DISCRETE MATHEMATICS - IIITB

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INTENDED AUDIENCE : The course is intended for any student from the computer science discipline

COURSE OUTLINE :
Discrete mathematics is the study of mathematical structures that are discrete in the sense that they assume only distinct, separate values, rather than in a range of values. It deals with the mathematical objects that are widely used in all most all fields of computer science, such as programming languages, data structures and algorithms, cryptography, operating systems, compilers, computer networks, artificial intelligence, image processing, computer vision, natural language processing, etc. The subject enables the students to formulate problems precisely, solve the problems, apply formal proof techniques and explain their reasoning clearly.

ABOUT INSTRUCTOR :
Prof. Ashish Choudhury is currently an Associate Professor at IIIT Bangalore. He did his MS and PhD in Computer science from IIT Madras, followed by postdoc at ISI Kolkata and University of Bristol. His research work is focused on the foundation of cryptographic protocols for real-world problems. His current projects aim to design efficient protocols in the asynchronous network model which can be realized in practice. In general he is interested in secure distributed computing and all areas of theoretical computer science.

COURSE PLAN :

Week 1: Logic: Proposition and Predicate Logic, introduction to proof techniques

Week 2: Advanced proof techniques, resolution, induction

Week 3: Set theory and relations

Week 4: Various types of relations and functions

Week 5: Combinatorics Part I: permutations, combinations, sum rule, product rule, pigeon-hole principle, Ramsey numbers

Week 6: Combinatorics Part II: Combinatorial proofs, Catalan numbers, counting using recursion, principal of inclusion-exclusion, advanced counting techniques

Week 7: Recurrence equations and various methods of solving recurrence equations

Week 8: Cardinality theory, countable and uncountable sets, Cantors diagonalization, uncomputable functions

Week 9: Graph theory Part I: basic definitions, Eulers theorem, bipartite graphs and matching, Halls marriage theorem, various operations on graphs

Week 10: Graph theory part II: isomorphism, vertex-connectivity, edge-connectivity, Euler graphs and Hamiltonian graphs, various characterizations, vertex and edge coloring

Week 11: Abstract algebra: groups, rings, fields

Week 12: Basic number theory: modular arithmetic, prime numbers and properties, GCD, Chinese remainder theorem, Fermats little theorem, RSA cryptosystem