BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus

**INSTRUCTION DIVISION**
**FIRST SEMESTER 2018-19**
**COURSE HANDOUT(PART-II)**

02.08.2018

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.** : **MATH F213**
**Course Title** : **Discrete Mathematics**
**Instructor In Charge** : **RAJIV KUMAR**

**1. COURSE DESCRIPTION:**

Language of Mathematics, sets & operations on sets, relations & equivalence relations, elementary logic, propositions, informal proof, logical equivalence, weak- strong form of mathematical induction, pigeonhole principle, elementary combinatorics, principle of inclusion and exclusion, recurrence relations, partial ordering, Boolean algebra.

**2 SCOPE & OBJECTIVE**

The course is helpful in the study of computational systems & study of concepts, techniques, and skills necessary to comprehend the structure of problems encountered in design and analysis of algos. To provide mathematical foundations , that rely upon the comprehension of formal abstract concepts. For objectives course will train students in informal notation for propositional logic. To construct formal proofs in propositional logic , negation of a statement that is needed in mathematical reasoning . To prove theorems with the techniques of direct proof, proof by contraposition, proof by contradiction and proof by induction, recursive definitions and to write recursive definitions for certain sequences and collections of objects. Generating function & recurrence relation Several mathematical structures like relations and partial order, Boolean algebra are studied as they are needed not only in mathematics but also in computer science.

**3. TEXT BOOK:**

**Mott , Kandel, & Baker** : Discrete Mathematics for Computer Scientists & Mathematicians PHI, 3e, 2003.

**4. REFERENCE BOOKS:**

**R1. Kolman , busby ,Ross: Discrete Mathematical Structures**, pearson , 4e, 2004
**R2 Goodaire & Parmenter : Discrete Mathematics and Graph theory** , PHI, 2000

**5. COURSE PLAN:**

| Lecture number | Reference | Learners objective |
|---|---|---|
| L1.Methods of proof and problem solving strategies | Text book article1.4 | Learn different ways in which we can solve a mathematical problem |
| L2 propositions, connectives and truth tables, tautology, Contingency, contradiction, their establishment using truth tables and abbreviated truth tables | Text book Article 1.5 | At the end lecture 2 student must know difference between tautology, Contingency, contradiction and when two propositions are logically equivalent and must be able to write converse, contra positive, opposite of an implication |
| L3 . logical equivalences converse, contra positive, opposite of an implication | Text book Article 1.5 | |
| L4 concept of logical inferences and their validity with some examples | Text book Article 1.6 | To be able to identify whether a inference is valid , to be able to connect |

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| L5. How to prove whether a inference is valid taking help of rule of inferences | Text book Article 1.6 | truth table and inferences |
| L6 ( vacuous, direct, indirect and proofs by contradiction) Examples of proof of an implication | Text book Article 1.7 | Differentiate between different methods of proof through examples, how a simple theorem like pigeonhole principle some times can solve difficult questions |
| L7 Pigeon-hole principle (different versions), some examples based on Pigeon-hole principles | Text book Article 1.7 | |
| L 8 First order logic , De Morgan's laws, methods of proof based on First order logic | Text book Article 1.8 | how Statements in Language can be transformed to symbols |
| L9 Multiple quantifiers, examples, negations and equivalences , Rules of inference in quantified propositions, validity of arguments | Text book Article 1.8 & 1.9 | how multiple quantifiers are needed to transform some statements how statements containing multiple quantifies can be negated |
| *L10* proof by mathematical induction | Text book article 1.10 | Several questions can not be done without mathematical induction? |
| Lecture n. 11 &12 .generating function of a sequence ,construction of generating function for a sequence finding coefficients of $X^n$ in an expression. | Textbook article 3.1.3.2 | Generating function concept helps in solving counting problems, partial fractions concepts helps in Coefficient computation, recurrence relation are outcome of several mathematical models solving first order linear recurrence relation is simple<br><br>Shifting property helps in computing generating function of sequence faster There are expressions for generating function of sequences that are of help |
| L13 Introduction to recurrence relations Recurrence relation models | Text book article 3.3 | |
| Lecture n.14 Solving recurrence relation by substitution | Text book article 3.4 | |
| L 15 &16 Solving recurrence relation by generating functions shifting property of generating function | Text book article 3.4 | |
| L17 Method of characteristic roots to solve homogeneous recurrence relations | Text book article 3.5 | Characteristic root method is simpler ,For solving linear homogenous recurrence relation but one needs to remember form of particular solution in solving nonhomogenous recurrence relation through method of undetermined coefficients |
| Lecture 18-20 Solving inhomogeneous recurrence relation through generating function and undetermined coefficients Solving nonlinear recurrence relations | Text book article 3.6 | |

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| Lecture 21-22 definition of relation , digraph, subdigraph, indegree ,outdegree , degree spectrum, digraphs on 2 three and four vertices ,Non isomorphic digraphs with same degree spectrum identifying non isomorphic sub digraphs | Article 4.1 | Digraph representation of relation helps in understanding relation better Concepts illustration isomorphic graphs have same degree spectrum but graph having same degree spectrum can be nonisomorphic |
| Lecture 23-24 Different type of relations on a finite set A and their digraphs Matrix of Relation on a finite set, explanations and counting number of relations of certain type Equivalence relation, partition of a set theorem equivalence classes , | Article 4.2-4.3 | isomorphism in digraphs is a equivalence relation, equivalence classes of digraphs matrix representation of a relation helps in operations on relation, number of equivalence relations and partition of a set are related . |
| **Lecture 25-26** : partial order, linear order well order, hasse diagram , nine : maximal, minimal, least, greatest, glb ,lub Join and meet semi lattice , lattice theorems of lattice. | Text book 4.4 & R1 6.1-6.3 | hasse diagram contains all information of partial order on the set, lattice structure is needed in study of Boolean algebra |
| Lecture 27-28 operations on relations and matrices Paths and relations and digraph, closure Of a set with respect to a property, reflexive and symmetric closure Paths of length n and matrices | Text book 4.5-4.6 | Matrix representation is helpful in understanding operations on relations as well as in concept of closure |
| Lecture 29-30 Warshall Algo for transitive closure Weakly , strongly and unilateral connected digraph | Textbook 4.6-4.7 | For Transitive closure computation there are several ways, distinguish between three different type of connectedness |
| Lecture 31-32 Big O Definition , theorem , theta Class of Functions | Textbook 4.2.1 & article 5.3 of R1 | Big O is needed in study of Complexity of Algorithms |
| Lecture 33-34 Complemented and distributive lattices, isomorphic lattices Sublattices | R1 6.3 | hasse diagram helps in identifying such lattices |
| Lecture 35-36 Boolean Algebra defn , boolean algebra as distributive complemented lattice Boolean Algebra theorems , well known examples of boolean algebra, dual of a boolean equation, Atom in Boolean Algebra | Text book 6.1, 6.2 R1 6.4 | All finite Boolean Algebra are isomorphic to $B_n$ for some n , |

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| theorems that are related with concept of atom | | |
| Lecture 37-40 Boolean functions , tabular representation, Literal , Minterm , max term Canonical form introduction , Computation of Canonical form through tabular representation , Simplifying boolean functions karnaugh map , construction for 3 and four variables karnaugh map and simplifying boolean function of three variables , karnaugh map and simplifying boolean function of four variables, Logic gates introduction Logic circuit for boolean function | Text book 6.3-6.5 | Boolean functions are needed in Computer science Canonical forms of a Boolean function are unique, karanaugh map is a powerful technique , |

**6. EVALUATION SCHEME:**

| Component | Time | weightage | Date & Time | Remarks |
|---|---|---|---|---|
| Mid Sem.Test | 90 minute | 35% | 12/10 9:00 - 10:30 AM | Closed book |
| Quiz | Regular | 20% | unannounced | Open book |
| Comprehensive | 3 hours | 45% | 11/12 FN | closed book |

**7. CHAMBER CONSULTATION HOUR:** To be announced in class

**8. MAKE-UP Policy:** Prior permission needed for make-up.

**9. NOTICES:** All notices related to the course will be put up on MATH NB normally information will be passed in the class.

**Instructor–in-charge**
**MATH F213**