

**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL**  
**(Formerly West Bengal University of Technology)**  
**Syllabus of BCA**  
**(Effective from 2023-24 Academic Sessions)**

**SEMESTER: IV**

**DEFINITION OF CREDIT**

1 HR LECTURE PER WEEK	1 CREDIT
1 HR TUTORIAL PER WEEK	1CREDIT
2 HR PRACTICAL PER WEEK	1 CREDIT

**SUBJECT NUMBERING SCHEME:**

<b>CODE FOR THE DEPT. OFFERING SUBJECT</b>	<b>SUBJECT TYPE</b>	<b>SEM</b>	<b>SUBJECT CODE</b>
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C	CORE MAJOR
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**SUBJECT NAME:** Data Base Management System  
**SUBJECT CODE:** BCAC401

**Credit: 5 (3L + 2P)**

**COURSE OBJECTIVE:**

The course on Database Management Systems (DBMS) aims to equip students with a comprehensive understanding of the core principles and practical applications of managing data effectively within organizational contexts. Throughout the course, students will delve into the fundamental concepts of database design, data manipulation, and database administration. They will learn to design efficient and robust databases using entity-relationship modeling and normalization techniques, ensuring data integrity and optimal performance. By the end of the course, students will be proficient in designing, implementing, and managing databases to support decision-making processes and organizational objectives effectively.

<b>COURSE OUTCOME</b>	
CO1	Understand the fundamental concepts and principles of database management systems (DBMS), including data modeling, database design, and normalization.
CO2	Demonstrate proficiency in using SQL (Structured Query Language) to perform data definition, manipulation, and query tasks in a relational database environment.

CO3	Apply indexing and query optimization techniques to enhance the performance of database systems
CO4	Evaluate different types of database architectures, such as centralized, distributed, and client-server architectures, and comprehend their advantages and limitations.

### DETAILED SYLLABUS:

Module No:	NAME OF THE TOPIC	HOURS	L	T	MAR KS
<b>M1</b>	Introduction: Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Data Abstraction, Three Schema architecture of DBMS.	2	2		2
<b>M2</b>	Entity Relationship Model: Entity Set, Simple and composite Attribute, Single valued and multivalued attribute, Relationship sets, Mapping cardinality, keys, Binary vs n-ary relationship, Entity Relationship Diagram : Need for E-R Model, Various steps of database design, Mapping Constraints, E-R diagram, Subclass, Generalization, Specialization, Aggregation, Strong Entity-Weak Entity, Tabular representation of Strong entity set, tabular representation of weak entity set, ER diagram and corresponding UML diagram	5	4	1	10
<b>M3</b>	Relational Algebra: Select operation, Project Operation, Set operations (union, intersection, difference), Join operations, Division operation, outer join and outer union, Examples queries in Realtional Algebra	4	3	1	8
<b>M4</b>	SQL : Concept of DDL, DML. Basic Structure Relational databases and tables, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Stored procedures,cursors and triggers.	4	3	1	10
<b>M5</b>	Relational Model and Relational Database Design: Concept of Relational Model, Design Issues, Keys, Closure set, Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd	10	7	3	14

	Normal Form, 3NF, Normalization using multivalued dependencies, 4NF,5NF.				
<b>M6</b>	Indexing and Hashing: Ordered indices (Primary Index, Dense and Sparse Indices), Secondary Index, B tree and B+ tree indexing, Hashing Concepts and its implementation Basic query optimization techniques, Cost estimation in query optimization	10	7	3	14
<b>M7</b>	Transaction Management: Transaction definition, properties, transaction state diagram, commit and rollback, Serializability (Conflict and View), Concurrency control, lock based protocols, Two phase locking, Timestamp ordering protocol, Recovery management, Deadlock handling and prevention	10	8	2	12
	<b>INTERNAL EXAMINATION</b>	3			30
	<b>TOTAL</b>	48	34	11	100

**Practical:**

**SUBJECT NAME: DBMS Lab**  
**SUBJECT CODE: BCAC491**

**Credit: 2**

**Use any database for the SQL implementation**

**List of sample Questions for Practical:**

1. Write a SQL query to retrieve all columns from a table named "Employees."
2. How do you select distinct values from a column in SQL?
3. Write a SQL query to retrieve all records from the "Orders" table where the order amount is greater than 1000.
4. Explain the difference between INNER JOIN and LEFT JOIN in SQL with an example.
5. How do you use the WHERE clause to filter rows in SQL?
6. Write a SQL query to calculate the total number of orders for each customer from the "Orders" table.
7. What is the purpose of the GROUP BY clause in SQL? Provide an example query.
8. How do you use the HAVING clause in SQL? Provide an example.
9. Write a SQL query to update the salary of an employee with ID 101 to 50000.
10. How do you delete records from a table in SQL? Provide an example.
11. Explain the concept of foreign keys in SQL with an example.
12. Write a SQL query to retrieve the top 5 highest-paid employees from the "Employees" table.
13. How do you use the ORDER BY clause in SQL? Provide an example query.
14. Explain the difference between the UNION and UNION ALL operators in SQL.

15. Write a SQL query to find the average salary of all employees.
16. How do you use the LIKE operator in SQL? Provide an example.
17. Write a SQL query to retrieve the names of all employees whose names start with the letter 'A.'
18. Explain the concept of indexes in SQL databases.
19. Write a SQL query to find the maximum and minimum salary from the "Employees" table.
20. How do you use the BETWEEN operator in SQL? Provide an example.

Based on the curriculum as covered by the subject teacher

### **SUGGESTED READING:**

1. "Database Management Systems" by Raghu Ramakrishnan, Johannes Gehrke - Publisher: McGraw-Hill Education
2. "Database System Concepts" by Abraham Silberschatz, Henry F. Korth, S. Sudarshan - Publisher: McGraw-Hill Education
3. "Fundamentals of Database Systems" by Ramez Elmasri, Shamkant B. Navathe - Publisher: Pearson
4. "Database Management Systems: Designing and Building Business Applications" by Gerald V. Post - Publisher: Wiley
5. "Database Systems: The Complete Book" by Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom - Publisher: Pearson
6. "Principles of Database Management" by Wilfred Hansen - Publisher: Cengage Learning
7. "Database Management Systems" by Ivan Bayross - Publisher: BPB Publications

**SUBJECT NAME: Operating System**  
**SUBJECT CODE: BCAC402**

**Credit: 4 L (3L +1 T)**

### **COURSE OBJECTIVE:**

The course on Operating Systems is designed to provide students with a comprehensive understanding of the fundamental principles and functionalities underlying modern computer operating systems. Throughout the course, students will explore key concepts such as process management, memory management, file systems, and I/O management. They will learn about the role of the operating system in resource allocation, scheduling, and synchronization, gaining insights into how these mechanisms contribute to efficient and reliable system operation.

<b>COURSE OUTCOME</b>	
CO1	Understand the fundamental concepts and functionalities of operating systems, including process management, memory management, file systems, and I/O management.
CO2	Analyze and compare different types of operating systems, such as batch processing systems, time-sharing systems, real-time systems, and distributed systems, in terms of their design principles, advantages, and limitations.
CO3	Evaluate different I/O management strategies, including buffering, caching, and device drivers, to optimize the performance and reliability of I/O operations in the operating system.
CO4	Apply memory management techniques, such as paging, segmentation, and virtual memory, to efficiently utilize the system's memory resources and provide a logical abstraction of memory to processes.
CO5	Collaborate effectively in teams to analyze, design, and implement operating system components and solutions for real-world scenarios, demonstrating effective communication and problem-solving skills.

#### **DETAILED SYLLABUS:**

Module No:	NAME OF THE TOPIC	HOURS	L	T	MARKS
M1	Computer H/w review (Processors, Memory, devices, I/O bus), Operating system Basic concepts, Architecture of OS, Introduction of Different types of Operating System(Mainframe, server side OS Multiprocessor OS, Embedded OS, Real Time OS, Sensor node OS, Smart card OS), Virtualization, Free and Open Source Operating System	3	2	1	5
M2	Operating System Architecture (Monolithic System, Layered System, Microkernel, client Server model, System Calls, Linker and Loader, Booting of an Operating System	2	1	1	5
M3	Process Management: Process, Process State Diagram, Process Control Block, Process Scheduling criteria, Process scheduling algorithms, Types of schedulers, threads, types of thread, Thread Scheduling, Inter Process Communication , Race Condition, Critical region, use of Semaphore, mutex, and monitor, Classical problems on Synchronization	18	14	4	18

M4	Deadlock: Deadlock Characterization, Methods of handling Deadlock, Deadlock prevention and avoidance, deadlock detection and Recovery from deadlock	4	3	1	8
M5	Memory Management: Continuous Memory Allocation, Paging, Swapping, Virtual memory: Paging, Page table Structure, Page Table for large memory, Page replacement Algorithms, page Size, Page Fault Handling, Segmentation	14	10	4	15
M6	File management: File naming, File structures, File Types, Single Level and Hierarchical OS, Shared file, Disk managent and related algorithms	4	3	1	8
M7	Security and Protection: security Threats and Attackers, Controlling Access to Resources (Protection Domain, access Control List,) Exploiting Software ( Buffer overflow attack, Integer Overflow attack, Dangling Pointer, Null Pointer Dereference Attack), Malware (Worm, virus and Trojan)	8	6	2	6
M8	Distributed Operating System: Goal of Distributed OS, Remoter Procedure call, Name resolution, Clock Synchronization	4	3	1	5
	INTERNAL EXAMINATION	3			30
	TOTAL	60	42	15	100

### SUGGESTED READING:

1. "Operating System Concepts" by Abraham Silberschatz, Peter Baer Galvin, Greg Gagne - Publisher: Wiley
2. "Modern Operating Systems" by Andrew S. Tanenbaum, Herbert Bos - Publisher: Pearson
3. "Operating Systems: Internals and Design Principles" by William Stallings - Publisher: Pearson
4. "Operating System Design and Implementation" by Andrew S. Tanenbaum, Albert S. Woodhull - Publisher: Pearson
5. "Operating Systems: Principles and Practice" by Thomas Anderson, Michael Dahlin - Publisher: Recursive Books
6. "Operating Systems: Three Easy Pieces" by Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau - Publisher: Arpaci-Dusseau Books
7. "Modern Operating Systems: Global Edition" by Andrew S. Tanenbaum, Herbert Bos - Publisher: Pearson

**SUBJECT NAME: Software Engineering**  
**SUBJECT CODE: BCAC403**

**Credit: 4 (3L + 1T)**

**COURSE OBJECTIVE:**

The course on Software Engineering aims to provide students with a comprehensive understanding of the principles, methodologies, and best practices essential for developing high-quality software systems. Throughout the course, students will delve into various aspects of the software development lifecycle, including requirements analysis, design, implementation, testing, deployment, and maintenance. By the end of the course, students will be proficient in designing, developing, and managing software systems that meet stakeholder requirements and industry standards.

<b>COURSE OUTCOME</b>	
CO1	Understand the fundamental principles and concepts of software engineering, including software development life cycle models, requirements engineering, and software design paradigms.
CO2	Analyze and apply various software development methodologies, such as Waterfall, Agile, Scrum, and DevOps, to plan, execute, and manage software projects effectively.
CO3	Apply software design principles, such as modularity, abstraction, encapsulation, and cohesion, to create maintainable, scalable, and extensible software solutions.
CO4	Perform software testing activities, including unit testing, integration testing, system testing, and acceptance testing, to ensure the quality, reliability, and correctness of software products.
CO5	Collaborate effectively in multidisciplinary teams to analyze, design, implement, and test software solutions for real-world problems, demonstrating effective communication, teamwork, and problem-solving skills

**DETAILED SYLLABUS:**

Module No:	NAME OF THE TOPIC	HOURS	L	T	MARKS
M1	Introduction: A Generic View of Software Engineering, Phases in software development, Linear Sequential Model, Prototype model, Evolutionary Model (Incremental and spiral model ), Specialized Process Model (Component-Based Development, Aspect-Oriented Software Development ), Agile Process (Principles, Human factors), Simple Case Study	4	3	1	6

M2	Project Metrics: Software Measurement (Size oriented, Function Oriented, Extended Function Point Metrics, Object-Oriented Metrics, Web application project Metric), metric for Software quality (Measuring Quality, Defect Removal efficiency), Integrate metric with software(Establishing a baseline)	4	3	1	5
M3	Object Oriented Concepts: class, Objects, attributes, Operations, Methods, and Services, Messages, Identifying the Elements of an Object Model (identification of class and objects, Defining Operations ), Object Oriented analysis and Design (use cases, Class-Responsibility-Collaborator Modeling,), Object-Relationship Model	4	3	1	6
M4	Project planning : Identification of Software scope (Feasibility), Resource Identification (Human resource, Reusable Software Resources ), Empirical Estimation Models (COCOMO model), Estimation for Object oriented project, Estimation for agile development, Estimation for Web application project, Estimation of human resource requirement, Team structure, Time estimation, Project scheduling (Time-Line Charts, Tracking the Schedule, Scheduling for WebApp Projects ) Make / buy decision (Creating a Decision Tree), Project Monitoring Plan (Time sheet, reviews, Cost schedule Milestone graph), Risk management (Identification, Prioritization, Risk Mitigation, Monitoring, and Management)	15	12	3	15
M5	Software Architecture (Fan out and fan in structure), Structural Partitioning (Horizontal and vertical Partition), Functional Independence (Coupling and Cohesion), Design heuristics for effective modularity	2	2	0	4
M6	Design: data Design , Architectural design / mapping using data Flow(Transform flow and Transactional flow), Designing class Based Components, Component Level design for Web Application, User Interface design Technique and documentation ( Reduce the User's Memory Load, make interface consistent), Interface Design steps ( User Interface Design Patterns, design issues), Discuss with a case study,	8	6	2	6



M7	Software Testing : Objective, Pimples, Test case Design for conventional software (Unit testing, Integration Testing), path testing , cyclometric complexity, Test Strategy for Object Oriented software, Test cases for web application, validation testing, System testing (Recovery testing, Security testing, stress testing, Performance testing)	10	7	3	14
M8	Quality Management: Define quality of software, McCall's Quality Factors, ISO 9126 Quality Factors, Achieve software quality (Software Engineering Methods, project Management Technique), Quality Control, Quality Assurance (elements of quality assurance), SQA goals, tasks, Metrics, Six Sigma for Software Engineering	6	5	1	6
M9	Software Configuration Management (SCM): Elements of a Configuration Management System, Baseline, Software Configuration Items, SCM Features, SM processes (Version Control, Change Control, Configuration Audit, Status Reporting), SCM for Web application ( WebApp Configuration Objects, Content management, Change management)	4	3	1	8
	INTERNAL EXAMINATION	3			30
	TOTAL	60	44	13	100

### SUGGESTED READING:

1. "Software Engineering: Principles and Practices" by Deepak Jain, S. K. Gupta - Publisher: Laxmi Publications
2. "Software Engineering and Quality Assurance" by Kshirasagar Naik, Priyadarshi Tripathy - Publisher: Oxford University Press
3. "Software Engineering: Theory and Practice" by Shariq Mahmood, A. A. Sastry - Publisher: Oxford University Press
4. "Software Engineering: A Precise Approach" by Pankaj Jalote - Publisher: Wiley India
5. "Software Engineering" by Pankaj Jalote - Publisher: Pearson Education India
6. "Software Engineering: A Lifecycle Approach" by Surajit Ghosh, Anirban Basu - Publisher: Pearson Education India
7. "Fundamentals of Software Engineering" by Rajib Mall - Publisher: Prentice Hall India
8. "Software Engineering: A Practitioner's Approach" by Roger S. Pressman - Publisher: McGraw-Hill Education
9. "Software Engineering" by Ian Sommerville - Publisher: Pearson Education Limited
10. "Introduction to the Team Software Process" by Watts S. Humphrey - Publisher: Addison-Wesley Professional