University of Information Technology

2024-2025 Academic Year

Faculty of Computer Science (FCS)

Scope for M.C.Sc. / M.C.Tech. + Ph.D. (IT) Entrance Exam

Operating System

Textbook – Operating Systems Internals and Design Principles (Seventh Edition) by William Stallings

Chapter 4 – Threads

Chapter 7 – Memory Management

Chapter 9 – Uniprocessor Scheduling

Chapter 11 – I/O Management and Disk Scheduling

Data Structure

Text Book – Introduction to the Design and Analysis of Algorithm by Anany Levitin

Chapter 3: Brute Force and Exhaustive Search

Chapter 4: Decrease- and- Conquer

Chapter 5: Divide- and- Conquer

Chapter 9: Greedy Technique

Artifical Intelligence

Text Book – Introduction to Artificial Intelligence, second edition", by Wolfgang Ertel

Chapter 2: Propositional Logic

Chapter 9: Neural Networks

Chapter 10: Reinforcement Learning

University of Information Technology

2024-2025 Academic Year

Faculty of Computer Systems and Technologies (FCST)

Scope for M.C.Sc. / M.C.Tech. + Ph.D. (IT) Entrance Exam

Computer Architecture

Text Book – Computer Architecture and Organization (3rd Edition) by John. P. Hayes, McGraw-Hill International Edition

Chapter 1: Computing and Computers

Chapter 2: Design Methodology

Chapter 3: Processor Basics

Communication and Networking

Text Books – 1) Data and Computer Communications by William Stallings (10th Edition)

PART II – Data Communications

PART VI – Data Communications and Wireless Networks

PART VII – Internetworking

2) Computer Networking – A Top-Down Approach by James F. Kurose (8th Edition)

Chapter 4 – The Network Layer: Data Plane

Chapter 5 – The Network Layer: Control Plane

Chapter 8 – Security in Compute Networks

University of Information Technology

Faculty of Information Science (FIS)

(2024-2025) Academic Year

Scope for M.C.Sc. / M.C.Tech. + Ph.D. (IT) Entrance Exam

1. **Text Book: Software Engineering**

   Author: Ian Sommerville

   Edition: Tenth Edition

   Chapter 8 - Software Testing

   Chapter 10 - Dependable Systems

   Chapter 11 - Reliability Engineering

2. **Text Book: Data Mining: Concepts and Techniques**

   Authors: Jiawei Han, Micheline Kamber, and Jian Pei

   Edition: Third Edition

   Chapter 2 - Getting to Know Your Data

   Chapter 3 - Data Preprocessing

   Chapter 6 - Mining Frequent Patterns, Associations, and Correlations

   Chapter 10 - Cluster Analysis

University of Information Technology

2024-2025 Academic Year

Faculty of Computing (FC)

Scope for M.C.Sc./ M.C.Tech. + Ph.D. (IT) Entrance Exam

Calculus

Textbook – Thomas Calculus (Fifteenth Edition)

1. **Limits and Continuity**:
   - Detailed understanding of limits, continuity, and differentiability.
   - Epsilon-delta definitions and proofs.
2. **Differentiation**:
   - Mastery of derivative techniques.
   - Applications of derivatives, including optimization, curve sketching, and related rates.
   - Higher-order derivatives and their applications.
3. **Integration**:
   - Both definite and indefinite integrals.
   - Techniques of integration (e.g., substitution, partial fractions, integration by parts).
   - Improper integrals and their convergence.
4. **Series and Sequences**:
   - Convergence tests for series.
   - Power series and Taylor series.
   - Fourier series and their applications.
5. **Multivariable Calculus**:
   - Partial derivatives, gradient, divergence, and curl.
   - Double and triple integrals in various coordinate systems.
   - Line integrals, surface integrals, and Green's, Stokes', and Divergence theorems.
6. **Differential Equations**:
   - First and second-order differential equations.
   - Application of differential equations in physical and engineering problems.
7. **Vector Calculus**:
   - Vectors, dot and cross products.
   - Vector fields and vector-valued functions.

- Applications of vector calculus in geometry and physics.

Discrete Mathematics

Text Book – Discrete Mathematics and its Application (7th Edition)

1. Set Theory

- **Basics of Sets**: Set operations (union, intersection, complement, difference, Cartesian product), Venn diagrams.
- **Relations on Sets**: Equivalence relations, partial orders, total orders.
- **Functions**: One-to-one, onto functions, inverse functions, bijections, composition of functions.

2. Logic and Propositional Calculus

- **Propositional Logic**: Logical operators, truth tables, tautologies, contradictions, logical equivalence, implications, and logical inference.
- **Predicate Logic**: Quantifiers (universal and existential), negation, and translating statements into predicate logic.
- **Proof Techniques**: Direct proofs, proof by contradiction, proof by induction, and counterexamples.

3. Combinatorics

- **Basic Counting Principles**: Permutations, combinations, Pigeonhole Principle, and inclusion-exclusion principle.
- **Recurrence Relations**: Solving linear recurrence relations with constant coefficients.
- **Generating Functions**: Application of generating functions to solve combinatorial problems.
- **Graphical Counting**: Counting paths, circuits, and trees in graphs.

4. Graph Theory

- **Graph Terminology**: Types of graphs (directed, undirected, weighted, simple, multigraphs), degree, adjacency, paths, circuits.

- **Graph Traversal Algorithms**: Depth-First Search (DFS), Breadth-First Search (BFS).
- **Graph Coloring**: Chromatic number, chromatic polynomials.
- **Planar Graphs**: Euler's formula, Kuratowski's Theorem.
- **Trees**: Properties of trees, spanning trees, minimal spanning trees (Kruskal's and Prim's algorithms).
- **Connectivity**: Cut vertices, bridges, and network flow.

5. Algebraic Structures

- **Groups and Monoids**: Definitions, examples (cyclic groups, permutation groups), group properties, homomorphisms, isomorphisms.
- **Rings and Fields**: Basic definitions, properties, examples of rings, integral domains, fields, and applications.
- **Boolean Algebra**: Boolean functions, logic gates, simplification of Boolean expressions (Karnaugh maps, Quine-McCluskey method).

6. Number Theory

- **Divisibility and GCD**: Division algorithm, Euclidean algorithm, greatest common divisor (GCD), least common multiple (LCM).
- **Modular Arithmetic**: Congruences, Chinese remainder theorem, Fermat's little theorem, Euler's theorem.
- **Primes**: Prime numbers, primality testing, prime factorization, sieve of Eratosthenes.

7. Recursion and Recurrence Relations

- **Mathematical Induction**: Strong and weak induction principles.
- **Recurrence Relations**: Solving linear recurrence relations using characteristic equations, homogeneous and non-homogeneous recurrences.
- **Divide and Conquer Recurrences**: Master Theorem for analyzing the complexity of recursive algorithms.

8. Algorithms and Complexity

- **Algorithm Complexity**: Big-O, Big-Theta, and Big-Omega notation for asymptotic complexity analysis.
- **Basic Algorithms**: Sorting (quicksort, mergesort, heapsort), searching algorithms, and their complexities.
- **Graph Algorithms**: Dijkstra's shortest path, Floyd-Warshall, Bellman-Ford algorithms, and complexity analysi

Linear Algebra

Text Book – Introduction to linear algebra 5th edition chegg,

Vector Spaces

- **Definition and Properties**: Understanding vector spaces, subspaces, and properties such as closure under addition and scalar multiplication.
- **Basis and Dimension**: Concept of a basis, spanning sets, and the dimension of a vector space.
- **Linear Dependence and Independence**: Criteria for linear independence and dependence of vectors in a vector space.
- **Finite and Infinite Dimensional Spaces**: Focus on finite-dimensional spaces but have an understanding of infinite-dimensional spaces.

2. Linear Transformations

- **Definition and Examples**: Functions that preserve vector addition and scalar multiplication.
- **Kernel and Image**: Understanding the null space (kernel) and range (image) of a linear transformation.
- **Rank-Nullity Theorem**: The relationship between the dimensions of the domain, image, and kernel of a linear transformation.
- **Matrix Representation**: How linear transformations can be represented as matrices, and changing bases for matrix representations.

3. Matrices

- **Matrix Operations**: Matrix addition, multiplication, and scalar multiplication.
- **Matrix Inverses**: Conditions for a matrix to be invertible, computation of the inverse, and the application of inverses.
- **Determinants**: Properties of determinants, Laplace expansion, and applications such as determining matrix invertibility.
- **Special Matrices**: Types of matrices like diagonal, symmetric, skew-symmetric, orthogonal, Hermitian, and unitary matrices.

4. Systems of Linear Equations

- **Solving Linear Systems**: Gaussian elimination, Gauss-Jordan elimination, back substitution, and understanding underdetermined/overdetermined systems.
- **Row-Reduction**: Row echelon form (REF) and reduced row echelon form (RREF), including techniques for determining the rank of a matrix.
- **Existence and Uniqueness Theorems**: Conditions for the existence and uniqueness of solutions in systems of linear equations.

5. Eigenvalues and Eigenvectors

- **Definitions and Computation**: How to compute eigenvalues and eigenvectors of a matrix.
- **Diagonalization**: Conditions under which a matrix can be diagonalized, and the process of diagonalizing a matrix using its eigenvalues and eigenvectors.
- **Applications**: Applications of eigenvalues and eigenvectors in differential equations, dynamical systems, and stability analysis.
- **Spectral Theorem**: For symmetric and Hermitian matrices, the existence of an orthonormal set of eigenvectors and diagonalization of such matrices.

6. Inner Product Spaces

- **Definition**: Understanding inner products, norms, and angles between vectors.
- **Orthogonality**: Orthogonal vectors, orthogonal projections, and orthogonal complements.

- **Gram-Schmidt Process**: Orthogonalization of a set of vectors and converting a basis into an orthonormal basis.
- **Normed Spaces**: Norms of vectors, including the Euclidean norm, and properties of normed spaces.
- **Orthogonal and Unitary Matrices**: Understanding properties and applications of these matrices, including preserving lengths and angles.

7. Singular Value Decomposition (SVD)

- **Definition and Computation**: Singular value decomposition of matrices and its applications.
- **Applications of SVD**: SVD in data analysis, principal component analysis (PCA), and other computational applications.
- **Rank of Matrices**: Using SVD to determine the rank, range, and nullity of a matrix.

Probability and Statistics

Text Book – Advance Engineering Mathematics, 10th edition kreyszing,

Probability Theory

- **Basic Probability Concepts**:
    - Sample spaces, events, and probability measures.
    - Axioms of probability (Kolmogorov's axioms).
    - Conditional probability, the law of total probability, and Bayes' theorem.
- **Random Variables**:
    - Definition of random variables (discrete and continuous).
    - Probability mass function (PMF) for discrete random variables.
    - Probability density function (PDF) for continuous random variables.
    - Cumulative distribution function (CDF) and properties.
- **Joint and Marginal Distributions**:
    - Joint distributions for multiple random variables (discrete and continuous).
    - Marginal and conditional distributions.
    - Independence of random variables.

- **Expectation and Moments**:
    - Expected value (mean), variance, and higher-order moments.
    - Moment-generating functions (MGF) and characteristic functions.
    - Covariance and correlation between random variables.
    - Chebyshev's inequality and applications in probability bounds.
- **Key Distributions**:
    - **Discrete Distributions**: Binomial, Poisson, geometric, hypergeometric distributions.
    - **Continuous Distributions**: Uniform, normal (Gaussian), exponential, gamma, beta, and Cauchy distributions.
    - Understanding how to derive moments, PDFs, and CDFs for these distributions.
- **Functions of Random Variables**:
    - How to compute the distribution of functions of random variables.
    - Transformations of random variables (e.g., change of variables technique).
    - Sum of independent random variables and convolution of PD