BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

AUGSD

SECOND SEMESTER 2020-2021

COURSE HANDOUT (PART-II)

Date: 10/02/2021

In addition to Part-I (General Handout for all courses appended to the Timetable) this portion gives further specific details regarding the course.

Course No. : CS F222

Course Title : Discrete Structures for Computer Science

Instructor In Charge : Dr. Jagat Sesh Challa (jagatsesh@pilani.bits-pilani.ac.in)

2. SCOPE & OBJECTIVE:

To develop logical and mathematical concepts necessary to appreciate computational systems. And study of concepts, techniques, and skills necessary to comprehend the structure of problems encountered in design and analysis of algorithms. To provide mathematical foundations for courses in computer science that rely upon the comprehension of formal abstract concepts. To study recursion and to write recursive definitions for certain sequences and collections of objects. Graphs, directed graphs, planar graphs & their relevance to circuit design & map colouring problems. Trees and their applications. Basic algebraic structures and their applications.

3. TEXT BOOK:

Mott, Kandel, & Baker: Discrete Mathematics for Computer Scientists & Mathematicians, PHI, 2e, 2002.

4. REFERENCE BOOKS:

R1. K H Rosen: Discrete Mathematics & its Applications, TMH, 7e, 2011.
R2. Douglas West: Introduction to Graph Theory, Pearson, 2e, 2001.
R3. J. A. Bondy and U. S. R. Murty: GRAPH THEORY WITH APPLICATIONS

5. COURSE PLAN:

Module	Lecture Session	Reference	Learning Outcomes
Module 0: Course Introduction and Background	L0 Course Introduction and Importance of Discrete Structures	Lecture Slides	Course Introduction and Motivation, Importance of studying Discrete structures in computer science
Module 1: Proof Methods	L1-L2 Brief study of various Proof Methods	Lecture Slides R1: Ch. 1.6	To learn various methods of writing formal proofs such as direct proof, contrapositive, proof by contradiction, and proof by cases

Module2: Algorithms and Complexity	L3 Introduction to Algorithms and complexity analysis	Lecture Slides R1: Ch. 3.1-3.3	To understand what algorithms are and how their performance is measured in terms of time complexity analysis
Module 3: Induction and Recursion	L4-L8 Mathematical Induction, Strong Induction, Well Ordering Principle, Recursive Definitions, Structural Induction, Recursive Functions.	Lecture Slides R1: Ch. 4.1-4.4	Mathematical Induction, Using mathematical induction to prove theorems or statements, Strong induction and well ordering principles, Recursive or Inductive definitions of functions, sets, and structures, Structural induction, proofs using structural induction, Problem solving using Recursion, Recursive Algorithms, Recursion vs Iteration
Module 4: Recurrence Relations and Generating Functions	L9-L11 Formulating and Solving Recurrence Relations, Divide & Conquer Algorithms with recurrence relations, generating functions	Lecture Slides R1: Ch. 6.1-6.4	To learn about recurrence relations and how to formulate them, methods to solve particular types of recurrence relations, deriving theorems about divide and conquer algorithms using recurrence relations, learn about generating functions and their applications to real world examples
Module 5: Countability of Sets & Pigeon-hole principle	L12-L13 Countability of Sets, diagonalization and pigeon-hole principle	Lecture Slides R1: Ch. 5.2	To understand countability of finite and infinite sets, finding whether a set is countable or not, proving uncountability of a set using diagonalization, pigeon-hole principle and its applications
Module 6: Relations	L14-18 Properties of relations, representing relations, closure of relations, Equivalence Classes, Partial Ordering, Lattices	Lecture Slides R1: Ch. 7.1-7.6	Mathematical definitions of relations, n-ary relations, Properties: reflexive, symmetric, transitive, antisymmetric, and asymmetric, Operations on Relations, Matrices, Diagraphs, Reflexive, Symmetric, and Transitive closures, Warshall's Algorithm, Equivalence Relations and Classes, Partial Ordering Relations, lattices, Hasse Diagram
Module 7: Graph Theory	L19-30 Introduction to Graph Theory, Graph Isomorphism and Connectivity, Euler and Hamiltonian Graphs Planar Graphs and Graph Coloring, Matching, Graph Algorithms	Lecture Slides R1: Ch. 8.1-8.8	Basic Concepts, Special Graphs, Elementary Theorems on Graphs, Graph Representation: Adjacency & Incidence Matrices Problem modeling, Path and Cycles, Isomorphism in Graphs, Connected graphs, connected components, cut-vertices, and cut-edges, Applications, Definitions, Conditions (necessary and sufficient) for existence of Euler path and Hamiltonian cycles Planar Graphs, Euler formula for planer graphs, characterization of planar graphs, Graph Coloring: Vertex and Edge coloring, Chromatic graphs chromatic number. Basic bounds on chromatic number. Five color theorem, Applications of Graph

			planarity, Applications of graph coloring, Matching and Covering in Bi-partite graph, Perfect Matching, Maximal Matching and Augmented Paths, Applications, Graph Traversal: BFS, DFS, Spanning Tree: Prim, Kruskal, Shortest Path: Dijkstra, Bellman Ford
Module 8: Trees	L31-L33 Intro to Trees, Tree Traversals, Spanning Trees	Lecture Slides R1: Ch. 9.1-9.5	Introduction to trees and its real-world applications, tree traversal algorithms, spanning trees, minimum spanning trees, MST algorithms and their applications
Module 9: Number Theory & Modular Arithmetic	L34-L38 Intro to number theory, modular arithmetic, cryptography basics	Lecture Slides R1: Ch. 3.3-3.8	To give an introduction to number theory, modular arithmetic and their applications to various domains of computer science including cryptography
Module 10: Algebraic Structures	L39-L42 Introduction to Algebraic Structures	Lecture Slides R1: Ch. 11.1-11.5	The structure of algebra, Types of algebraic systems: Semi-group, monoid, group, generator of a group, Rings, Fields, & Vector Spaces

6. EVALUATION SCHEME:

Component Duration Weightage (%) Date & Time

Component	**Duration**	**Marks and Weightage**	**Date & Time**
Mid Sem (Closed Book)	90 mins	60M (30%)	6-Mar-21 – 2 PM
Quiz 1 (Closed Book)	45 mins	30M (15%)	24-Mar-2021 – 8 AM
Quiz 2 (Closed Book)	45 mins	30M (15%)	14-Apr-2021 – 8 AM
Comprehensive (Partly Open Book)	120 mins	80M (40%)	15-May-2021 FN

*The mode of conduction and the syllabus for each evaluative component will be announced well before the date of the examination.

7. CHAMBER CONSULTATION HOUR:

Prior appointment by email.

8. MAKE-UP POLICY:

Mid Sem Test: Make-up shall be granted on genuine basis.
Quizzes: No make-up for quizzes.
Compre: Make up for compre exam will be given as per institute rules.
Prior permission from I/C is a must for makeup of any evaluation component.

9. NOTICES:

All the announcements will be made by sending broadcast or personal mails. Announcements will also be made on Nalanda.

Instructor–in-charge