Lectures Outline

Lecture 1-6: Chapter # 1

Lecture 1:
- Introduction

Motivation of DM
- Applications of DM
- Logic and its applications

Lecture 2:
- Logic types
  - Classical, Fuzzy

Classical Logic
- Simple Logic
  - Proposition
- Compound Logic
  - Logical Connectors
    - AND, OR, NOT, IMPLICATION, BI-Implication
  - Logical Equivalence

Lecture 3:
- Quiz
- Tautology
- Contradiction
- Logical Equivalence using Tautology
- Converse
- Inverse
- Contradiction
- Negation

Lecture 4:
- Predicate Logic
  - Motivation
- Quantification
  - Prefix and Quantifiers
  - Proposition Function
  - Types of Quantifiers
    - Existential
    - Universal
  - Negation of quantifiers

Lecture 5:

- Translation English into Quantifiers
- Binding and Free Variables
- Nested Quantifiers

Lecture 6:

- Logical Proofs
- Types of Proof
  - Direct proof
  - Indirect Proof
    - Proof by Contraposition
    - Proof by Contradiction

Lecture 7-9: Chapter # 2

Lecture 7:

- Set Theory
  - Set Representation
    - Set Builder Notation
    - Veinn Diagrams
    - Subset and its Derivatives
  - Set Operations
  - Representation of Set Concepts using Predicate Logic
  - Proof of Set Properties using Set Builder Notation
  - Representation of Set in Computers using Bit strings
  - Set Operations using Bit strings

Self Study: Cartesian Product

- Intro to Functions
  - What is a Function
  - Domain, Range, Co-Domain and Image of a Function

Lecture 8:

- Types of Functions
  - Onto functions
  - One-to-one
  - Bijective
- Inverse of Functions
- Composition of Functions
- Widely used functions
  - Increasing, Strictly-Increasing, Decreasing, Strictly Decreasing, Ceiling, Floor
  - Representation of increasing and decreasing functions using predicate logic

Sequence and Summations
- Recurrence Relations
- Base Conditions
- Expressing Summations

Lecture 9:

Class Feedback
Closed-Form Solutions vs Recurrence relations
Closed-Form Solution of Geometric Series
- Limit Shifting
- Summation Expansion

Lecture 10-12: Chapter # 5

Lecture 10:

Long Quiz
Introduction to Induction
- Sample Questions

Lecture 11:

Weak Induction
Practice Examples
Strong Induction

Lecture 12:

Weak Induction Quiz
Strong Induction
Recursion

Lecture 13:

Long Quiz Solution
Recurrence relations and Recursion

Lecture 14-18: Chapter # 3

Lecture 14:

Revision of set concepts
Function Growth

Lecture 15

- Function Growth
- Proofs revision

Lecture 16

- Mid term Revision

Lecture 17

- Time Complexity
- Importance of time Complexity

Lecture 18

- Big oh, omega and Theta

Lecture 19

- Mid term solution
- Paper show

Lecture 20-22: Chapter # 4

Lecture 20

- Number Theory
    - Modular Arithmetic
    - Congruent

Lecture 21

- Number Theory
    - Prime Numbers
    - GCD, LCM

Lecture 22

- Number Theory
- Cryptography

Lecture 23-27: Chapter # 10

Lecture 23

- Graphs
    - Introduction
    - Terminology

Lecture 24

- Graphs Representation
    - Adjacency List
    - Adjacency Matrix
    - Incidence Matrix

Lecture 25

- Number Theory
- Cryptography

Practice Questions

Chapter 1: Logic

Propositional Logic:

Exercise (starting Page 12): Q#1-12, 16-18, 31-39

Read De-Morgan's law from Page 26

Logical Equivalence

Exercise (starting Page 34): Q#1-10, 13-33

Quantification

Exercise (starting Page 53): Q# 1-18, 21, 22, 25, 28, 29

Nested Quantifiers

Exercise (starting Page 64): Q# 1-4, Q5 part (a)-(d), 25-27, 29

Proof practice Questions

Page 91: Q# 1-9, 15-17

Reading:

Rules of Inference: Page # 71-72

Proofs: Page # 81-87

Fuzzy Logic

Page 16: Q# 45-47

Chapter 2: Sequence and Summations[2.1-2.4]

Set Theory:

Basics of Set Theory

Page 125: Q# 1-44

Topic: Set operations, BitStrings, multi-sets, fuzzy-sets

V2: Page 136: Q# 1-11, 25-35, 52-65

V1: Page 136-137: Questions 1-4, 25, 26, 27, 29, 30, 31, 32, 52, 53, 63, 64 , 65

Reading:

Set Identities Page # 130

Function

Page 152: Q# 1-33, 77 (Partial Function)

Reading:

Section 2.3 starting Page 138-145

Summation

Page 167: Q#1-6(a)-(f), 7-10, 18(a), 19(a), 29-34

Reading : Page # 156-160, Page # 164-166, Theorem 1 at Page 164

Chapter 5: Induction and Recursion

Induction:

Page # 329: Q# 1-24, 31-36

Chapter 4: Number Theory and CryptoGraphy

- **Section 4.1 (Divisibility and Modular Arithmetic):**
  - Page # 244: 1, 2 , 5, 6, 9 b) c) , 11, 12, 15, 21, 25 d), 28 to 33, 40
  - Compute $(53 * 3^{100} + 3^{101})^{25} \bmod 7$.

- **Section 4.3 (Primes and Greatest Common Divisors)**
  - Page # 272, Q# 1 to 4, 17, 25, 27, 28, 30, 31, 33

Chapter 10: Graphs

Graphs and Graph Models: Page 649: Q#1-10

Graph Terminology, Special Graphs and their applications:Page 665-666: Q#1-5, 7-10, 20-26

Representation of Graphs and Isomorphism: Page 675-677: Q#1-22, 34-40

Connectivity: Page 689 1-5,11

Euler and Hamiltonian Graphs: Page 703-705: 1-8, 13-15, 18-23, 26, 30-36

Shortest Path Problems: Page 716: 1-8

Planar Graphs: Page 725: 2,3,4

Graph Coloring: Page 732-733: Q 1-11

For dual graphs: please read page 727.

10.2 Graph Terminology, Special Graphs and their applications: Page 651 to 662
10.3 Representation of Graphs and Isomorphism: 668 to 673
10.4 Connectivity: Page 678-682
10.5 Euler and Hamilton Paths: Page 693 to 700
10.6 Shortest Path Problems: Page 708-716
10.7 Planar Graph: Page 718-720
10.8 Graph Coloring: Page 727-732

Chapter 11: Trees

Introduction Page 755: 1-10
Traversals Page 783-785: 7-19, 22-29
Spanning Tree Page 796-797: 1-9, 13-18

Chapter 6: Counting

Section 6.1 (The Basics of Counting):
    - 1 - 22, 26, 32, 34, 35, 41, 47, 53, 55, 56.

- Section 6.2 (The Pigeonhole Principle):
    - 5, 9, 19, 31.

- Section 6.3 (Permutations and Combinations):
    - 3, 5, 11, 10, 19, 21(a)(d), 23, 25, 30, 32, 33, 34, 37, 40.