माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर
MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
Deemed to be University
(Declared under Distinct Category by Ministry of Education, Government of India)
NAAC ACCREDITED WITH A++ Grade
Gola Ka Mandir, Gwalior (M.P.)- 474005, INDIA
Ph.:+91-751-2409300, E-mail: director@mitsgwalior.in, Website: www.mitsgwalior.in

Department of Engineering Mathematics and Computing 2025

B. Tech. (Third Semester)
Simulation Modeling and Analysis
25242101

Course Objectives

- To understand the system, specify systems using natural models of computation
- To explore the modelling techniques
- To discuss the prediction of behaviour and decision support

Unit-I: Introduction – Simulation Terminologies, Need and use of modelling and Simulation, advantages and limitation of models, Application areas, Model Classification, Steps in a Simulation study, relationships between model and simulation techniques

Unit-II: System Models: Concept, environment, stochastic activities, continuous and discrete variables, system modeling, Model Type- static, dynamic and probabilistic models, Growth and Decay models, time series input models, AR(1) and EAR(1) model.

Unit-III: Discrete system simulation, properties of random numbers, techniques for generating random numbers, Linear congruential method, testing of random number generator, stochastic variable generation. Test of hypothesis, confidence interval, parameter estimation, goodness of fit test.

Unit-IV: System Simulation: techniques of simulation, Monte Carlo method, types of system simulation, numerical computation technique for continuous and discrete models, distributed leg models, cobweb models, continuous system models, Simulation of Single Server Queuing Systems.

Unit-V: Model Building, Verification of Simulation Models. Calibration and Validation of Models, Validation of Model Assumptions. Validating Input– Output Transformations, Transfer Line model, Deadlock Detection model.

Course Outcomes:
After completing this course, the students will be able to:

CO's	Description of CO's
CO1	Understand and articulate fundamental simulation terminologies
CO2	Explain the concepts for modeling a discrete and continuous systems
CO3	Develop and implement techniques and testing of random number generation
CO4	Apply simulation techniques to discrete and continuous models
CO5	Demonstrate validation and verification of model

Recommended Books:

1. Jerry Banks and John Carson: Discrete Event System Simulation, PHI, Fourth Edition, 2005.
2. Geoffrey Gordon: System Simulation, PHI, Second Edition, 2006.
3. Frank L. Severance: System Modeling and Simulation. Wiley, 2001.
4. Averill M. Law and W. David Kelton: Simulation Modeling and Analysis, McGraw Hill, Third Edition, 2006.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1	1	1	1	1	2	3	1
CO2	3	2	2	2	2	1	1	1	1	1	1	2	3	2
CO3	3	3	2	2	2	1	1	1	1	1	1	2	3	2
CO4	3	3	2	2	2	1	1	1	1	1	1	2	3	1
CO5	3	3	2	2	3	1	1	1	1	1	1	2	3	2

1 - Slightly; 2 - Moderately; 3 – Substantially

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Department of Engineering Mathematics and Computing 2025

B. Tech. (Third Semester)
Operating Systems
25242102

Course Objectives

- Understand OS fundamentals, architectures, and security.
- Learn process management, scheduling, and synchronization.
- Study memory and storage management techniques.
- Develop problem-solving skills for deadlocks and performance optimization.

Unit I

Basics of Operating System: Definition, Objectives, and Evolution (Generations: Batch, Multiprogramming, Time-Sharing, etc.), Types of OS: Monolithic, Layered, Microkernel, Modular (e.g., Linux), Real-Time, Distributed, Mobile. OS Services and Interfaces: CLI, GUI, System Calls, APIs. **Protection and Security:** Access Control, Authentication, Threats (Malware, Privilege Escalation).

Unit II

Process Management: Process Concepts: Process and Program, Process States (PCB, Context Switching). Process Scheduling: Preemptive and Non-Preemptive. CPU Scheduling: Scheduling Criteria (Throughput, Latency, Fairness). Algorithms: FCFS, SJF, Priority, Round Robin, Multilevel Queues. **Threads & Concurrency:** Thread Concepts and Threading Models.

Unit III

Process Synchronization: Background, Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors. **Deadlock:** System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

Unit IV

Memory Management: Main Memory, Swapping, Contiguous Memory Allocation, Paging, Structure of Page Table, Segmentation, **Virtual Memory**: Demand Paging, Page Replacement Algorithms, Allocation of Frames, Thrashing.

Unit V

Storage Management: Mass-Storage Structure, Overview, Disk Structure, Disk Attachment, Disk Scheduling. **File System Interface:** The Concept of a File, Access Methods, Directory Structure, File System Structure, Allocation Methods, Free-Space Management.

Recommended Books

1. Operating System Concepts, Silberschatz, Ninth Edition, Willey Publication.
2. Operating Systems, internals and Design Principles, Stallings, Seventh Edition, Pearson Publication.
3. Modern Operating Systems, Tanenbaum, Fourth Edition. Pearson Publication.

Course Outcomes

After the successful completion of this course, the student will be able to:

CO's	Description of CO's
CO1	Understand OS fundamentals, types, services, and security mechanisms
CO2	Analyze process scheduling, threads, and concurrency issues.
CO3	Solve synchronization problems and apply deadlock handling strategies.
CO4	Evaluate memory management techniques and page replacement algorithms.
CO5	Simulate disk scheduling and file system operations for performance optimization.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1		1	1	1	3	3	1
CO2	3	2	2	2	2	1	1		1	1	1	3	3	2
CO3	3	3	2	2	2	1	1		1	1	1	3	3	2
CO4	3	3	2	2	2	1	1		1	1	1	3	3	2
CO5	3	3	2	2	3	1	1		1	1	1	3	3	2

1 - Slightly; 2 - Moderately; 3 – Substantially

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Department of Engineering Mathematics and Computing 2025

B. Tech. (Third Semester)
Discrete Mathematical Structures
25242103

Course Objectives

- To understand the concept Set Theory
- To understand the various aspect of algebraic structures
- To explore Graph Theory
- To perceive knowledge of tree and discrete numeric functions.

Unit 1: Sets, Relations and Functions- Sets, Subsets, Power sets, Complement, Union and Intersection, Demorgan's law Cartesian products, Relations, relational matrices, properties of relations, equivalence relation, functions, Injection, Surjection and Bijective mapping, Composition of functions, Permutations, the characteristic functions and Mathematical induction.

Unit 2: Lattices- Partial order set, Hasse diagrams, upper bounds, lower bounds, Maximal and minimal element, first and last element, Lattices, sub lattices, Isotonicity, distributive inequality, Lattice homomorphism, lattice isomorphism, complete lattice, complemented lattice distribution lattice.

Unit 3: Graphs- Introduction, Operation of graphs (Union, Intersection, complement, product and composition), Sub graph, Fusion of graph, Planer graphs, Region of graph, Euler's formula, connected graph, Brook's theorem, directed graphs: Types of directed graphs, Digraphs and binary relations, Euler graphs, Hamiltonian paths, Walks and circuits, Graph colouring (vertex colouring), Chromatic Number, upper bound and lower bound of chromatic number, Network flows, Matrix representation of graph.

Unit 4: Trees & Spanning trees- Trees – Rooted and binary trees and Properties, Distance and centres in tree, Spanning trees, Binary Search tree, Spanning trees in a weighted graph, Connectivity and seperability, Network flows, cut sets, Properties of cut set, all cut sets, Fundamental circuits and cut sets.

Unit 5: Discrete Numeric function and Recurrence relation- Introduction to discrete numeric functions and generating functions, introduction to recurrence relations and recursive algorithms, linear recurrence relations with constant coefficients, homogeneous solutions, particular solutions and total solutions

Course Outcomes

After completing this course, the students will be able to:

CO's	**Description of CO'**
CO1	Acquire the knowledge of Set Theory
CO2	Find the analytical solution of algebraic structures'
CO3	Express the Graph Theory
CO4	Acquire the knowledge of Tree
CO5	Illustrate the concept of discrete numeric functions

Recommended Books:

1. J.P Tremblay and R.Manohar:Discrete Mathematical Structures with Application to Computer science, McGraw Hill, 5th edition, 2008.
2. NarsinghDeo: Graph Theory with Applications to Engineering and Computer Science, PHI,3rd, 1987.
3. Swapam Kumar Sarkar: Discrete Mathematics, S.Chand & Company, 2nd edition, 2019.
4. Rosen: Discrete Mathematics and its Applications, McGraw Higher Ed, 7th Edition 2008.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1		1	1	1	3	3	2
CO2	3	2	2	2	2	1	1		1	1	1	3	3	2
CO3	3	3	2	3	2	1	1		1	1	1	3	3	2
CO4	3	3	2	2	2	1	1		1	1	1	3	3	2
CO5	3	3	2	3	3	1	1		1	1	1	3	3	2

1 - Slightly; 2 - Moderately; 3 – Substantially

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Department of Engineering Mathematics and Computing 2025

B. Tech. (Third Semester)
Design and Analysis of Algorithms
25242104

Course Objective

- To introduce the topic of algorithms as a precise mathematical concept.
- To demonstrate the familiarity with major algorithm design paradigms and methods of analysis.
- To design efficient algorithms for common computer engineering problems.

Unit-I: Introduction to Computational Model- Algorithms and its Importance, Recurrences and Asymptotic Notations, Mathematical Analysis of Non-Recursive and Recursive Algorithm.

Unit-II: Divide and Conquer Method- Introduction and its Examples such as Finding the Maximum and Minimum, Binary Search, Merge Sort, Quick Sort and Strassen's Matrix Multiplication.

Unit-III: Greedy Method- Introduction, Characteristics, Examples of Greedy Methods such as Single-Source Shortest Paths, **Minimum Cost Spanning Trees-** Prism's and Kruskal's Algorithm, Knapsack Problem, Dijkstra's Single Source Shortest Path Algorithm, Optimal Storage on Tapes.

Unit-IV: Dynamic Programming- Introduction, The Principle of Optimality, Examples of Dynamic Programming Methods such as – 0/1 Knapsack, Traveling Salesman Problem, Floyd's All Pairs Shortest Path, Longest Common Subsequence and Reliability Design, Matrix Chain Multiplication. **Backtracking-** Concept and its Examples like 4-Queen's Problem, Knapsack problem Hamiltonian Circuit Problem, Graph Coloring Problem etc., **Branch & Bound-** Introduction, **NP-Completeness-** Introduction, Class P and NP, NP-Hard and NP- Complete Problems.

Unit-V: Recent Trends in Algorithm Design- Randomized Algorithms, Types: Las Vegas and Monte Carlo Algorithms, Approximation Algorithms, Amortized Analysis, Parallel and Distributed Algorithms, Quantum Algorithms, Streaming Algorithms, Privacy Algorithms etc.

Recommended Books

1. Fundamentals of Computer Algorithms, Horowitz & Sahani, Universities press
2. Introduction to Algorithms, Coreman Thomas, Leiserson CE, Rivest RL, PHI.
3. Design & Analysis of Computer Algorithms, Ullman, Pearson.
4. Algorithm Design, Michael T Goodrich, Robarto Tamassia, Wiley India.

Course Outcomes

After Completion of this course, the students would be able to:

CO's	Description of CO's
CO1	Analyse algorithmic problems using computational models and evaluate their efficiency
CO2	Select greedy algorithms for optimization problems
CO3	Solve synchronization problems and apply deadlock handling strategies.
CO4	Solve complex problems using dynamic programming, backtracking, and branch & bound, and classify decision problems based on computational complexity
CO5	Discuss the recent trends in algorithm design.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	3	2	1	1	1	2	3	2
CO2	3	3	3	2	2	2	2	1	1	1	1	2	3	2
CO3	3	3	3	2	2	2	1	2	1	1	1	2	3	2
CO4	3	3	3	2	2	2	2	3	1	1	1	2	3	2
CO5	3	3	3	2	2	2	3	3	1	1	1	2	3	2

1 - Slightly; 2 - Moderately; 3 – Substantially

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B. Tech. (Third Semester)
Stochastic Process and Financial Mathematics
Subject Code: 25242105

Objective of Course

- To know stochastic process
- To perceive the mathematical techniques in financial sector
- To explore the concept of free and risky assets
- To understand mathematical models and risk management

Unit I: Background on Probability- Conditional probability and independence, mean and variance of Binomial Distribution, Poisson Distribution, Exponential and Normal Distribution,

Unit II: Random Variable- Discrete and Continuous Variable, Distributions, Two dimensional random variables, Cumulative distribution function, Joint probability distribution, Marginal probability distribution,

Unit III: Stochastic Process- Basic concept of stochastic process, Markov Chain, classification of states Markov process with discrete and continuous state, Birth & Death process, Random Walks, Kolmogorov equation, Poisson process, Wiener process, Pollaczek-Khinchine formula.

Unit IV: Basics of Financial Mathematics- Basic Notions and Assumptions, No-Arbitrage Principle, One-Step Binomial Model, Risk and Return, Forward Contracts, Call and Put Options, Growth and decay curves, Managing Risk with Options, Credit and loan, Amortization

Unit V: Risk-free and Risky Securities- Time Value of Money, Simple Interest, Periodic Compounding Streams of Payments, Discrete and Continuous Compounding, how to Compare Compounding Methods, Investment Strategies, Dynamics of Stock Prices, Expected Return, Binomial Tree Model, Risk-Neutral Probability, Martingale Property, Monte-Carlo methods, Portfolio Management: Risk and Expected Return on a Portfolio

CO's	Description of CO's
CO1	Explore probability distributions
CO2	Evaluate Markov process with discrete and continuous states
CO3	Analyze Random wal and Poisson process
CO4	Employ discrete mode in managing investment strategies
CO5	Deal with free risk assets in financial sector and market risk measurement and management

Recommended Books:

1. T. Veerarajan: Probability, Statistics and Random Processes, McGraw Hill, 3rd Edition 2008.
2. Marek Capinski and Tomasz Zastawniak, "Mathematics for Finance", Springer (201 1).
3. Kannoo Ravindran, The Mathematics of Financial Models: Solving Real-World Problems with Quantitative Methods, Wiley Finance, (2014)
4. Ambad NazriWahidudin, "Financial Mathematics and its Applications", Ventus Publishing ApS (2011)

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	3	2	1	1	1	1	1	3	3	3
CO2	3	2	3	3	3	2	1	1	1	1	1	2	3	3
CO3	3	2	3	3	3	2	1	1	1	1	1	3	2	3
CO4	3	3	2	3	3	2	2	1	1	1	1	3	3	2
CO5	3	2	3	3	2	2	2	1	1	1	1	3	2	3

1 - Slightly; 2 - Moderately; 3 – Substantially

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Department of Engineering Mathematics and Computing 2025

B. Tech. (Third Semester)
Problem Solving Through Python Programming
25242108

Course Objectives

- To develop the understanding of algorithms, programming approaches and program documentation techniques in Python.
- To study the concepts of procedural and object-oriented programming techniques in Python.
- To design and implement basic programming solutions using Python programming constructs.

Module 1: Introduction to Python programming language; Data and Expressions: Literals; Variables and Identifiers; Operators; Expressions and Data Types; Control Structures: Boolean Expressions. The first program, Variables, expressions, keywords, Operators, Expressions and statements, Interactive mode and script mode, Order of operations. Datatypes: Numeric, string, list tuple, dictionary, set.

Module 2: Control Statements: Conditional and unconditional branching, while loop, for loop, loop control statements, range function. Numeric, String, list, tuple, dictionary and set manipulation operations using loops and inbuilt manipulation functions. Function, ways of passing arguments to functions, user defined and inbuilt functions, lambda function. Packages and modules in python.

Module 3: Exception and File Handling: Errors vs exceptions, Exceptions handling with try block, handling multiple exceptions, writing your own exceptions, file handling modes, reading, writing and appending a file, Handling file exceptions.

Module 4: Object-Oriented Programming: Introduction to Object Oriented Programming; Encapsulation; Inheritance; Polymorphism; constructors and destructors, Object Oriented Design using UML.

Module 5: Graphics Programming: Graphics Programming, Using Graphical Objects, Interactive Graphics, Graphics Objects, Entry Objects, Displaying Images, Generating Colours. Array manipulation and visualization using numpy and matplotlib libraries.

Recommended Books

- Python Crash Course: A Hands-On, Project-Based Introduction to Programming, By Eric Matthes.
- Learn Python the Hard Way: third Edition T.R. Padmanabhan, Programming with Python, Springer, first Ed., 2016.
- Kenneth Lambert, Fundamentals of Python: First Programs, Cengage Learning, first Ed., 2012.
- Yashavant Kanetkar, Let Us Python (1st ed.), BPB Publishers, 2019. ISBN 978-9388511568.

Course Outcomes

After completion of this course, the students would be able to:

CO1. explain basic syntax and building blocks in python programming language.
CO2. solve computational problems using python programming language
CO3. design a program utilizing the features of object-oriented concepts.
CO4. analyze the key libraries available for solving problems.
CO5. construct the Python code for real-world problems using the libraries.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1			2					1		1	2	1
CO2	3	3	1	1	2				1	1	1	2	3	1
CO3	2	2	3	1	2			1	2	2	2	2	2	2
CO4	2	3	2	3	3		1	1	1	2	2	2	2	1
CO5	2	3	3	3	3	1	2	1	3	3	3	3	3	3

1 - Slightly; 2 - Moderately; 3 – Substantially