Program: B Tech All Program (except Data Science, Civil and Mechanical, CSE(DS) 311 (VT)] MBA Tech All Program (except Data Science), B Tech Integrated Computer	**Semester:** III /IV /V / VII
Course: Discrete Mathematics	**Course Code:** 702BS0C047

Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
2	0	1	3	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Linear Algebra and Ordinary Differential Equations

Course Objective

The principal objective of the course is to train the students in the construction and understanding of mathematical proofs and common mathematical arguments. It will instil sound knowledge of different topics of discrete mathematics which students will readily apply in the subsequent courses of their programme.

Course Outcomes

After completion of the course, students will be able to -

1. Define and relate basic notions of discrete mathematics
2. Demonstrate the ability to understand mathematical logic, concepts in abstract algebra and mathematical proof techniques
3. Solve problems based on combinatorics, graph theory and abstract algebra

4.Demonstrate understanding of the applications of algebra, combinatorics and graph theory

Detailed Syllabus

Unit	**Description**	**Duration**
1.	**Set Theory, Relations and Functions** ***Revision of prerequisite concepts - 'Sets, Venn diagrams, Operations on sets, Laws of set theory'.*** Power set, The principle of Inclusion-Exclusion, Partitions of sets. Relations, Properties and types of binary relations, Equivalence relation. Functions, injective, surjective and bijective functions, Composition, inverse of a function.	06

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2.	**Logic** ***Revision of prerequisite concepts – 'Propositions, Truth table, Laws of logic, Equivalence'.*** Satisfiability, tautology, validity, disjunctive and conjunctive normal forms, Predicates and Quantifiers, Proof Techniques, Mathematical Induction.	06
3.	**Combinatorics** Pigeonhole principle, Homogeneous and non-homogeneous linear recurrence relations with constant coefficients, Generating functions.	04
4.	**Graphs and Trees** Graphs and their properties, Degree, Connectivity, Path, Cycle, Eulerian graph, Hamiltonian graph, Planar graphs, Graph Coloring. Trees, Rooted trees, Spanning tree and minimum spanning tree, Kruskal's and Prim's algorithms for minimal spanning trees.	08
5.	**Abstract algebra** Definition and examples of groups, subgroups, cyclic groups, group homomorphism, group isomorphisms. Definitions and Examples of Rings and Fields.	06
	Total	**30**

Text Books

1. Kenneth H. Rosen, *Discrete Mathematics and its Applications*, 8th Edition, Tata McGraw Hill, 2018.
2. Kolman, Busby and Ross, *Discrete Mathematical Structures*, 6th Edition, Prentice Hall India, 2015.

Reference Books

1. C. L. Liu, *Elements of Discrete Mathematics*, 4th Edition, McGraw Hill, New Delhi, 2017.
2. Seymour Lipschutz and Mark Lipson, *Discrete Mathematics*, 3rd Edition, McGraw Hill education, Schaum's Outline Series, 2017.
3. I. N. Herstein , "*Topics in Algebra*", , 2nd Edition, John Wiley and Sons, 1975.
4. Narsingh Deo, *Graph theory with Applications to Engineering and computer science*, 1st Edition, Prentice Hall India, 2016.

Laboratory/ Tutorial Work

8 to 10 tutorials based on the syllabus.

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Mukesh Patel School of Technology Management & Engineering

Program: B Tech /MBA Tech Artificial Intelligence B Tech (AI and ML and AI and DS)				**Semester:** III	
Course: Random Processes and Estimation Techniques				**Code:** 702AI0C005	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA)** **(Marks - 50)**	**Term End Examinations (TEE)** **(Marks - 100)**
3	**2**	**0**	**4**	**Marks Scaled to 50**	**Marks Scaled to 50**

Pre-requisite: Probability and Random variables

Course Objective

1. To develop sound knowledge and skills in theoretical, computational and application-oriented statistics.
2. To develop the concepts and techniques associated with the understanding of random processes and estimation techniques.

Course Outcomes

After completion of the course, the student will be able to -

1. Know the basics of random processes.
2. Know the spectral representation of random signals and calculate power spectral density, cross-spectral density.
3. Recognize the applications of different types of random processes.
4. Demonstrate the ability to understand the concepts of estimation, parametric and non-parametric inference.
5. Apply knowledge of parametric and non-parametric techniques in estimation and statistical inference.

Detailed Syllabus

Unit	Description	Duration
1	**Introduction to Random Processes: Basic Concepts** Classification of Random Processes, Statistics– first order, Second order, Wide-Sense Stationary Processes, Strict Sense Stationary Processes, Ergodic Random Processes.	08
2	**Linear Systems with Random Inputs** Fourier Transform of Random signals, Power Spectral Density, Cross Spectral Densities, Overview of linear system with deterministic inputs, Linear system with Discrete and continuous random inputs	06
3	**Special Random Processes**	08

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	The Bernoulli Process, Random walk process, Gaussian process, Poisson process, Markov Process	
4	**Estimation Theory** Point estimation, Interval estimate and confidence Interval, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation.	08
5	**Hypothesis Testing** I. Large Sample estimation of the population parameters and Hypothesis testing: Basics of Estimating the populations mean and difference; estimating the proportion and difference; large sample test for population mean, difference; large sample test for proportion, difference. II. Estimation of a population variance: Sampling distribution of variance, estimation. III. Inferences from small sample: Student's t distribution; Small sample t test for following – A population mean, A difference between two means, Confidence interval. IV. Rejection and Non-rejection region, Type I and Type II errors, testing hypothesis about a population mean using the Z- statistic, using p-values to test Hypothesis	15
	Total	**45**

Text Books

1. Oliver C. Ibe, *Fundamentals of applied probability and random processes*, 2nd Edition, Academic Press, 2014.
2. Anthanasios Papoulis, S. Unnikrishna Pillai, *Probability, Random Variables and Stochastic Processes*, 4th Edition, Tata McGraw-Hill, 2002
3. Richard, L & David, *Statistics for Management*, 7th Edition, E book, Pearson, 2013

Reference Books

1. I.R. Miller, J.E. Freund and R. Johnson, *Probability and Statistics for Engineers*, 8th Edition, Pearson Publication, 2015.
2. A. Goon, M. Gupta and B. Dasgupta, "*Fundamentals of Statistics*", vol. I & II, World Press.

Laboratory/ Tutorial Work

8 to 10 experiments/programming exercises (and a practicum where applicable) based on the syllabus.

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Mukesh Patel School of Technology Management & Engineering

Program: B Tech /MBA Tech Artificial Intelligence				**Semester:** III	
Course: Computer Architecture				**Code:** 702AI0C003	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks - 100)**
2	0	0	2	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Nil

Course Objective

To provide knowledge of the basic principles of the organization, operation and performance of modern day computer systems and the underlying semiconductor circuit architectures used to construct parallel computer components.

Course Outcomes

After completion of the course, the student will be able to -

1. Understand the basic concepts of digital logic circuits
2. Apply various operations of memory and ALU techniques
3. Analyse processor performance using various components of CPU
4. Evaluate various I/O operations and multiprocessor architectures

Detailed Syllabus

Unit	Description	Duration
1	**Overview** General Organization and architecture, Structural/functional view of a computer, Computer Functional Components. **Number system** Decimal, Binary, Hexadecimal notations and problems, Conversions using 1s and 2s complement	04
2	**System Buses** Overview of basic instruction cycle, Interrupts, Bus interconnection, Elements of bus design, Read and write timings diagram, Bus hierarchy, Bus arbitration techniques	03
3	**Memory Organization** **Internal Memory,** Memory characteristics and memory hierarchy, **Cache memory**, Elements of cache design, Address mapping and Translation-Direct mapping, Address mapping and translation- Associative mapping, Address mapping and translation -Set associative mapping, Performance	08

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	characteristics of two level memory, Semiconductor main memory- Types of RAM, DRAM and SRAM, Chip logic, Memory module organization. High speed memories- Associative memory, High speed memories- Interleaved memory.	
4	**Data path Design** IEEE 754 data format, IEEE 754 data format numerical, Design of serial and parallel adder and subtractor, Booth's algorithm, ALU -Combinational and sequential ALU.	04
5	**Central Processing Unit** Basic Instruction Cycle and Instruction set, Formats and addressing, Processor Organization and Register Organization, Instruction Pipelining, Co-processors, Pipeline processors, RISC and CISC computers	05
6	**Control Unit and peripheral devices** Control Unit- Micro Operations, Hardwired Implementations, Micro Programmed control, Micro instruction format and applications of microprogramming, I/O processors and channels, General-Purpose Graphics Processing Unit, GPU applications, synchronization, coherence	04
7	**Multiprocessor Processor Organizations** Flynn's classification of parallel processing Systems, Superscalar Processors.	02
	Total	**30**

Text Books

1. William Stallings, *Computer Organization and Architecture: Designing and Performance*, 10th Edition, Pentice Hall, 2016.
2. John P. Hayes Mc-Graw Hill, *Computer Architecture and Organization*, 2nd Edition, 2010.
3. Morris Mano, *Computer System Architecture*, 3rd Edition, PHI, 2002.

Reference Books

1. Tannenbaum, *Computer Organization*, 3rd Edition, PHI, 2010
2. V. Carl Hamacher and Zaky, *Computer Organization*, 5th Edition, McGraw Hill, 2010.

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Program: B Tech /MBA Tech (Computer Engineering and Artificial Intelligence), B Tech (AI and DS, AI and ML, Computer Science)				**Semester:** III/ V	
Course: Operating Systems				**Code**: 702CO1C002	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (marks -50)**	**Term End Examinations (TEE) (marks -100)**
2	2	0	3	Marks Scaled to 50	Marks Scaled to 50

Prerequisite: Programming, Computer Organization and Architecture, Data Structures and Algorithms

Course Objective

The objective of this course is to provide an introduction to functions of the computer operating system.

Course Outcomes

After completion of the course, students will be able to -

1. Describe the fundamental concepts of Operating system
2. Apply process management strategies
3. Simulate memory management, I/O management and file management strategies.

Detailed Syllabus

Unit	Description	Duration
1	**Operating System Overview:** Operating system objectives and functions, evolution of operating system, basic concepts: Processes, Files, System Calls, Layered structure v/s Monolithic structure of OS	**02**
2	**Process and Process Scheduling:** Process Description, Process Control Block (PCB), Threads, Thread management, comparison between Processes and threads, Process Scheduling: Types, study and comparison of various scheduling algorithms	**06**
3	**Process Concurrency:** Principles of Concurrency, Mutual Exclusion-Hardware Approaches, Semaphores, Monitors, Message Passing, Classical IPC Problems: Reader's / Writer's Problem, Producer / Consumer Problem	**06**
4	**Deadlock:** Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery, Dining Philosopher Problem	**05**

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5	**Memory Management:** Memory Management Requirements, Memory Partitioning, Paging, Segmentation, Page Replacement algorithms	**06**
6	**I/O Management and Disk Scheduling:** I/O devices, organization of I/O function, I/O buffering, Disk structure, Disk scheduling algorithms	**03**
7	**File Management:** Overview, File Organization, File Directories, File Sharing	**02**
	Total	**30**

Text Books

1. Silberschatz A. Galvin, *Operating Systems Principles*, 10th Edition, P Wiley Publications, 2018.
2. William Stallings, *Operating Systems: Internals and Design Principles*, 8th Edition, Pearson Education, 2015.

Reference Books

1. Andrew S. Tannenbaum, *Modern Operating System*, 4th Edition, PHI, 2014.

Laboratory Work:

8 to 10 experiments (and a practicum where applicable) based on the syllabus.

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SVKM's NMIMS
Mukesh Patel School of Technology Management & Engineering

Program: B Tech /MBA Tech Artificial Intelligence B Tech (AI and ML)				**Semester:** III	
Course: Intelligent Systems - I				**Code:** 702AI0C002	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA)** **(Marks - 50)**	**Term End Examinations (TEE)** **(Marks - 100)**
2	2	0	3	Marks Scaled to 50	Marks Scaled to 50

Pre-requisite: Calculus, Statistics

Course Objective

This course helps students to learn basics of agents and environments and implement different search strategies for problem solving. It also focuses on need for knowledge representation and different ways of doing it.

Course Outcomes

After completion of the course, students will be able to -

1. Describe approaches to artificial intelligence
2. Define and identify different types of agents and environments.
3. Implement different search based problem solving techniques.
4. Represent and apply propositional logic & predicate logic to simple knowledge-based applications.

Detailed Syllabus

Unit	Description	Duration
1	**Introduction to Artificial Intelligence** Definition, Foundations of AI, Approaches to AI.	**02**
2	**Intelligent Agents** How agents should act, structure of Intelligent agents, Environment	**03**
3	**Problem-solving by Searching** Solving Problems by Searching: Problem solving agents, Formulating problems, Search strategies, Informed Search Methods: Best first search, Heuristic functions, A* search, AO* algorithm, Local search algorithms.	**05**
4	**Adversarial search** Games as search problems, Optimal decision in games, Mini-max algorithm, Alpha-beta Pruning, State of the art games.	**04**
5	**Constraint Satisfaction Problem** Defining CSP, Constraint propagation, Backtracking search for CSP, Local search for constraint satisfaction problem	**05**
6	**Knowledge and reasoning**	**05**

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	Agents that Reason Logically, The Wumpus world environment, propositional logic, Propositional theorem proving.	
7	**First-Order Logic** Syntax and Semantics, Using first order logic, Axioms definitions and theorems, Building a Knowledge Base, Inference in First-Order Logic, Logical Reasoning System	**06**
	Total	**30**

Text Books

1. Stuart Russel and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th edition, Pearson Education, 2021

Reference Books

1. Elaine Rich, Kavin Knight, Shivshankar Nair, *Artificial intelligence*, 3rd edition, Tata McGraw Hill 2019

Laboratory/ Tutorial Work

8 to 10 experiments/programming exercises (and a practicum where applicable) based on the syllabus

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SVKM's NMIMS University
Mukesh Patel School of Technology Management & Engineering

Program: B Tech CSBS B Tech and MBA Tech (All programs except Civil and Mechanical) B Tech Computer Science and Engineering (Data Science) B Tech Integrated Computer	**Semester:** II III III VII
Course: Data Structures and Algorithms	**Code:** 702CO1C001

Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE) (Marks- 100)**
3	2	0	4	Marks Scaled to 50	Marks Scaled to 50

Prerequisite: Programming for Problem Solving

Course Objective

This course imparts knowledge of data structures and algorithms so as to identify and implement appropriate data structure and determine the computational complexity of the given application.

Course Outcomes

After completion of the course, students will be able to -

1. Understand the concept of data structures and computational complexity
2. Identify and implement appropriate linear data structure for the given problem.
3. Identify and implement appropriate non-linear data structure for the given problem.
4. Differentiate various searching and sorting algorithms.

Detailed Syllabus

Unit	Description	Duration
1	**Introduction** Introduction to data structure and its importance, Classification of data structures, Basic operations., Abstract data type, Performance analysis- time and space complexity, Asymptotic Notations.	04
2	**Linear Data Structure I** Representation of arrays in memory, Operations on arrays -Traversal, Insertion, Deletion. Introduction to Stacks, Operations on Stacks, Applications of stacks - Expression conversion and evaluation (Polish notation), Balanced parenthesis checker, Recursion, Introduction to Queue, Operation on Queues, Linear queue Circular queue, Priority queue, Application of Queues.	10
3	**Linear Data Structure II** Introduction to linked list, Representation of linked list in memory, Singly linked list and its operations, Introduction to Doubly Linked list Linked list	07

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	representation of Stack and Queues, Applications of linked list – Polynomial Addition	
4	**Non-Linear Data Structures - I** Introduction, Binary tree terminologies, Representation of Binary trees in memory, Binary Tree traversal algorithms, Construction of Binary Tree from traversals, Binary Search Tree: Insertion, Deletion, Applications of tree data structure: Expression trees, Huffman trees.	10
5	**Non- Linear Data Structures - II** Introduction, Graph theory terminology, Representation of graph: Adjacency Matrix, Adjacency List, Graph Traversal: Breadth first search, Depth first search, Applications of Graphs (Problem Solving): Shortest path (Dijkstra's algorithm), Minimum Spanning Tree.	06
6	**Searching and Sorting** Linear Search, Binary Search, Selection Sort, Insertion sort, Merge sort, Introduction to Hashing	08
	Total	**45**

Text Books

1. Seymour Lipschutz, "*Data structures with C*", Schaum's Outlines, 1st Edition, 2017.
2. Reema Thareja, "*Data Structures using C*", Oxford University Press, 2nd Edition, 2014.
3. Y. Langsam, M.J. Augenstein, A.M. Tenenbaum, "*Data Structures using C and C++*", PHI 2nd Edition, 2015.

Reference Books

1. Richard F. Gillberg, Behrouz A. Forouzen, "*Data Structures – A Pseudo Approach with C*", Cengage Publication, 2nd Edition 2004. (Classic)
2. Mark Allen Weiss, "*Data Structures and Algorithm analysis in C++*", PHI, 4th Edition, 2013.
3. Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "*Introduction to Algorithms*", MIT Press, 3rd Edition 2009.

Laboratory Work

8 to 10 experiments (and a practicum where applicable) based on the syllabus.

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Mukesh Patel School of Technology Management and Engineering

Program: B Tech All Program [except CSBS and CSE(DS) 311 (VT)], MBA Tech All Program, B Tech Integrated Mechanical, Computer	**Semester:** III /VII
Course: Technical Communication	**Code:** 702BS0C062

Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Internal Continuous Assessment (ICA) (Marks - 50)**	**Term End Examinations (TEE)**
0	**0**	**1**	**1**	**Marks scaled to 50**	**-**

Pre-requisite: Fundamentals of English Communication

Course Objective

The objective of the course is to develop students' proficiency in written technical communication so that they are able to produce documents of the kind required in the workplace, such as reports and letters, that are sound, effective, coherent and error-free

Course Outcomes

After completion of the course, the student will be able to –

1. Apply the fundamentals of written communication to create written documents that are coherent, error-free and well organized
2. Develop the ability to create effective and persuasive business correspondence, such as letters and emails, that follow etiquette and are able to achieve the desired outcomes
3. Create basic reports such as memo, letter and survey-based report, using their understanding of report writing

Detailed Syllabus

Unit	Description	Duration
1.	**Principles of Effective Writing** Salient features of sentence construction, Paragraph writing, 7 Cs of communication, Making outlines, Writing for the Web	**02**
2.	**Writing Skills** Note taking, Summarizing Fiction / Non-fiction	**04**
3.	**Business Correspondence** Business letter writing – principles and types, Business email writing – subject line, recipient design, language, structuring content, framing, etiquette, cultural sensitivity	**04**

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4.	**Report Writing** Introduction – what is a report, types, and characteristics of reports, pre-writing, principles and of report writing, Ethics in Writing - plagiarism. Survey-based reports Memo Report Letter Report Academic Report (with References and Citations)	**05**
	Total	**15**

Text Books

1. Meenakshi Raman and Sangeeta Sharma, *Technical Communication: Principles and Practice*, 3rd ed. Oxford University Press, 2015

Reference Books

1. Shirley Mathew, *Communication Skills*, Technical Publications, 2013
2. Sheryl Lindsell-Roberts, *Technical Writing for Dummies*, Hungry Minds Inc., 2001
3. Mike Markel, *Technical Communication*, Palgrave Macmillan, 2012

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