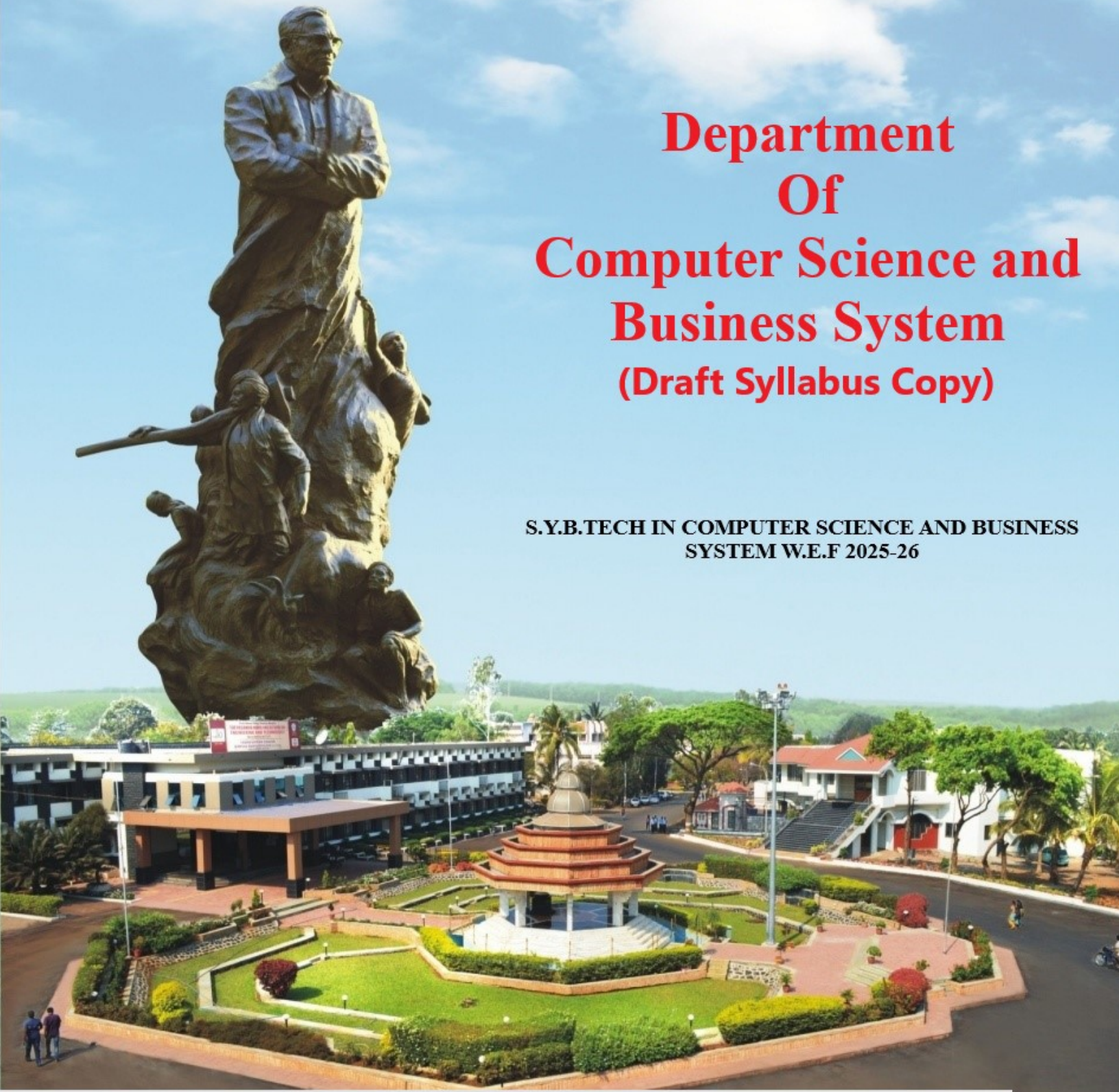
Shree Warana Vibhag Shikshan Mandal's

Tatyasaheb Kore Institute of Engineering And Technology, Warananagar

Department Of Computer Science and Business System

(Draft Syllabus Copy)

S.Y.B.TECH IN COMPUTER SCIENCE AND BUSINESS SYSTEM W.E.F 2025-26



S. Y. B.Tech. (Sem-III & IV) Computer Science & Business System

Syllabus Structure and Curriculum as per NEP 2020

Department of Computer Science and Business System

Vision

To be a leading Computer Science & Business Systems department recognized for excellence in technical and management education, fostering innovation, academic flexibility, industry readiness, and a commitment to professional ethics, shaping future leaders who drive sustainable development and societal progress.

Mission

- To continuously implement a dynamic and adaptable curriculum.
- To enhance industry-institute collaboration to effectively promote internships, improve employability, and foster entrepreneurial skills among students.
- To cultivate an environment that inspires faculty and students to actively participate in impactful academic and research pursuits.
- To expand access to quality education for rural and underprivileged sections of society.
- To instill a commitment to lifelong learning enriched with human values, social responsibility

Program Educational Objectives (PEOs)

Graduates will be,

- To design and develop computing systems by integrating modern technologies and addressing business intelligence challenges.
- To acquire capabilities for pursuing higher education and entrepreneurship with a strong aptitude for innovation
- To function effectively as professionals with excellent interpersonal skills, upholding ethical and social responsibilities
- To lead in their respective domains and contribute positively to societal needs, working efficiently in multidisciplinary and multicultural environments.

Quality Policy

To promote excellence in academic and training activities by inspiring students for becoming competent professionals to cater industrial and social needs.

Program Outcomes (POs)

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

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

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

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

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

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

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

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

Abbreviations

Sr.No	Acronym	Defination
1	ISE	In-Semester Examination
2	ISE-I	In-Semester Examination-I
3	ISE-II	In-Semester Examination-II
4	ESE	End Semester Examination
5	ISA	In-Semester Assessment (Term Work)
6	L	Lecture
7	T	Tutorial
8	P	Practical
9	CH	Contact Hours
10	C	Credit

Course Categories

Sr.No	Acronym	Defination
1	BSC	Basic Science Course
2	ESC	Engineering Science Course
3	PCC	Program Core Courses
4	HSSM	Humanities Social Science and Management
5	VSEC	Vocational and Skill Enhancement Course
6	CC	Co-curricular course

Course/ Subject Code for Theory and Practical

2	5	UG	PCC	CB	3	0	1	T/P/A
Course Introduced Year		Under Graduate	Program Code	Course Category	Semester	Course Number		T-Term work P-POE A - Audit Course

Shree Warana Vibhag Shikshan Mandal's
Tatyasaheb Kore Institute of Engineering & Technology
Warananagar, Tal- Panhala, Dist- Kolhapur -416 113. Maharashtra
An Autonomous Institute, Affiliated to Shivaji University, Kolhapur

Second Year B.Tech in Computer Science & Business System Semester-IV

To be Implemented from 2025-26
Scheme Curriculum Structure, Credit Scheme and Evaluation

Sr. No	Category	Sub- Category	Course Code	Course Title	Teaching Scheme					Examination & Evaluation Scheme			
					L	T	P	C	CH	Component	Marks	Min Marks for Passing	
1	Program Core Course	PCC	25UG-PCC- CB401	Operating Systems	3*	--	--	2	3	ISE	40	16	40
										ESE	60	24	
2		PCC	25UG-PCC- CB402	Database Management Systems	3*	--	--	2	3	ISE	40	16	40
										ESE	60	24	
		PCC	25UG-PCC- CB403	Software Design with UML	3*	--	--	2	3	ISE	40	16	40
										ESE	60	24	
4		PCC	25UG-PCC- CB404	Operations Research	2	--	--	2	2	ESE	60	24	40
										ESE	60	24	
6	Multi-Disciplinary Course	MDM-1I	25UG- MDM2- CB405	Strategic Operations Research for MDM	2	--	--	2	2	ISA	50	20	20
		OE-I	25UG-OE1-CB4061	Marketing Research & Marketing Management	2			2	2	ISE	40	16	40
										ESE	60	24	
	Skill Courses	Vocational & Skill Enhancement	25UG-VSEC1-CB4062	Business Communication and Value Science	1		2	2	3	ISA	50	20	20
	Humanities Social Science and Management	Ability Enhancement Course	25UG-AEC1-CB4063	Modern Indian Language	1	--	--	1	1	ISA	25	10	10
7		Entrepreneurship/Economics/ Mgmt. Course	25UG- EEC1-CB40964	Introduction to Innovation, IP Management and Entrepreneurship	2	--	--	2	2	ISA	25	10	10
8		Value Education Course	23UG- VEC1- CB4065	Professional Ethics and Human Values	1	--	--	1	1	ISA	25	10	10
10	Program Core Courses	PCC	23UG-PCC- CB401P	Operating Systems Lab	--	--	2	1	2	ISA	25	10	10
										POE	50	20	20
11		PCC	23UG-PCC- CB402P	Database Management Systems Lab			2	1	2	ISA	25	10	10
										POE	50	20	20
12		PCC	23UG-PCC- CB404P	Operations Research Lab	--	--	2	1	2	ISA	25	10	10
					20		08	21	28	--	800	320	320

Multidisciplinary Minor (MDM) Courses Bucket

Branch: Computer Science & Buisness System

Fundamentals of Computing and Software Systems

Sr. No	Semester	Category	Course Code	Course Title	Teaching Scheme					Examination & Evaluation Scheme			
					L	T	P	C	CH	Component	Marks	Min Marks for Passing	
1	III	MDM-1	25UG- MDM1- CB306	Object Oriented Programming	2	--	--	2	2	ISA	50	20	20
2	IV	MDM-II	25UG- MDM2- CB405	Operations Research	2	--	--	2	2	ISA	50	20	20
3	V	MDM-III	25UG-PCC- CB505	Data Structure & Algorithm	3	--	--	3	3	ISE	40	16	40
										ESE	60	24	
4	VI	MDM-IV	25UG-PCC- CB605	Operating System	2	--	--	2	2	ISA	50	20	20
5	VII	MDM-V	25UG-PCC- CB705	Database Management Systems	3	--	--	3	3	ISA	50	20	20
6	VIII	MDM-VI	25UG-PCC- CB804	System Analysis and Software Testing	2	--	--	2	2	ISA	50	20	20
					14			14	14	--	350	140	140

Second Year B. Tech.
(Semester –IV)
Detailed Syllabus
In
Computer Science & Business System

Curriculum Structure, Credits and Evaluation Scheme as per NEP 2020
(To be implemented from AY 2025-26)

25UG-PCC- CB401- OPERATING SYSTEMS

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3* Hrs/Week	**ISE**	**:**	40 Marks
Credits	**:**	2			
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objective: The objective of this course is to	
1	To introduce fundamental concepts and structures of modern operating systems.
2	To understand process management, scheduling, and concurrency control.
3	To explore memory management strategies and virtual memory systems.
4	To study file systems, I/O management, and disk scheduling algorithms.
5	To apply operating system principles through case studies like UNIX.

Course Outcomes:

COs	**At the end of successful completion of the course, the students will be able to**	**Bloom's Taxonomy**
CO1	Explain the structure, functions, and services of operating systems.	Understand
CO2	Apply CPU scheduling, process synchronization, and deadlock handling mechanisms.	Apply
CO3	Analyze memory allocation, paging, and virtual memory techniques.	Analyze
CO4	Evaluate file systems, I/O systems, and disk scheduling algorithms.	Evaluate
CO5	Develop solutions using UNIX shell programming and system calls.	Create

Course Description :

This course provides a comprehensive introduction to the fundamental principles and concepts of operating systems. It covers process and thread management, memory and file system management, scheduling algorithms, deadlock handling, inter-process communication, and case studies like UNIX. Students gain practical understanding of OS components and design principles.

Prerequisites :	• Basic knowledge of computer organization • Programming knowledge in C/C++ • Data structures and algorithms

Section – I		
Unit-1	**Introduction to Operating Systems:** Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS**.**	**06Hr**
Unit-2	**Processes, Threads, and Scheduling:** Processes: Definition, Process Relationship, States of a Process, State transitions, Process Control Block (PCB), Context switching. Threads: Definition, States, Benefits, Types of threads, Concept of multithreading. Process Scheduling: Scheduling objectives, Types of Schedulers, Scheduling criteria – CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time. Scheduling algorithms: Pre-emptive and non-preemptive, FCFS, SJF, Round Robin, Multiprocessor scheduling, Real Time scheduling – RM and EDF.	**06Hr**
Unit-3	**Inter-process Communication and Concurrency:** Concurrent processes, Precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solutions, Semaphores, Strict Alternation, Peterson's Solution. Classical IPC Problems – Producer/Consumer Problem, Reader's & Writer Problem, Dining Philosopher Problem, Barber's shop problem. Message Passing, Event Counters, Monitors. Concurrent Programming: Critical region, Conditional critical region, Monitors, Concurrent languages, Communicating Sequential Process (CSP).	**06Hr**
Section-II		
Unit-4	**Deadlocks and Memory Management:** Deadlocks: Definition, Necessary and sufficient conditions, Deadlock Prevention, Avoidance – Banker's algorithm, Detection and Recovery. Memory Management: Concepts of memory, Logical and Physical address mapping. Memory Allocation: Contiguous allocation – Fixed and variable partitioning, Internal and External fragmentation, Compaction.	**6Hr**
Unit-5	**Virtual Memory and File Systems:** Virtual Memory: Concept, Locality of Reference, Hardware and control structures. Page allocation, Partitioning, Paging, Segmentation, Demand Paging, Page Faults, Working Set. Page Replacement Algorithms: Optimal, FIFO, Second Chance (SC), Not Recently Used (NRU), Least Recently Used (LRU). File Management: File concepts, Access methods, File types and operations, Directory structure, File System organization. Allocation Methods – Contiguous, Linked, Indexed. Free-space management – Bit vector, Linked list, Grouping. Directory implementation – Linear list, Hash table, Efficiency and performance.	**6Hr**
Unit-6	**I/O and Disk Management with UNIX Case Study:** I/O Hardware: I/O Devices, Device Controllers, Direct Memory Access, Principles of I/O. Disk Management: Disk structure, Disk scheduling – FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks. Case Study – UNIX OS: UNIX file system, Shell, Filters, Shell programming,	**6Hr**

	Standard I/O programming, UNIX system calls.	

References

Text Books :

1. . *Operating System Concepts Essentials.* Abraham Silberschatz, Peter Baer Galvin and Greg Gagne.

Reference Books :

1. *Operating Systems: Internals and Design Principles*. William Stallings.
2. *Operating System: A Design-oriented Approach*. Charles Patrick Crowley.
3. *Operating Systems: A Modern Perspective*. Gary J. Nutt.
4. *Design of the Unix Operating Systems*. Maurice J. Bach.

25UG-PCC- CB402- Database Management Systems

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3* Hrs/Week	**ISE**	**:**	40 Marks
Credits	**:**	2			
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objective: The objective of this course is to	
1	Understand the structure and functioning of database systems.
2	Design conceptual models using ER modeling and transform them into relational schemas.
3	Formulate queries using relational algebra and SQL.
4	Apply normalization techniques for schema refinement.
5	Understand transaction management, concurrency control, and recovery techniques.

Course Outcomes:

COs	**At the end of successful completion of the course, the students will be able to**	**Bloom's Taxonomy**
CO1	Design relational databases using ER modeling and normalization principles.	Apply
CO2	Formulate queries using relational algebra, calculus, and SQL for given problems.	Apply
CO3	Analyze and evaluate query processing and optimization techniques.	Analyze
CO4	Implement transaction control and concurrency mechanisms to ensure data consistency.	Apply
CO5	Compare and contrast different data models and advanced database concepts.	Evaluate

Course Description :

This course introduces the fundamental concepts of database systems, focusing on relational models, query languages, normalization, transaction processing, and advanced topics like distributed databases and data warehousing. It emphasizes both theoretical foundations and hands-on skills using modern DBMS tools.

Prerequisites :	• Fundamentals of Programming (C/C++) • Data Structures • Basic Discrete Mathematics

Section – I		
Unit-1	**Introduction to Databases and Database Models** Introduction to Databases, File systems vs. DBMS, Advantages of DBMS. Hierarchical, Network, and Relational data models. Database system architecture – levels of abstraction, schema and instance, data independence. Database languages: Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL).	**06Hr**
Unit-2	**Data Models and Entity Relationship Model** Entity-Relationship (E-R) model: Entities, attributes, relationships, E-R diagrams. Extended E-R features: Generalization, Specialization, Aggregation. Relational model: Structure, keys, integrity constraints (key, domain, referential, and user-defined). Mapping E-R model to relational schema.	**06Hr**
Unit-3	**Relational Query Languages and SQL** Relational algebra: selection, projection, set operations, joins, division, and assignment. Tuple relational calculus and domain relational calculus. SQL: DDL, DML, and advanced SQL features (nested queries, aggregation, views, joins, triggers). Overview of Open-source and Commercial DBMS: MySQL, Oracle, DB2, SQL Server.	**06Hr**
Section-II		
Unit-4	**Relational Database Design** Functional Dependencies and Armstrong's axioms.Normal forms: 1NF, 2NF, 3NF, BCNF, 4NF.Lossless join and dependency preservation.Decomposition and normalization algorithms.	**6Hr**
Unit-5	**Query Processing, Optimization and Storage** Query processing stages, evaluation of relational algebra expressions.Query optimization: Heuristics and cost-based optimization, join strategies.Storage strategies: File organization, indexing (single-level and multi-level), B+ Trees, Hashing techniques.	**6Hr**
Unit-6	**Transactions, Concurrency, Security, and Advanced Topics** Transaction processing: Concepts, ACID properties, schedules, serializability. Concurrency control: Lock-based, time-stamp based, multisession techniques, deadlock handling.Database recovery: log-based recovery, checkpoints.Database Security: Authentication, Authorization, DAC, MAC, RBAC, SQL injection. Advanced topics: Object-oriented databases, distributed databases, web databases, data warehousing, and data mining basics.	**6Hr**

References

Text Books :

1. Database System Concepts. Abraham Silberschatz, Henry F. Korth and S. Sudarshan.

Reference Books :

1. *Principles of Database and Knowledge – Base Systems*, Vol 1 by J. D. Ullman.
2. *Fundamentals of Database Systems*. R. Elmasri and S. Navathe.
3. *Foundations of Databases*. Serge Abiteboul, Richard Hull, Victor Vianu.

25UG-PCC- CB403- Software Design with Uml

Teaching Scheme			Evaluation Scheme		
Lectures	:	3* Hrs/Week	**ISE**	:	40 Marks
Credits	:	2			
Tutorials	:	--	**ESE**	:	60 Marks

Course Objective: The objective of this course is to	
1	To understand the fundamentals of object-oriented methodologies and their role in software design.
2	To model system requirements and design software using UML notations and diagrams.
3	To apply various UML models in real-world scenarios for both static and dynamic system views.
4	To integrate design patterns into software architecture to promote reuse and flexibility.
5	To understand the physical aspects of system development including component and deployment modeling.

Course Outcomes:

COs	**At the end of successful completion of the course, the students will be able to**	**Bloom's Taxonomy**
CO1	Explain the principles of object-oriented technology and UML modeling techniques.	Understand
CO2	Apply UML notations to model system requirements using use case and interaction diagrams.	Apply
CO3	Design structural and behavioral models for object-oriented systems using UML.	Apply
CO4	Analyze software designs for reusability using design patterns and best practices.	Analyze
CO5	Create complete system design using component and deployment diagrams.	Create

Course Description :

This course introduces students to object-oriented software development using the Unified Modeling Language (UML). It emphasizes object modeling, system analysis and design, and the application of UML in representing software architecture through various diagrams. The course also covers use cases, interaction, structural and behavioral models, design patterns, and deployment techniques in modern software systems.

Prerequisites :	• Object-Oriented Programming (OOP) •Software development life cycle • software engineering principles.

Section – I		
Unit-1	**Introduction to Object-Oriented Technologies and Software Processes:** Introduction to Object-Oriented Technologies and UML Method, Software development models: Waterfall and Spiral Model, The Software Crisis, Real-world modeling using Object Model, Classes, Inheritance, Multiple Configurations, Characteristics of Quality Software, Comparison of Object-Oriented Analysis with Structured Analysis.	**06Hr**
Unit-2	**Object-Oriented Modeling and UML Language Basics:** Introduction to UML Language, UML Standards and Elements, Overview of UML Models, Object-Oriented Software Development Process, Introduction to Design Patterns, Basics of Distributed Systems and their impact on design.	**06Hr**
Unit-3	**Requirements Analysis and Use Case Modeling:** System Requirement Analysis, Defining Actors and Use Case Goals, Use Case Diagrams, Use Case Relationships: Include, Extend, Generalize, Writing Use Case Scenarios.	**06Hr**
Unit-4	**Transition from Analysis to Design Using Interaction Diagrams:** Transferring Use Cases to Design Stage, Defining UML Methods, Operations, Object Interfaces, Sequence Diagrams, Identifying Objects from Flow of Events, Collaboration Diagrams, Mapping Use Cases to Design Components.	**6Hr**
Unit-5	**Static Structure Modeling Using Class and Package Diagrams:** Class Diagram Model, Attributes, Operations, and Relationships, Association, Generalization, Aggregation, Dependency, Interfaces, Multiplicity, Package Diagram Model: White box and Black box, Interfaces and Dependencies among Packages.	**6Hr**
Unit-6	**Dynamic, Component, and Deployment Modeling:** Dynamic Modeling: State Diagrams, Event Handling, Activity Diagrams, Component Diagrams: Logical and Physical Aspects, Dependencies, Interfaces, Initial Database Design using UML, Deployment Diagrams: Processors, Components, Connections, Tasks, Threads, Signals, Events.	**6Hr**

References

Text Books :

Object-Oriented Software Engineering: using UML, Patterns, and Java. Bernd Bruegge and Allen H. Dutoit.

Reference Books :

1. *Design Patterns: Elements of Reusable Object-Oriented Software*. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides.

25UG-PCC- CB404- Operations Research

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3* Hrs/Week	**ISE**	**:**	40 Marks
Credits	**:**	2			
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objective: The objective of this course is to	
1	To introduce the fundamental principles, scope, and models of Operations Research.
2	To develop analytical skills through optimization techniques such as linear programming, simplex method, and transportation models.
3	To apply decision-making models under certainty, risk, and uncertainty in business and engineering scenarios.
4	To understand and analyze queuing models and simulation methods.
5	To enable effective planning and scheduling of projects using CPM and PERT.

Course Outcomes:

COs	**At the end of successful completion of the course, the students will be able to**	**Bloom's Taxonomy**
CO1	Explain the scope, phases, and applications of Operations Research.	Understand
CO2	Formulate and solve linear programming problems using graphical and simplex methods.	Apply
CO3	Analyze and solve transportation and assignment problems using appropriate algorithms.	Analyze
CO4	Apply game theory and decision-making models to determine optimal strategies in various settings.	Apply
CO5	Solve queuing and project scheduling problems using analytical and simulation techniques.	Evaluate

Course Description :

This course provides a comprehensive introduction to Operations Research (OR), emphasizing the formulation, analysis, and application of mathematical models to real-world decision-making problems. Students will learn optimization techniques including linear programming, transportation, assignment, game theory, queuing, and project scheduling methods, with a focus on applications in engineering, business, and management.

Prerequisites :	• Basic knowledge of mathematics (matrices, algebra, probability) • Logical reasoning and analytical thinking skills • Familiarity with problem-solving techniques

Section – I		
Unit-1	**Introduction to OR:** Origin of OR and its definition. Concept of optimizing performance measure, Types of OR problems, Deterministic vs. Stochastic optimization, Phases of OR problem approach – problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution.	**06Hr**
Unit-2	**Linear Programming:** Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP.Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence / Dependence of vectors, Rank, Basis, System of linear eqns., Hyperplane, Convex set, Convex polyhedron, Extreme points, Basic feasible solutions.Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy & degeneracy, Sensitivity analysis.Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations.Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.	**06Hr**
Unit-3	**Transportation and Assignment problems:** TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution.AP - Examples, Definitions – decision variables, constraints, formulation, Balanced & unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution.	**06Hr**
Unit-4	**PERT – CPM:** Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off.	**6Hr**
Unit-5	**Inventory Control:** Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed order-quantity models – EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness, Special cases of EOQ models for safety stock with known / unknown stock out situations, models under prescribed policy, Probabilistic situations.	**6Hr**
Unit-6	**Queuing Theory:** Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase).Kendall's notation, Little's law, steady state behaviour, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures; M/M/m and its performance measures; brief description about some special models.	**6Hr**

References

Text Books :

1.Operations Research: An Introduction. ***Hamdy A. Taha*, Pearson Education, 10th Edition**

Reference Books :

1. Operations Research. ***P. K. Gupta and D. S. Hira*, S. Chand & Company Ltd.**
2. Introduction to Operations Research. ***Frederick S. Hillier and Gerald J. Lieberman*, McGraw Hill Education.**
3. Operations Research: Principles and Practice. ***Ravindran, Phillips & Solberg*, Wiley India.**
4. Operations Research. ***J. K. Sharma*, Macmillan India.**

25UG- MDM2- CB405- Operations Research

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	2 Hrs/Week	**ISA**	**:**	50
Credits	**:**	2			
Tutorials	**:**	--	**ESE**	**:**	--

Course Objective: The objective of this course is to	
1	To introduce the fundamental principles, scope, and models of Operations Research.
2	To develop analytical skills through optimization techniques such as linear programming, simplex method, and transportation models.
3	To apply decision-making models under certainty, risk, and uncertainty in business and engineering scenarios.
4	To understand and analyze queuing models and simulation methods.
5	To enable effective planning and scheduling of projects using CPM and PERT

Course Outcomes:		
COs	**At the end of successful completion of the course, the students will be able to**	**Bloom's Taxonomy**
CO1	Explain the scope, phases, and applications of Operations Research.	Understand
CO2	Formulate and solve linear programming problems using graphical and simplex methods.	Apply
CO3	Analyze and solve transportation and assignment problems using appropriate algorithms.	Analyze
CO4	Apply game theory and decision-making models to determine optimal strategies in various settings.	Apply
CO5	Solve queuing and project scheduling problems using analytical and simulation techniques.	Evaluate

Course Description :

This course provides a comprehensive introduction to Operations Research (OR), emphasizing the formulation, analysis, and application of mathematical models to real-world decision-making problems. Students will learn optimization techniques including linear programming, transportation, assignment, game theory, queuing, and project scheduling methods, with a focus on applications in engineering, business, and management.

Prerequisites :	• Basic knowledge of mathematics (matrices, algebra, probability) • Logical reasoning and analytical thinking skills • Familiarity with problem-solving techniques

Section – I		
Unit-1	**Introduction to OR:** Origin of OR and its definition. Concept of optimizing performance measure, Types of OR problems, Deterministic vs. Stochastic optimization, Phases of OR problem approach – problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution.	**04Hr**
Unit-2	**Linear Programming:** Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP.Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence / Dependence of vectors, Rank, Basis, System of linear eqns., Hyperplane, Convex set, Convex polyhedron, Extreme points, Basic feasible solutions.Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy & degeneracy, Sensitivity analysis.Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations.Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.	**04Hr**
Unit-3	**Transportation and Assignment problems:** TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution.AP - Examples, Definitions – decision variables, constraints, formulation, Balanced & unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution.	**04Hr**
Unit-4	**PERT – CPM:** Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off.policy, Probabilistic situations.	**04Hr**

References

Text Books :

1.Operations Research: An Introduction. ***Hamdy A. Taha*, Pearson Education, 10th Edition**

Reference Books :

1. Operations Research. ***P. K. Gupta and D. S. Hira*, S. Chand & Company Ltd.**
2. Introduction to Operations Research. ***Frederick S. Hillier and Gerald J. Lieberman*, McGraw Hill Education.**
3. Operations Research: Principles and Practice. ***Ravindran, Phillips & Solberg*, Wiley India.**
4. Operations Research. ***J. K. Sharma*, Macmillan India.**

25UG-OE1-CB4061- Marketing Research & Marketing Management

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	2 Hrs/Week	**ISE**	**:**	40 Marks
Credits	**:**	2			
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objective: The objective of this course is to	
1	To introduce the fundamental principles, scope, and models of Operations Research.
2	To develop analytical skills through optimization techniques such as linear programming, simplex method, and transportation models.
3	To apply decision-making models under certainty, risk, and uncertainty in business and engineering scenarios.
4	To understand and analyze queuing models and simulation methods.
5	To enable effective planning and scheduling of projects using CPM and PERT.

Course Outcomes:

COs	**At the end of successful completion of the course, the students will be able to**	**Bloom's Taxonomy**
CO1	Explain the scope, phases, and applications of Operations Research.	Understand
CO2	Formulate and solve linear programming problems using graphical and simplex methods.	Apply
CO3	Analyze and solve transportation and assignment problems using appropriate algorithms.	Analyze
CO4	Apply game theory and decision-making models to determine optimal strategies in various settings.	Apply
CO5	Solve queuing and project scheduling problems using analytical and simulation techniques.	Evaluate

Course Description :

This course provides a comprehensive introduction to Operations Research (OR), emphasizing the formulation, analysis, and application of mathematical models to real-world decision-making problems. Students will learn optimization techniques including linear programming, transportation, assignment, game theory, queuing, and project scheduling methods, with a focus on applications in engineering, business, and management.

Prerequisites :	• Basic knowledge of mathematics (matrices, algebra, probability) • Logical reasoning and analytical thinking skills • Familiarity with problem-solving techniques

Section – I		
Unit-1	**Introduction to Marketing & Marketing Management** Definition, nature, scope, and importance of marketing; Core marketing concepts: needs, wants, demand, value, and satisfaction; Marketing vs Selling; Marketing management philosophies; The marketing environment – micro and macro factors; Introduction to Marketing Mix (4Ps and 7Ps).	**06Hr**
Unit-2	**Consumer Behavior and Market Segmentation** Understanding consumer behavior – cultural, social, personal, and psychological factors; Buyer decision process – individual and organizational buyers; Market segmentation – bases, requirements, and process; Target marketing and positioning strategies; Customer Relationship Management (CRM) fundamentals.	**06Hr**
Unit-3	**Introduction to Marketing Research** Definition, scope, significance and applications of marketing research; Marketing research process – problem definition, setting objectives, research design; Types of research – exploratory, descriptive, causal; Data types – primary and secondary; Questionnaire design and sampling methods.	**06Hr**
Unit-4	**Data Collection and Analysis in Marketing Research** Methods of data collection – surveys, interviews, focus groups, observations, experiments; Measurement and scaling; Data processing and analysis – coding, tabulation, and interpretation; Statistical tools for analysis (Excel/SPSS); Hypothesis testing, report writing and presentation; Ethical issues in marketing research.	**6Hr**
Unit-5	**Marketing Strategies – Product, Price, Place and Promotion** Product – classification, branding, packaging, product life cycle (PLC), new product development; Pricing – factors, methods, strategies; Place – marketing channels, channel design and management, logistics; Promotion – elements, advertising, sales promotion, personal selling, PR, digital promotion.	**6Hr**
Unit-6	**Contemporary Marketing Trends and Analytics** Introduction to digital, mobile, and social media marketing; Services marketing and relationship marketing; Green marketing, rural marketing; Global marketing – challenges and strategies; Introduction to marketing analytics, dashboards, and common analytical tools.	**6Hr**

References

Text Books :

1. **Marketing Management** by Philip Kotler, Kevin Lane Keller – Pearson Education, Latest Edition.

Reference Books :

1. **Marketing Research: An Applied Orientation** by Naresh K. Malhotra – Pearson Education, Latest Edition.
2. **Principles of Marketing** by Philip Kotler and Gary Armstrong – Pearson Education.
3. **Marketing Research** by G.C. Beri – McGraw Hill Education.
4. **Marketing Management** by Rajan Saxena – Tata McGraw Hill.

25UG-AEC1-CB4063- Modern Indian Language

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	1 Hrs/Week	**ISA**	**:**	25
Credits	**:**	1			
Tutorials	**:**	--	**ESE**	**:**	--

अभ्यासक्रमाचे उद्दिष्ट:: या अभ्यासक्रमाचे उद्दिष्ट असे आहे की	
१.	विद्यार्थ्यांमध्ये मराठी भाषेतील ऐकणे, बोलणे, वाचन आणि लेखन या मूलभूत कौशल्यांचा विकास करणे.
२	विद्यार्थ्यांना भाषेच्या माध्यमातून प्रभावी संवाद साधण्याची क्षमता प्रदान करणे.
३	साहित्यिक अभिव्यक्ती, विश्लेषण आणि सृजनशील लेखनासाठी आवश्यक भाषिक संवेदनशीलता व अभिरुची विकसित करणे.

Course Outcomes:		
COs	या अभ्यासक्रमाच्या यशस्वी पूर्णतेनंतर विद्यार्थी पुढील क्षमता प्राप्त करू शकतील.	**Bloom's Taxonomy**
१.	भाषा आणि बौद्धिक विकास यामधील सहसंबंध समजून सांगू शकेल.	समजून घेणे
२.	भाषिक कौशल्यांचा विकास करू शकेल.	उपयोग
३	कथा या मराठी साहित्यप्रकाराचे विश्लेषण करू शकेल.	विश्लेषण
४	एकांकिका या मराठी साहित्यप्रकाराच्या विश्लेषणाची क्षमता आत्मसात करेल.	विश्लेषण

Course Description :	
सर्वांगीण बौद्धिक विकासासाठी भाषा, साहित्य आणि कला यांचे परिणामकारकपणे समजून घेणे ही आजच्या काळाची गरज बनली आहे. जीवनाच्या परिपूर्ण आकलनासाठी आणि अभिव्यक्तीसाठी भाषिक तसेच साहित्यिक क्षमता अंगीकारणे आवश्यक झाले आहे.या अभ्यासविषयाच्या माध्यमातून विद्यार्थी भाषेचा आणि बौद्धिक विकासाचा परस्परसंबंध समजून घेतील. विविध भाषिक कौशल्ये आणि भाषेसंबंधी उपाययोजना यांच्या विविध अंगांची ओळख विद्यार्थ्यांना होईल.तसेच, विद्यार्थी मराठी साहित्याच्या कथा आणि एकांकिका या प्रकारांचे विश्लेषण करणे शिकतील. या प्रक्रियेतून त्यांची अभिव्यक्ती, समज आणि भाषिक समृद्धी वाढीस लागेल.	
पूर्वतयारी:	विद्यार्थ्यांनी मराठी भाषेतील मूलभूत भाषिक कौशल्ये — ऐकणे, बोलणे, वाचन आणि लेखन — आत्मसात केलेली असावीत. तसेच, भाषिक कौशल्य विकासाची प्राथमिक जाणीव विद्यार्थ्यांमध्ये असावी.

Section – I		
०१	**भाषा आणि बौद्धिक विकास: सहसंबंध** भाषिक कौशल्यविकास – नैसर्गिक: आकलनासह श्रवण	०२ तास
०२	**भाषिक कौशल्यविकास :** संभाषण, वाचन, लेखन, इ-संवाद कौशल्ये प्रगत: सारांशलेखन, सारग्रहण	०२ तास
०३	**भाषा उपयोजनाचे विविध आविष्कार:** संवादलेखन, कृतीनिवेदन, घोषवाक्य लेखन, भाषांतर	०२ तास
०४	**कथा: स्वरूप, घटक आणि प्रकार** (रचनात्मकता आणि प्रवाह) **एकांकिका:** प्रकार, घटक, संहितामूल्य व प्रयोगमूल्य	०२ तास
०५	**समकालीन मराठी कथा:** १. लाल चिखल – भालचंद्र नेमाडे २. कष्टाची भाकरी – सचिन पाटील	०२ तास
०६	**मराठी एकांकिका**: "विठ्ठल *तो आला आला*" – पु. ल. देशपांडे	०२ तास

संदर्भग्रंथ (Reference Books):

Text Books :

1. **मराठी साहित्य : प्रेरणा आणि प्रकार**
   संपादक: डॉ. गो. मा. पवार, डॉ. म. द. हातकणंगलेकर
   प्रकाशक: पॉप्युलर प्रकाशन, १९८६
2. **साहित्यमूल्य आणि अभिरुची**
   लेखक: डॉ. गो. मा. पवार
   प्रकाशक: साकेत प्रकाशन
3. **कथा : संकल्पना आणि समीक्षा**
   लेखिका: सुधा जोशी
   प्रकाशक: मौज प्रकाशन, २०००
4. **प्राव्हाहारिक मराठी**
   प्रकाशक: पुणे विद्यापीठ, पुणे
5. **प्राव्हाहारिक आणि उपयोजित मराठी**
   लेखक: डॉ. मनोहर रोकडे
   प्रकाशक: प्रेमवर्धन प्रकाशन
6. **मराठी भाषेची संवाद कौशल्ये (पुस्तक क्र. १ ते ८)**
   प्रकाशक: यशवंतराव मुक्त विद्यापीठ, नाशिक
7. **मराठी कथा : विसावे शतक**
   संपादक: के. ज. पुरोहित, सुधा जोशी
   प्रकाशक: मॅजेस्टिक प्रकाशन
8. **समकालीन मराठी कथा**
   संपादक: डॉ. शिरीष लांडगे, डॉ. दिलीप पवार, डॉ. संदीप सांगळे
   प्रकाशक: अतिशयबंध प्रकाशन, पुणे, २०१९
9. **मराठी भाषा उपयोजन आणि सर्जन**

लेखक: प्रा. सुहासकुमार बोबडे

10. **मराठी एकांकिका**
(एकांकिका: *विसावले तो आला आला – पु. ल. देशपांडे, हंडाभर चांदणं – द. पाटील*)
संपादक: डॉ. शिरीष लांडगे, डॉ. बाळकृष्ण लळीत, डॉ. भास्कर ढोक
प्रकाशक: पिंगंधा प्रकाशन, पुणे, २०१९
11. **मराठी एकांकिका: तत्व आणि विकास**
लेखक: श्री. रं. भि. भिंडे
प्रकाशक: सुपर्ण प्रकाशन, पुणे
12. **एकांकिका विचार आणि सर्वोत्तम एकांकिका**
लेखक: जयंत पवार व इतर
प्रकाशक: नेहमीस सेंटर प्रकाशन, मुंबई, १९९३

25UG- EEC1- CB40964- Introduction to Innovation, IP Management and Entrepreneurship

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	1 Hrs/Week	**ISA**	**:**	25
Credits	**:**	1			
Tutorials	**:**	--	**ESE**	**:**	--

Course Objective: The objective of this course is to	
1	To understand the significance of innovation and its integration in business processes and organizational structures.
2	To develop entrepreneurial thinking, opportunity recognition, and financial planning skills required for launching ventures.
3	To explore the fundamentals of intellectual property rights and their strategic role in protecting and commercializing innovation.

Course Outcomes:		
COs	**At the end of successful completion of the course, the students will be able to**	**Bloom's Taxonomy**
CO1	Understand the key principles and models of innovation and their application in organizations.	Understand
CO2	Apply entrepreneurial tools for opportunity evaluation, venture creation, and financial planning.	Apply
CO3	Analyze and evaluate different types of intellectual property and their role in innovation management.	Analyze

Course Description :	
This course introduces the foundational concepts of innovation, entrepreneurship, and intellectual property rights (IPR). It explores innovation as a strategic and systematic process, emphasizing its role in entrepreneurship and business success. Students will learn to identify business opportunities, plan ventures financially, and protect ideas through various forms of intellectual property.	
Prerequisites :	• Problem-solving and critical thinking abilities. • Effective communication and interpersonal skills.

Section – I		
Unit-1	**Fundamentals of Innovation** Definition and importance of innovation; Innovation as a core business process; Key sources of innovation – internal and external; Models of innovation: knowledge push vs. need pull innovations; Innovation dynamics and technology lifecycles; Organizational culture and the role of leadership in innovation;	**02Hr**
Unit-2	**Building an Innovative Organization** Organizational structures that support innovation; Creating new products, services, and processes; Leveraging open innovation, co-creation, and collaborative networks; Design thinking and agile development; Innovation for new venture creation; Case studies of innovative organizations;	**02Hr**
Unit-3	**Entrepreneurship and Innovation Management** Opportunity identification and evaluation; Entry strategies for new ventures; Entrepreneurship as a management style – risk-taking, resource leveraging, and adaptability; Sustaining innovation and building competitive advantage; Role of intellectual property rights (IPR) in safeguarding innovation;	**02Hr**
Unit-4	**Entrepreneurial Financial Planning** Basics of entrepreneurial finance and capital requirements; Preparing financial projections – revenue, cost, and profit forecasts; Business valuation techniques; Funding stages: seed, early-stage, growth; Overview of financing options – self-funding, angel investors, venture capital, bank loans, crowdfunding; Investor pitch preparation and fundraising challenges.	**02Hr**
Unit-5	**Introduction to Intellectual Property Rights (IPR)** Economic and business rationale behind IPR; Overview of global IPR frameworks; Evolution and status of IPR in India; Comparative analysis of IPR regimes (India vs. global); IPR as a strategic business tool; Role of IP management in marketing and commercialization of innovation.	**04Hr**
Unit-6	**Types of Intellectual Property** **Patents** – Patentability criteria, procedure for filing, licensing and assignment, infringement issues and penalties; **Trademarks** – Registration, brand protection, use in marketing, examples including domain names; **Geographical Indications (GI)** – Concept, examples, rationale for protection; **Copyright** – Definition, coverage, importance for creative industries; **Industrial Designs** – Meaning, registration process, enforcement of design rights; Real-life examples and case studies of IP utilization in startups and businesses.	**04Hr**

References

Text Books :

1. Joe Tidd, John Bessant. Managing Innovation: Integrating Technological, Market and Organizational Change
2. Case Study Materials: To be distributed for class discussion

25UG- EEC1- CB40964- Professional Ethics and Human Values

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	1 Hrs/Week	**ISA**	**:**	25
Credits	**:**	1			
Tutorials	**:**	--	**ESE**	**:**	--

Course Objective: The objective of this course is to	
1	Understand the significance of ethics and human values in professional and personal life.
2	Identify and resolve ethical dilemmas in engineering and business settings.
3	Analyze the impact of technology on society through the lens of professional ethics.
4	Integrate Indian value systems into ethical decision-making and leadership behavior.

Course Outcomes:		
COs	**At the end of successful completion of the course, the students will be able to**	**Bloom's Taxonomy**
CO1	Explain the key concepts of ethics, human values, and fundamental moral theories, and describe their relevance in professional and personal life.	Understanding
CO2	Interpret professional codes of ethics and apply them to real-life case studies.	Apply
CO3	Analyze ethical dilemmas in digital technologies, social media, and environmental challenges.	Analyze
CO4	Evaluate personal and professional responsibilities using Indian ethical philosophies and practices.	Evaluate

Course Description :	
This course aims to develop an understanding of human values, ethical theories, and professional responsibilities. It emphasizes the importance of ethical behavior in personal and professional contexts, particularly in technology-driven environments. Students will explore Indian value systems, ethical dilemmas, digital ethics, and global sustainability. The course fosters critical thinking, integrity, and a sense of responsibility essential for ethical decision-making and professional conduct.	
Prerequisites :	• General awareness of ethical issues in society and professional life. • Basic communication and interpersonal skills

Section – I		
Unit-1	**Introduction to Ethics and Human Values** Definition and need for ethics and human values; Types of values – moral, cultural, social, and professional; Ethics vs. laws; Integrity, honesty, compassion, empathy, and respect; Introduction to ethical theories – Utilitarianism, Deontology, Virtue ethics; Role of ethics in personal and professional life.	**03Hr**
Unit-2	**Professional Ethics and Responsibilities** Engineering and business ethics; Responsibilities of professionals – loyalty, accountability, and commitment; Ethical codes of conduct – IEEE, ACM; Conflict of interest, whistleblowing, and confidentiality; Case studies on ethical failures in business/tech domains; Ethical dilemmas in decision-making.	**03Hr**
Unit-3	**Ethics in Technology and Global Context** Digital ethics – privacy, data security, intellectual property; Ethics in social media, artificial intelligence, and automation; Environmental and global ethics – sustainability, climate change, social justice; Ethical concerns in global supply chains, e-waste, and corporate social responsibility (CSR).	**03Hr**
Unit-4	**Indian Ethos and Value Systems** Indian value system – relevance of teachings from scriptures (Bhagavad Gita, Upanishads); Ethics in Indian culture and heritage; Role of values in leadership and governance; Integrating personal values with professional life; Reflection on ethical living through Indian philosophy.	**03Hr**

References

Text Books :

1. **R. S. Naagarazan**, *A Textbook on Professional Ethics and Human Values*, New Age International Publishers.

Reference Books :

1. **Mike Martin & Roland Schinzinger**, *Ethics in Engineering*, McGraw-Hill Education.
2. **Govindarajan M., Natarajan S., Senthil Kumar V. S.**, *Engineering Ethics*, Prentice Hall of India.
3. **B. K. Punia**, *Personality Development and Soft Skills*, Sultan Chand & Sons.
4. **S. K. Chakraborty**, *Values and Ethics for Organizations: Theory and Practice*, Oxford University Press.

25UG-PCC- CB401P - Operating Systems Lab

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	--	**Practical's**	**:**	2 Hrs./Week
Credits	**:**	1	**ISA**	**:**	25 Marks
Tutorials	**:**	--	**POE**	**:**	50 Marks

Course Description :

The Operating Systems Laboratory course provides hands-on experience with the core concepts and functionalities of modern operating systems. Students will implement and simulate operating system components such as process management, scheduling algorithms, inter-process communication (IPC), memory management, and file systems. The lab also introduces system-level programming using UNIX/Linux environments, including shell scripting and basic system calls. Through practical experiments and simulations, students gain a deeper understanding of how operating systems manage hardware resources and support concurrent processes.

Experiments List

Expt. No.	Experiment Title	Bloom's Taxonomy
1	**Study and execution of basic UNIX commands** – including file handling, directory navigation, user and permission management.	Apply
2	**Write a shell script to find the largest of three numbers** – to practice conditional statements and arithmetic operations.	Apply
3	**Create a menu-driven shell script for basic operations** – such as calculator functions or file copying and deletion.	Apply
4	**Simulate First Come First Serve (FCFS) scheduling algorithm** – using shell script or C programming to understand scheduling logic.	Apply
5	**Simulate Shortest Job First (SJF) and Round Robin scheduling algorithms** – to observe differences in waiting time and turnaround time.	Apply
6	**Implement inter-process communication (IPC) using pipes and shared memory** – to demonstrate how processes exchange data.	*Apply*
7	**Write a C program to simulate the Producer-Consumer problem using semaphores** – to explore synchronization in concurrent processes.	*Analyze*
8	**Demonstrate file handling using UNIX system calls** – such as `open()`, `read()`, `write()`, and `close()` in C programming.	*Apply*
9	**Write a shell script to automate user creation and permission assignment** – to learn about system administration tasks in Unix.	*Apply*
10	**Simulate a page replacement algorithm (FIFO or LRU)** – to demonstrate virtual memory management and page faults.	*Analyze*

25UG-PCC- CB402P - Database Management Systems Lab

Teaching Scheme			Evaluation Scheme		
Lectures	:	--	**Practical's**	:	2 Hrs./Week
Credits	:	1	**ISA**	:	25 Marks
Tutorials	:	--	**POE**	:	50Marks

Course Description :

This laboratory course is designed to provide practical experience in the design, implementation, and management of relational databases. It focuses on data modeling, writing complex SQL queries, and applying data manipulation and definition techniques using open-source or commercial database management tools like MySQL or Oracle. Students will learn to enforce data integrity through constraints, implement views, indexes, and triggers, and write stored procedures and PL/SQL blocks. The lab also emphasizes real-world problem-solving, normalization, transaction handling, and the basics of database security, helping students build robust database applications with hands-on skills.

Experiments List

Expt. No.	Experiment Title	Bloom's Taxonomy
1	**Data Definition Language (DDL):** Design and develop SQL DDL statements demonstrating the use of SQL objects such as Table, View, Index, Sequence, Synonym, and various constraints (Primary Key, Foreign Key, Not Null, Unique, Check).	Apply
2	**Data Manipulation Language (DML):** Write at least 10 SQL queries using `SELECT`, `INSERT`, `UPDATE`, and `DELETE` on a suitable sample database (e.g., Student or Employee database).	Apply
3	**Constraints Implementation:** Create a table for a use case (e.g., Roadway Travels or Hotel Booking) and apply SQL constraints – primary key, foreign key, not null, unique, and check. Execute relevant queries to test their functionality.	Apply
4	**String Functions, Set Operations & Aggregate Functions:** Write SQL queries using string functions (`LIKE`, `UPPER`, `SUBSTR`, etc.), set operators (`UNION`, `INTERSECT`), aggregate functions (`COUNT`, `SUM`, `AVG`, `GROUP BY`, `ORDER BY`).	Apply
5	**Joins and Views:** Write SQL queries demonstrating the use of joins – equi-join, inner join, and create views from one or more tables.	Apply
6	**PL/SQL Basics:** Write a simple PL/SQL block that uses control structures (`IF`, `LOOP`) to perform computations (e.g., factorial, summation).	*Apply*
7	**PL/SQL – Exception Handling:** Write PL/SQL programs to demonstrate exception handling – using predefined and user-defined exceptions.	*Analyze*
8	**Database Design and Normalization:** Design a University or Airline Reservation database. Identify functional dependencies and perform normalization up to 3NF. Use closure of FDs and canonical cover to justify the design.	*Analyze*

9	**Query Optimization and Execution Plan:** Use EXPLAIN PLAN or similar tools in MySQL/PostgreSQL to analyse query performance. Compare different join strategies or query rewriting techniqu	*Analyze*
10	**Disk Storage and RAID Simulation:** Simulate and compare the fault-tolerance and performance aspects of different RAID levels (RAID 0, 1, 5) using tools or pseudo-code.	*Apply*
11	**Transaction and Concurrency Control Simulation:** Simulate concurrency control using protocols like Two-Phase Locking or Timestamp Ordering. Implement conflict serializability or view serializability checks.	*Analyze*

25UG-PCC- CB404P Operation research Lab

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	--	**Practical's**	**:**	2 Hrs./Week
Credits	**:**	1	**ISA**	**:**	25 Marks
Tutorials	**:**	--	**POE**	**:**	--

Course Description :

This course introduces the fundamental concepts and methods of Operations Research (OR) with applications in decision-making and optimization. It emphasizes modeling real-world problems using mathematical techniques such as Linear Programming, Transportation and Assignment models, Project Scheduling (PERT/CPM), Inventory Management, and Queuing Theory. Students will develop the ability to construct, solve, and interpret optimization models using systematic approaches and algorithms.

Experiments List

Expt. No.	Experiment Title	Bloom's Taxonomy
1	Formulate and solve a real-life problem using Linear Programming	Apply
2	Solve LPP using the **Simplex Method** with slack, surplus, and artificial variables	Apply
3	Analyze special cases in LPP: infeasibility, unboundedness, degeneracy	Analyze
4	Solve **Transportation Problems** using **North-West Corner and Vogel's Approximation Methods**	Apply
5	Apply **MODI method** for optimality test in Transportation Problems	Apply
6	Solve **Assignment Problems** using the Hungarian Method	Apply
7	Develop a project network and compute critical path using **PERT/CPM**	Apply
8	Estimate project duration and calculate variance using statistical methods in PERT	Analyze
9	Solve **EOQ (Economic Order Quantity)** problems and perform sensitivity analysis	Apply
10	Analyze **M/M/1 Queuing System** and compute performance measures using Kendall's notation	Analyze

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TKIET,Wrananagar