural Networks,	6	CO3
4	Unsupervised Network Kohonen Self Organizing Maps, Basic Learning Vector Quantization, Basic Adaptive Resonance Theory, Competitive Learning Networks, Clustering and Feature Mapping, Hebbian Learning Rule, Applications of Self-Organizing Networks	6	CO4
5	Hybrid Systems and Introduction to Deep Learning Fuzzy-Neural Systems, Neuro-Genetic Systems, Deep Learning: Definition & background, historical context of deep learning, Three classes of deep learning network. Introduction to Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN)	6	CO5
6	Applications and Case Study Automobile Fuel Efficiency using ANFIS Color Receipt prediction using CANFIS Medical Diagnosis using Neuro-Fuzzy Systems, Pattern Recognition Applications	6	CO6

Learning Resources**Text Books:**

1. J.S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.
2. S. Rajasekaran and G.A. VijaylakshmiPai.. Neural Networks Fuzzy Logic, and Genetic Algorithms, Prentice Hall of India.
3. Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
4. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
5. Samir Roy, Udit Chakraborty "Introduction to Soft Computing" Pearson Education India.
6. Jacek.M.Zurada "Introduction to Artificial Neural Systems" Jaico Publishing House.
7. Timothy J.Ross "Fuzzy Logic With Engineering Applications" Wiley.

Reference Books:

1. Fakhreddine O. Karry, Clarence De Silva," Soft Computing and Intelligent systems Design Theory, Tools and Applications" Pearson 2009.
2. Li Deng and Dong Yu , "Deep Learning Methods and Applications".

Online Courses:

1. Fuzzy Logic and Neural Network - IIT Kharagpur (Prof. Dilip Kumar Pratihari), NPTEL, https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge31
2. Soft Computing Techniques - IIT (ISM) Dhanbad (Prof. Santimoy Kundu), NPTEL, https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ma35

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- The question paper shall consist of six questions, carrying 10 marks each.
 - Question No. 1 shall be set from CO1.
 - Question No. 2 shall be set from CO2.
 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- The options should be of comparable difficulty level and should test similar learning outcomes.
- Internal choice may be provided within each question, ensuring both options cover the same module.
- Students will attempt all questions.

CO-PO-PSO Mapping (ASC)

Course Outcomes (CO)	Program Outcomes (PO)												PS O1	PS O2
	PO 1	PO 2	P O3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11			
CO1	3	2	1	-	-	-	-	-	-	1	1	2	1	
CO2	3	3	2	1	1	-	-	-	-	1	1	3	2	
CO3	3	3	2	2	2	-	-	-	1	1	1	3	2	
CO4	2	3	2	2	2	-	-	-	1	1	1	3	2	
CO5	3	3	3	2	3	1	-	-	1	1	2	3	3	
CO6	2	3	3	3	3	1	1	-	2	2	2	3	3	

Program	F. Y. M. Tech Computer Engineering								
Course	Ethical Hacking and Digital Forensics					Semester	II		
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
MTechCE DLOC34	3	L	T	P	CIA (40)		ESE	CI	PR/OR
					IAT	CIAT		AL	
		3	--	--	20	20	60	--	--
Course Prerequisites: Computer Networks, Operating Systems, Programming Fundamentals, Cryptography and System Security, Information Security Basics, Database Management Systems, Web Technologies									
Course Objectives: <ol style="list-style-type: none"> To apply ethical hacking methodologies and penetration testing techniques. To analyze cyber threats and attack vectors. To apply digital forensic procedures for evidence acquisition and preservation. To analyze malware behavior and network traffic. To apply vulnerability assessment and security auditing tools. To analyze legal and ethical issues in cybersecurity. 									
Course Outcomes: After successful completion of the course, the learner will be able to: CO1: Apply reconnaissance and scanning techniques. CO2: Analyze vulnerabilities and recommend mitigation strategies. CO3: Apply forensic acquisition and evidence preservation techniques. CO4: Analyze logs, malware behavior, and network traffic. CO5: Apply penetration testing tools for web and wireless security. CO6: Analyze legal and ethical issues in digital forensics.									
Syllabus									
Unit No.	Description							Hrs.	CO Mapping
1	Introduction to Ethical Hacking and Reconnaissance: Cyber Security Fundamentals, Ethical Hacking Concepts, Footprinting and Reconnaissance, OSINT, Nmap Scanning. Self-Learning: Cyber Kill Chain, Social Engineering.							6	CO1
2	System Hacking and Vulnerability Analysis: Vulnerability Assessment, Password Cracking, Privilege Escalation, Malware Threats. Self-Learning: Zero-Day Vulnerabilities, Secure System Hardening.							6	CO2
3	Digital Forensics Fundamentals: Digital Evidence, Chain of Custody, Disk Imaging, Cloud Forensics. Self-Learning: Blockchain Forensics, File Recovery Techniques.							6	CO3
4	Network and Malware Forensics: Network Traffic Analysis, Log Analysis, Memory Forensics, Malware Analysis. Self-Learning: SIEM Tools, Reverse Engineering Basics.							6	CO4
5	Web Application and Wireless Security: OWASP Top 10, SQL Injection, XSS and CSRF, Wireless Security. Self-Learning: API Security Testing, DevSecOps Practices.							6	CO5
6	Cyber Laws, Ethics, and Forensic Reporting: Cyber Laws and IT Act, Privacy and Data Protection, Forensic Reporting. Self-Learning: GDPR, Ethical Issues in AI Security.							6	CO6
Learning Resources									

Text Books:

1. CEH Certified Ethical Hacker All-in-One Exam Guide – Matt Walker
2. Digital Forensics and Incident Response – Gerard Johansen
3. Hacking: The Art of Exploitation – Jon Erickson

Reference Books:

- 1 The Basics of Hacking and Penetration Testing – Patrick Engebretson
- 2 Practical Malware Analysis – Michael Sikorski

Online Courses:

1. EC-Council CEH : <https://www.eccouncil.org/>
2. Cisco Networking Academy: <https://www.netacad.com/>
3. Coursera Cybersecurity Courses: <https://www.coursera.org/courses?query=cybersecurity>
4. TryHackMe: <https://tryhackme.com/>
5. Hack The Box: <https://www.hackthebox.com/>

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (EHDF)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	3	3	-	-	-	-	-	3	3
CO2	3	3	3	2	3	3	-	-	-	-	-	3	3
CO3	3	3	2	3	3	3	-	-	-	-	-	3	3
CO4	2	3	2	3	3	3	-	-	2	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	3	3
CO6	3	3	3	3	3	3	-	-	2	2	2	3	3

Program	F. Y. M. Tech Computer Engineering								
Course	Blockchain Technology and Applications					Semester	II		
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechC EDLOC41	3	L	T	P	CIA (40)		ESE	CIA	PR/OR
					IAT	CIAT		L	
		3	--	--	20	20	60	--	--
Course Prerequisites: Hash functions, Public - Private keys, SHA, ECC, Digital signatures.									
Course Objectives: <ol style="list-style-type: none"> To get acquainted with the concept of Distributed ledger system and Blockchain. To learn the concepts of consensus and mining in Blockchain through the Bitcoin network. To understand Ethereum and develop-deploy smart contracts using different tools and frameworks. To understand permissioned Blockchain and explore Hyperledger Fabric. To understand different types of crypto assets. To apply Blockchain for different domains IOT, AI and Cyber Security. 									
Course Outcomes: At the end of the course student should be able to <ul style="list-style-type: none"> CO1. Describe the basic concept of Blockchain and Distributed Ledger Technology. CO2. Interpret the knowledge of the Bitcoin network, nodes, keys, wallets and transactions. CO3. Implement smart contracts in Ethereum using different development frameworks. CO4. Develop applications in permissioned Hyperledger Fabric network. CO5. Interpret different Crypto assets and Crypto currencies. CO6. Analyze the use of Blockchain with AI, IoT and Cyber Security using case studies. 									
Syllabus									
Unit No.	Description							Hrs.	CO Mapping
1	Introduction to DLT and Blockchain: Fundamental concepts of Distributed systems, Distributed Ledger Technologies (DLTs) Introduction, Types of Blockchains. Blockchain: Origin, Phases, Components. Block in a Blockchain: Structure of a Block, Block Header Hash and Block Height, The Genesis Block, Linking Blocks in the Blockchain, Merkle Tree. Self-Learning: Blockchain Demo (https://andersbrownworth.com/blockchain/)							6	CO1
2	Consensus and Mining: What is Bitcoin and the history of Bitcoin, Bitcoin Transactions, Bitcoin Concepts: keys, addresses and wallets, Bitcoin Transactions, validation of transactions, PoW consensus. Bitcoin Network: Peer-to-Peer Network Architecture, Node Types and Roles, Incentive based Engineering, The Extended Bitcoin Network, Bitcoin Relay Networks, Network Discovery, Full Nodes, Exchanging Inventory, Simplified Payment Verification (SPV) Nodes, SPV Nodes and Privacy, Transaction Pools, Blockchain Forks. Self-Learning: Study and compare different consensus algorithms like PoA, PoS, Pbf.							6	CO2
3	Permissionless Blockchain - Ethereum: Components, Architecture of Ethereum, Miner and mining node, Ethereum virtual machine, Ether, Gas, Transactions, Accounts, Patricia Merkle Tree, Swarm, Whisper and IPFS, Ethash, End to end							6	CO3

	<p>transaction in Ethereum. Smart Contracts: Smart Contract programming using solidity, Metamask (Ethereum Wallet), Setting up development environment, Use cases of Smart Contract, Smart Contracts: Opportunities and Risk. Smart Contract Deployment: Introduction to Truffle, Use of Remix and test networks for deployment. Other Permissionless Blockchain platforms Introduction: IOTA, Hashgraph, EOS, etc.</p> <p>Self-Learning: Smart contract development using Java or Python.</p>		
4	<p>Permissioned Blockchain - Hyperledger Fabric: Introduction to Framework, Tools and Architecture of Hyperledger Fabric Blockchain. Components: Certificate Authority, Nodes, Chain codes, Channels, Consensus: Solo, Kafka, RAFT. Designing Hyperledger Blockchain. Other Permissioned Blockchain platforms Introduction: Corda, Quorum, etc.</p> <p>Self-Learning: Fundamentals of Hyperledger Composer.</p>	6	CO4
5	<p>Crypto assets and Cryptocurrencies: Fungible and Nonfungible tokens, ERC20 and ERC721 standards, comparison between ERC20 & ERC721, ICO, STO, Different Crypto currencies.</p> <p>Self-Learning: Defi, Metaverse, Types of cryptocurrencies.</p>	6	CO5
6	<p>Blockchain Applications & Research Areas Blockchain in IoT, AI, Cyber Security. Research Areas: Interoperability, Privacy, Performance, Oracles, Security of smart contracts and platforms.</p> <p>Self-Learning: Applications of Blockchain in various domains: Education, Energy, Healthcare, Real-estate, Logistics, Supply chain.</p>	6	CO6

Learning Resources

Text Books:

1. Andreas M. Antonopoulos, “Mastering Bitcoin, Programming the Open Blockchain”, 2nd Edition, O’Reilly Media, Inc., June 2017, ISBN: 9781491954386.
2. Andreas M. Antonopoulos, Dr. Gavin Wood, “Mastering Ethereum, Building Smart Contract and Dapps”, O’Reilly.
3. Chandramouli Subramanian, Asha A George, Abhillash K. A and Meena Karthikeyen, “Blockchain Technology”, Universities Press.
4. Ashwani Kumar, “Hyperledger Fabric In-Depth: Learn, Build and Deploy Blockchain Applications Using Hyperledger Fabric”, BPB Publications.
5. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Blockchain”, Packt Publication.
6. Chris Burniske & Jack Tatar, “Cryptoassets: The Innovative Investor’s Guide to Bitcoin and Beyond”.

Reference Books:

1. Imran Bashir, “Mastering Blockchain”, Packt Publishing.
2. Kumar Saurabh and Ashutosh Saxena, “Blockchain Technology: Concepts and Applications”, Wiley.
3. Antony Lewis, “The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them”.
4. Andreas M. Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly Media.

Online Courses:

1. NPTEL courses: (a) Blockchain and its Applications, (b) Blockchain Architecture Design and Use Cases | www.swayam.gov.in | www.coursera.org | <https://ethereum.org/en/> | <https://www.trufflesuite.com/tutorials> | <https://hyperledger-fabric.readthedocs.io/en/release-2.2/whatis.h>

Blockchain demo: <https://andersbrownworth.com/blockchain/> | Blockchain Demo Public/Private Keys & Signing: <https://andersbrownworth.com/blockchain/public-private-keys/>

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- Six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in end semester examination. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- The question paper shall consist of six questions, carrying 10 marks each.
 - Question No. 1 shall be set from CO1.
 - Question No. 2 shall be set from CO2.
 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- The options should be of comparable difficulty level and should test similar learning outcomes.
- Internal choice may be provided within each question, ensuring both options cover the same module.
- Students will attempt all questions.

CO-PO-PSO Mapping (Blockchain Technology and Applications)

Course Outcome s (CO)	Program Outcomes (PO)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	
CO1	3	-	-	-	-	-	-	-	-	-	-	2	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2	-	2
CO3	3	-	-	-	-	-	-	-	-	-	-	2	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO6	2	-	-	-	-	-	-	-	-	-	-	2	-	2

Program		F. Y. M. Tech Computer Engineering							
Course		Generative AI					Semester	II	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech CEDLO C42	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--
Course Prerequisites: Data Structures and Algorithms, Probability and Statistics, Linear Algebra, Machine Learning Fundamentals, Deep Learning Basics, Python Programming, Basics of Neural Networks.									
Course Objectives: <ol style="list-style-type: none"> Understand the fundamental concepts and evolution of Generative AI. Apply deep learning architectures for generative modelling tasks. Analyze transformer-based Large Language Models (LLMs). Explore diffusion models, GANs, and VAEs for content generation. Design prompt engineering and retrieval-augmented generation systems. Evaluate ethical, societal, and deployment aspects of Generative AI systems. 									
Course Outcomes: After successful completion of the course, the learner will be able to: CO1. Understand foundational concepts and mathematical principles of Generative AI models. CO2. Apply neural network architectures and transformer models for sequence generation tasks. CO3. Analyze GANs, VAEs, and diffusion models for image and data generation. CO4. Design and evaluate prompt engineering and retrieval-augmented generation (RAG) systems. CO5. Develop applications using Large Language Models for real-world tasks. CO6. Evaluate ethical, deployment, and optimization aspects of Generative AI systems.									
Syllabus									
Unit No.	Description							Hrs.	CO Mapping
1	Introduction to Generative AI and Foundations 1.1 Introduction to Artificial Intelligence, Machine Learning, and Deep Learning 1.2 Evolution of Generative AI and applications 1.3 Generative vs Discriminative models 1.4 Probability foundations: Bayes theorem and probabilistic modeling 1.5 Latent variable models and representation learning 1.6 Real-world applications of Generative AI Self-Learning: Overview of modern AI tools (ChatGPT, Midjourney, Gemini)							6	CO1
2	Neural Networks and Transformer Architectures 2.1 Artificial Neural Networks: perceptron, MLP, activation functions 2.2 Backpropagation and optimization techniques 2.3 RNN, LSTM, GRU for sequence modeling 2.4 Attention mechanism and intuition 2.5 Transformer architecture: encoder-decoder design 2.6 Self-attention, multi-head attention, positional encoding 2.7 Introduction to Large Language Models (GPT, BERT, T5) Self-Learning: Evolution of transformer-based models							6	CO2
3	Generative Models (GAN, VAE, Diffusion Models) 3.1 Variational Autoencoders (VAE): architecture and loss function 3.2 Generative Adversarial Networks (GAN): generator and discriminator 3.3 Training instability and improvements in GANs 3.4 Diffusion models: forward and reverse process 3.5 Stable Diffusion and image generation pipeline 3.6 Evaluation metrics for generative models							6	CO3

	Self-Learning: Text-to-image and image-to-text systems		
4	Prompt Engineering and RAG Systems 4.1 Prompt engineering: zero-shot, few-shot, chain-of-thought 4.2 Prompt optimization techniques 4.3 Fine-tuning LLMs: full vs parameter-efficient tuning (LoRA, adapters) 4.4 Reinforcement Learning from Human Feedback (RLHF) 4.5 Retrieval-Augmented Generation (RAG) architecture 4.6 Vector databases and embeddings (FAISS concepts) Self-Learning: LLM APIs and prompt design frameworks	6	CO4
5	Applications and LLM-based Systems 5.1 Applications of Generative AI: chatbots, copilots, content generation 5.2 AI agents and autonomous systems 5.3 Multimodal generative AI (text, image, audio) 5.4 LLM-based application development 5.5 Model optimization and inference efficiency 5.6 Deployment using APIs and cloud platforms Self-Learning: Open-source LLM ecosystem	6	CO5
6	Ethics, Safety and Future of Generative AI 6.1 Ethical challenges: bias, hallucination, misinformation 6.2 Responsible AI and governance frameworks 6.3 Data privacy and security concerns 6.4 Model limitations and risks 6.5 Optimization techniques and compression 6.6 Future trends: AGI, multimodal agents, autonomous AI systems Self-Learning: AI regulation policies (global perspective)	6	CO6

Learning Resources

Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press
2. Lewis Tunstall, et al., *Natural Language Processing with Transformers*, O'Reilly
3. Aurélien Géron, *Hands-On Machine Learning*, O'Reilly

Reference Books:

1. Richard S. Sutton & Andrew G. Barto, *Reinforcement Learning*
2. Christopher Bishop, *Pattern Recognition and Machine Learning*
3. Simon Prince, *Understanding Deep Learning*

Online Courses:

1. Deep Learning Specialization – Coursera (Andrew Ng)
2. Stanford CS224N – Natural Language Processing with Deep Learning
3. Hugging Face Course – Transformers & LLMs

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (GenAI)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	3	3	2	2	3	-	-	-	-	-	-	2	3
CO2	3	3	3	2	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO4	3	3	2	3	3	2	-	-	-	2	-	3	3
CO5	3	3	3	3	3	2	-	-	-	2	2	3	3
CO6	3	3	3	3	3	3	2	-	2	2	2	3	3

ogram		F. Y. M. Tech Computer Engineering							
Course	Design Thinking					Semester	II		
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech CEDLO C43	3	L	T	P	CIA (40)		ESE	CI	PR/OR
					IAT	CIAT		AL	
		3	--	--	20	20	60	--	--
Course Prerequisites: Data Structures and Algorithms, Database Management Systems, Probability and Statistics, Machine Learning Fundamentals, Python Programming, Basics of Data Mining and Web Technologies.									
Course Objectives: <ol style="list-style-type: none"> To stress the importance of good design. To recognize the latest and future issues and challenges in innovation. To expose the students to state-of-the-art perspectives, ideas, concepts, and solutions related to design and innovation using Design Thinking principles. To develop an advanced innovation and growth mindset for problem identification, reframing, and insight generation. To provide a social and thinking space for the recognition of innovation challenges and the design of creative solutions. To propose a concrete, feasible, viable, and relevant innovation project/challenge with implementation. 									
Course Outcomes: After successful completion of the course, the learner will be able to: <ul style="list-style-type: none"> CO1. Understand good features of designs. CO2. Understand the importance of innovation in day-to-day life. CO3. Illustrate and analyze user needs, and formulate design and innovation solutions using Design Thinking principles. CO4. Interpret and evaluate the data collected during the process of problem identification, reframing, and insight generation. CO5. Evaluate designs based on theoretical frameworks and methodological approaches. CO6. Design innovative applications that are usable, effective, and efficient for intended users. 									
Syllabus									
Unit No.	Description	Hrs.	CO Mapping						
1	Introduction to Design 1.1 Good and Poor Design 1.2 What is Interaction Design 1.3 The User Experience 1.4 The Process of Interaction Design 1.5 Interaction Design and the User Experience 1.6 Necessity of UI/UX Self-learning Topics: Study of various interactive day-to-day applications	6	CO1						
2	Design Thinking Background 2.1 Definition of Design Thinking 2.2 Business uses of Design Thinking 2.3 Variety of approaches within the Design Thinking discipline 2.4 Design Thinking mindset Self-learning Topics: Design Thinking in business applications	6	CO2						
3	Design Thinking Approach 3.1 Fundamental Concepts: Empathy, Ethnography, Divergent Thinking, Convergent Thinking, Visual Thinking, Assumption Testing, Prototyping, Validation within Design Thinking	6	CO3						

	<p>3.2 Design Thinking Resources: Human resources, Preferred workspace preparation, Commonly used materials, Dynamics between Design Thinking teams and the organization</p> <p>3.3 Design Thinking Processes Design Thinking approaches, Double Diamond approach, d.School 5-Stage approach, Growth approach, Role of Project Management within Design Thinking</p> <p>Self-learning Topics: Study of various resources for Design Thinking</p>		
4	<p>Design Thinking in Practice</p> <p>4.2 Process Stages of Designing for Growth</p> <p>4.2 Design Thinking Tools and Methods: Need to use tools and methods, Visualization, Journey Mapping, Value Chain Analysis, Mind Mapping, Brainstorming, Concept Development, Assumption Testing, Rapid Prototyping, Customer Co-creation, Learning Launch</p> <p>Self-learning Topics: Study of concept development with any application</p>	6	CO4
5	<p>UX Evaluation, The Interaction Cycle and the User Action Framework</p> <p>UX Goals, Metrics, and Targets, UX Evaluation Techniques, Formative vs Summative Evaluation, Analysis of UX, The Interaction Cycle, The User Action Framework (UAF), Adding a structured knowledge base to the Interaction Cycle, Interaction Cycle and UAF content categories, Role of affordances within the UAF, Practical value of the UAF</p> <p>Self-learning Topics: Study of UI and UX goals with any application</p>	6	CO5
6	<p>Design Thinking Application</p> <p>Case study-based exploration of product development using Design Thinking, Any domain can be selected for implementation</p> <p>Self-learning Topics: Study of any domain application</p>	6	CO6

Learning Resources

Text Books:

4. Daniel Jurafsky and James H. Martin, “Speech and Language Processing,” 3rd edition, 2020
5. Charu. C. Aggarwal, Cheng Xiang Zhai, Mining Text Data, Springer Science and Business Media, 29 2012.
6. BingLiu, “WebData Mining-Exploring Hyperlinks, Contents, and Usage Data”, Springer, Second Edition, 2011.

Reference Books:

3. Jeanne Liedtka & Tim Ogilvie (2011) *Designing for Growth: A Design Thinking Tool Kit for Managers* ISBN: 978-0-231-15838-1
4. Michael Lewrick, Patrick Link, Larry Leifer (2018) *The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems* ISBN: 978-1-119-46747-2
5. Leo Frishberg & Charles Lambdin (2016) *Presumptive Design: Design Provocations for Innovation* ISBN: 978-0-12-803086-8
6. Jamshid Gharajedaghi (2011) *Systems Thinking: Managing Chaos and Complexity: A Platform for Designing Business Architecture* (Chapter 7: Design Thinking) ISBN: 978-0-12-385915-0
7. J. Preece, Y. Rogers & H. Sharp *Interaction Design* ISBN: 0-471-49278-7
8. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale *Human-Computer Interaction*

Online Courses:

3. NPTEL Course: Design Thinking – A Primer (IIT Madras)
<https://nptel.ac.in/courses/110106124>
4. NPTEL Course Preview: Design Thinking (Management – noc22_mg32)
https://onlinecourses.nptel.ac.in/noc22_mg32/preview
5. NPTEL Course Preview: Design Thinking (noc21_ar05)
https://onlinecourses.nptel.ac.in/noc21_ar05/preview
6. NPTEL Course: Product Engineering and Design Thinking (IIT Kharagpur / IIT Ropar)

<https://nptel.ac.in/courses/124/107/124107008/>

7. **NPTEL Course Archive: Design Thinking – A Primer (noc19_ar10)**

<https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ar10/>

8. **NPTEL Course: Human Computer Interaction / Interaction Design (107103083)**

<https://nptel.ac.in/courses/107/103/107103083/>

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (DT)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	2	-	1	-	-	-	-	-	-	1	1
CO2	1	2	1	-	-	2	1	-	-	-	1	1	2
CO3	2	3	3	2	2	1	-	2	2	-	-	2	3
CO4	2	3	2	3	2	1	-	1	2	-	1	2	2
CO5	2	2	3	2	3	1	2	1	2	1	-	2	2
CO6	2	2	3	1	3	2	1	3	2	2	2	3	3

Program		F. Y. M. Tech Computer Engineering							
Course	Text , Web and Social Media Analytics					Semester	II		
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech CEDLOC 44	3	L	T	P	CIA (40)		ESE	CI AL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--
Course Prerequisites: Data Structures and Algorithms, Database Management Systems, Probability and Statistics, Machine Learning Fundamentals, Python Programming, Basics of Data Mining and Web Technologies.									
Course Objectives: <ol style="list-style-type: none"> 1 Understand fundamental and advanced concepts of text, web, and social media analytics. 2 Apply text mining and information extraction techniques to unstructured data. 3 Analyze and implement clustering, classification, and probabilistic models for textual data. 4 Explore web mining and web usage mining techniques for intelligent analytics. 5 Develop recommendation and behaviour analysis models for social media platforms. 6 Design sentiment analysis and opinion mining systems for real-world applications. 									
Course Outcomes: After successful completion of the course, the learner will be able to: <ul style="list-style-type: none"> CO1. Analyze textual data using advanced text mining and information extraction techniques. CO2. Apply clustering, classification and sequence modelling methods for solving text analytics problems. CO3. Evaluate web mining and web usage mining techniques for extracting meaningful web intelligence. CO4. Interpret social network structures and perform social media analytics for behavioural analysis and recommendation systems. CO5. Develop sentiment analysis and opinion mining solutions using machine learning and deep learning approaches. CO6. Design research-oriented analytical solutions for real-world applications involving text, web and social media data. 									
Syllabus									
Unit No.	Description							Hrs.	CO Mapping
1	Introduction to Text Mining and Information Extraction: 1.1 Introduction to Text Mining: Introduction, Algorithms for Text Mining, Applications of Text Analytics, Scalable and Deep Learning-based Text Mining Approaches, Future Directions 1.2 Information Extraction from Text: Named Entity Recognition (NER) Relation Extraction, Unsupervised Information Extraction, Transformer-based Information Extraction 1.3 Text Representation: Tokenization, Stemming and Lemmatization Stop Words, N-gram Modelling, Word Embeddings and Contextual Embeddings Self-Learning: BERT and Transformer Models for Text Analytics							6	CO1
2	Clustering, Classification and Text Modelling: 2.1 Text Clustering: Feature Selection and Transformation Methods Distance-based Clustering Algorithms, Word and Phrase-based Clustering, Probabilistic Document Clustering 2.2 Text Classification: Feature Selection Techniques, Decision Tree Classifiers, Rule-based Classifiers, Probabilistic Classifiers,							6	CO2

	Proximity-based Classifiers, Ensemble and Deep Learning Classifiers 2.3 Text Modelling: Bayesian Networks, Hidden Markov Models, Markov Random Fields, Conditional Random Fields, Topic Modelling Basics Self-Learning: Neural Text Classification using LSTM and Transformers		
3	Web Mining: 3.1 Introduction to Web Mining: Inverted Indices and Compression, Latent Semantic Indexing, Web Search, Semantic and Personalized Search 3.2 Meta Search: Similarity Scores, Rank Positions, Search Result Aggregation 3.3 Web Spamming: Content Spamming, Link Spamming, Hiding Techniques, Combating Web Spam Self-Learning: PageRank Algorithm and Modern Search Engines	6	CO3
4	Web Usage Mining: 4.1 Web Usage Mining Concepts: Data Collection and Pre-processing Sources and Types of Data, Data Modelling 4.2 User Behaviour Analytics: Session and Visitor Analysis, Cluster Analysis and Visitor Segmentation, Association and Correlation Analysis 4.3 Pattern Discovery and Prediction: Sequential and Navigational Pattern Analysis, Classification and Prediction based on Web Transactions, Clickstream Analytics Self-Learning: Web Log Analytics using Big Data Frameworks	6	CO4
5	Social Media Mining: 5.1 Introduction to Social Media Mining: Introduction, Challenges, Types of Social Network Graphs 5.2 Mining Social Media: Influence and Homophily, Behaviour Analytics Social Network Analysis 5.3 Recommendation Systems in Social Media: Challenges in Recommendation, Classical Recommendation Algorithms, Recommendation using Social Context, Hybrid and Context-aware Recommendation Systems, Evaluation of Recommendations Self-Learning: Mining Twitter/X and LinkedIn Data using APIs	6	CO5
6	Opinion Mining and Sentiment Analysis: 6.1 Introduction to Opinion Mining: The Problem of Opinion Mining, Applications of Sentiment Analysis 6.2 Document Sentiment Classification: Supervised Approaches, Unsupervised Approaches, Aspect-based Sentiment Analysis 6.3 Opinion Lexicon Expansion: Dictionary-based Approaches, Corpus-based Approaches 6.4 Opinion Spam Detection: Supervised Learning Methods, Abnormal Behaviours, Group Spam Detection, Fake Review and Bot Detection Self-Learning: Multilingual Sentiment Analysis using Deep Learning	6	CO6
Learning Resources			

Text Books:

7. Daniel Jurafsky and James H. Martin, “Speech and Language Processing,” 3rd edition, 2020
8. Charu. C. Aggarwal, Cheng Xiang Zhai, Mining Text Data, Springer Science and Business Media, 29 2012.
9. BingLiu, “WebData Mining-Exploring Hyperlinks, Contents, and Usage Data”, Springer, Second Edition, 2011.

Reference Books:

9. Christopher D. Manning and Hinrich Schütze, “Foundations of Statistical Natural Language Processing”, MIT Press, First Edition, 1999.
10. Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, First Edition, 2016.
11. Matthew A. Russell and Mikhail Klassen, “Mining the Social Web”, O’Reilly Media, Third Edition, 2019.

Online Courses:

9. Social Network Analysis – IIT Delhi (Prof. Tanmoy Chakraborty), IIT Delhi, NPTEL IIT Delhi, https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs100

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (TWSMA)

Course Outcome s (CO)	Program Outcomes (PO)												
	P O 1	P O2	P O 3	P O4	PO 5	P O6	P O7	P O8	PO9	PO 10	PO1 1	PS O1	PSO 2
CO1	3	3	2	2	3	-	-	-	-	-	-	2	3
CO2	3	3	3	2	3	-	-	-	-	-	-	2	3
CO3	3	3	2	3	3	-	-	-	-	-	-	2	3
CO4	2	3	2	3	3	-	-	-	2	-	-	2	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	3
CO6	3	3	3	3	3	2	-	-	2	2	2	3	3

Program	F. Y. M. Tech Computer Engineering								
Course	Project Management					Semester	II		
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech ILOC21	3	L	T	P	CIA (40)		ESE	CIA	PR/OR
					IAT	CIAT		L	
		3	--	--	20	20	60	--	--

Course Objectives:

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Identify appropriate projects from various options and mention their selection criteria.
- CO2. Prepare Project Charter for the selected project
- CO3. Prepare Work Break Down Structure for a project and also prepare a schedule using GANTT chart, CPM, PERT
- CO4. Identify opportunities and threats to decide risk response strategy of a project.
- CO5. Apply Earned Value Management techniques to determine & predict status of the project and implement project termination process.
- CO6. Identify reasons of project termination

Syllabus

Unit No.	Description	Hrs.	CO Mapping
1	<p>Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)</p> <p>Self-Learning: Case studies on successful and failed projects</p>	6	CO1
2	<p>Initiating Projects: How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.</p> <p>Self-Learning: Case studies on project portfolio management</p>	6	CO2
3	<p>Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).</p> <p>Self-Learning: Applications of PMIS in monitoring and controlling projects</p>	6	CO3

4	<p>Planning Projects: Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks</p> <p>Self-Learning: Applications of probability-impact matrix in real projects</p>	6	CO4
5	<p>Executing Projects: Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings</p> <p>Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit</p> <p>Project Contracting Project procurement management, contracting and outsourcing</p> <p>Self-Learning: Case studies on project audits and procurement management</p>	6	CO5
6	<p>Project Leadership and Ethics: Introduction to project leadership, ethics in projects, Multicultural and virtual projects</p> <p>Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.</p> <p>Self-Learning: Challenges in virtual project management</p>	6	CO6

Learning Resources

Reference Books:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Project Management, Gido Clements, Cengage Learning
4. Project Management, Gopalan, Wiley India
5. Project Management, Dennis Lock, 9th Edition, Gower Publishing England

Online resources:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_mg75
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mg107

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.

- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- The question paper shall consist of six questions, carrying 10 marks each.
 - Question No. 1 shall be set from CO1.
 - Question No. 2 shall be set from CO2.
 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- The options should be of comparable difficulty level and should test similar learning outcomes.
- Internal choice may be provided within each question, ensuring both options cover the same module.
- Students will attempt all questions.

CO-PO-PSO Mapping (PM)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO1	PSO2
CO1	3	2		1				1	1	1	1	2	3
CO2	3	3	1					1	1	1	1	2	3
CO3	3	2	1					1	1	1	1	3	3
CO4	3	3	1					1	1	1	1	2	3
CO5	3	2	1					1	1	1	1	3	3
CO6	3	3	1					1	1	1	1	2	3

Program		F. Y. M. Tech Computer Engineering							
Course		Finance Management					Semester	II	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech ILOC22	3	L	T	P	CIA (40)		ESE	CIA L	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--
Course Prerequisites:									
Course Objectives: <ol style="list-style-type: none"> To provide an overview of Indian financial system, instruments and market To understand the basic concepts of value of money, returns and risks in financial decision-making. To understand the objectives and functions of corporate finance and financial ratio analysis To understand the concepts and importance of working capital and its management. To gain knowledge about sources of finance, capital structure, dividend policy. To gain knowledge about dividend policy and its approaches 									
Course Outcomes: After successful completion of the course, the learner will be able to: <ul style="list-style-type: none"> CO1. Understand the structure, components, functions, and instruments of the Indian financial system and financial markets.. CO2. Apply the concepts of return, risk, and time value of money to solve investment and financing problems. CO3. Apply financial ratio analysis techniques to interpret financial statements and measure the financial performance of business organizations CO4. Apply the principles of corporate finance in investment, financing, dividend, and working capital decisions. CO5. Apply capital budgeting techniques such as ARR, Payback Period, NPV, PI, IRR, and MIRR for investment appraisal CO6. Apply the concepts of sources of finance, capital structure, and dividend policy in determining suitable financial strategies for organizations. 									
Syllabus									
Unit No.	Description							Hrs	CO Mapping
1	Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges .							6	CO1
2	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting							6	CO2

3	<p>Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.</p> <p>Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.</p>	6	CO3
4	<p>Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)</p> <p>Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.</p>	6	CO4
5	<p>Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance.</p> <p>Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure</p>	6	CO5
6	<p>Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach</p>	6	CO6

Learning Resources

Text Books:

8. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
9. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
10. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
11. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi

Reference Books:

6. Applied Corporate Finance-A User's Manual by Aswath Damodaran, Wiley India Edition, 2nd edition
7. Financial Management-Theory and Practice, 11th edition by Eugene F. Brigham & Michael C. Ehrhardt- Thomson Corporation

Online Courses:

1. 1. Financial Management for Managers, Prof. Chandra Shekhar, IIT Roorkee, NPTEL IIT Roorkee, https://onlinecourses.nptel.ac.in/noc25_mg23/preview

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the

syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- The question paper shall consist of six questions, carrying 10 marks each.
 - Question No. 1 shall be set from CO1.
 - Question No. 2 shall be set from CO2.
 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- The options should be of comparable difficulty level and should test similar learning outcomes.
- Internal choice may be provided within each question, ensuring both options cover the same module.
- Students will attempt all questions.

CO-PO-PSO Mapping (FM)

Course Outcome s (CO)	Program Outcomes (PO)												
	P O 1	P O2	P O 3	P O4	PO 5	P O6	P O7	P O8	PO9	PO 10	PO1 1	PS O1	PSO 2
CO1	2	-	1	-	-	-	1	1	1	2	2	-	1
CO2	2	-	1	-	-	-	1	1	1	2	2	-	1
CO3	2	-	1	-	-	-	1	1	1	2	2	-	1
CO4	2	-	1	-	-	-	1	1	1	2	2	-	1
CO5	2	-	1	-	-	-	1	1	1	2	2	-	1
CO6	2	-	1	-	-	-	1	1	1	2	2	-	1

Program	F. Y. M. Tech Computer Engineering								
Course	Entrepreneurship Development and Management					Semester	II		
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech ILOC23	3	L	T	P	CIA (40)		ESE	CIA	PR/OR
					IAT	CIAT		L	
		3	--	--	20	20	60	--	--

Course Objectives:

1. To understand the concepts, functions, and importance of entrepreneurship and business management.
2. To apply entrepreneurial skills and business planning techniques for establishing and managing enterprises.
3. To analyze financial, legal, and managerial aspects involved in entrepreneurship development.
4. To analyze the role of innovation, government policies, and support systems for entrepreneurial growth.
5. To apply strategies for effective management of small businesses and sustainable business practices.
6. To develop ethical, leadership, communication, and teamwork skills required for entrepreneurship and professional growth.

Course Outcomes:

After successful completion of the course, the learner will be able to:

After successful completion of the course, the learner will be able to:

CO1. Understand the concepts, characteristics, and functions of entrepreneurship and business management.

CO2. Apply entrepreneurial skills and business planning techniques for establishing enterprises.

CO3. Apply financial and managerial strategies for effective business operations and growth

CO4. Analyze the impact of government policies, legal frameworks, and support systems on entrepreneurship development.

CO5. Analyze innovation, sustainability, and technology-driven approaches in entrepreneurship and small business management.

CO6. Apply leadership, ethical practices, communication, and teamwork skills in entrepreneurial and professional activities.

Syllabus

Unit No.	Description	Hrs	CO Mapping
1	Concept of Entrepreneurship: Concept and Meaning of Entrepreneurship; Characteristics and Functions of an Entrepreneur; Role of Entrepreneurship in Economic Development; Types of Entrepreneurs; Entrepreneurship Process; Qualities and Competencies of Successful Entrepreneurs; Entrepreneurship Development in India; Challenges and Opportunities for Entrepreneurs	6	CO1
2	Business Planning and Financial Management : Business Idea Generation and Opportunity Identification; Preparation of Business Plan; Market Analysis and Feasibility Study; Sources of Finance for Startups and Small Enterprises; Financial Planning and Budgeting; Working Capital Management; Risk Management in Business.	6	CO2
3	Entrepreneurship Development and Innovation : Innovation and Creativity in Entrepreneurship; Product and Process Innovation; Startup Ecosystem; Technology-based Entrepreneurship; Digital Entrepreneurship and E-commerce; Role of Innovation in Business Growth; Sustainable Entrepreneurship Practices	6	CO3
4	Government Policies and Support Systems: Government Policies for Entrepreneurship Development; Role of MSME and Startup India Initiatives; Institutional Support for Entrepreneurs; Legal Requirements for Starting a Business; Intellectual Property Rights	6	CO4

	(IPR); Taxation and Regulatory Framework; Women and Rural Entrepreneurship Support Schemes.		
5	Effective Management of Business : Principles of Management; Leadership and Team Building; Communication Skills for Entrepreneurs; Marketing Management; Human Resource Management; Operations and Supply Chain Management; Decision Making and Problem Solving in Business Organizations.	6	CO5
6	Achieving Success in Small Business :Growth Strategies for Small Businesses; Business Ethics and Professional Values; Customer Relationship Management; Quality Management and Continuous Improvement; Sustainability and Social Responsibility; Case Studies of Successful Entrepreneurs; Future Trends in Entrepreneurship and Innovation	6	CO6

Learning Resources

Text Books:

1. Vasant Desai, Entrepreneurship Development, Himalaya Publishing House.
2. Poornima M. Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education.
3. S.S. Khanka, Entrepreneurial Development, S. Chand Publications.
4. Robert D. Hisrich and Michael P. Peters, Entrepreneurship, McGraw Hill Education.
5. D.F. Kuratko, Entrepreneurship: Theory, Process and Practice, Cengage Learning.

Reference Books:

1. C.B. Gupta and N.P. Srinivasan, Entrepreneurial Development, Sultan Chand & Sons.
2. P. Saravanavel, Entrepreneurship Development, Ess Pee Kay Publishing House.
3. Donald F. Kuratko, Entrepreneurship in the New Millennium, Cengage Learning.
4. Rajeev Roy, Entrepreneurship, Oxford University Press.
5. Harold Koontz and Heinz Weihrich, Essentials of Management, McGraw Hill.

Online Courses:

1. NPTEL – Entrepreneurship
2. SWAYAM – Entrepreneurship Development
3. Coursera – Entrepreneurship Specialization
4. edX – Innovation and Entrepreneurship
5. Udemy – Entrepreneurship Fundamentals

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.

iii. Question No. 3 shall be set from CO3.

iv. Question No. 4 shall be set from CO4.

v. Question No. 5 shall be set from CO5.

vi. Question No. 6 shall be set from CO6.

b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.

c. The options should be of comparable difficulty level and should test similar learning outcomes.

d. Internal choice may be provided within each question, ensuring both options cover the same module.

e. Students will attempt all questions.

CO-PO-PSO Mapping (Entrepreneurship Development and Management)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	2	2	-	-	-	2	-	-	-	-	-	1	2
CO2	2	2	3	-	-	2	-	2	2	2	-	2	3
CO3	2	3	3	2	2	2	-	2	2	3	-	2	3
CO4	1	3	2	2	1	3	2	-	2	-	2	2	2
CO5	2	2	3	2	3	3	2	-	2	-	3	3	2
CO6	-	-	-	-	-	2	3	3	3	2	2	1	3

Program		F. Y. M. Tech Computer Engineering							
Course		Human Resource Management					Semester	II	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech ILOC24	3	L	T	P	CIA (40)		ESE	CIA	PR/OR
					IAT	CIAT	L		
		3	--	--	20	20	60	--	--
Course Objectives: <ol style="list-style-type: none"> To introduce the students with basic concepts, techniques and practices of the human resource management To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations To familiarize the students about the latest developments, trends & different aspects of HRM To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers 									
Course Outcomes: After successful completion of the course, the learner will be able to: CO1: Explain basic concepts of HRM. CO2: Apply organizational behaviour concepts in workplaces. CO3: Apply leadership and organizational structure principles. CO4: Apply HR planning and performance appraisal techniques. CO5: Apply emerging HR practices in organizations. CO6: Apply strategic HRM and labour law concepts.									
Syllabus									
Unit No.	Description							Hrs	CO Mapping
1	Introduction to HR · Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions · Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues Self-Learning: AI in HRM , Ethics and Employee Empowerment							6	CO1
2	Organizational Behaviour (OB) · Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues · Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness · Perception: Attitude and Value, Effect of perception on Individual Decision making, Attitude and Behaviour · Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor); · Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Self-Learning: Case Study on Workplace Motivation, Case Study on Team Dynamics							6	CO2

	and Leadership		
3	<p>Organizational Structure & Design</p> <ul style="list-style-type: none"> · Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. · Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. · Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies. <p>Self-Learning: Organizational Role Conflict Analysis, Contemporary Leadership Practices, Workplace Stress Management, Organizational Culture and Structure Analysis</p>	6	CO3
4	<p>Human resource Planning</p> <ul style="list-style-type: none"> · Recruitment and Selection process, Job-enrichment, Empowerment - Job Satisfaction, employee morale · Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning · Training & Development: Identification of Training Needs, Training Methods <p>Self-Learning: HR Interview Simulation, Resume Screening Activity, Performance Appraisal Report Analysis, Training Program Design, Career Planning Exercise</p>	6	CO4
5	<p>Emerging Trends in HR</p> <ul style="list-style-type: none"> · Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment · Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation <p>Self-Learning: Cross-Cultural Communication Activity, Diversity Management Practices, Organizational Change Analysis, Workplace Inclusion Strategies</p>	6	CO5
6	<p>HR & MIS: Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries)</p> <ul style="list-style-type: none"> · Strategic HRM: Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals · Labor Laws & Industrial Relations: Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act <p>Self-Learning: HRIS Tools Exploration, Strategic HRM Practices, Mission and Vision Statement Analysis, Industrial Relations Practices, Overview of Indian Labour Laws</p>	6	CO6

Learning Resources

Text Books:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing

3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015

Reference Books:

1. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
2. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Online Courses:

1. AI in Human Resource Management, Prof. Abraham Cyril Issac, IIT Guwahati, NPTEL IIT Guwahat, https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg19

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (HRM)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	–	–	–	–	–	–	2	1	–	1	1	–	–
CO2	–	1	–	–	–	–	2	3	2	1	1	–	2
CO3	–	1	1	–	–	1	2	3	2	2	1	–	2
CO4	–	1	1	–	1	–	1	2	1	2	1	–	2
CO5	–	1	1	–	1	2	2	2	1	1	2	1	2
CO6	–	1	1	–	1	2	3	1	1	2	2	–	2

Program	F. Y. M. Tech Computer Engineering								
Course	Professional Ethics and Corporate Social Responsibility (CSR)					Semester	II		
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech ILOC25	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Objectives:

3. To understand professional ethics in business
4. 2. To recognized corporate social responsibility

Course Outcomes:

After successful completion of the course, the learner will be able to:

- CO1. Understand rights and duties of business.
- CO2. Analyze and explore duties of business and professional ethics in the marketplace.
- CO3. Analyze and Demonstrate professional ethics of consumer protection and job discrimination.
- CO4. Describe and analyze different aspects of corporate social responsibility
- CO5. Analyze interrelatedness of enterprises and corporate social responsibility.
- CO6. Understand legal aspects of corporate social responsibility.

Syllabus

Unit No.	Description	Hrs	CO Mapping
1	<p>Professional Ethics and Business: The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business</p> <p>Self-Learning: Case studies on business ethics and corporate scandals</p>	6	CO1
2	<p>Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources</p> <p>Self-Learning: Role of government regulations in competitive markets</p>	6	CO2
3	<p>Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.</p> <p>Self-Learning: Case studies on consumer protection and workplace discrimination</p>	6	CO3
4	<p>Introduction to Corporate Social Responsibility: Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India</p> <p>Self-Learning: Role of CSR in community development and social welfare</p>	6	CO4

5	Corporate Social Responsibility: Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India Self-Learning: Case studies on CSR initiatives by Indian SMEs and corporations	6	CO5
6	Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013. Self-Learning: Comparative study of CSR policies in different countries	6	CO6

Learning Resources

Reference Books:

6. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
7. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
8. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
9. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (PECSR)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	P O 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2
CO1						2	1	3	1	1	1	1	3
CO2						2	1	3	1	1	1	1	3
CO3						3	1	3	1	1	1	1	2
CO4						3	1	3	1	1	1	1	2
CO5						3	1	3	1	1	1	1	2
CO6						3	1	3	1	1	1	1	2

Program		F. Y. M. Tech Computer Engineering							
Course		Research Methodology					Semester	II	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech ILOC26	3	L	T	P	CIA (40)		ESE	CIAL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--
Course Prerequisites: Fundamental knowledge of data collection and analysis, Basic understanding of statistics and mathematical concepts.									
Course Objectives: <ol style="list-style-type: none"> To introduce the fundamental concepts, characteristics, and significance of research in business and social sciences. To familiarize students with different types of research and qualitative and quantitative research approaches. To develop understanding of research design, sampling methods, and sampling techniques used in research studies. To explain the stages involved in research methodology and scientific research process. To enable students to formulate and analyze research problems effectively. To develop the ability to prepare research reports and understand validity testing and ethical issues in research. 									
Course Outcomes: After successful completion of the course, the learner will be able to: <ul style="list-style-type: none"> CO1. Understand the basic concepts, objectives, characteristics, and importance of research in business and social sciences. CO2. Apply suitable qualitative and quantitative research approaches by differentiating among various types of research. CO3. Design appropriate research and sampling methods for conducting effective research studies. CO4. Apply the stages of research methodology in conducting systematic scientific research. CO5. Apply appropriate techniques to formulate research problems by considering relevance, data availability, and analysis requirements. CO6. Apply appropriate methods for preparing research reports with proper interpretation, conclusions, validity testing, and ethical considerations. 									
Syllabus									
Unit No.	Description							Hrs	CO Mapping
1	Introduction and Basic Research Concepts 1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology 1.2 Need of Research in Business and Social Sciences 1.3 Objectives of Research 1.4 Issues and Problems in Research 1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical							6	CO
2	Types of Research 2.1. Basic Research 2.2. Applied Research 2.3. Descriptive Research 2.4. Analytical Research 2.5. Empirical Research 2.6 Qualitative and Quantitative Approaches							6	CO
3	Research Design and Sample Design 3.1 Research Design – Meaning, Types and Significance 3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques							6	CO

	Sampling Errors		
4	Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	6	CO4
5	Formulating Research Problem 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis. 5.2 Problem Formulation Process: Selecting a topic, Defining scope, statement of problem, research questions	6	CO5
6	Outcome of Research 6.1 Preparation of the report on conclusion reached 6.2 Validity Testing & Ethical Issues 6.3 Suggestions and Recommendation	6	CO6

Learning Resources

Text Books:

1. Cooper, Donald R. and Schindler, Pamela S., 2014, Business Research Methods, New York, McGraw-Hill Education.
2. Kothari, C.R., 1985, *Research Methodology: Methods and Techniques*, New Delhi, Wiley Eastern Limited.

Reference Books:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Online Courses:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ar05
2. https://www.udemy.com/course/research-methodology-101/?utm_source=&couponCode=25BBPMXNVD35

Assessment:

Internal Assessment Test (IAT) for 20 marks each:

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:

Question paper format

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
 - i. Question No. 1 shall be set from CO1.
 - ii. Question No. 2 shall be set from CO2.
 - iii. Question No. 3 shall be set from CO3.
 - iv. Question No. 4 shall be set from CO4.
 - v. Question No. 5 shall be set from CO5.
 - vi. Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping(RM)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO1 1	PS O1	PSO 2
CO1	2	2	-	-	-	-	2	2	2	-	2	2	-
CO2	2	3	-	2	-	-	2	2	2	-	2	2	2
CO3	3	2	3	3	2	-	2	2	2	-	-	3	2
CO4	2	3	-	3	2	-	2	2	2	-	2	3	2
CO5	2	3	2	2	-	-	2	2	2	-	2	2	2
CO6	2	2	-	3	-	-	2	2	2	-	-	2	3

Program		F. Y. M. Tech Computer Engineering							
Course		IPR and Patenting					Semester	II	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech ILOC27	3	L	T	P	CIA (40)		ESE	CIA L	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--

Course Prerequisites: Basic understanding of engineering concepts, innovations and intellectual property concepts. Familiarity with legal and ethical practices in engineering.

Course Objectives:

1. To understand IPR concepts, types, and their economic significance.
2. To learn IPR enforcement and legal framework in India and globally.
3. To analyze emerging issues in IPR.
4. To understand patent fundamentals and patentability criteria.
5. To gain knowledge of patent rules and international agreements.
6. To learn patent filing procedures, licensing, and patent databases.

Course Outcomes:

After successful completion of the course, the learner will be able to:

CO1: Understand IPR concepts, types, and significance.

CO2: Describe IPR legal framework and enforcement.

CO3: Analyze emerging issues in IPR.

CO4: Understand patent fundamentals and patentability.

CO5: Interpret patent rules and international agreements.

CO6: Apply patent search, filing, and licensing procedures.

Syllabus

Unit No.	Description	Hrs	CO Mapping
1	<p>Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc.</p> <p>Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development</p> <p>IPR Protection and Enforcement Mechanisms: Infringement of IPR, Legal remedies and penalties, Dispute resolution mechanisms, Role of national and international bodies (WIPO, WTO), Challenges in enforcement of IPR laws.</p>	6	CO1
2	<p>Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement</p> <p>Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.</p>	6	CO2
3	<p>Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.</p> <p>IPR Management and Commercialization: Licensing, franchising, technology transfer, valuation of intellectual property, and strategies for commercialization of IP assets.</p>	6	CO3

4	Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims	6	CO4
5	Patent Rules: Indian Patent Act, overview of international patent systems (US & European), and key multilateral treaties (TRIPS Agreement, Paris Convention).	6	CO5
6	Procedure for Filing a Patent (National and International): Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication Patent databases: Important websites, Searching international databases	6	CO6

Learning Resources

Text Books:

1. Intellectual Property Rights, 2nd Edition (2019) by Neeraj Pandey and Khushdeep Dharni; Publisher: PHI Learning, New Delhi.
2. Patent Law and Practice, 2nd Edition (2014) by K.C. Kailasam and Ramu Vedaraman; Publisher: LexisNexis, New Delhi.
3. Intellectual Property: Patents, Trademarks, Copyrights, Trade Secrets, 5th Edition (2017) by Richard Stim; Publisher: Cengage Learning, Boston.
4. Intellectual Property Rights in India, Revised Edition (2017) by P. Narayanan; Publisher: Eastern Law House, New Delhi.

Reference Books:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley IEEE Press.

Online Courses:

1. Intellectual Property, Prof. Feroz Ali, IIT Madras, NPTEL IIT Madras, <https://nptel.ac.in/courses/109106137>

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- The question paper shall consist of six questions, carrying 10 marks each.
 - Question No. 1 shall be set from CO1.
 - Question No. 2 shall be set from CO2.
 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- The options should be of comparable difficulty level and should test similar learning outcomes.
- Internal choice may be provided within each question, ensuring both options cover the same module.
- Students will attempt all questions.

CO-PO-PSO Mapping (IPR & Patenting)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PSO 2
CO1	1	1	-	-	-	2	2	-	1	-	1	1	1
CO2	1	2	-	-	-	2	3	-	1	-	1	1	1
CO3	-	2	1	-	-	3	2	-	1	-	2	1	1
CO4	2	2	1	-	-	1	2	-	1	-	1	1	1
CO5	1	2	-	-	-	2	3	-	1	-	1	1	1
CO6	2	2	2	1	2	1	2	1	2	1	2	1	1

Program		F. Y. M. Tech Computer Engineering							
Course		Digital Business Management					Semester	II	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTech ILOC28	3	L	T	P	CIA (40)		ESE	CIA L	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--
Course Objectives: <ol style="list-style-type: none"> To familiarize with digital business concept To acquaint with E-commerce To give insights into E-business and its strategies 									
Course Outcomes: After successful completion of the course, the learner will be able to: CO1: Explain the concepts and drivers of digital business. CO2: Apply e-commerce models and strategies in digital business environments. CO3: Apply digital business support services and application development concepts. CO4: Apply e-business management and security techniques in organizations. CO5: Apply e-business strategies for digital transformation processes. CO6: Apply business planning techniques for successful e-business implementation.									
Syllabus									
Unit No.	Description							Hrs	CO Mapping
1	Introduction to Digital Business- Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business, Self-Learning: Digital Business Models Analysis, E-Marketplace Study, IoT Applications in Business, Cloud Computing in Digital Business							6	CO1
2	Overview of E-Commerce E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC Self-Learning: E-Commerce Website Analysis, Consumer Behaviour in Online Shopping, Affiliate Marketing Strategies, Mobile Commerce Applications, Legal and Ethical Issues in E-Commerce							6	CO2
3	Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system Application Development: Building Digital business Applications and Infrastructure Self-Learning: ERP Applications in Business, Digital Business Infrastructure Study,							6	CO3

	Knowledge Management Tools, Information System Applications, E-Business Application Development Concepts		
4	<p>Managing E-Business-Managing Knowledge, Management skills for e business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications Self-Learning: E-Business Risk Management, Cyber Security in E-Commerce, Digital Signature Applications, Cryptography Techniques Study, SSL and Firewall Security Mechanisms</p>	6	CO4
5	<p>E-Business Strategy- E-business Strategic formulation- Analysis of Company’s Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation) Self-Learning: Digital Transformation Strategies, SWOT Analysis for E-Business, E-Business Strategy Implementation, Challenges in Digital Transition, Strategic Planning in E-Business</p>	6	CO5
6	<p>Materializing e-business: From Idea to Realization-Business plan preparation Self-Learning: E-Business Plan Development, Startup Business Model Design, Digital Business Idea Validation, Online Business Pitch Preparation, E-Business Feasibility Analysis</p>	6	CO6

Learning Resources

Text Books:

1. A textbook on E-commerce, ErArunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-Business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan

Reference Books:

1. E-Governance-Challenges and Opportunities in: Proceedings in 2nd International Conference theory and practice of Electronic Governance
2. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
3. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-enOECD Publishing

Online Courses:

1. Business Analytics For Management Decision, Prof. Rudra P Pradhan, IIT Kharagpur, NPTEL IIT Kharagpur,
https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg39

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- The question paper shall consist of six questions, carrying 10 marks each.
 - Question No. 1 shall be set from CO1.
 - Question No. 2 shall be set from CO2.
 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- The options should be of comparable difficulty level and should test similar learning outcomes.
- Internal choice may be provided within each question, ensuring both options cover the same module.
- Students will attempt all questions.

CO-PO-PSO Mapping (DBM)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO1 1	PS O1	PSO 2
CO1	1	–	–	–	1	–	–	–	–	–	2	1	–
CO2	1	2	2	–	2	1	1	1	1	1	2	2	2
CO3	2	2	2	1	3	–	–	1	1	1	2	3	2
CO4	1	2	1	1	3	1	2	1	1	1	2	3	2
CO5	1	2	2	–	2	2	1	1	1	2	2	2	2
CO6	1	2	2	1	2	1	1	2	2	3	2	2	3

Program		F. Y. M. Tech Computer Engineering							
Course		Environmental Management					Semester		II
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechIL OC29	3	L	T	P	CIA (40)		ESE	CI AL	PR/OR
					IAT	CIAT			
		3	--	--	20	20	60	--	--
Course Prerequisites:									
Course Objectives:									
<ol style="list-style-type: none"> 1. Understand and identify environmental issues relevant to India and global concerns 2. Learn concepts of ecology 3. Familiarise environment related legislations 									
Course Outcomes:									
After successful completion of the course, the learner will be able to:									
CO1: Explain the concepts and significance of environmental management.									
CO2: Apply knowledge of global environmental issues for sustainable development.									
CO3: Apply ecological concepts to analyze ecosystem interactions.									
CO4: Apply environmental management practices and corporate responsibilities in organizations.									
CO5: Apply environmental quality standards and EMS frameworks in industries.									
CO6: Apply environmental legislations and regulatory policies in professional practice.									
Syllabus									
Unit No.	Description							Hrs.	CO Mapping
1	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario Self-Learning: Sustainable Development Practices, Environmental Issues in India, Renewable Energy Sources, Green Career Opportunities, Energy Conservation Techniques							6	CO1
2	Global Environmental concerns: Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc. Self-Learning: Global Warming Impact Analysis, Biodiversity Conservation Practices, Hazardous Waste Management, Industrial Disaster Case Analysis, Ozone Layer Protection Measures							6	CO2
3	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc Self-Learning: Ecosystem Structure Analysis, Food Chain and Food Web Study, Biodiversity and Habitat Conservation, Carrying Capacity Assessment, Ecological Balance and Sustainability							6	CO3
4	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility							6	CO4

	Self-Learning: Corporate Environmental Responsibility Practices, Environmental Planning and Regulation		
5	Total Quality Environmental Management, ISO-14000, EMS certification. Self-Learning: ISO 14000 Standards Study	6	CO5
6	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc. Self-Learning: Environmental Protection Laws in India, Industrial Safety and Pollution Control Acts	6	CO6

Learning Resources**Text Books:**

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005

Reference Books:

1. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
2. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
3. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Online Courses:

1. Environmental Planning and Management, Prof. Sonal K. Thengane, IIT Roorkee, NPTEL IIT Roorkee,
https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge08

Assessment:**Internal Assessment Test (IAT) for 20 marks each:**

IAT will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I, and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II. The average of both tests will be considered

Continuous Internal Assessment-Theory (CIAT) for 20 Marks:

- A total of three CIA components (such as assignments, quizzes, presentations, case studies, etc.) shall be conducted.
- Each component will carry 5 marks, totaling 15 marks.
- Attendance will carry 5 marks.

End Semester Theory Examination (ESE) 60 marks:**Question paper format**

Time duration for 60 marks paper is 2 hours

Question paper carrying 60 marks:

- a. The question paper shall consist of six questions, carrying 10 marks each.
- Question No. 1 shall be set from CO1.
 - Question No. 2 shall be set from CO2.
 - Question No. 3 shall be set from CO3.
 - Question No. 4 shall be set from CO4.
 - Question No. 5 shall be set from CO5.
 - Question No. 6 shall be set from CO6.
- b. Each question shall have two options – Option A and Option B, and both options must be set from the same module.
- c. The options should be of comparable difficulty level and should test similar learning outcomes.
- d. Internal choice may be provided within each question, ensuring both options cover the same module.
- e. Students will attempt all questions.

CO-PO-PSO Mapping (EM)

Course Outcomes (CO)	Program Outcomes (PO)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO1 1	PS O1	PSO 2
CO1	1	–	–	–	–	2	1	–	–	–	2	–	–
CO2	1	2	1	–	–	3	2	1	1	–	2	–	1
CO3	1	2	1	1	–	3	1	–	–	–	2	–	1
CO4	1	2	2	–	1	3	2	1	1	1	2	–	2
CO5	1	1	2	1	2	3	2	1	1	1	2	1	2
CO6	1	2	1	–	–	3	3	–	1	1	2	–	1

Program	F. Y. M. Tech Computer Engineering								
Course	Computational Laboratory II						Semester	II	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
VMTechCEL201	1	L	T	P	CIA		ESE	CIAL	OR
					IAT	CIAT			
		--	--	2	--	--	--	25	25

Lab Objectives:

1. To understand virtualization and cloud computing platforms.
2. To implement cloud-based services and application deployment techniques.
3. To demonstrate cloud resource management and data synchronization techniques.
4. To perform data preprocessing and exploratory data analysis using statistical tools.
5. To apply machine learning and statistical techniques for predictive analytics.
6. To visualize and interpret analytical results for real-world applications.

Lab Outcomes:

After successful completion of the course, the learner will be able to:

- LO1: Implement virtualization and cloud computing services using modern cloud platforms.
 LO2: Deploy and manage applications in cloud environments.
 LO3: Demonstrate cloud resource management, virtual machine migration, and cloud synchronization Techniques.
 LO4: Perform data preprocessing and exploratory data analysis using Python libraries.
 LO5: Apply statistical analysis and machine learning techniques on datasets.
 LO6: Visualize, interpret, and develop predictive analytics solutions using open-source tools.

Lab Prerequisite:

Students should have basic knowledge of cloud computing concepts, virtualization, Python programming, statistics, and database fundamentals. Familiarity with Python libraries such as NumPy, Pandas, Matplotlib, and Scikit-learn will be beneficial...

List of laboratory experiments: (Any Ten Experiments)

Sr. No.	Name of the Experiment	Hours	LO Mapping
1	Study and installation of virtualization tools such as VirtualBox/VMware	02	LO1
2	Creation and management of virtual machines using cloud platforms	02	LO1
3	Deployment of web applications using cloud services	02	LO2
4	Demonstration of virtual machine migration in cloud environment	02	LO2
5	Implementation of mobile cloud data synchronization using cloud platforms	02	LO3
6	Implementation of containerization and orchestration using Docker and Kubernetes in a cloud environment.	02	LO3
7	Data preparation and preprocessing using NumPy and Pandas	02	LO4
8	Data Visualization and Exploratory Data Analysis using Matplotlib and Seaborn	02	LO4
9	Implementation of Statistical Hypothesis Testing using Scipy and Scikit-learn	02	LO5
10	Regression Analysis using Machine Learning Models	02	LO5
11	Predictive Data Analytics using RStudio/RWeka/RHadoop or equivalent tools	02	LO6
12	Mini Project on Cloud-based Data Analytics Application	02	LO6

Sr No	List of Assignments / Tutorials	Hrs	LO Mapping
01	Introduction to Cloud Computing Platforms and Virtualization	02	LO1
02	Cloud Service Models and Application Deployment Techniques		LO2
03	Virtual Machine Migration and Cloud Synchronization		LO3
04	Containerization using Docker		LO3
05	Data Cleaning and Preprocessing using Python		LO4
06	Exploratory Data Analysis and Data Visualization		LO4
07	Statistical Analysis and Machine Learning Techniques		LO5
08	Predictive Analytics using Open-source Tools		LO6

Assessment :

Continuous Internal Assessment-Lab (CIAL): CIAL shall consist of at least 10 practicals based on the above list. Also, the CIAL Journal must include at least 6 assignments.

CIAL Marks: 25 Marks (Total marks) = 15 Marks (Average marks of Experiments) +10 Marks (At least 2 LMs of 5 marks each)

LO-PO-PSO Mapping (CC II)

Lab Outcomes (LO)	Program Outcomes (PO)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
LO1	3	-	-	-	2	-	1	1	2	2	2	3	2
LO2	3	2	2	-	3	-	1	1	2	2	2	3	3
LO3	3	2	-	2	3	-	1	1	2	2	2	3	2
LO4	2	3	2	3	3	-	1	1	2	-	2	3	2
LO5	2	2	-	2	3	-	1	1	2	-	2	2	2
LO6	2	3	3	2	3	-	1	1	2	-	2	2	2

Program	F. Y. M. Tech. Computer Engineering								
Course	Skill Based Lab						Semester	II	
Code	Credits	Teaching Scheme (Hrs/Week)			Theory Examination Scheme			Laboratory Examination Scheme	
VMTech CESBL20 2	1	L	T	P	CIA		ESE	CIAL	OR
					IAT	CIA T			
		--	--	2	--	--	--	50	50
Lab Objectives: To be framed as per the DLOC offered									
Lab Outcomes: To be framed as per the DLOC offered									
Detail Content: Skill Based Lab II shall include activity/ Case study/ project-based learning like Mini-project in engineering domains related to the specialization or interdisciplinary domains, product design application software development, idea proposal and validation.									
Assessment :									
Continuous Internal Assessment-Lab (CIAL): CIAL shall consist of continuous assessment based on activities, case studies, mini-projects, product design, software development, idea proposal and validation related to the specialization or interdisciplinary domains as per the defined Lab Outcomes (DLOCs). Students shall perform at least 10 skill-based practical activities/tasks. The CIAL Journal must also include at least 6 assignments covering implementation, analysis, design, and validation aspects.									
CIAL Marks: 25 Marks (Total Marks) = Average Marks of Practicals/Activities/Mini-Project Work									