Department : **Mathematics**		Programme: **B.Tech. (CS)**						
Semester : **Fourth**		Course Category Code: **BSC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MA206	**Mathematics for Computing**	3	1	-	4	40	60	100
Prerequisite	**Nil**							
Course Outcome	**CO1**	Develop knowledge of logical connectivity, compound propositions, formal symbols of propositional logic and find exact value of expressions.						
	CO2	Understand the formal symbols to predicate logic						
	CO3	Knowledge of Inference theory of the predicate calculus						
	CO4	Construct sample spaces of random experiments and identify the distributions.						
	CO5	Stochastic processes and solve Queuing theory problems						

UNIT-I	**Mathematical Logic**	**Periods: 12**
Connectives, Statement formulae, well-formed formulae-Tautologies. Equivalence of Statement formulae, Duality law-Tautological implications- Functionally complete set of connectives-NAND and NOR connectives.		**CO1**
UNIT-II	**Normal Forms and Inference Theory**	**Periods: 12**
Principal conjunctive and disjunctive normal forms Inference calculus-validity of conclusion using truth table-Rules of inference -Derivation process-Conditional proof-Indirect method of proof-Derivation of validity of conclusion by these methods.		**CO2**
UNIT-III	**Predicate Calculus**	**Periods: 12**
Predicate calculus: Predicates, the statement function, variables and quantifiers-Predicate formulas-symbolizing the statement. Inference theory of the predicate calculus-Rules of specification and generalization-Derivation of conclusion using the rules of inference theory.		**CO3**
UNIT-IV	**Discrete and Continuous Distributions**	**Periods: 12**
Random Variables and their event spaces - Probability mass function, Distribution functions, Special discrete distributions: Bernoulli, Binomial, Poisson, Geometric, Hyper geometric, Negative Binomial, Discrete Uniform, Constant and Indicator - Characteristic function. Reliability, Failure density and Hazard function - Some important Continuous distributions: Exponential, Hypo exponential, Erlang, Gamma, Hyper exponential, Weibull, Gaussian, Uniform and Pareto distributions.		**CO4**
UNIT-V	**Stochastic Processes and Poisson Queuing Models**	**Periods: 12**
Stochastic Processes: Definition, Classification of Stochastic Processes - Bernoulli Process, Poisson process, Markov Process, Markov Chain. The Birth and Death process: M/M/1, M/M/c, M/M/1/N, M/M/c/N (c < N), M/M/c/c, M/M/∞ models only - derivation of mean number of customer in the system, queue and waiting time - Simple applications.		**CO5**

Lecture Periods: 48	**Tutorial Periods: 12**	**Practical Periods: -**	**Total Periods: 60**

Reference Books

1. J.P.Tremblay and R.Manohar, Discrete Mathematical Structures with Applications to Computer science, Tata McGraw-Hill Publishing company pvt. Ltd., New Delhi, 2002.
2. Kishore S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, John Wiley & Sons Inc. Second Edition, 2012.
3. D.Gross and C.M.Harris, Fundamentals of Queuing Theory, Wiley Students Edition, Third Edition, 2012.
4. J.Medhi, Stochastic models in Queuing Theory, Academic Press, Second Edition, 2012.
5. J. Medhi, Stochastic Processes, New Age International (P) Ltd., Second Edition, 2012.

Department : **Computer Science and Engineering**		Programme: **B.Tech. (CS)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CS208	**Operating Systems**	3	-	-	3	40	60	100
Prerequisite	**Nil**							
Course Outcome	**CO1**	Describe the basic concepts and functions of operating systems						
	CO2	Analyze various scheduling algorithms						
	CO3	Solve synchronization and deadlock issues						
	CO4	Compare various memory management schemes						
	CO5	Discuss file systems concepts and i/o management						

UNIT-I	**Introduction to Operating System**	**Periods: 9**
Computer System Organization, Architecture – Operating System Structure, Operations – Process, Memory, Storage Management, Protection and Security – Computing Environments – Open Source Operating Systems – OS Services – User Operating System Interface – System Calls – Types – System Programs – OS Structure – OS Generation – System Boot– Case Study : Linux –History, Design Principles.		**CO1**
UNIT-II	**Process Communication and Scheduling**	**Periods: 9**
Process Concept – Scheduling – Operations on Processes – Cooperating Processes –Inter-Process Communication – Threads-Multithreading Models -Thread Libraries-Threading Issues-Scheduling Criteria – Scheduling Algorithms –Algorithm Evaluation- Case Study: Linux- Scheduling.		**CO2**
UNIT-III	**Process Synchronization and Deadlocks**	**Periods: 9**
The Critical-Section Problem – Peterson's Solution – Synchronization Hardware – Mutex Locks - Semaphores – Classic Problems of Synchronization– Critical Regions – Monitors –Deadlocks – System Model – Deadlock Characterization – Methods for Handling Deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock Detection – Recovery From Deadlock- Case Study : Linux- Process Management.		**CO3**
UNIT-IV	**Memory Management**	**Periods: 9**
Swapping – Contiguous Memory Allocation – Paging – Segmentation- Structure of the Page Table - Virtual Memory- Background – Demand Paging – Copy on Write – Page Replacement – Allocation of Frames – Thrashing- Case Study : Linux- Memory Management.		**CO4**
UNIT-V	**Storage and I/O Management**	**Periods: 9**
Overview Of Mass Storage Structure-Disk Structure- Disk Scheduling And Management-File System Interface – File Concept - Access Methods -Directory and Disk Structure- Directory Implementation-Allocation Methods- I/O Systems – I/O Hardware- Application I/O Interface- Kernel I/O Subsystem - Case Study : Linux- File System, Input and Output.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating Systems Concepts, Ninth Edition, Wiley, 2012.
2. William Stallings, Operating Systems: Internals and Design Principles, Ninth Edition, Prentice-Hall, 2018.
3. Andrew Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall, 2009.

Department : **Computer Science and Engineering**			Programme: **B.Tech. (CS)**						
Semester : **Fourth**			Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CS209	**Design and Analysis of Algorithms**		3	-	-	3	40	60	100
Prerequisite	**Nil**								
Course Outcome	**CO1**	Understand and derive the time and space complexities of algorithms							
	CO2	Understand and design the divide-and-conquer and greedy techniques							
	CO3	Formulate and design the Dynamic Programming approach for the given problem							
	CO4	Design and apply Backtracking technique to the problems							
	CO5	Design and analyze the performance of problems with Branch and Bound technique							
UNIT-I	**Introduction to Searching, Sorting and Analysis**					**Periods: 9**			
Definitions and Notations: Standard Notations - Asymptotic Notations – Worst Case, Best Case And Average Case Analysis; Big Oh, Small Oh, Omega and Theta Notations; Analyzing Control Structures. Analysis of Sorting and Searching: Heap, Shell, Radix, Insertion, Selection and Bubble Sort; Sequential, Binary And Fibonacci Search. Recursive Algorithms, Analysis of Non-Recursive and Recursive Algorithms, Solving Recurrence Equations.									**CO1**
UNIT-II	**Divide and Conquer, Greedy**					**Periods: 9**			
Divide and Conquer: General Method – Binary Search – Maximum And Minimum – Merge Sort - Quick Sort – Strassen's Matrix Multiplication. Greedy Method: General Method – Knapsack Problem – Minimum Spanning Tree Algorithms – Single Source Shortest Path Algorithm – Scheduling, Optimal Storage on Tapes, Optimal Merge Patterns.									**CO2**
UNIT-III	**Dynamic Programming**					**Periods: 9**			
General Method – Multi-Stage Graphs – All Pair Shortest Path Algorithm – 0/1 Knapsack and Travelling Salesman Problem – Chained Matrix Multiplication. Basic Search And Traversal Techniques for Binary Trees and Graphs – AND/OR Graphs – Bi-connected Components – Topological Sorting.									**CO3**
UNIT-IV	**Backtracking**					**Periods: 9**			
The General Method – 8-Queens Problem – Sum of Subsets – Graph Coloring – Hamiltonian Cycle – Knapsack Problem.									**CO4**
UNIT-V	**Branch and Bound**					**Periods: 9**			
Least Cost (LC) Search – The 15-Puzzle Problem – Control Abstractions For LC-Search – Bounding – FIFO Branch and-Bound - 0/1 Knapsack Problem – Travelling Salesman Problem. Introduction to NP-Hard and NP-Completeness.									**CO5**
Lecture Periods: 45	**Tutorial Periods: -**		**Practical Periods: -**			**Total Periods: 45**			

Reference Books

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Second Edition, Galgotia Publications, Pvt. Ltd., 2008.
2. Gilles Brassard and Paul Bratley, Fundamentals of Algorithmics, Theory and Practice PHI, 2010.
3. Thomas H. Corman, Charles E. Leiserson, Ronald and L. Rivest, Introduction to Algorithms, Second Edition, Prentice-Hall of India, 2003.

Department : **Computer Science and Engineering**			Programme: **B.Tech. (CS)**						
Semester : **Fourth**			Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CS210	**Database Management Systems**		3	-	-	3	40	60	100
Prerequisite	**Nil**								
Course Outcome	**CO1**	Understand the concepts and features of database systems and mastering in different data models							
	CO2	Transforming an data model into a relational database schema by effectively organizing the data using Normalization and Formulating solutions using SQL							
	CO3	Master the basics of query processing, optimization and fast retrieval techniques using indexing and hashing with the familiarity of transaction processing							
	CO4	Understand the issues in concurrency control and familiarizing indifferent database architectures							
	CO5	Demonstrate an understand of data mining techniques and the principles of information retrieval							
UNIT-I	**Database Concepts and Data Model**					**Periods: 9**			
Database System: Definition, Purpose, Application, Data Abstraction, Database Architecture, Database Users, Database Administrators, Instances & Schema, Data Models Entity Relationship Model: Overview, Definitions, ER diagram, Mapping Cardinalities, Reduction to Relational Schema, Extended ER Features. Relational Model: Structure of Relational Database, Keys (Primary, Foreign, Candidate, Super). Relational Query Languages: Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus.									**CO1**
UNIT-II	**Database Design and Querying**					**Periods: 9**			
Relational Database Design: Overview, Features, Normalization, Normal Forms (First, Second, Third, Boyce Codd), Decomposition using Functional Dependencies and Multi-Valued Dependencies. SQL: Definition, Basic Structure, Data types, Basic Operations (DDL, DML, DCL), Set Operations, Aggregate Functions, Nested Sub-queries, Join Expression, Views, Transactions, Integrity Constraints, Authorization. PL-SQL: Definition, Basic Structure, Procedures, Functions, Cursors, Triggers, Packages.									**CO2**
UNIT-III	**Query Processing and Fast Retrieval**					**Periods: 9**			
Query Processing: Basic Steps, Measures of Query Cost, Query Optimization, Equivalent Expression and Query Evaluation Plan. Indexing: Definition, Purpose, Types of Indexing, B Tree and B+ Tree. Hashing: Basic Concepts, Hash Function, Static and Dynamic Hashing, Comparison of Indexing and Hashing. Transaction: Overview, Transaction States, ACID properties, Implementation of ACID properties, Serializability.									**CO3**
UNIT-IV	**Concurrency Control and DB Architecture**					**Periods: 9**			
Concurrency Control: Overview, Lock Types, Lock based Protocols, Deadlock Conditions and Handling. Recovery Systems: Failure Classification, Storage, Recovery Algorithms. Parallel Databases: Parallelism (I/O, Inter-query, Intra-query, Intra-operation, and Interoperation) Distributed Databases: Homogeneous vs Heterogeneous, Transaction System Architecture, Concurrency control.									**CO4**
UNIT-V	**Data Mining and Information Retrieval**					**Periods: 9**			
Data Mining: Association Rules, Classification, Clustering. Data warehouse: Architecture and Schemes. Information Retrieval: Ranking (keyword based, Relevance based), Retrieval Effectiveness measures, Web Crawling and Indexing. Introduction to Spatial Databases, Temporal Databases, Multimedia Databases. Case Study: Oracle.									**CO5**
Lecture Periods: 45	**Tutorial Periods: -**		**Practical Periods: -**				**Total Periods: 45**		

Reference Books

1. Abraham Silberschatz, Henry F. Korth and S.Sudarshan, Database System Concepts, Sixth Edition, McGraw-Hill International, Inc., 2011.
2. Elmasri and Navathe, Fundamentals of Database Systems, Seventh Edition, Addison-Wesley, 2012.
3. Fred R McFadden, Jeffery A. Hoffer and Mary B. Prescott, Modern Database Management, Addison Wesley, 2000.

Department : **Computer Science and Engineering**		Programme: **B.Tech. (CS)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CS211	**Software Engineering**	3	1	-	4	40	60	100
Prerequisite	**Nil**							
Course Outcome	**CO1**	Compare various software life cycle models						
	CO2	Estimate project cost/effort and manage project schedule						
	CO3	Develop good software design for effective software development						
	CO4	Practice good coding and design test cases to test software systems						
	CO5	Discuss on the maintenance process and quality management standards						

UNIT-I	**Introduction to Software Engineering**	**Periods:12**
Software Engineering Discipline – Evolution and Impact – Software Development Projects – Emergence of Software Engineering – Computer System Engineering – Software Life Cycle Models – Classic Waterfall Model – Iterative Life Cycle Model – Prototyping Model – Evolutionary Model – RAD Model – Agile Development Models – Spiral Model – Comparison of Software Life Cycle Models – Introduction to DevOps – DevOps Lifecycle – DevOps Vs Agile – DevOps Automation Tools.		**CO1**
UNIT-II	**Software Project Management and Requirements Analysis**	**Periods: 12**
Responsibilities of a Software Project Manager – Project Planning – Metrics for Project Size Estimation – Empirical Estimation Techniques – COCOMO – Halstead's Software Science – Staffing Level Estimation – Scheduling –Organization and Team Structures – Staffing – Risk Management – Software Configuration Management –Requirements Gathering and Analysis – Software Requirements Specification.		**CO2**
UNIT-III	**Software Design**	**Periods: 12**
Outcome of a Design Process – Characteristics of a Good Software Design – Cohesion and Coupling– Approaches to Software Design – Function Oriented Software Design Approaches – Structured Analysis –Data Flow Diagrams – Applying DFD to Real Time Systems – Structured and Detailed Design – Brief Overview of UML Diagrams.		**CO3**
UNIT-IV	**Coding and Software Testing**	**Periods: 12**
Coding Standards and Guidelines – Code Review – Software Documentation – Testing – Unit Testing – Black Box Testing – White Box Testing – Debugging – Program Analysis Tools – Integration Testing – System Testing – Issues with Testing.		**CO4**
UNIT-V	**Software Maintenance and Quality Management**	**Periods: 12**
Characteristics of Software Maintenance – Reverse Engineering – Software Maintenance Process Models – Estimation of Maintenance Cost – Software Quality – Quality Management System – ISO 9000 – SEI CMM – Personal Software Process – Six Sigma.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books

1. Rajib Mall, Fundamentals of Software Engineering, Fifth Edition, PHI Learning Pvt. Ltd., 2018.
2. Roger S. Pressman, Software Engineering: A Practitioner's Approach, Seventh Edition, McGraw-Hill, 2014.
3. Ian Sommerville, Software Engineering, Tenth Edition, Pearson Publishers, 2016.

Department : **Computer Science and Engineering**		Programme: **B.Tech. (CS)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CS212	**Operating System Laboratory**	-	-	3	1.5	40	60	100
Prerequisite	**Nil**							

Course Outcome		
	CO1	Practise Linux working environment
	CO2	Comprehend the usage of different system calls
	CO3	Experiment with various process management techniques
	CO4	Analyze different virtual memory management Strategies
	CO5	Compare the performance of Disk Scheduling Techniques

1. Study of basic Linux Commands 2. Implementation of Shell Programming a. Script to check if the given input is a directory and display its contents. b. Script to check if the given inputs are files and copy the contents of one file to another file. c. Scripts to execute basic commands using case construct. d. Script to check if the given input is a file and change the permission of the file. e. Script to display the file with maximum size for the given list of files.	**CO1**
3. Implementation of System Calls a. Implementation of Directory related system calls such as opendir(), closedir(), readdir() etc. b. Implementation of File related system calls such as open(), close(), read(), write, lseek() etc. c. Implementation of Process related system calls such as fork(), exec(), wait(),getpid()system calls. d. Program to implement forking of multiple child process.	**CO2**
4. Implementation of Inter-Process Communication mechanism a. Implementation of parent and child process communication using pipes. b. Implementation of parent and child process communication using shared memory. 5. Implementation of various CPU Scheduling Algorithms 6. Implementation of Process Synchronization using semaphores a. Implementation of Producer – Consumer Problem using semaphores. b. Implementation of Reader-Writer Problem using semaphores. c. Implementation of Dining-Philosopher Problem using semaphores.	**CO3**
7. Implementation of various Page Replacement Strategies.	**CO4**
8. Implementation of Disk Scheduling Techniques.	**CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating Systems Concepts, Ninth Edition, Wiley, 2012.
2. William Stallings, Operating Systems: Internals and Design Principles, Ninth Edition, Prentice-Hall, 2018.
3. Andrew Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall, 2009.

Department : **Computer Science and Engineering**			Programme: **B.Tech. (CS)**						
Semester : **Fourth**			Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CS213	**Design and Analysis of Algorithms Laboratory**		-	-	3	1.5	40	60	100
Prerequisite	**Nil**								
Course Outcome	**CO1**	Choose and implement the relevant searching/sorting							
	CO2	Implement the algorithm using a single technique							
	CO3	Implement the algorithm using more than one techniques							
	CO4	Analyze the complexities and the computation time of algorithms							
	CO5	Apply optimization measures in the technique							

1. Searching: Implementation of Sequential Search, Binary Search and Fibonacci Search. 2. Sorting: Implementation of Bubble Sort, Selection Sort, Insertion Sort and Heap Sort.	**CO1**
3. Divide-and-Conquer: Implementation of Binary Search, Merge Sort, Quick Sort and Max-min Problem.	**CO1 CO2 CO4**
4. Greedy: Implementation of Knapsack, Minimum Cost Spanning Tree, Single-Source-Shortest Path and Scheduling.	**CO1 CO2 CO5**
5. Dynamic Programming: Implementation of Multi-Stage Graphs, All-Pairs Shortest Path, Travelling Salesman, Basic Search Traversals Of Tree and Graph.	**CO2 CO3 CO5**
6. Backtracking: Implementation of N-Queen, Sum-of-Subsets, Graph-Coloring.	**CO3 CO4 CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Galgotia Publications, Pvt. Ltd., 2008.

Department : **Computer Science and Engineering**			Programme: **B.Tech. (CS)**						
Semester : **Fourth**			Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CS214	**Database Management Systems Laboratory**		-	-	3	1.5	40	60	100
Prerequisite	**Nil**								
Course Outcome	**CO1**	Understand the basic concepts database and its design principles							
	CO2	Formulate solutions to a broad range of query and data updateproblems using SQL							
	CO3	Master in SQL queries using advanced operators and concepts							
	CO4	Formulate Programming solutions for various queries using PL-SQL							
	CO5	Apply SQL query language for real time application							

1. Study of Database Concepts: Relational model – table – operations on tables – index – table space – clusters – synonym – view – schema – data dictionary – privilege – role – transactions.	**CO1**
2. Study of SQL: Primitive Data Types – User Defined data Types – create, alter, drop, select, insert, delete, update, commit, rollback, save point, grant, revoke - Built-in Functions – Integrity Constraint – Authorization – Transactions.	**CO2**
3. Study of Query Types: Queries involving Set Operators: Union, Intersection, Difference, Cartesian product, and Divide Operations – Sub Queries – Join Queries – Nested Queries – Correlated, Queries – Recursive Queries.	**CO3**
4. Study of Procedural Query Language: Blocks, Exception Handling, Functions, Procedures, Cursors, Triggers, Packages.	**CO4** **CO5**
5. Design and develop the following application: a. Library Information System b. Hospital Management System c. Students' Information System d. Employee Information System.	**CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books

1. Abraham Silberschatz, Henry F. Korth and S.Sudarshan, Database System Concepts, Sixth Edition, McGraw-Hill International Inc., 2011.
2. https://www.tutorialspoint.com/
3. https://www.w3schools.com/