



**BITS Pilani**  
Pilani | Dubai | Goa | Hyderabad

**BIRLA INSTITUTE OF  
TECHNOLOGY & SCIENCE,  
PILANI  
WORK INTEGRATED LEARNING PROGRAMMES  
COURSE HANDOUT**

**Part A: Content Design**

|                      |                                       |
|----------------------|---------------------------------------|
| <b>Course Title</b>  | Data Structures and Algorithms Design |
| <b>Course No(s)</b>  | SS ZG519                              |
| <b>Credit Units</b>  | 5                                     |
| <b>Course Author</b> | A. Baskar                             |
| <b>Version No</b>    |                                       |
| <b>Date</b>          |                                       |

**Course Objectives**

|            |   |
|------------|---|
| <b>CO1</b> | Introduce mathematical and experimental techniques to analyze algorithms  |
| <b>CO2</b> | Introduce linear and non-linear data structures and best practices to choose appropriate data structure for a given application   |
| <b>CO3</b> | Teach various dictionary data structures (Lists, Trees, Heaps) with illustrations on possible representation, various operations and their efficiency   |
| <b>CO4</b> | Exposes students to various sorting and searching techniques  |
| <b>CO5</b> | Discuss in detail various algorithm design approaches ( Greedy method, divide and conquer, dynamic programming, backtracking, and branch and bound) with appropriate examples, methods to make correct design choice and the efficiency concerns. |
| <b>CO6</b> | Introduce complexity classes , notion of NP-Completeness, ways of classifying problem into appropriate complexity class   |
| <b>CO7</b> | Introduce reduction method to prove a problem's complexity class.   |

**Text Book(s)**

|    |  |
|----|--|
| T1 | Algorithms Design: Foundations, Analysis and Internet Examples Michael T. Goodrich, Roberto Tamassia, 2006, Wiley (Students Edition) |
|----|--|

**Reference Book(s) & other resources**

|    |  |
|----|--|
| R1 | Data Structures, Algorithms and Applications in C++, Sartaj Sahni, Second Ed, 2005, Universities Press |
| R2 | Introduction to Algorithms, TH Cormen, CE Leiserson, RL Rivest, C Stein, Third Ed, 2009, PHI           |

**Content Structure**

1. Analyzing Algorithms [3 Hours]
  - 1.1. Theoretical Foundation

- 1.1.1. Algorithms and it's Specification
    - 1.1.2. Random Access Machine Model
    - 1.1.3. Counting Primitive Operations
    - 1.1.4. Notion of best case, average case and worst case
  - 1.2. Characterizing Run Time
    - 1.2.1. Use of asymptotic notation
    - 1.2.2. Big-Oh Notation, Little-Oh, Omega and Theta Notations
  - 1.3. Correctness of Algorithms
  - 1.4. Analyzing Recursive Algorithms
    - 1.4.1. Recurrence relations
    - 1.4.2. Specifying runtime of recursive algorithms
    - 1.4.3. Solving recurrence equations
  - 1.5. Case Study: Analyzing Algorithms
- 2. Elementary Data Structures [2 hours]
  - 2.1. Stacks
    - 2.1.1. Stack ADT and Implementation
    - 2.1.2. Applications
  - 2.2. Queues
    - 2.2.1. Queue ADT and Implementation
    - 2.2.2. Applications
  - 2.3. List
    - 2.3.1. Notion of position in lists
    - 2.3.2. List ADT and Implementation
- 3. Non-Linear Data Structures [4 hours]
  - 3.1. Trees
    - 3.1.1. Terms and Definition
    - 3.1.2. Tree ADT
    - 3.1.3. Applications
  - 3.2. Binary Trees
    - 3.2.1. Properties
    - 3.2.2. Representations (Vector Based and Linked)
    - 3.2.3. Binary Tree traversal (In Order, Pre Order, Post Order)
    - 3.2.4. Applications
  - 3.3. Heaps
    - 3.3.1. Definition and Properties
    - 3.3.2. Representations (Vector Based and Linked)
    - 3.3.3. Insertion and deletion of elements
    - 3.3.4. Heap implementation of priority queue
    - 3.3.5. Heap sort
- 4. Dictionaries [ as Hash Tables and Search Trees] [3 hours]
  - 4.1. Unordered Dictionary
    - 4.1.1. ADT Specification
    - 4.1.2. Applications
  - 4.2. Hash Tables
    - 4.2.1. Notion of Hashing and Collision (with a simple vector based hash table)
    - 4.2.2. Hash Functions
      - 4.2.2.1. Properties
      - 4.2.2.2. Simple hash functions
    - 4.2.3. Methods for Collision Handling
      - 4.2.3.1. Separate Chaining
      - 4.2.3.2. Notion of Load Factor
      - 4.2.3.3. Rehashing

- 4.2.3.4. Open Addressing [ Linear & Quadratic Probing, Double Hash]
- 4.3. Ordered Dictionary
  - 4.3.1. ADT Specification
  - 4.3.2. Applications
- 4.4. Binary Search Tree
  - 4.4.1. Motivation with the task of Searching and Binary Search Algorithm
  - 4.4.2. Properties of BST
  - 4.4.3. Searching an element in BST
  - 4.4.4. Insertion and Removal of Elements
  - 4.4.5. Performance
- 5. Algorithm Design Techniques [ 6 Hours ]
  - 5.1. Greedy Method
    - 5.1.1. Design Principles and Strategy
    - 5.1.2. Fractional Knapsack Problem
    - 5.1.3. Task Scheduling Problem
  - 5.2. Divide and Conquer
    - 5.2.1. Design Principles and Strategy
    - 5.2.2. Analyzing Divide and Conquer Algorithms
    - 5.2.3. Integer Multiplication Problem
    - 5.2.4. Sorting Problem
      - 5.2.4.1. Merge Sort Algorithm
      - 5.2.4.2. Quick Sort Algorithm
    - 5.2.5. Searching Problem and Binary Search Algorithm [Ref to 4.4.1]
  - 5.3. Dynamic Programming
    - 5.3.1. Design Principles and Strategy
    - 5.3.2. Matrix Chain Product Problem
    - 5.3.3. 0/1 Knapsack Problem
  - 5.4. Graph Algorithms
    - 5.4.1. Introduction to Graphs
    - 5.4.2. Prim's and Kruskal's Algorithms [Greedy]
    - 5.4.3. Dijkstra's Algorithm [Greedy]
    - 5.4.4. Bellman-ford Shortest Path Algorithm [Greedy]
    - 5.4.5. All Pair Shortest Path Algorithm [Dynamic Programming]
- 6. Complexity Classes [4 hours]
  - 6.1. Definition of P and NP classes and examples
  - 6.2. Understanding NP-Completeness
    - 6.2.1. NP-Hardness
    - 6.2.2. Polynomial time reducibility
    - 6.2.3. Cook-Levin theorem
    - 6.2.4. Problems in NP-Complete and using polynomial time reductions
      - 6.2.4.1. CNF-SAT, 3-SAT
      - 6.2.4.2. Vertex Cover
      - 6.2.4.3. Clique and Set-Cover
      - 6.2.4.4. Subset-Sum and Knapsack
      - 6.2.4.5. Hamiltonian Cycle and TSP

**Learning Outcomes:**

| No  | Learning Outcomes   |
|-----|---|
| LO1 | Describe various fundamental data structures, their properties, algorithm design techniques |

|     |  |
|-----|--|
|     | and various means of evaluating algorithms   |
| LO2 | Demonstrate the ability to evaluate algorithms, to select from a range of possible options, to provide justification for that selection, and to implement the algorithm in a particular context. |
| LO3 | Solve problems using Algorithms for Linear and Non-Linear Data Structures, Graph algorithms (Shortest Paths Algorithms, Connectivity and Reachability Algorithms, Spanning Trees)                |
| LO4 | Explain with a practical example, each of the algorithm design strategies (brute-force, greedy, divide-and-conquer, recursive backtracking, and dynamic programming)                             |
| LO5 | Use brute-force, greedy, divide-and-conquer, recursive backtracking, and dynamic programming techniques to solve a given algorithm design problem.   |
| LO6 | Relate the real-world problems to known data structures and algorithms leading to the recommend appropriate solutions in representation and implementation.                                      |
| LO7 | Explain the significance of NP-completeness  |
| LO8 | Classify problems into complexity classes P and NP and to prove hardness of problems   |

## Part B: Contact Session Plan

|                          |                                       |
|--------------------------|---------------------------------------|
| <b>Academic Term</b>     | Second Semester 2021-2022             |
| <b>Course Title</b>      | Data Structures and Algorithms Design |
| <b>Course No</b>         | SS ZG519                              |
| <b>Content Developer</b> | BASKAR                                |

### Glossary of Terms

- Contact Hour (CH) stands for a hour long live session with students conducted either in a physical classroom or enabled through technology. In this model of instruction, instructor led sessions will be for 22 CH.
  - Pre CH = Self Learning done prior to a given contact hour
  - During CH = Content to be discussed during the contact hour by the course instructor
  - Post CH = Self Learning done post the contact hour
- Contact Hour (CS) stands for a two-hour long live session with students conducted either in a physical classroom or enabled through technology. In this model of instruction, instructor led sessions will be for 11 CS.
  - Pre CS = Self Learning done prior to a given contact session
  - During CS = Content to be discussed during the contact session by the course instructor
  - Post CS = Self Learning done post the contact session
- RL stands for Recorded Lecture or Recorded Lesson. It is presented to the student through an online portal. A given RL unfolds as a sequences of video segments interleaved with exercises
- SS stands for Self-Study to be done as a study of relevant sections from textbooks and reference books. It could also include study of external resources.
- LE stands for Lab Exercises
- HW stands for Home Work.

7. M stands for module. Module is a standalone quantum of designed content. A typical course is delivered using a string of modules. M2 means module 2.

### **Teaching Methodology (Flipped Learning Model)**

The pedagogy for this course is centered around flipped learning model in which the traditional class-room instruction is replaced with recorded lectures to be watched at home as per the student's convenience and the erstwhile home-working or tutorials become the focus of classroom contact sessions. Students are expected to finish the home works on time.

### **Contact Session Plan**

- o Each Module (M#) covers an independent topic and module may encompass more than one Recorded Lecture (RL).
- o **Contact Sessions (2hrs each week)** are scheduled alternate weeks after the student watches all Recorded Lectures (RLs) of the specified Modules (listed below) during the previous week
- o In the flipped learning model, Contact Sessions are meant for in-classroom discussions on cases, tutorials/exercises or responding to student's questions/clarification--- may encompass more than one Module/RLs/CS topic.
- o Contact Session topics listed in course structure (numbered CSx.y) may cover several RLs; and as per the pace of instructor/students' learning, the instructor may take up more than one CS topic during each of the below sessions.

### **Detailed Structure**

**Introductory Video/Document:** << *Introducing the faculty, overview of the course, structure and organization of topics, guidance for navigating the content, and expectations from students*>>

- Each of the sub-modules of **Recorded Lectures** (RLx.y) shall delivered via **30 – 60mins videos** followed by:
- **Contact session** (CSx.y) of 2Hr each for illustrating the concepts discussed in the videos with exercises, tutorials and discussion on case-problems (wherever appropriate); contact sessions (CS) may cover more than one recorded-lecture (RL) videos.

### **Course Contents**

#### **Contact Hour 1**

| Time      | Type  | Description  | Content Reference |
|-----------|-------|--|-------------------|
| Pre CH    | RL1.1 |  |                   |
| During CH | CH1   | CH1.1= Introduction<br>CH1.2 = Algorithms and it's Specification,<br>CH1.3 = Random Access Machine Model, Counting<br>Primitive Operations<br>CH1.4= Notion of best case, average case and worst<br>case | T1: 1.1.1-1.1.3   |
| Post CH   | SS1   |  |                   |
|           | HW1   |  |                   |

|               |     |  |  |
|---------------|-----|--|--|
|               | LE1 |  |  |
|               | QZ1 |  |  |
| Lab Reference |     |  |  |

### **Contact Hour 2**

| Time          | Type  | Description  | Content Reference |
|---------------|-------|--|-------------------|
| Pre CH        | RL1.1 |  |                   |
| During CH     | CH2   | CH2.1 =Use of asymptotic notation (Big-Oh Notation, Little-Oh, Omega and Theta Notations)<br>CH2.2 = Correctness of Algorithms | T1: 1.2           |
| Post CH       | SS2   | T1 – 1.3   |                   |
|               | HW2   | T1 - R-1.15, R-1.19  |                   |
|               | LE2   |  |                   |
|               | QZ2   |  |                   |
| Lab Reference |       |  |                   |

### **Contact Hour 3**

| Time          | Type | Description  | Content Reference      |
|---------------|------|--|------------------------|
| Pre CH        |      |  |                        |
| During CH     | CH3  | CH3.1= Analyzing Recursive Algorithms:<br>CH3.2= Recurrence relations, CH3.3= Specifying runtime of recursive algorithms,<br>CH3.4= Solving recurrence equations | T1: 1.1.4, Class Notes |
| Post CH       | SS3  |  |                        |
|               | HW3  |  |                        |
|               | LE3  |  |                        |
|               | QZ3  |  |                        |
| Lab Reference |      |  |                        |

### **Contact Hour 4**

| Time          | Type  | Description  | Content Reference |
|---------------|-------|--|-------------------|
| Pre CH        | RL1.2 |  |                   |
| During CH     | CH4   | CH4.1 =Stacks: ADT and Implementation, Applications<br>CH4.2= Queues: Queue ADT and Implementation, Applications | T1: 2.1           |
| Post CH       | SS4   |  |                   |
|               | HW4   |  |                   |
|               | LE4   |  |                   |
|               | QZ4   |  |                   |
| Lab Reference |       |  |                   |

### **Contact Hour 5**

| Time      | Type  | Description   | Content Reference |
|-----------|-------|---|-------------------|
| Pre CH    | RL1.2 |   |                   |
| During CH | CH5   | CH5.1 =List: Notion of position in lists<br>CH5.2 = List ADT and Implementation | T1: 2.2           |

|               |     |            |  |
|---------------|-----|------------|--|
| Post CH       | SS5 |            |  |
|               | HW5 | T1 - R-2.1 |  |
|               | LE5 |            |  |
|               | QZ5 |            |  |
| Lab Reference |     |            |  |

#### **Contact Hour 6**

| Time          | Type  | Description  | Content Reference |
|---------------|-------|--|-------------------|
| Pre CH        | RL1.3 |  |                   |
| During CH     | CH6   | CH6.1 =Trees: Terms and Definition,<br>CH6.2= Tree ADT, Applications<br>CH6.3= Binary Trees : Terms and Definition,<br>CH6.4= Properties | T1: 2.3.1, 2.3.2  |
| Post CH       | SS6   |  |                   |
|               | HW6   |  |                   |
|               | LE6   |  |                   |
|               | QZ6   |  |                   |
| Lab Reference |       |  |                   |

#### **Contact Hour 7**

| Time          | Type  | Description  | Content Reference |
|---------------|-------|--|-------------------|
| Pre CH        | RL1.3 |  |                   |
| During CH     | CH7   | CH7.1 =Binary Trees : Representations (Vector Based and Linked),<br>C H7.2= Binary Tree traversal (In Order, Pre Order, Post Order), CH7.3= Applications | T1: 2.3.3         |
| Post CH       | SS7   |  |                   |
|               | HW7   |  |                   |
|               | LE7   |  |                   |
|               | QZ7   |  |                   |
| Lab Reference |       |  |                   |

#### **Contact Hour 8**

| Time          | Type  | Description  | Content Reference |
|---------------|-------|--|-------------------|
| Pre CH        | RL2.2 |  |                   |
| During CH     | CH8   | CH8.1 =Heaps: Definition and Properties,<br>CH8.2 = Representations (Vector Based and Linked), CH8.3 =Insertion and deletion of elements | T1:2.4.1, 2.4.3   |
| Post CH       | SS8   |  |                   |
|               | HW8   |  |                   |
|               | LE8   |  |                   |
|               | QZ8   |  |                   |
| Lab Reference |       |  |                   |

#### **Contact Hour 9**

| Time   | Type  | Description | Content Reference |
|--------|-------|-------------|-------------------|
| Pre CH | RL2.2 |             |                   |

|               |     |   |                  |
|---------------|-----|---|------------------|
| During CH     | CH9 | CH9.1 =Heaps: Heap implementation of priority queue,<br>CH9.2 = Heap sort | T1: 2.4.2, 2.4.3 |
| Post CH       | SS9 | T1 - Section 2.4.2 PQ-Sort  |                  |
|               | HW9 |   |                  |
|               | LE9 |   |                  |
|               | QZ9 |   |                  |
| Lab Reference |     |   |                  |

### **Contact Hour 10**

| Time          | Type  | Description   | Content Reference              |
|---------------|-------|---|--------------------------------|
| Pre CH        | RL3.1 |   |                                |
| During CH     | CH10  | CH10.1 =Unordered Dictionary :ADT, Applications<br>CH10.2= Hash Tables: Notion of Hashing and Collision (with a simple vector based hash table)<br>CH10.3 = Hash Functions: Properties, Simple hash functions | T1: 2.5.1, 2.5.2, 2.5.3, 2.5.4 |
| Post CH       | SS10  |   |                                |
|               | HW10  |   |                                |
|               | LE10  |   |                                |
|               | QZ10  |   |                                |
| Lab Reference |       |   |                                |

### **Contact Hour 11**

| Time          | Type  | Description   | Content Reference |
|---------------|-------|---|-------------------|
| Pre CH        | RL3.2 |   |                   |
| During CH     | CH11  | CH11.1 =Methods for Collision Handling:<br>CH11.2 = Notion of Load Factor,<br>CH11.3 = Rehashing,<br>CH11.4 = Open Addressing | T1: 2.5.5         |
| Post CH       | SS11  |   |                   |
|               | HW11  |   |                   |
|               | LE11  |   |                   |
|               | QZ11  |   |                   |
| Lab Reference |       |   |                   |

### **Contact Hour 12**

| Time      | Type  | Description   | Content Reference |
|-----------|-------|---|-------------------|
| Pre CH    | RL4.1 |   |                   |
| During CH | CH12  | CH12.1= Ordered Dictionary: ADT, Applications<br>CH12.2 = Binary Search Tree: Motivation with the task of Searching and Binary Search Algorithm,<br>CH12.3 = Properties of BST<br>CH12.4 = Searching an element in BST, Insertion and Removal of Elements | T1: 3.1.1-3.1.5   |
| Post CH   | SS12  | T1: 3.1.6   |                   |
|           | HW12  |   |                   |
|           | LE12  |   |                   |



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|               | QZ12 |  |  |
| Lab Reference |      |  |  |

### **Contact Hour 13**

| Time          | Type | Description   | Content Reference |
|---------------|------|---|-------------------|
| Pre CH        |      |   |                   |
| During CH     | CH13 | CH13.1 =CH12.1 =Greedy Method: Design Principles and Strategy,<br>CH12.2 =Fractional Knapsack Problem | T1: 5.1.1         |
| Post CH       | SS13 |   |                   |
|               | HW13 |   |                   |
|               | LE13 |   |                   |
|               | QZ13 |   |                   |
| Lab Reference |      |   |                   |

### **Contact Hour 14**

| Time          | Type | Description                                   | Content Reference |
|---------------|------|---|-------------------|
| Pre CH        |      |   |                   |
| During CH     | CH14 | CH14.1 =Greedy Method Task Scheduling Problem | T1:5.1.2          |
| Post CH       | SS14 |   |                   |
|               | HW14 |   |                   |
|               | LE14 |   |                   |
|               | QZ14 |   |                   |
| Lab Reference |      |   |                   |

### **Contact Hour 15**

| Time          | Type  | Description   | Content Reference |
|---------------|-------|---|-------------------|
| Pre CH        | RL2.1 |   |                   |
| During CH     | CH15  | CH15.1 =Divide and Conquer: Design Principles and Strategy,<br>CH15.2 = Analyzing Divide and Conquer Algorithms CH15.3 = Integer Multiplication Problem | T1:5.2.1, 5.2.2   |
| Post CH       | SS15  |   |                   |
|               | HW15  |   |                   |
|               | LE15  |   |                   |
|               | QZ15  |   |                   |
| Lab Reference |       |   |                   |

### **Contact Hour 16**

| Time      | Type            | Description                               | Content Reference |
|-----------|-----------------|---|-------------------|
| Pre CH    | RL2.1,<br>RL2.2 |   |                   |
| During CH | CH16            | CH16.1 = Merge Sort<br>CH16.2 =Quick Sort | T1:4.1, 4.3       |
| Post CH   | SS16            |   |                   |
|           | HW16            |   |                   |
|           | LE16            |   |                   |

|               |      |  |  |
|---------------|------|--|--|
|               | QZ16 |  |  |
| Lab Reference |      |  |  |

### **Contact Hour 17**

| Time          | Type | Description  | Content Reference |
|---------------|------|--|-------------------|
| Pre CH        |      |  |                   |
| During CH     | CH17 | CH17.1 =Dynamic Programming: Design Principles and Strategy, CH17.2 = Matrix Chain Product Problem<br>CH17.3 =0/1 Knapsack Problem | T1: 5.3.1, 5.3.2  |
| Post CH       | SS17 |  |                   |
|               | HW17 |  |                   |
|               | LE17 |  |                   |
|               | QZ17 |  |                   |
| Lab Reference |      |  |                   |

### **Contact Hour 18**

| Time          | Type         | Description  | Content Reference |
|---------------|--------------|--|-------------------|
| Pre CH        | RL5.1, RL5.2 |  |                   |
| During CH     | CH18         | CH18.1 = Graphs : Terms and Definitions, Properties, CH18.2 = Representations (Edge List, Adjacency list, Adjacency Matrix)<br>CH18.3 = Graph Traversals | T1: 6.1, 6.2,6.3  |
| Post CH       | SS18         | T1: 6.4  |                   |
|               | HW18         |  |                   |
|               | LE18         |  |                   |
|               | QZ18         |  |                   |
| Lab Reference |              |  |                   |

### **Contact Hour 19**

| Time          | Type           | Description  | Content Reference        |
|---------------|----------------|--|--------------------------|
| Pre CH        | RL 5.4, RL 5.5 |  |                          |
| During CH     | CH19           | CH 19.1 =Single Source Shortest Path algorithm: Dijkstra's Algorithm<br>CH19.2 = Definition of P and NP classes and examples | T1:7.1.1<br><br>T1: 13.1 |
| Post CH       | SS19           | T1.7.1.2, 7.2.1, 7.3.1, 7.3.2  |                          |
|               | HW19           |  |                          |
|               | LE19           |  |                          |
|               | QZ10           |  |                          |
| Lab Reference |                |  |                          |

### **Contact Hour 20**

| Time      | Type | Description   | Content Reference |
|-----------|------|---|-------------------|
| Pre CH    |      |   |                   |
| During CH | CH20 | CH20.1 =Understanding NP-Completeness: CNF-SAT Cook-Levin theorem | T 13.2, T 13.3    |

|               |      |   |  |
|---------------|------|---|--|
|               |      | CH20.2 =Polynomial time reducibility: CNF-SAT and 3-SAT, Vertex Cover |  |
| Post CH       | SS20 |   |  |
|               | HW20 |   |  |
|               | LE20 |   |  |
|               | QZ20 |   |  |
| Lab Reference |      |   |  |

### **Contact Hour 21**

| Time          | Type | Description   | Content Reference |
|---------------|------|---|-------------------|
| Pre CH        |      |   |                   |
| During CH     | CH21 | CH21.1 =Clique and Set-Cover,<br>CH21.2 = Subset-Sum and Knapsack | T1:13.3           |
| Post CH       | SS21 | Traveling Salesman Problem  |                   |
|               | HW21 |   |                   |
|               | LE21 |   |                   |
|               | QZ21 |   |                   |
| Lab Reference |      |   |                   |

### **Contact Hour 22**

| Time          | Type | Description            | Content Reference |
|---------------|------|------------------------|-------------------|
| Pre CH        |      |                        |                   |
| During CH     | CH22 | CH22.1 = Course Review |                   |
| Post CH       | SS22 |                        |                   |
|               | HW22 |                        |                   |
|               | LE22 |                        |                   |
|               | QZ22 |                        |                   |
| Lab Reference |      |                        |                   |

### **Evaluation Scheme:**

Legend: EC = Evaluation Component; AN = After Noon Session; FN = Fore Noon Session

| No   | Name                    | Type        | Duration | Weight | Day, Date, Session, Time                     |
|------|-------------------------|-------------|----------|--------|--|
| EC-1 | Quiz-I/ Assignment-I    | Online      | -        | 5%     | February 1-15, 2021                          |
|      | Quiz-II                 |             |          | 5%     | March 1-15, 2021                             |
|      | Quiz-III/ Assignment-II |             |          | 5%     | April 1-15, 2021                             |
| EC-2 | Mid-Semester Test       | Closed Book | 2 hours  | 35%    | Saturday, 06/03/2021 (FN)<br>10 AM - 12 Noon |
| EC-3 | Comprehensive Exam      | Open Book   | 3 hours  | 50%    | Saturday, 01/05/2021 (FN)<br>9 AM – 12 Noon  |

**Note** - Evaluation components can be tailored depending on the proposed model.

### **Important Information:**

Syllabus for Mid-Semester Test (Closed Book): Topics in CS 1-5.

Syllabus for Comprehensive Exam (Open Book): All topics given in plan of study

Evaluation Guidelines:

1. For Closed Book tests: No books or reference material of any kind will be permitted. Laptops/ Mobiles of any kind are not allowed. Exchange of any material is not allowed.
2. For Open Book exams: Use of prescribed and reference text books, in original (not photocopies) is permitted. Class notes/slides as reference material in filed or bound form is permitted. However, loose sheets of paper will not be allowed. Use of calculators is permitted

in all exams. Laptops/Mobiles of any kind are not allowed. Exchange of any material is not allowed.

3. If a student is unable to appear for the Regular Test/Exam due to genuine exigencies, the student should follow the procedure to apply for the Make-Up Test/Exam. The genuineness of the reason for absence in the Regular Exam shall be assessed prior to giving permission to appear for the Make-up Exam. Make-Up Test/Exam will be conducted only at selected exam centres on the dates to be announced later.

It shall be the responsibility of the individual student to be regular in maintaining the self-study schedule as given in the course handout, attend the lectures, and take all the prescribed evaluation components such as Assignment/Quiz, Mid-Semester Test and Comprehensive Exam according to the evaluation scheme provided in the handout.