

 Estd. 1962 "A++" Accredited by NAAC (2021) With CGPA 3.52	SHIVAJI UNIVERSITY, KOLHAPUR 416 004, MAHARASHTRA PHONE : EPABX - 2609000, BOS Section - 0231-2609094, 2609487 Web : www.unishivaji.ac.in Email: bos@unishivaji.ac.in शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४, २६०९४८७ वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in		
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SU/BOS/Sci & Tech/ 183

Date: 10/06/2026

The Principal / Director,
All Concerned Affiliated Colleges / Institutions,
Shivaji University, Kolhapur.

Subject: Regarding revised syllabus of **B. Tech. degree Programme (Affiliated Colleges)** under the Faculty of Science and Technology as per NEP 2020.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, Nature of Question paper and equivalence of B. Tech. degree programme under the Faculty of Science & Technology as per National Education Policy 2020 (NEP 2020).

Sr. No.	B. Tech Course Syllabus	
1	Civil Engineering	Part-III
2	Mechanical Engineering	Part-III
3	Mechanical and Mechatronic Engineering (Additive Manufacturing)	Part-III
4	Electrical Engineering	Part-III
5	Electrical and Computer Engineering	Part-III
6	Electronics and Telecommunication Engineering	Part-III
7	Electronics & Computer Science Engineering	Part-III
8	Computer Science and Engineering	Part-III
9	Computer Science and Engineering (Artificial Intelligence & Machine Learning) (AIML)	Part-III
10	Computer Science and Engineering (Data Science) (DS)	Part-III
11	Computer Science and Engineering (Artificial Intelligence & Data Science) (AIDS)	Part-III
12	Electronics and communication Engineering (Bio-Medical Engineering)	Part-II

This Syllabus, nature of question and equivalence shall be implemented from the academic year **2026-27** onwards. A soft copy containing the syllabus is attached herewith and it is available on university website www.unishivaji.ac.in > Syllabus > Syllabus as per NEP-2020.

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October/ November 2026 & March / April 2027. These chances are available for repeater students, if any

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,



Dy. Registrar

Copy to: for Information and necessary action

1	The I/c Dean, Faculty of Science & Technology	7	Appointment A & B Section
2	Director, Board of Examinations & Evaluation	8	Affiliation (T.1) (T.2) Section
3	The Chairperson, Respective Board of Studies	9	P.G. Admission Section,
4	Other Exam 4 Section,	10	P.G Seminar Section
5	Eligibility Section,	11	Computer Centre/ IT Cell
6	Internal Quality Assurance Cell (IQAC)		



Shivaji University Kolhapur

**Revised Syllabus
as per**

**National Education Policy-2020
(NEP-2.0)**

T. Y. B. Tech.

Computer Science and Engineering

**To be Implemented from
Academic Year 2026-27**





Third Year B. Tech. CSE Semester V

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs./Wk.	Course Credits	EXAM SCHEME			
									MSE	ISE/CA	ESE	TOTAL
1	PCC	CSE3101	Artificial Intelligence	3	-	-	3	3	30	10	60	100
2	PCC	CSE3102	Computer Algorithms	3	1	-	4	4	30	10	60	100
3	PCC	CSE3103	Java Programming	2	-	-	2	2	30	10	60	100
4	PEC	CSE3104	Elective-I	3	-	-	3	3	30	10	60	100
5	MDM	CSE3105	Multi-disciplinary Minor – 03	3	-	-	3	3	30	10	60	100
6	OE	CSE3106	Open Elective -03	2	-	-	2	2	30	10	60	100
7	PCC	CSE3107	Java Programming Lab	-	-	4	4	2	-	25	50	75
8	PEC	CSE3108	Elective-I Lab	-	-	2	2	1	-	25	-	25
9	MDM	CSE3109	Multi-disciplinary Minor– 03 Lab	-	-	2	2	1	-	50	-	50
10	EL	CSE3110	Mini Project-II Lab	-	-	2	2	1	-	25	25	50
			Total	16	1	10	27	22	180	185	435	800

[illegible]



Third Year B. Tech. CSE Semester VI

Course Category	Basic Science Courses (BSC)	Engineering Science Courses (ESC)	Programme Core Course (PCC)	Programme Elective Course (PEC)	Open Elective other than particular Programme (OE/MDM)	Vocational and Skill Enhancement Course (VSEC)	Humanities Social Science and Management (HSSM)	Experiential Learning (EL)	Co-curricular and Extracurricular Activities (CCA)
Last Sem. Cumulative Sum	16	16	30	04	16	09	14	03	02
Semester Credits	-	-	13	06	02	-	-	01	-
Cumulative Sum	16	16	43	10	18	09	14	04	02

PROGRESSIVE TOTAL CREDITS : 110 + 22 = 132



Exit option: Award of B. Vocational in Major with 132 credits and an additional 8 credits from following Exit Courses

Sr. No	Course Code	Corse Title	Mode	Credits
01	CSE-EC-05	Artificial Intelligence	Online/offline certification Course or project of total 8 credits	8
Or				
02	CSE-EC-06	Data Science or Cyber Security		8

List of Elective Courses

Elective-I	Object Oriented Modelling & Design	Information Security	Image Processing	Computer Vision
Elective-II	Software Engineering	Advanced Computer Networks	Business Intelligence Systems	E-Commerce & Digital Marketing
Elective-III	Project Management	Block chain Technologies	Data Mining	Storage Networks

Open Elective 03 (Course Offered by CSE Department)

Examination Scheme

Semester	Course Title	L	P	Total Hrs.	Credits	MSE	ISE/CA	ESE	TOTAL
5	Cyber Security	2	-	2	4	30	10	60	100

Multidisciplinary minor for Semester V and VI

Semester	Course Title	L	P	Total Hrs.	Credits
5	Programming Using Java	3	1	4	4
6	Database Concepts & Design	2	-	2	2

Abbreviations

Abbreviation	Definition	Abbreviation	Definition	Abbreviation	Definition
MSE	Mid Semester Evaluation	BSC	Basic Science Courses	L	Lecture
ISE	In Semester Evaluation	ESC	Engineering Science Courses	T	Tutorial
CA	Continuous Assessment	PCC	Programme Core Course	P	Practical
ESE	End Semester Evaluation	PEC	Programme Elective Course	VSEC	Vocational and Skill Enhancement Course
	For Laboratory, End Semester Performance	OE	Open Elective	HSSM	Humanities Social Science and Management
		MDM	Multi-Disciplinary Minor	EL	Experimental Learning
				CCA	Co-curricular and Extracurricular Activities



Shivaji University Kolhapur

**Revised Syllabus
as per**

**National Education Policy-2020
(NEP-2.0)**

T. Y. B. Tech.

Computer Science and Engineering

5th Semester



Year and Semester	Third Year B. Tech - Semester V - Computer Science and Engineering				
Course Category	Programme Core Course (PCC)				
Title of Course	Artificial Intelligence			Course Code	CSE3101
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Basic Programming in Python.	
Course Objective	1	To impart artificial intelligence principles, techniques, and its history.
	2	To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems.
	3	To develop intelligent systems by assembling solutions to concrete computational problems.
Course Outcomes	After Completion of this course Students will be able to	
	CO1	Evaluate Artificial Intelligence (AI) methods and describe their foundations.
	CO2	Apply basic principles of AI in solutions that require problem solving, inference, Perception, knowledge representation and learning.
	CO3	Demonstrate knowledge of reasoning and knowledge representation for solving real world problems.
	CO4	Analyze and illustrate how search algorithms play vital role in problem solving.
	CO5	Illustrate the construction of learning and expert system.
	CO6	Discuss current scope and limitations of AI and societal implications.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	1		2		2				
CO2	3	3	3	3		2	3				1
CO3	2	3	3	1		1	2				3
CO4	1	3	3	2		1					
CO5		1	2	1	1		1				1
CO6			1			3		1			
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
- Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 % - Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units). - No compulsory passing for MSE. ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).

Unit No.	Title and Content of Unit	Hours
1	Artificial Intelligence and Its Issues:	5 Hrs
	Definitions - Importance of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment, Knowledge Inferring systems and Planning, Uncertainty and towards Learning Systems.	
2	Overview to Problem Solving & Heuristic Search:	6 Hrs
	Problem solving by Search, Problem space - State space, Blind Search - Types, Performance measurement. Types, Game playing mini-max algorithm, Alpha-Beta Pruning	
3	Probabilistic Reasoning & Markov Decision process:	7 Hrs
	Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model. MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.	
4	Learning Systems & Expert Systems:	7 Hrs
	Forms of Learning Types - Supervised, Unsupervised, Reinforcement Learning, Learning Decision Trees. Expert Systems - Stages in the development of an Expert System - Probability based Expert Systems - Expert System Tools - Difficulties in Developing Expert Systems - Applications of Expert Systems.	
5	Reinforcement Learning:	5 Hrs
	Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.	
6	AI with Python:	5 Hrs
	Study of important inbuilt libraries of Python like NumPy, SciPy, matplotlib, nltk, Simple AI. Installing Python. Setting up PATH. Running Python. Study of real time applications of AI with Python, Case Studies: AI Platforms-Azure ML, Google AI, Swift AI, Tensorflow.	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Artificial Intelligence - A Modern Approach	Russell, S. and Norvig, P.	3rd edition, Prentice Hall.2015
02	Artificial Intelligence: Foundations of Computational Agents	Poole, D. and Mackworth, A.	Cambridge University Press.2010

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Artificial Intelligence, 3rd edition	Ric, E., Knight, K and Shankar, B.	Tata McGraw Hill.2009
02	Artificial Intelligence -Structures and Strategies for Complex Problem Solving	Luger, G.F.	6th edition, Pearson.2008
03	Knowledge Representation and Reasoning	Brachman, R. and Levesque, H.	Morgan Kaufmann. 2004
04	Artificial Intelligence with Python: A Comprehensive Guide to Building Intelligent Apps for Python Beginners and Developers	Prateek Joshi	Packt publication January 2017 Edition
05	Reinforcement Learning: An Introduction	Sutton R.S. and Barto, A.G.	MIT Press. 1998
06	Artificial Intelligence and Intelligent Systems	Padhy, N.P.	Oxford University Press. 2009

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•	No compulsory passing for MSE. ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).

Unit No.	Title and Content of Unit	Hours
1	Divide and conquer	8 Hrs
	What is algorithm, Algorithm Specification, Recurrence relations, Performance Analysis, Randomized Algorithms. Divide and Conquer: The general method, Binary search, Finding the maximum and minimum, Merge sort, Quicksort, DC Selection Algorithm, analysis of Divide and Conquer algorithms.	
2	The Greedy Method	6 Hrs
	The general method, Knapsack problem, Job sequencing with deadlines, minimum-cost spanning trees – Prim's and Kruskal's Algorithms, Optimal storage on tapes, Optimal merge Patterns, Single source shortest paths.	
3	Backtracking	5 Hrs
	The general method, 8-queen problem, sum of subsets, Knapsack Problem, Hamiltonian Cycle, and Graph Colouring.	
4	Dynamic Programming	6 Hrs
	The general method, Multistage graphs, all pair shortest paths, 0/1 knapsack, Reliability design, Traveling Sales person problem.	
5	Basic Traversal and Search Techniques	7 Hrs
	Techniques for Binary Trees, Game Tree, Techniques for Graphs – Breadth First Search & Traversal, Depth First Search & Traversal, AND/OR graphs, Connected components and Spanning Trees, Bi-connected components and depth first search.	
6	NP Hard and NP Complete Problems	4Hrs
	Basic Concepts, Introduction to NP Hard Graph Problems.	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Fundamentals of Computer Algorithms	Ellis Horowitz, Satraj Sahani, Saguthevar Rajasejaram	Universities Press, Second Edition

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Fundamentals of Algorithmics	Gilles Brassard, Paul Bratley	Pearson Education
02	Mastering Algorithms with C	Kyle Loudon	SPD O'Reilly
03	Computer Algorithms- Introduction to Design and Analysis	Sara Baase, Allen Van Gelder	Pearson Education

Marking Scheme	
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Unit No.	Title and Content of Unit	Hours
1	Fundamental Programming in Java:	5Hrs
	The Java Buzzwords, The Java Programming Environment- JVM, JIT Compiler, Byte Code Concept, Hotspot, A Simple Java Program, Source File Declaration Rules, Comments, Data Types, Variables, Operators, Strings, Input and Output, Control Flow, Arrays-Jagged Array. Objects and Classes: Object-Oriented Programming Concepts, Declaring Classes, Declaring Member Variables, Defining Methods, Constructor, Passing Information to a Method or a Constructor, Creating and using objects, Controlling Access to Class Members, Static Fields and Methods, this keyword.	
2	Inheritance, Interface and Packaging	5Hrs
	Inheritance: Definition, Super classes, and Subclasses, Overriding and Hiding Methods, Polymorphism, Inheritance Hierarchies, Super keyword, Final Classes and Methods, Abstract Classes and Methods. Interfaces: Defining an Interface, Implementing an Interface, Using an Interface as a Type, Evolving Interfaces, and Default Methods. Packages: Class importing, creating a Package, naming a Package, Using Package Members, Managing Source and Class Files.	
3	Exception and I/O Streams:	5Hrs
	Exception: Definition, Dealing with Errors, The Classification of Exceptions, Declaring Checked Exceptions, Throw an Exception, Creating Exception Classes, Catching Exceptions, Catching Multiple Exceptions, , finally clause, Advantages of Exceptions I/O Streams: Byte Stream – Input Stream, Output Stream, Data Input Stream, Data Output Stream, File Input Stream, File Output Stream, Character Streams, Buffered Stream, Scanner, ,Random File Access File.	

Unit No.	Title and Content of Unit	Hours
4	Graphical User Interfaces using Swing, Event handling	5Hrs
	Introduction to GUI programming in Java, Overview of Java GUI toolkits – AWT and Swing, Features and advantages of Swing, Swing architecture and packages; Creating basic Swing applications; Containers and components; Swing components – JLabel, JButton, JTextField, JTextArea, JCheckBox, JRadioButton, ButtonGroup, JComboBox, JList, JTable, JScrollPane; Menu components – JMenuBar, JMenu, JMenuItem; Layout managers – FlowLayout, BorderLayout, GridLayout, BoxLayout; Event-driven programming model: Event handling mechanism; events and listeners; Handling ActionEvent using ActionListener; Mouse events; Keyboard events; Window events; Adapter classes; Handling multiple events; Introduction to MVC pattern in Swing; Development of simple GUI-based applications.	
5	Multithreading, Collections	4Hrs
	Multithreading: Processes and Threads, Runnable Interface and Thread Class , Thread Objects, Defining and Starting a Thread, Pausing Execution with Sleep, Interrupts, Thread States, Thread Properties, Joins, Synchronization Collections: Collection Interfaces, Concrete Collections- List, Queue, Set, Map, the Collections Framework	
6	Database Programming	4Hrs
	Database Programming: The Design of JDBC, The Structured Query Language, JDBC Installation, Basic JDBC Programming Concepts, Query Execution, Scrollable and Updatable Result Sets, Metadata, Row Sets, Transactions	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Core Java- Volume I Fundamentals	Cay Horstmann and Gary Cornell	Pearson, Eight edition
02	Core Java- Volume II Advanced Features	Cay Horstmann and Gary Cornell	Pearson, Eight edition

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	JAVA-The Complete Reference	Herbert Schildt	McGraw Hill, Oracle Press
02	Head First Java	Eric Freeman Elisabeth Robson Bert Bates Kathy Sierra	O'Reilly Publication
03	Head First Servlets and JSP	Bryan Basham, Kathy Sierra, Bert Bates	O'Reilly Publication

Year and Semester	Third Year B. Tech - Semester V - Computer Science and Engineering				
Course Category	Programme Elective Course (PEC)				
Title of Course	Object Oriented Modelling & Design (Elective-I)			Course Code	CSE3104-1
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Software Engineering & Object-Oriented Concepts	
Course Objective	1	To Understand the Object Based View of the System
	2	To design Problems using Object Oriented Analysis and Design Techniques
	3	To Understand UML notations and compare with OMT
	4	To inculcate necessary skills to handle complexities in Software Design
Course Outcomes	After completion of this course Students will be able to	
	CO1	Analyze and model software systems
	CO2	Design object, dynamic, and functional models for software systems.
	CO3	Apply object-oriented design methodologies to create optimized system designs.
	CO4	Design UML diagrams to model structural, behavioural, and architectural aspects of software systems.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1								
CO2	3	2	2	1							
CO3	2	2	2								
CO4	3	2	3	2							
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
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Unit No.	Title and Content of Unit	Hours
1	Introduction: Ability to analyze and model software systems	7 Hrs
	Object oriented themes, modelling as a design technique. Object Modelling: Object, classes, Link & association, advanced link & Association concepts, generalization & Inheritance, grouping constructs, aggregation, abstract classes, generalization as extension & restriction, multiple inheritance, metadata, candidate key & constraints.	
2	Dynamic & Functional Modeling:	7 Hrs
	Dynamic modelling: Events & states, operations, nested state diagrams, concurrency, advanced dynamic modelling concepts & simple dynamic model, relation of object dynamic models. Functional Modelling: functional model, data flow diagrams, specifying operations, construction, a simple functional model, relation of functional to object & dynamic model.	
3	Design Methodology	3 Hrs
	OMT methodology, Impact of an object-oriented approach, analysis, system design with examples, combining models, design algorithms, design optimization, implementation of controls, design association & physical packaging.	
4	Introducing the UML	7 Hrs
	An overview of the UML, Conceptual Model of UML, Architecture of UML Structure modelling Using UML: Classes, Relationship, Diagrams, Class Diagrams.	
5	Behavioural Modelling	7 Hrs
	Interactions, Use Cases, Use Case Diagram, Interaction diagrams, Activity diagrams, Events & Signals, State Machines, Process & Threads, Time & Space, State chart diagrams.	
6	Architectural Modelling	5 Hrs
	Components, Deployment, Collaboration, Patterns & frameworks, component diagrams, Deployment diagrams.	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Object-orientated Modeling & Design: (Unit 1 to 3)	James Rambaugh, Michael Blaha, William Premerlani, Frederick Eddy, William Lorensen	PHI
02	The Unified Modeling Language User Guide	Grady Booch, James Rambaugh, Ivar Jacobson	Addison Wesley

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Object oriented analysis & design using UML	H. Srimathi, H. Sriram, A. Krishnamoorthy	SCITECH PUBLICATION 2nd Edition
02	Object Oriented analysis & design	Andrew High	TMG
03	Practical Object-Oriented Design with UML	Mark Priestley	McGraw-Hill Education
04	Threat first Object oriented analysis & design	Breet McLaughline, Garry Police & Devide West	OREILLY

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Unit No.	Title and Content of Unit	Hours
1	Classical Encryption Techniques and DES	6 Hrs
	The OSI Security Architecture, Classical encryption techniques: Symmetric cipher model: Substitution ciphers-Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One time pad, Steganography. Transposition Techniques: Rail Fence Transposition, Columnar Transposition. Block Ciphers and Data Encryption Standards (DES): Traditional Block Cipher structures, Data Encryption Standard (DES), A DES Example, The strength of DES, Block cipher design principles.	
2	Public-Key Cryptosystems, Key Management and Authentication	7 Hrs
	Public Key Cryptography and RSA: Principles of public key cryptosystems-Public key cryptosystems, Applications for public key cryptosystems, Requirements for public key cryptography, public key Cryptanalysis, The RSA algorithm: Description of the Algorithm, Computational aspects, The Security of RSA. Diffie-Hellman key exchange: The Diffie-Hellman Key Exchange Algorithm, Key exchange Protocols, Man-in-the-middle Attack, Authentication: Authentication requirements, Authentication functions, MAC and Hash functions and their requirements.	
3	Digital Signatures and Authentication Applications	5 Hrs
	Digital Signature, Digital Signature Standard, Authentication applications -Kerberos, X.509 Authentication service.	

Unit No.	Title and Content of Unit	Hours
4	Electronic mail and IP security	6 Hrs
	Email Security - PGP, S/MIME, IP Security-IP Security Architecture, Authentication Header and Encapsulating Security Payload.	
5	Web and System Security	7 Hrs
	Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction, Intruders, Intruder Detection, Password Management, Firewall Design Principles, Trusted Systems.	
6	Non-Cryptographic Protocol Vulnerabilities	5 Hrs
	DoS and DDoS, Session Hijacking and Spoofing, Pharming attacks. Software Vulnerabilities - Phishing, Buffer Overflow, Format String attacks, SQL Injection.	

Textbooks				
Sr. no.	Title	Author	Edition/Publication	Units Covered
01	Cryptography and Network Security	William Stallings	Pearson Edition	(Unit I to V)
02	Network Security and Cryptography	Bernard Menezes	Cengage Learning	Unit -VI

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Cryptography and network security	Atul Kahate	TMGH
02	Cryptography and Network Security	B. A. Forouzan	TMGH
03	Network Security Know it All	Joshi et. al	Morgan Kaufmann Publisher

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Unit No.	Title and Content of Unit	Hours
1	Introduction	7 Hrs
	Concept of Digital Image Processing, Steps in Image Processing, Components of Image Processing System, Applications areas, Image representation, grey scale and color images.	
2	Image Enhancement and Processing	5 Hrs
	Basic Grey level transformation, Histogram Processing techniques, Color Fundamentals, color models, Pseudo color image processing.	
3	Image Compression	7 Hrs
	Fundamental of Redundancies, Basic Compression Methods, Huffman coding, Arithmetic coding, LZW coding, JPEG compression, Standard.	
4	Image Restoring and Reconstruction:	5 Hrs
	Noise models, Noise Reduction, Inverse filtering, MMSE filtering	
5	Image Segmentation	7 Hrs
	Detection of Discontinuities, Point, Line and Edge detection, Thresholding, Region based Segmentation.	
6	Image Processing Applications	7 Hrs
	Biometric Pattern Recognition, Face Recognition. Preprocessing of Signature Patterns, Lung Disease Identification.	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Digital Image Processing	R. C. Gonzalez and R. E. Woods	Pearson Edition
Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Digital Image Processing	A. K. Jain	PHL
02	Image processing, Analysis and Machine vision	M. Sonka, V. Hlavac, and R. Boyle	Thomson Asia pvt. Ltd

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Unit No.	Title and Content of Unit	Hours
1	Introduction to Computer Vision	5 Hrs.
	Human vision vs. computer vision, Applications of computer vision, Image formation and camera models, Image acquisition and representation, Basics of digital image processing	
2	Image Processing Fundamentals	7 Hrs.
	Image enhancement techniques, Spatial and frequency domain filtering, Edge detection (Sobel, Canny), Image smoothing and sharpening, Morphological operations	
3	Feature Detection and Description	6 Hrs
	Corner detection (Harris, FAST), Feature descriptors (SIFT, SURF, ORB), Feature matching techniques, Image registration and alignment	
4	Image Segmentation and Object Detection	6 Hrs.
	Thresholding techniques, Region-based segmentation, Contour detection, Traditional object detection methods, Introduction to CNN-based detectors.	
5	Motion Analysis and Tracking	6 Hrs.
	Optical flow, Background subtraction, Object tracking methods, Kalman and Particle filters, Video analytics applications	
6	Deep Learning for Computer Vision	6 Hrs.
	Convolutional Neural Networks (CNNs), Transfer learning, Object detection models (YOLO, SSD), Face recognition systems, Ethical issues in vision-based AI	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Digital Image Processing	Gonzalez R. C., Woods R. E	PHI, Second Edition
02	Digital Image Processing	Sonka Milan, Vaclav Hlavac,	Cengage Learning

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Computer Vision: Algorithms and Applications	Richard Szeliski	Springer, 2nd Edition
02	Computer Vision: A Modern Approach	<i>David A. Forsyth, Jean Ponce</i>	Pearson Education
03	Deep Learning for Computer Vision	Adrian Rosebrock	Py Image Search

Marking Scheme	
- Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 % - Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units). - No compulsory passing for MSE. ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).	

Unit No.	Title and Content of Unit	Hours
1	Fundamental Programming in Java	5 Hrs
	The Java Features and Java Programming Environment-Object Oriented, compiled, Interpreted, platform independent, Portable, Robust and Secure, Dynamic. The Java Programming Environment- JVM, JIT Compiler, Hotspot, Java Tokens and Data Types, Operators and Expression, Decision making and Looping.	
2	Objects & Constructor	6 Hrs
	Defining a class, creating object, accessing class members, Constructor, Passing Information to a Method or a Constructor, Creating and using objects, Controlling Access to Class Members, Static Fields and Methods, this keyword, Object Cloning.	
3	Inheritance, Interface and Package	7 Hrs
	Inheritance: Definition, Super classes, and Sub classes, Overriding and Hiding Methods, Polymorphism, Inheritance Hierarchies, Super keyword, Final Classes and Methods, Abstract Classes and Methods, Nested classes & Inner Classes, finalization and garbage collection. Interface: Interfaces: Defining an Interface, Implementing an Interface, Using an Interface as a Type. Evolving Interfaces and Default Methods. Packages: Class importing, creating a Package, naming a Package, Using Package Members, Managing Source and Class Files. Developing and deploying (executable) Jar File.	
4	Exception and I/O Streams:	7 Hrs
	Exception: Definition, Dealing with Errors, The Classification of Exceptions, Declaring Checked Exceptions, Throw an Exception, Creating Exception Classes, Catching Exceptions, Catching Multiple Exceptions, finally clause, Advantages of Exceptions I/O Streams: Byte Stream – Input Stream, Output Stream, Data Input Stream, Data Output Stream, File Input Stream, File Output Stream, Character Streams, Buffered Stream, Scanner, Random File Access File.	

Unit No.	Title and Content of Unit	Hours
5	Multithreading and Collections	5 Hrs
	Multithreading: Processes and Threads, Runnable Interface and Thread Class, Thread Objects, Defining and Starting a Thread, Pausing Execution with Sleep, Interrupts, Thread States, Thread Properties, Joins, Synchronization Collections: Collection Interfaces, Concrete Collections- List, Queue, Set, Map, the Collections Framework	
6	Graphical User Interfaces using Swing	6 Hrs
	Graphical User Interfaces using Swing: Introduction to the Swing, Swing features, Swing Top Level Containers-Creating a Frame, positioning a Frame, Displaying Information in a Panel, The Model-View-Controller Design Pattern, The JComponent Class. Layout Management: Introduction to Layout Management, APIs for Border Layout, Flow Layout, Grid Layout Event Handling: Basics of Event Handling, The AWT Event Hierarchy, Semantic and Low-Level Events in the AWT, Low-Level Event Types User Interface Components: Text Input, Choice Components, Menus, Dialog Boxes Setting the Look and Feel of UI, Introduction to JApplet	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Core Java- Volume I Fundamentals	Cay Horstmann and Gary Cornell	Pearson, Eight edition
02	Core Java- Volume II Advanced Features	Cay Horstmann and Gary Cornell	Pearson, Eight edition

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	JAVA-The Complete Reference	Herbert Schildt	McGraw Hill, Oracle Press
02	Head First Java	Eric Freeman Elisabeth Robson Bert Bates Kathy Sierra	O'Reilly Publication
03	Head First Servlets and JSP	Bryan Basham, Kathy Sierra, Bert Bates	O'Reilly Publication

Marking Scheme
In Semester Evaluation/ Continuous Assessment has 25 Marks Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc. Lab File should be prepared and should be assessed continuously during academic. End Semester Evaluation has 50 Marks External Practical Examination with Performance and Oral Examination

Guidelines for Lab Performance	
Faculty can create Experiment list based on following listed topics. Minimum 10-12 Experiments should get performed.	
Exp. No.	Title of Experiment/ Problem Statement
1	Create a class called Employee that includes three pieces of information as instance variables- first name, a last name and a monthly salary. Your class should have a constructor that initializes the three instance variables. Provide a set and a get method for each instance variable. If the monthly salary is not positive, set it to 0.0. Write a test application named EmployeeTest that demonstrates class Employee's capabilities. Create two Employee objects and display each object's yearly salary. Then give each Employee a 10% raise and display each Employee's yearly salary again.
2	Create class SavingsAccount. Use a static variable annualInterestRate to store the annual interest rate for all account holders. Each object of the class contains a private instance variable savingsBalance indicating the amount the saver currently has on deposit. Provide method calculateMonthlyInterest to calculate the monthly interest by multiplying the savingsBalance by annualInterestRate divided by 12 this interest should be added to savingsBalance. Provide a static method modifyInterestRate that sets the annualInterestRate to a new value. Write a program to test class SavingsAccount. Instantiate two savingsAccount objects, saver1 and saver2, with balances of Rs 2000.00 and Rs 3000.00, respectively. Set annualInterestRate to 4%, then calculate the monthly interest and print the new balances for both savers. Then set the annualInterestRate to 5%, calculate the next month's interest and print the new balances for both savers.
3	Create Vehicle Interface with name, maxPassanger, and maxSpeed variables. Create LandVehicle and SeaVehicleInteface from Vehicle interface. LandVehicle has numWheels variable and drive method. SeaVehicle has displacement variable and launch method. Create Car class from LandVehicle, HoverCraft from LandVehicle and SeaVehicle interface. Also create Ship from SeaVehicle. Provide additional methods in HoverCraft as enterLand and enterSea. Similarly provide other methods for class Car and Ship. Demonstrate all classes in a application.
4	Create abstract class Shape which has instance variables side, area and perimeter and methods calculateArea(), calculatePerimeter() as abstract methods and display() as concrete method. Write subclasses which extend Shape class like Triangle, Rectangle, Circle, Cube and Squere and override abstract methods and display methods in subclass take instance variable if needed as per the formula. And use parameterized constructor to initialize instance variables using "this" reference variable. Write Test class and Create a reference variable of Shape which will hold the objects of all the sub classes and calculate respective area, perimeter and display the results.

Exp. No.	Title of Experiment/ Problem Statement
5	Create the interface stack which has variable size, abstract methods push (), pop (), display (), overflow () and underflow (). We need to implement 3 subclasses IntegerStack, StringStack and Double Stack respectively by implementing interface. All the methods in interface are declared for string. And in subclass for integer Stack convert string to integer. Same thing to all other. Create one test class and check for the working of all the classes.
6	Develop a mathematical package for Statistical operations like Mean, Median, Average, Standard deviation. Create a sub package in the math package -convert. In "convert" package provide classes to convert decimal to octal, binary, hex and vice-versa. Develop application program to use this package, and build executable jar file of it.
7	Develop application which can handle any 5 combinations of predefined compile time and runtime exceptions using multiple catch blocks. Use throws and finally keywords as well.
8	Create Employee and Manager classes. Demonstrate inheritance, method overriding, and use of super keyword.
9	Develop a BankAccount class which should contain all methods of Bank i.e. balanceEnquiry(), withdraw(), transfer() and deposit(). You should create at least two objects of BankAccount using array and do all operations mentioned above. Also generate user defined exception LowBalanceException, NegativeNumberException and PasswordMismatchException whenever required. To transfer amount from one account to another use two BankAccount objects.
10	Write a program to read a text file and copy its content to another file using byte and character streams.
11	Take file name as input to your program through command line, if file exists then open and display contents of the file. After displaying contents of file ask user – 1. do you want to add the data at the end of file or 2. replace specified text in file by other text. Based on user's response, then accept data from user and append it to file. If file is not existing then create a fresh new file and store user data into it. User should type exit on new line to stop the program. Do this program using Character stream classes.
12	Take Student information such as name, age, weight, height, city, phone from user and store it in the file using DataOutputStream and FileOutputStream and Retrieve data using DataInputStream and FileInputStream and display the result. Use Serialization concept and Bytestream classes.
13	Develop a Swing GUI based standard calculator program. Use event handling, Layout of swing package.
14	Create Stop Watch with Swing GUI and Multithreading. Provide Facility for Lap Counting.

Exp. No.	Title of Experiment/ Problem Statement
15	Create two threads: one prints numbers from 1 to 50, another prints even numbers. Demonstrate sleep(), join (), and synchronization.
16	Write a program to read a text file one line at a time. Read each line as a String and place that String object into a LinkedList. Print all of the lines in the LinkedList in reverse order.
17	Fill a HashMap with key-value pairs. Print the results to show ordering by hash code. Extract the pairs, sort by key, and place the result into a LinkedHashMap. Show that the insertion order is maintained.
18	Write a GUI based program to create a student registration and Login. Store Registration data in Database and take Login information from Database.

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Core Java- Volume I Fundamentals	Cay Horstmann and Gary Cornell	Pearson, Eight edition
02	Core Java- Volume II Advanced Features	Cay Horstmann and Gary Cornell	Pearson, Eight edition

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	JAVA-The Complete Reference	Herbert Schildt	McGraw Hill, Oracle Press
02	Head First Java	Eric Freeman Elisabeth Robson Bert Bates Kathy Sierra	O'Reilly Publication
03	Head First Servlets and JSP	Bryan Basham, Kathy Sierra, Bert Bates	O'Reilly Publication

Year and Semester	Third Year B. Tech - Semester V - Computer Science and Engineering				
Course Category	Programme Elective Course (PEC)				
Title of Course	Object Oriented Modelling & Design Lab (Elective-I Lab)			Course Code	CSE3108
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	02	02	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	--	25	

Course Pre-Requisite	Software Engineering & Object Oriented Concepts	
Course Objective	1	To Understand the Object Based View of the System
	2	To analyze dynamic and functional behaviour of software systems
	3	To Understand UML notations
	4	To inculcate necessary skills to handle complexities in Software Design
Course Outcomes	After Completion of this course Students will be able to	
	CO1	Analyze software systems using object modeling concepts
	CO2	Design dynamic and functional models using state diagrams and data flow diagrams
	CO3	Develop UML-based structural and behavioural diagrams.
	CO4	Create complete UML models for real-world systems.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									
CO2	3	1	2	1	1						
CO3	2	1	2	1	2						
CO4	2	1	2	2	2						
Level of Mapping as: Low 1, Moderate 2, High 3											

Guidelines for Lab Performance
Faculty can create Experiment list based on following listed topics. Minimum 10-12 Experiments should get performed.

Exp. No.	Title of Experiment/ Problem Statement
1	Study concepts of object modelling
2	Design the dynamic behaviour of a software system using state diagrams.
3	Design the functional model of a system (DFD – Level 0 and Level 1)
4	Identify the conceptual classes and Design UML class diagrams
5	Design use case diagrams to represent system functionality and actor interactions.
6	Find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams
7	Design state chart diagrams representing events, signals, processes, threads, and state transitions.
8	Represent workflows and control flows using activity diagrams.
10	Model software architecture using UML component diagrams.
11	Model physical deployment of software using UML deployment diagrams.
12	Design ATM System Using Structural & Behavioural UML Diagram.
13	Design College Admission Process Using Structural & Behavioural UML Diagram.
14	Design Library Management System using Structural & Behavioural UML Diagram.
15	Design Railway Reservation System Using Structural & Behavioural UML Diagram

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Object-orientated Modeling & Design: (Unit 1 to 3)	James Rumbaugh, Michael Blaha, William Premerlani, Frederick Eddy, William Lorensen	PHI
02	The Unified Modeling Language User Guide	Grady Booch, James Rumbaugh, Ivar Jacobson	Addison Wesley

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Object oriented analysis & design using UML	H. Srimathi, H. Sriram, A. Krishnamoorthy	SCITECH PUBLICATION 2nd Edition
02	Object Oriented analysis & design	Andrew High	TMG
03	Practical Object-Oriented Design with UML	Mark Priestley	McGraw-Hill Education
04	Threat first Object oriented analysis & design	Breet McLaughline, Garry Police & Devide West	OREILLY

Marking Scheme
In Semester Evaluation/ Continuous Assessment has 25 Marks Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc. Lab File should be prepared and should be assessed continuously during academic.

Guidelines for Lab Performance	
✓ Minimum 10 Experiments should get performed. ✓ Practical should include the implementation and use of the following mechanisms/ Algorithms/Tools/ Techniques. ✓ Implementation can be in C/C++ Programming Language.	
Exp. No.	Title of Experiment/ Problem Statement
1	GCD Using Euclidean Algorithm/Computing Multiplicative Inverse/Prime number and modular arithmetic operations.
2	Substitution/ Transposition/Product Cipher and their Analysis.
3	Single Round of DES algorithm/ Double DES/Triple DES and its analysis.
4	RSA Algorithm to provide Confidentiality and Authentication services or any other Public Key Algorithm.
5	Diffie-Hellman or any other Key Exchange Algorithm.
6	Implementation and use of Authentication Function/ Algorithm.
7	Generation and use of Digital Signature for real world situation
8	Usage of PGP Security package and S/MIME features.
9	Experimenting with SSL/ TLS/E-Commerce Applications and Identifying their Vulnerabilities.
10	Demo and usage of network Traffic analysis tools.
11	Experimentation on identifying non-cryptographic Protocol Vulnerabilities and remedies thereon.
12	Experimentation on identifying software vulnerabilities using various tools/techniques and their analysis.
13	Any other Implementation/ Demo/ Experimentation based on the topics of syllabus.

Textbooks				
Sr. no.	Title	Author	Edition/Publication	Units Covered
01	Cryptography and Network Security	William Stallings	Pearson Edition	(Unit I to V)
02	Network Security and Cryptography	Bernard Menezes	Cengage Learning	Unit -VI

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Cryptography and network security	Atul Kahate	TMGH
02	Cryptography and Network Security	B. A. Forouzan	TMGH
03	Network Security Know it All	Joshi et. al	Morgan Kaufmann Publisher

Year and Semester	Third Year B. Tech - Semester V - Computer Science and Engineering				
Course Category	Programme Elective Course (PEC)				
Title of Course	Image Processing Lab (Elective-I Lab)			Course Code	CSE3108
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	02	02	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	--	25	

Course Pre-Requisite	Fundamentals of C Programming	
Course Objective	1	The primary objective of Image Processing Course is to understand and apply image processing tools to process the Digital image
Course Outcomes	After completion of this course Students will be able to	
	CO1	Apply image enhancement technique
	CO2	Apply image segmentation technique
	CO3	Perform binary image processing Operation
	CO4	Develop fast image transform flow graph.
	CO5	Solve image compression and decompression
	CO6	Develop image processing application

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	1						
CO2	3	2	2	2	3						
CO3	3	2	1	1	2						
CO4	3	3	2	2	2				1	1	
CO5	3	3	3	2	3				1	1	
CO6	3	3	3	2	3				1	1	

Guidelines for Lab Performance	
Faculty can create Experiment list based on following listed topics. Minimum 10 to 12 Experiments should get performed.	
Exp. No.	Title of Experiment/ Problem Statement
1	Image Enhancement using zero memory point processing
2	Image Enhancement using Histogram Processing
3	Image Enhancement using Spatial Filtering
4	Image Segmentation based on discontinuity property
5	Image Segmentation based on similarity property
6	Morphological Image Processing
7	Thinning and Thickening Algorithm
8	Image representation using Chain code, Shape Number and Moments
9	Fast Image Transform
10	Image Compression using Lossless Compression techniques
11	Image Compression using Lossy Compression techniques
12	Application of Image Processing

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Digital Image Processing	Rafel C. Gonzalez and Richard E. Woods	Pearson Education Asia

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Fundamentals and Digital Image Processing	Anil K. Jain	Prentice Hall of India Private Ltd
02	Digital Image Processing and computer Vision	Milan Sonka, Vaclav Hlavac and Roger Boyle	Cengage Learning 2008
03	Digital Image Processing	William Pratt	John Wiley & Sons

Marking Scheme
<u>In Semester Evaluation/ Continuous Assessment has 25 Marks</u> Parameters for In Semester Evaluation could be: Attendance, Assignments, Experiments, oral, Presentation, Online Activities like (Virtual Labs, NPTEL) etc. Lab File should be prepared and should be assessed continuously during academic.

Guidelines for Lab Performance	
Faculty can create Experiment list based on following listed topics. Minimum 10-12 Experiments should get performed.	
Exp. No.	Title of Experiment/ Problem Statement
1	Image acquisition and basic operations using OpenCV.
2	Image enhancement and filtering techniques.
3	Edge and corner detection implementation.
4	Feature extraction and matching.
5	Image segmentation techniques.
6	Object detection using pre-trained CNN models.
7	Motion detection and tracking.
8	Mini project on real-world vision application.

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Digital Image Processing	Gonzalez R. C., Woods R. E	PHI, Second Edition
02	Digital Image Processing	Sonka Milan, Vaclav Hlavac,	Cengage Learning

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Computer Vision: Algorithms and Applications	Richard Szeliski	Springer, 2nd Edition
02	Computer Vision: A Modern Approach	David A. Forsyth, Jean Ponce	Pearson Education
03	Deep Learning for Computer Vision	Adrian Rosebrock	PyImageSearch

Marking Scheme
In Semester Evaluation/ Continuous Assessment has 50 Marks Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc. Lab File should be prepared and should be assessed continuously during academic.

Guidelines for Lab Performance	
Faculty can create Experiment list based on following listed topics. Minimum 10-12 Experiments should get performed. 5/6 Experiments from first 1 to 10 and 5/6 experiments from 11 to 20 should get performed	
Exp. No.	Title of Experiment/ Problem Statement
1	Write programs using operators, decision making, and loops: (a) factorial, (b) Fibonacci series, (c) prime number check.
2	Design and implement a Java program for a Bank Account Management System to demonstrate the use of public, private, protected, and default access modifiers.
3	Create a class Student with data members and methods to accept and display student details.
4	Write a Java program to create a class that demonstrates the use of default and parameterized constructors, this keyword, static variables/methods, and performs basic object cloning.
5	Write a Java program to demonstrate inheritance and method overriding by creating a base class and a derived class, where the derived class overrides a method of the base class
6	Write a Java program for a Bank Account System using an abstract class BankAccount with methods like deposit (), withdraw () and checkBalance (). Create two classes SavingsAccount and CurrentAccount that extend BankAccount. Also, use interfaces Interest (to calculate interest for savings) and OnlineBanking (to perform fund transfer).
7	Create and use user-defined packages, import classes, and generate executable JAR file.
8	Create the interface stack which has variable size, abstract methods push (), pop (), display (), overflow () and underflow (). We need to implement 3 subclasses IntegerStack, StringStack and Double Stack respectively by implementing interface. All the methods in interface are declared for string. And in subclass for integerStack convert string to integer. Same thing to all other. Create one test class and check for the working of all the classes.
9	Create and use user-defined packages, import classes, and generate executable JAR file
10	Write programs to handle runtime errors using try-catch-finally, multiple catch, and user-defined exceptions.
11	Create Employee and Manager classes. Demonstrate inheritance, method overriding, and use of super keyword.
12	Write a program to accept array elements and handle ArrayIndexOutOfBoundsException
13	Write a program to read a text file and copy its content to another file using byte and character streams.

Exp. No.	Title of Experiment/ Problem Statement
14	Take file name as input to your program through command line, if file exists then open and display contents of the file. After displaying contents of file ask user – 1. Do you want to add the data at the end of file or 2. replace specified text in file by other text. Based on user's response, then accept data from user and append it to file. If file is not existing then create a fresh new file and store user data into it. User should type exit on new line to stop the program. Do this program using Character stream classes.
15	Develop a Java program to manage student records using File Handling and I/O Streams.
16	Write a program to read a text file one line at a time. Read each line as a String and place that String object into a LinkedList. Print all of the lines in the LinkedList in reverse order.
17	Create Stop Watch with Swing GUI and Multithreading. Provide Facility for Lap Counting.
18	Create two threads: one prints numbers from 1 to 50, another prints even numbers. Demonstrate sleep (), join (), and synchronization.
19	Design a Swing form for Student Registration using JLabel, JTextField, JRadioButton, JCheckBox, JComboBox, and JButton.
20	Develop a Swing GUI based standard calculator program. Use event handling, Layout of swing package.

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Core Java- Volume I Fundamentals	Cay Horstmann and Gary Cornell	Pearson, Eight edition
02	Core Java- Volume II Advanced Features	Cay Horstmann and Gary Cornell	Pearson, Eight edition

Reference Books			
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02	Head First Java	Eric Freeman Elisabeth Robson Bert Bates Kathy Sierra	O'Reilly Publication
03	Head First Servlets and JSP	Bryan Basham, Kathy Sierra, Bert Bates	O'Reilly Publication

Platform: C++, Python, Java.

Course Guidelines:

- Students can choose project based on industry defined problem or user defined problem which must emulate the real-life problems.
- It is desirable that students should work on the project in group of 3 or 4 but not more than four.
- After making the group, students must decide the title of the project and they will present to the department. Also, students will prepare the synopsis report of 4-5 pages and submit at the time of presentation.
- At the end, students must submit the final report of the project and the format for the same will be given by the department.
- The students will report to the respective guide/supervisor at every fortnight to discuss their progress.
- The final evaluation of the project will be done based on the demonstration and presentation.

Project Assessment Rubrics:

CO	Rubric 1	Rubric 2	Rubric 3
CO1	Creativity and Originality in problem statement	Domain knowledge of the problem statement	Use of Resources
CO2	Study and analysis of methodology / approaches to solve the problem in hand	Developing effective design to solve the problem	Identification of alternative solutions to the problem
CO3	Problem solving ability by applying common, special and interdisciplinary engineering knowledge social, ethical and environmental aspects in view	Understanding and proper code development of project using modern tools and techniques	Testing of project modules
CO4	To demonstrate interpersonal communication skills, teamwork and leadership qualities for project management	Understanding and contribution in coding, Technical Contents in the report	Successfully completion of the changes suggested in code development, Preparation of genuine reports using modern tools

Year and Semester	Course Offered by Department of Computer Science and Engineering				
Course Category	Open Elective -03				
Title of Course	Cyber Security			Course Code	CSE2106
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	02	--	--	02	02
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Fundamentals of Computer Graphics	
Course Objective	1	To gain knowledge about securing both clean and corrupted systems, protect personal data, and secure computer networks
	2	To examine secure software development practice
	3	To understand key terms and concepts in I.T. ACT
Course Outcomes	After completion of this course Students will be able to	
	CO1	Explain the cyber security concepts
	CO2	Describe the cyber security vulnerabilities and prevention techniques
	CO3	Explain the different rules and regulations under I.T. ACT
	CO4	Explain the concepts of digital forensics & incident management

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1		2								2
CO2		2								2	
CO3			1							1	
CO4				1							
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
- Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 % - Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units). - No compulsory passing for MSE. - ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units)

Unit No.	Title and Content of Unit	Hours
1	Computer and Network Security	4 Hrs
	Introduction to Computer Security - Introduction, How Seriously Should You Take Threats to Network Security? Identifying Types of Threats, Basic Security Terminology, Concepts and Approaches, Online Security Resources Networks and the Internet: Introduction, Network Basics.	
2	Cyber Frauds, DoS, Viruses	4 Hrs
	Cyber Stalking, Fraud, and Abuse: Introduction, How Internet Fraud Works, Identity Theft, Cyber Stalking, Protecting Yourself Against Cyber Crime. Denial of Service Attacks: Introduction, DoS, Illustrating an Attack, Malware: Introduction, Viruses, Trojan Horses, The Buffer-Overflow Attack	
3	Techniques Used by Hackers	4 Hrs
	Introduction, Basic Terminology, The Reconnaissance Phase, Actual Attacks, Malware Creation, Penetration Testing	
4	Computer Security Technology	4 Hrs
	Introduction, Virus Scanners, Firewalls, Antispyware, IDS, Digital Certificates, SSL/TLS, Virtual Private Networks, WiFi Security	
5	I.T. ACT	4 Hrs
	Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, I.T. Act	
6	Introduction to Forensics	4 Hrs
	Introduction, General Guidelines, Finding Evidence on the PC, Finding Evidence in System Logs, Getting Back Deleted Files, Operating System Utilities	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Computer Security Fundamentals	Chuck Easttom	Pearson, third edition

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Incident Response & Computer Forensics	Jason Luttgens, Matthew Pepe, Kevin Mandia	McGraw Hill Osborne Media, 3rd edition, 2014
02	Computer Security and Incident Response	Keith J. Jones, Richard Bejtlich, Curtis W. Rose	Real Digital Forensics: Paperback – Import, 2005



Shivaji University Kolhapur

**Revised Syllabus
as per**

**National Education Policy-2020
(NEP-2.0)**

T. Y. B. Tech.

Computer Science and Engineering

6th Semester



Marking Scheme	
- Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 % - Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units). - No compulsory passing for MSE. ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).	

Unit No.	Title and Content of Unit	Hours
1	Introduction to Machine Learning	7 Hrs
	Machine Learning: Introduction to Artificial Intelligence, Machine Learning, and Data Science, Types of learning, Machine Learning Problem categories, Machine process, Lifecycle, Performance measures, tools and framework, data visualization. Challenges and limitations of Machine Learning.	
2	Regression	7 Hrs
	Probability and Statistics: Probability, Bayes' theorem, Distributions, Variance, Co-Variance. Simple regression – hypothesis, cost function, parameter learning with gradient descent, learning rate, Gradient Descent for linear regression, examples, simple regression in matrix form. Multivariate Linear Regression – multiple features, hypothesis functions, Gradient Descent for multiple variables, Feature scaling, polynomial regression.	
3	Supervised Learning Techniques	6 Hrs
	Concept of supervised learning, multiple linear regression, Logistic regression and classification problems, k-Nearest Neighbours (k-NN) algorithm, Decision Trees: construction, splitting criteria, and pruning, Model evaluation metrics: accuracy, precision, recall, F1-score, and confusion matrix.	
4	Unsupervised Learning Techniques	6 Hrs
	Concept of unsupervised learning, Clustering techniques: k-Means clustering and hierarchical clustering, Distance measures and similarity metrics, Dimensionality reduction: Principal Component Analysis (PCA), Applications of clustering and dimensionality reduction, Interpretation and evaluation of unsupervised learning results	
5	Neural Networks and Learning Models	5 Hrs
	Introduction to artificial neural networks, biological inspiration and structure of neural networks, Perceptron model and its limitations, Multilayer perceptron concept, learning process in neural networks, Overview of activation functions and learning rate, Introductory concepts of regularization	

Unit No.	Title and Content of Unit	Hours
6	Machine Learning Applications, Deployment & Ethics	5 Hrs
	Real-world applications of machine learning in healthcare, finance, education, and industry, Case study-based understanding of end-to-end ML solutions, Basics of model deployment and usage, Model saving, loading, and reuse concepts, Ethical issues in machine learning: bias, fairness, transparency, and accountability, Social and environmental impact of machine learning systems, Responsible and sustainable use of AI technologies.	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Machine Learning with Python- an approach to applied ML	Abhishek Vijayvargia	BPB Publications
02	Hands-On Machine Learning with Scikit-Learn	Aurélien Géron	O'Reilly Publications
03	Machine Learning	Tom M. Mitchell	McGraw Hill Education; First Edition

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press, 2012.
02	Introduction to Machine Learning	Ethem Alpaydin	PHI 2nd Edition-2013
03	http://neuralnetworksanddeeplearning.com/		Link.

Marking Scheme	
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Unit No.	Title and Content of Unit	Hours
1	Introduction:	5 Hrs
	Compilers, Phases of a compiler, Compiler construction tools, cousins of the compiler.	
2	Lexical Analysis:	6 Hrs
	Role of a Lexical analyzer, input buffering, specification and recognition of tokens, finite automata implications, designing a lexical analyzer generator.	
3	Syntax Analysis:	7 Hrs
	Role of Parser, Writing grammars for context free environments, Top- down parsing, Recursive descent and predictive parsers (LL), Bottom-Up parsing, Operator precedence parsing, LR, SLR and LALR parsers.	
4	Syntax Directed Translation and Intermediate Code Generation:	7 Hrs
	Syntax directed definitions, construction of syntax tree, S-attributed definitions, L-attributed definitions, Intermediate languages, assignment statements, back patching.	
5	Code Optimization:	5 Hrs
	Principle sources of optimization, optimization of Basic Blocks, loops in flow graphs, Peephole optimization	
6	Code Generation:	6 Hrs
	Issues in design of a code generator and target machine, Run time storage management, Basic blocks and flow graphs, Next use information and simple code generator, Issues of register allocation, code generation from Dags.	

Term Work

Minimum of 10 to 12 tutorials should be carried out based on the overall syllabus.

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Compilers - Principles, Techniques and Tools	A. V. Aho, R. Shethi and J. D. Ullman	Pearson Education

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Compiler construction	D. M. Dhamdare	Mc-Millan
02	LEX & YACC	Dong Brown, John Levine, Tony Mason	O'Reilly 2nd Edition

Year and Semester	Second Year B. Tech - Semester III - Computer Science and Engineering				
Course Category	Programme Core Course (PCC)				
Title of Course	Database Engineering			Course Code	CSE3203
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	3	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Set Theory, Operating System, Data Structures	
Course Objective	1	To understand core concepts and architecture of database systems.
	2	To acquire proficiency in SQL for database creation and manipulation.
	3	To apply database design principles for real-world applications.
Course Outcomes	After completion of this course Students will be able to...	
	CO1	Explain the fundamentals and components of DBMS.
	CO2	Design databases using Entity–Relationship modelling.
	CO3	Apply normalization techniques to improve database design.
	CO4	Write SQL queries to manage and retrieve data effectively.
	CO5	Apply transaction management and concurrency control techniques.
	CO6	Implement database recovery mechanisms for failure handling.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	1							
CO2	2	3	2	1							
CO3	2	3	3	2	1						
CO4	2	3	3	2	2						
CO5	2	3	2	3	2						
CO6	2	2	2	3	1						

Marking Scheme
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Unit No.	Title and Content of Unit	Hours
1	DATABASE FUNDAMENTALS AND ARCHITECTURE	4 Hrs
	Purpose of database System, Database system applications, advantages of DBMS, data abstraction, database users, DBMS architecture, Data Models, schemas, keys, and relational algebra operations.	
2	CONCEPTUAL DATABASE DESIGN AND NORMALIZATION	6 Hrs
	Entity–Relationship model, entity types, attributes, relationships, mapping constraints, ER diagrams, and conversion of ER model to relational schema, extended ER features. Normalization concepts including data redundancy, anomalies, functional dependencies, canonical cover, normalization process, 1NF, 2NF, 3NF, BCNF, 4NF, and 5NF.	
3	SQL AND PL/SQL	8 Hrs
	SQL: -Overview of SQL query Language, Basic Structure of SQL, SQL Language DDL, DML, DCL, TCL commands, set operations, Aggregate Function, Nested subqueries, Join Expression, Views PL/SQL: - Triggers, Stored Procedure, Cursor and PL/SQL Stored Functions	
4	DATA STORAGE & INDEXING	6 Hrs
	File organization, record organization, data dictionary, buffer management, indexing techniques, ordered indices, Primary Indices, Dense and Sparse Index, multi-key access methods, static and dynamic hashing.	
5	TRANSACTION MANAGEMENT	8 Hrs
	Transaction concepts, transaction states, ACID properties, schedules, serializability, concurrency control problems, lock-based protocols, deadlock handling, Multiple Granularity, timestamp-based, and validation-based protocols.	
6	DATABASE RECOVERY AND FAULT TOLERANCE	4 Hrs
	Types of failures, storage structure, recovery concepts, log-based recovery, checkpoints, recovery algorithms, loss of non-volatile storage, backup and remote recovery techniques.	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Database System Concepts	A. Silberschatz, H.F. Korth, S. Sudarshan	6th Edition, McGraw Hill Education.
02	Database Systems - A practical approach to Design, Implementation and Management	Thomos Connolly, Carolyn Begg	3rd Edition, Pearson Education

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Database Systems – Design, Implementation and Management	Rob & Coronel	5th Edition Thomson Course Technology
02	Fundamentals of Database Systems	Ramez Elmasri, Shamkant B. Navathe	4th Edition, Pearson Education

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Unit No.	Title and Content of Unit	Hours
1	Introduction to Software Engineering	7 Hrs
	The evolving role of software, Changing Nature of Software, legacy software, Software myths. A Generic view of process: Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, process assessment, personal and team process models. Process models: The waterfall model, Incremental process models, Evolutionary process models, specialized process models, The Unified process.	
2	Software Requirements	6 Hrs
	Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. System models: Context Models, Behavioural models, Data models, Object models, structured methods.	
3	Design Engineering	7 Hrs
	Design process and Design quality, Design concepts, the design model, pattern based software design. Creating an architectural design: software architecture, Data design, Architectural styles and patterns, Architectural Design, assessing alternative architectural designs, mapping data flow into software architecture. Modelling component-level design: Designing class-based components, conducting component-level design, object constraint language, designing conventional components. Performing User interface design: Golden rules, User interface analysis, and design, interface analysis, interface design steps, Design evaluation.	

Unit No.	Title and Content of Unit	Hours
4	Testing Strategies	6 Hrs
	A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging. Product metrics: Software Quality, Frame work for Product metrics, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance. Metrics for Process and Products: Software Measurement, Metrics for software quality.	
5	Risk management	5 Hrs
	Reactive vs Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.	
6	Quality Management	5 Hrs
	Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, Software reliability, The ISO 9000 quality standards.	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Software engineering A practitioner's Approach	Roger S Pressman	McGraw Hill International Edition.
02	Software Engineering	Ian Sommerville	Pearson education.

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Software Engineering, A Precise Approach	Pankaj Jalote	Wiley India
02	Fundamentals of Software Engineering	Rajib Mall	PHI
03	Software Engineering, Principles and practice	Waman S Jawadekar	Mc Graw-Hill Companies

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Unit No.	Title and Content of Unit	Hours
1	High Speed Networks	7Hrs
	- Cellular Networks (1G to 5G) - The need of speed and Quality of Service - High Speed Networks: Frame Relay, Asynchronous Transfer Mode, High Speed LANs. - Advanced Data Link Layer & MAC Protocols: Broadband Wireless, Bluetooth, RFID	
2	Network Layer & Routing	5Hrs
	- Advanced routing algorithms - Mobile IP - Unicast Routing Protocols-RIP, OSPF, BGP - Multicast Routing Protocols-IGMP	
3	Transport Layer	7 Hrs
	- TCP congestion control mechanisms - TCP performance analysis - SCTP	
4	Network Management	7 Hrs
	- Secure email and DNS security - Network management protocols-SNMP - Firewalls, IDS/IPS and VPNs - SSL/TLS and secure communication	
5	Storage Networks and Ad-Hoc Wireless Networks	7 Hrs
	- MAC Protocols for Ad Hoc Wireless Networks, Routing Protocols for Ad Hoc Wireless Networks, Multicast routing in Ad Hoc Wireless Networks, Quality of Service in Ad Hoc Wireless Networks. - Storage and Networking Concepts, Fiber Channel Internals, Fiber Channel SAN Topologies. - IP SAN Technology, IP SAN Products, Management of SANs	

Unit No.	Title and Content of Unit	Hours
6	Wireless Networks, Security & Emerging Trends	5 Hrs
	• 4G LTE and 5G architecture • Wireless security challenges • Cloud networking and NFV • IoT, SDN and edge computing	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
1	TCP/IP Protocol Suite	Behrouz A. Forouzan	McGraw-Hill Publication 4th Edition
2	Computer Networks	Andrew S. Tanenbaum	-
3	High Speed Networks and Internet	William Stallings	Prentice Hall

Reference Books			
Sr. no.	Title	Author	Edition/Publication
1	Behrouz A. Forouzan	Data Communications and Networking	-
2	Ad Hoc Wireless Networks: Architectures and Protocols	C. Siva Ram Murthy, B.S. Manoj	Prentice Hall, 2004
3	Designing Storage Area Networks, A Practical Reference for Implementing fiber Channel and IP SANs	Tom Clark	Addison-Wesley Professional, 2nd Edition

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Unit No.	Title and Content of Unit	Hours
1	Introduction to Business Intelligence	06
	Introduction, History and Evolution -Business Intelligence Segments - Difference between Information and Intelligence - Defining Business Intelligence Value Chain - Factors of Business Intelligence System - Real time Business Intelligence - Business Intelligence Applications.	
2	Essentials of Business Intelligence	06
	Introduction - Creating Business Intelligence Environment - Business Intelligence Landscape - Types of Business Intelligence - Business Intelligence Platform -Applications in Business Analytics -Dynamic roles in Business Intelligence - Challenges - Business Intelligence Tools - Modern Business Intelligence - Enterprise Business Intelligence - Information Workers.	
3	BI Implementation	06
	Key Drivers, Key Performance Indicators and operational metrics, BI Architecture/Framework, Best Practices, Business Decision Making. Business Analytics: Objective Curve, Web Analytics and Web Intelligence, Customer Relationship Management.	
4	Business/Corporate Performance Management	06
	Dash Boards and Scorecards, Business Activity Monitoring, Six Sigma. Advanced BI: Big Data and BI, Social Networks, Mobile BI, emerging trends. Working with BI Tools: Overview of managerial, strategic and technical issues associated with Business Intelligence and Data Warehouse design, implementation, and utilization.	
5	Data Warehousing (DW)	05
	Introduction & Overview; Data Marts, DW architecture – DW components, Implementation options; Meta Data, Information delivery. ETL: Data Extraction, Data Transformation – Conditioning, Scrubbing, Merging, etc.	
6	Dimensional Modeling, OLAP & Data Mining	07
	Dimensional Modeling: Facts, dimensions, measures, examples; Schema Design – Star and Snowflake, slow changing Dimensions. OLAP: OLAP Vs OLTP, Multi-Dimensional Databases (MDD); OLAP – ROLAP, MOLAP, HOLAP, Data Mining: Types of Analysis, Data mining concepts, Rules, Role of machine learning in BI	

Text Books:					
Sr. No.	Title	Author	Publisher	Edition	Year of Edition
1	Decision Support and Business Intelligence Systems	Efraim Turban, Ramesh Sharda, Jay Aronson, David King	Pearson Education,	9 th	2009
2	Business Intelligence, Analytics, Data Science and AI – A Managerial Perspective	Ramesh Sharda, Dursun Delen and Efraim Turban	Pearson Education Limited	5th edition, Global Edition	2024

Reference Books				
Sr. No.	Title	Author	Publisher	Year of Edition
1	Business Intelligence	David Loshin,	The Savy Manager's Guide Getting Onboard with Emerging IT, Morgan Kaufmann Publishers	2009
2	Business Intelligence Strategy and Big Data Analytics - A General Management Perspective	Steve Williams	Morgan Kaufmann (Elsevier)	2016
3	Data Analytics and Business Intelligence Computational Frameworks, Practices, and Applications	Vincent Charles, Pratibha Garg, Neha Gupta and Mohini Agarwal	CRC Press	2023

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Unit No.	Title and Content of Unit	Hours
1	Introduction to E-commerce	6 Hrs
	E-commerce: Meaning, Features of E-commerce, Categories of E-commerce, Advantages & Limitations of E-Commerce, Traditional Commerce & E-Commerce E-commerce Environmental Factors: Economic, Technological, Legal, Cultural & Social Impact: E-Commerce on Business, Ecommerce in India Trends: E-Commerce in Various Sectors: Retail, Banking, Tourism, Government, Education	
2	Issues and Security in E Commerce	4 Hrs
	Issues: Understanding Ethical, Social and Political issues in E-Commerce: A model for Organizing the issues, Basic Ethical Concepts Security: Threats in Computer Systems: Virus, Cyber Crime Network Security: Encryption, Protecting Web server with a Firewall, Firewall and the Security Policy, Network Firewalls and Application Firewalls, Proxy Server.	
3	Introduction to Digital Marketing	6 Hrs
	How digital technologies transformed marketing? Definitions: digital marketing and multichannel marketing Digital marketing strategy: key features of digital marketing strategy, applications of digital marketing, benefits of digital marketing, difference between e-commerce and e-business, challenges in developing and managing digital marketing strategy.	
4	Introduction to SEO	7 Hrs
	Introduction: SEO, Introduction to SEM, Web Analytics, Mobile Marketing. Trends in Digital Advertising: Introduction and need for SEO, how to use internet & search engines. Web Analytics: - Google Analytics & Google AdWords; data collection for web analytics	
5	Digital Marketing Strategy and relationship marketing	6 Hrs
	Digital Marketing strategy development: how to structure digital marketing strategy, strategy implementation Relationship marketing using digital platforms: Introduction, the challenge of customer engagement, customer lifecycle management.	

Unit No.	Title and Content of Unit	Hours
6	Social Media Marketing	7 Hrs
	Social Media Marketing: Role of Influencer Marketing, Tools & Plan– Introduction to social media platforms. Facebook & LinkedIn Marketing: Business through Facebook Marketing, Creating Advertising Campaigns, Facebook Marketing Tools, LinkedIn Marketing, Introduction and Importance of LinkedIn Marketing. Twitter Marketing: Introduction to Twitter Marketing, how twitter Marketing is different than other forms of digital marketing Mobile Marketing: - Mobile Advertising, Forms of Mobile Marketing, Features, Mobile Campaign Development, Mobile Advertising Analytics Introduction to social media metrics	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Introduction to E-commerce: Combining Business & Information Technology	Martin Kutz	1st Edition, (2016)
02	Digital Marketing: Strategy, Implementation and Practice	Dave Chaffey, Fiona Ellis-Chadwik	6th Edition

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Electronic Commerce	Elias. M. Awad	Prentice-Hall of India Pvt Ltd
02	Electronic Commerce-A Manager's guide	Ravi Kalakota, Andrew B. Whinston	Addison-Wesley

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Unit No.	Title and Content of Unit	Hours
1	Introduction to Project Management:	05
	Project and Project Management (PM), Role of project Manager, System view of PM, Organization, Stakeholders, Project phases and lifecycle, Context of IT projects, process groups, mapping groups to Knowledge areas	
2	Project Integration Management:	05
	Strategic planning and project selection, Developing a Project Management Plan, Directing and Managing Project Work, Monitoring and Controlling Project Work, Performing Integrated Change Control, Closing Projects or Phases	
3	Project Scope, Time and Cost management:	08
	Planning Scope Management, Collecting Requirements, Defining Scope, Creating the Work Breakdown Structure, Validating Scope, Controlling Scope Planning Schedule Management, Defining Activities, Sequencing and Estimating Activity, Resources & Duration, Developing & Controlling Schedule. Basic Principles of Cost Management, Planning Cost Management, Estimating Costs, Determining the Budget, Controlling Costs	
4	Quality Management & Sustainable Project Practices:	07
	Importance, Planning Quality Management, Performing Quality Assurance, Controlling Quality, Tools and Techniques for Quality Control, Modern Quality Management, Improving IT Project Quality. Overview of sustainability and ESG (Environmental, Social, Governance) in projects, integration of sustainability objectives into project planning and execution, green project management principles and frameworks, eco-metrics and sustainability performance measurement, and sustainability as a source of strategic project value.	
5	Human Resource and Communications Management:	07
	Importance Human Resource management, keys to managing people, human resource planning, acquiring, developing and managing project team, software assistance. Importance of Communications Management, Identifying Stakeholders Planning Communications, Distributing Information, Managing Stakeholders, Reporting Performance, Suggestions for Improving Project Communications	

Unit No.	Title and Content of Unit	Hours
6	Risk management	04
	Importance, risk management planning, sources of risk, risk identification, qualitative and quantitative risk analysis, risk response planning, risk monitoring and control.	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Information Technology Project Management	Kathy Schwalbe	7th Edition/Cengage Learning

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	IT Project Management	Joseph Phillips	3rd Edition / McGraw Hill Edu. (India) Pvt. Ltd.
02	Software Project Management	Bob Huges, Mike Cotterell, Rajib Mall	5th Edition / Tata McGraw Hill Edu. (India) Pvt. Ltd.
03	A Guide to the Project Management Body of Knowledge	Newtown Square	5th Edition / PA, Project Management Institute

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Unit No.	Title and Content of Unit	Hours
1	Introduction to blockchain	6Hrs
	Distributed systems, Two General Problem, Byzantine General problem and Fault Tolerance, introduction to cryptographic concepts, public key cryptosystems, CAP theorem and block chain, private vs public blockchain, Hash Puzzles. Zero Knowledge Proof	
2	Blockchain Fundamentals	6Hrs
	Basic architecture of Blockchain, different terminologies associated, Merkle Patricia Tree, Characteristics of Blockchain, Types of Blockchain, Soft & Hard Fork, Introduction to Smart contract concept in Blockchain.	
3	Distributed Consensus	6Hrs
	Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate, Benefits and limitations of blockchain	
4	Cryptocurrency	6Hrs
	History Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Side chain, Name coin.	
5	Cryptocurrency Regulation	6 Hrs
	Stakeholders, Roots of Bitcoin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy, Future of Blockchain for crypto currencies	
6	Blockchain Applications	6 Hrs
	Domain Name Service, Supply Chain Management, Finance, Health Care, Media, Internet of Things (IoT), Land Records, Voting and election, Loyalty Programs.	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Blockchain: The Beginners Guide to Understanding the Technology Behind Bitcoin & Crypto currency	Artemis Caro	-
02	Blockchain for Beginners: Guide to Understanding the Foundation and Basics of the Revolutionary Blockchain Technology	Scott Marks	Create Space Independent Publishing Platform

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder	Princeton University Press
02	Blockchain for Beginners	Mark Watney	-

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Unit No.	Title and Content of Unit	Hours
1	Introduction	6 Hrs.
	Introduction and Data Preprocessing: Why data mining, what is data mining, what kinds of data can be mined, what kinds of patterns can be mined, Which Technologies Are used, which kinds of Applications are targeted, Major issues in data mining. Data Preprocessing: An overview, Data cleaning, Data integration, Data reduction, Data transformation and data discretization	
2	Classification	6 Hrs.
	Statistical-based algorithm, Distance based algorithm, Tree based algorithm, Rule based algorithm, Neural based algorithm, Combining technique.	
3	Clustering	6 Hrs.
	Similarity and Distance Measures, Hierarchical Algorithm, Partitional algorithm, Clustering Large Databases, Clustering with categorical Attributes	
4	Association Rules	6 Hrs.
	Motivation and terminology, Example: mining weather data, Basic Idea: item sets, generating item sets and rules efficiently, correlation analysis Experiments with Weka-mining association rules	
5	Prediction	6 Hrs.
	The prediction task, Statistical (Bayesian) classification, Bayesian network Instance-based methods (nearest neighbour), Linear Models, Experiments with Weka-prediction	
6	Advanced Techniques, Data Mining software and applications	6 Hrs.
	Text mining: extracting attributes(keywords), structural approaches (parsing, soft parsing). Bayesian approach to classifying text web mining: classifying web pages, extracting knowledge from the web data mining software and applications	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Data Mining: Practical Machine Learning Reading Tools and Techniques	Ian H. Witten and Eibe Frank,	3rd Edition
02	Data Mining: Introductory and Advanced Topics	M. H. Dunham	3rd Edition

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Principle of Data Mining	David J. Hand, Heikki Mannila and Padhraic Smyth	1st Edition
02	Data Mining: Concepts and Techniques	Jiawei Han, Micheline Kamber, Jian Pei Professor.	3rd Edition

Year and Semester	Third Year B. Tech - Semester VI - Computer Science and Engineering				
Course Category	Programme Elective Course (PEC)				
Title of Course	Storage Networks (Elective-III)			Course Code	CSE3205-4
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	03	--	--	03	03
Examination Scheme	MSE	ISE/CA	ESE	Total	
	30	10	60	100	

Course Pre-Requisite	Fundamentals of Storage and Networking	
Course Objective	1	Finding key challenges in information management.
	2	Storage system architecture and data protection.
	3	Storage Area Network- concepts, components and protocols.
	4	Network -Attached Storage - concepts, components, implementation and protocols.
	5	Architecture of Storage Virtualization.
	6	Need of Replication, Replication techniques and Storage Security.
Course Outcomes	After completion of this course Students will be able to	
	CO1	Explain the concept of storage system environment and need for data protection.
	CO2	Discuss Storage Area Networks related concepts, its components and protocols used.
	CO3	Discover the facts about Network Attached storage, its component and implementation strategies.
	CO4	Analyze various virtualization techniques and its usage in real world problem
	CO5	Describe the business continuity and different backup and recovery topologies.
	CO6	Describe various replication techniques and storage security solutions.

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									
CO2			3		3						
CO3			3		2						
CO4					3						2
CO5		3	3								
CO6		3	2								
Level of Mapping as: Low 1, Moderate 2, High 3											

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Unit No.	Title and Content of Unit	Hours
1	Introduction to information storage	6 Hrs
	Evolution of storage technology and architecture, Data Centre Infrastructure, Key challenges in Managing Information, Information Lifecycle. Components of Storage System Environment, Intelligent Storage System, Direct Attached Storage and Data Protection: Components of Intelligent Storage System, Intelligent Storage Array. Direct Attached Storage – types, benefits and limitation, Disk drive Interface, Introduction to parallel SCSI, SCSI command model. Data Protection (RAID): Implementation of RAID, RAID array components, RAID levels, Comparison, RAID, Impact on disk performance, Hot Spares.	
2	Storage Area Network	6 Hrs
	SAN – Evolution, Components of SAN, Fibre Channel Protocol Stack- Links, ports and topologies, FC-0: Cables, plugs and Signal Encoding, FC-1: 8b/10b encoding, ordered sets and link control protocol, FC-2: data Transfer, FC-3: common Services, FC-4 and ULPs, Fibre Channel SAN – point-to- point topology, Fabric topology, Arbitrated loop topology.	
3	Network -Attached Storage	6 Hrs
	Local File Systems, Network File System and File Servers, Benefits of NAS, NAS file I/O, Components of NAS, NAS Implementations, NAS File sharing Protocols, NAS I/O operations, Factors affecting NAS Performance. Case Study: Direct Access File System, Shared Disk File System Comparison: NAS, Fibre Channel SAN and iSCSI SAN	
4	Storage Virtualization	6 Hrs
	Introduction, Virtualization in the I/O path, Limitations and requirements, Definition of Storage Virtualization, Implementation considerations, Storage Virtualization on block, level, File level Virtualization, Storage Virtualization on various levels of the storage, network, Symmetric and Asymmetric Storage Virtualization.	

Unit No.	Title and Content of Unit	Hours
5	Business Continuity, Backup and Recovery	6 Hrs
	Introduction, Information Availability, Cause of Information unavailability, Measuring information Availability, Consequences of down time, BC terminology, BC planning life cycle, Failure Analysis, BC Technology Solutions, Backup Purpose, Backup, Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup, Process, Backup and Restore Operations, Backup Topology, Backup in NAS environment, Backup Technologies.	
6	Replication and Storage Security	6 Hrs
	Local Replication, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations. Storage Security: Storage Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking.	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	An Information Storage and Management	G. Somasudaram	Wiley India
02	Storage Networks	Ulf Troppen, Rainer Erkens, Wolfgang Müller	Wiley India

Marking Scheme	
	• Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40 % • Mid sem. examination will be based on 50 % syllabus from beginning (First Three Units). • No compulsory passing for MSE. • ESE paper setting weightage will be, 25 % on syllabus covered for MSE (First Three Units) and 75 % on remaining syllabus (Last Three Units).

Unit No.	Title and Content of Unit	Hours
1	Introduction to Database Systems	4 Hrs
	• Database system applications • Purpose and advantages of database systems • View of data • Database users and administrators • Basic structure of relational databases	
2	Database Schema and Relational Concepts	4 Hrs
	• Database schema and schema diagrams • Keys: primary key, foreign key, candidate key • Structure of relational tables • Basic relational operations	
3	Entity–Relationship (ER) Model	5 Hrs
	• Entity, attributes, and relationships • Mapping constraints • ER diagrams • Conversion of ER model to relational schema • Introduction to extended ER concepts	
4	Database Normalization	4 Hrs
	• Data redundancy and update anomalies • Functional dependencies • Normalization process • First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF)	

Unit No.	Title and Content of Unit	Hours
5	SQL, Storage, and Transaction Basics	4 Hrs
	• Overview of SQL • SQL data definition and data manipulation • Basic SQL queries, joins, aggregate functions, and views • Introduction to data storage and file organization • Basic concepts of indexing • Introduction to transaction management and ACID properties	
6	Recovery System	3 Hrs
	• Failure Classification • Storage • Recovery and Atomicity • Remote Backup System	

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Database System Concepts	A. Silberschatz, H.F. Korth, S. Sudarshan	6 th Edition, McGraw Hill Education.
02	Database Systems - A practical approach to Design, Implementation and Management	Thomos Connolly, Carolyn Begg	3rd Edition, Pearson Education

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Database Systems – Design, Implementation and Management	Rob & Coronel	5th Edition Thomson Course Technology
02	Fundamentals of Database Systems code Approach with C	Ramez Elmasri, Shamkant B. Navathe	4 th Edition, Pearson Education

Year and Semester	Third Year B. Tech - Semester V - Computer Science and Engineering				
Course Category	Programme Core Course (PCC)				
Title of Course	Database Engineering Lab			Course Code	CSE3207
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	04	04	02
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	50	75	

Course Pre-Requisite	Set Theory, Operating System, Data Structures	
Course Objective	1	To understand core concepts and architecture of database systems.
	2	To acquire proficiency in SQL for database creation and manipulation.
	3	To apply database design principles for real-world applications.
Course Outcomes	After completion of this course Students will be able to	
	CO1	Explain the fundamentals and components of DBMS.
	CO2	Design databases using Entity–Relationship modelling.
	CO3	Apply normalization techniques to improve database design.
	CO4	Write SQL queries to manage and retrieve data effectively.
	CO5	Apply transaction management and concurrency control techniques.
	CO6	Implement database recovery mechanisms for failure handling.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	1							
CO2	2	3	2	1							
CO3	2	3	3	2	1						
CO4	2	3	3	2	2						
CO5	2	3	2	3	2						
CO6	2	2	2	3	1						

Marking Scheme
In Semester Evaluation/ Continuous Assessment has 25 Marks Parameters for In Semester Evaluation could be: Attendance, Assignments, Unit Tests, Presentation, Online Activities like (Virtual Labs, NPTEL) etc. Lab File should be prepared and should be assessed continuously during academic. End Semester Evaluation has 50 Marks External Practical Examination with Performance and Oral Examination

Guidelines for Lab Performance	
Faculty can create Experiment list based on following listed topics. Minimum 14 to 16 Experiments should get performed.	
Exp. No.	Title of Experiment/ Problem Statement
1.	Installation of DBMS like MySQL, Oracle.
2.	Design and draw an E–R diagram for a real-world application (College / Hospital / Library / Bank).
3.	Convert the E–R diagram into relational tables with appropriate primary and foreign keys.
4.	Normalize a given unnormalized database step-by-step from 1NF to BCNF with justification.
5.	Create a database and tables using DDL commands (CREATE, ALTER – add/modify/drop columns, RENAME, DROP).
6.	Implement integrity constraints (PRIMARY KEY, UNIQUE, NOT NULL, CHECK) on created tables.
7.	Implement referential integrity constraints (FOREIGN KEY with ON DELETE CASCADE and ON DELETE SET NULL).
8.	Perform DML operations (INSERT, UPDATE, DELETE, SELECT with WHERE conditions).
9.	Execute SQL queries using aggregate functions and Clause (MIN, MAX, AVG, SUM, COUNT)(Group By, having, order by, Between)
10.	Perform SQL join operations and Set operations on two tables (INNER, NATURAL, LEFT, RIGHT, FULL, SELF, CROSS JOIN).
11.	Demonstrate SQL string and date functions (UPPER, LOWER, SUBSTRING, LENGTH, CONCAT, DATE, INITCAP, TRIM, PAD functions).
12.	Demonstrate PL/SQL stored procedure and Function
13.	Demonstrate Cursor and Trigger using PL/SQL
14.	Create, modify, and query SQL views.
15.	Write a Java program to establish database connectivity using JDBC.
16.	Implement transaction management using JDBC (COMMIT, ROLLBACK, SAVEPOINT).
17.	Write a Java program to implement dense and sparse indexing.
18.	Mini Project

Mini Project Statement			
<u>1. Student Management System</u> Design and implement a database system to manage student information such as personal details, course enrolment, attendance, and examination marks. The system should allow adding, updating, deleting, and retrieving student records efficiently. <u>2. Library Management System Problem Statement</u> Develop a database to manage library operations including book details, member information, book issue/return records, and fine calculation. The system should help librarians track available books and borrowing history. <u>3. Hospital Management System Problem Statement</u> Create a database system to store and manage patient records, doctor details, appointment schedules, and billing information. The system should ensure quick access to patient data and efficient hospital administration. <u>4. Online Examination System Problem Statement</u> Design a database for an online examination system that stores student details, question banks, exam schedules, and results. The system should support secure data storage and easy result generation. <u>5. Inventory Management System Problem Statement</u> Develop a database application to manage product details, stock levels, suppliers, and sales transactions. The system should help monitor inventory status and reduce manual recordkeeping.			

Textbooks			
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01	Database System Concepts	A. Silberschatz, H.F. Korth, S. Sudarshan	6th Edition, McGraw Hill Education.
02	Database Systems - A practical approach to Design, Implementation and Management	Thomos Connolly, Carolyn Begg	3rd Edition, Pearson Education

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02	Fundamentals of Database Systems code Approach with C	Ramez Elmasri, Shamkant B. Navathe	4th Edition, Pearson Education

Marking Scheme
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Guidelines for Lab Performance	
Faculty can create/perform Experiment list based on following listed topics. Minimum 12 to 14 Experiments should get performed.	
Exp. No.	Title of Experiment/ Problem Statement
1	Introduction to Python ML Stack Install and configure Python environment with Anaconda, Jupyter Notebook/VS Code. Implement basic ML workflow: data loading → exploration → visualization → model building → evaluation using Scikit-learn
2	Data Visualization and EDA Load real-world dataset. Perform EDA using Pandas, Matplotlib, Seaborn. Create distribution plots, correlation heatmaps, pair plots, missing value analysis
3	Data Pre-processing Techniques Implement data cleaning (handling missing values: mean/median/mode imputation). Apply feature scaling (Min-Max, Standardization, Robust scaling). Encode categorical variables (Label, One-Hot Encoding)
4	Feature Engineering and Selection Create new features (polynomial features, interaction terms, binning). Implement feature selection: Filter methods (correlation, chi-square), Wrapper methods (RFE), Embedded methods (Lasso)
5	Simple and Multiple Linear Regression Implement Simple Linear Regression using gradient descent and Scikit-learn. Extend to Multiple Linear Regression. Perform polynomial regression. Evaluate using MSE, RMSE, MAE, R^2 . Visualize regression lines
6	Logistic Regression for Classification Implement Logistic Regression for binary classification. Apply L1 and L2 regularization. Plot decision boundary. Evaluate using accuracy, precision, recall, F1-score, ROC-AUC
7	k-Nearest Neighbours (k-NN) Algorithm Implement k-NN classifier and regressor. Experiment with k values (1, 3, 5, 7, 9, 11). Analyze effect of distance metrics and feature scaling. Plot decision boundaries.
8	Decision Tree and Model Interpretation Implement Decision Tree Classifier/Regressor. Visualize tree structure. Experiment with splitting criteria (Gini, Entropy), max_depth, min_samples_split. Analyze feature importance
9	Ensemble Methods: Random Forest and Boosting Implement Random Forest with varying n_estimators (10, 50, 100, 200). Compare with AdaBoost and Gradient Boosting. Analyze OOB error and feature importance
10	Model Evaluation and Cross-Validation Implement k-Fold and Stratified K-Fold Cross-Validation. Compare models using multiple metrics. Generate confusion matrices and ROC curves. Perform hyperparameter tuning.

Guidelines for Lab Performance	
Faculty can create/perform Experiment list based on following listed topics. Minimum 12 to 14 Experiments should get performed.	
Exp. No.	Title of Experiment/ Problem Statement
11	K-Means Clustering Implement K-Means clustering. Determine optimal k using Elbow Method and Silhouette Score. Visualize clusters using PCA. Compare initialization methods
12	Hierarchical Clustering and DBSCAN Implement Agglomerative Hierarchical Clustering with dendrogram. Apply DBSCAN for density-based clustering. Compare results on datasets with varying densities.
13	Dimensionality Reduction using PCA Implement PCA from scratch and using Scikit-learn. Analyze explained variance ratio. Visualize high-dimensional data in 2D/3D. Compare reconstruction error.
14	Neural Networks with Tensor Flow/Keras Build Multi-Layer Perceptron (MLP) for classification. Experiment with architectures, activation functions, optimizers. Apply Dropout and Early Stopping.
15	Association Rule Mining using Apriori Implement Apriori algorithm for market basket analysis. Generate frequent item sets and association rules with support, confidence, lift metrics
16	Model Deployment and Ethics Serialize model using Pickle/Job lib. Create Flask API for model serving. Analyze case study on bias, fairness, and ethical implications
17	Mini Project

Mini Project Statement
- House Price Prediction System: - Build end-to-end regression system with complete pipeline: EDA → Pre-processing → Feature Engineering → Multiple models → Hyperparameter tuning → Evaluation. - Customer Churn Prediction: - Develop classification system with class imbalance handling. Compare multiple algorithms and create retention strategies. - Student Performance Predictor: - Predict academic performance, identify at-risk students, evaluate fairness across groups. - Customer Segmentation: - Implement unsupervised learning for customer segmentation using RFM analysis. Create targeted marketing strategies. - Sentiment Analysis: - Build NLP pipeline for product review classification using TF-IDF and multiple algorithms. - Credit Risk Assessment: - Develop binary classification with model interpretability and fairness evaluation

Textbooks			
Sr. no.	Title	Author	Edition/Publication
01	Machine Learning with Python: An Approach to Applied ML	Abhishek Vijayvargia	BPB Publications
02	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Publications, 3rd Edition
03	Machine Learning	Tom M. Mitchell	McGraw Hill Education, First Edition

Reference Books			
Sr. no.	Title	Author	Edition/Publication
01	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press, 2012
02	Introduction to Machine Learning	Ethem Alpaydin	PHI, 2nd Edition, 2013
03	Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer, 2006
04	The Hundred-Page Machine Learning Book	Andriy Burkov	2019
05	Hands-On Unsupervised Learning Using Python	Ankur A. Patel	O'Reilly Media, 2019

Year and Semester	Third Year B. Tech - Semester VI - Computer Science and Engineering				
Course Category	Experiential Learning (EL)				
Title of Course	Domain Specific Mini Project			Course Code	CSE3209
Teaching Scheme	L	T	P	Contact Hrs/Week	Credits
	--	--	02	02	01
Examination Scheme	MSE	ISE/CA	ESE	Total	
	--	25	50	75	

Course Pre-Requisite	Software Engineering Concepts, Object Oriented Concepts	
Course Objective	1	To expose the students to use engineering approach to solve domain specific real time problem
	2	To use the appropriate and newer technologies while developing the project.
	3	To learn the skills of team building and team work.
Course Outcomes	After completion of this course Students will be able to	
	CO1	Identify specific problem statement from a selected domain.
	CO2	Analyze the problem and design appropriate system architecture and solution methodology.
	CO3	Prepare working prototype or software model by using modern tools & techniques
	CO4	Test & validate the results of the developed prototype.
	CO5	Demonstrate the project and prepare the detailed project documentation

CO PO Mapping											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1				1		1			1
CO2	2	2	2	2	1			1		1	1
CO3	2	1	2	2	2			1		1	1
CO4	1	1	1	1	2		1	1		1	1
CO5	1		1				1	1	2	1	1
Level of Mapping as: Low 1, Moderate 2, High 3											

Marking Scheme
- Compulsory passing with 40% marks is mandatory in ESE examinations - ESE and ISE/CA will be evaluated based on different review presentations.

Details
✓ The students should form group consisting of 3 to 5 members. ✓ Each group must select a specific domain aligned with the Sustainable Development Goals (SDGs), preferably addressing Smart India Hackathon (SIH) problem statements, industry-relevant challenges, or pressing societal needs. ✓ Further the group should identify the relevant problem in the selected domain and propose the solution, which can be implemented as a mini-project using suitable technology. ✓ The mini-project work should be evaluated by a team of teachers appointed by the department. ✓ The evaluation and marking should include In semester Evaluation (ISE/CA) and End Semester Examination (ESE) during which the group should give presentation and demonstration of their work done. ✓ Proper project documentation must be maintained. ✓ Care should be taken to avoid out-sourcing of the work.