Lovely Professional University, Punjab

Course Code	Course Title	Course Planner
MTH401	DISCRETE MATHEMATICS	11033::Dr. Kulwinder Singh

Course Outcomes :Through this course students should be able to

CO1 :: understand various ways to prove or disapprove some logical statements.

CO2 :: solve recurrence relation by using different methods.

CO3 :: describe the concept of graphs and their properties.

CO4 :: understand various concepts of number theory and its applications.

	TextBooks (T)		
Sr No	**Title**	**Author**	**Publisher Name**
T-1	DISCRETE MATHEMATICS AND ITS APPLICATIONS	KENNETH H ROSEN	MCGRAW HILL EDUCATION

	Reference Books (R)		
Sr No	**Title**	**Author**	**Publisher Name**
R-1	HIGHER ENGINEERING MATHEMATICS	B. V. RAMANA	MC GRAW HILL

Other Reading (OR)	
Sr No	**Journals articles as Compulsary reading (specific articles, complete reference)**
OR-1	https://drive.google.com/file/d/1tCLv0YkzFQbdo5IYrUXuEFaveTMa18fM/view?usp=sharing ,
OR-2	https://drive.google.com/file/d/1NHPr0ZOBzLkmLk1ci2qzWRRnWatD9Yr3/view?usp=sharing ,
OR-3	https://drive.google.com/file/d/1bHD4iF5M4LoDacNlFaEbbUsrfggK5Hdy/view?usp=sharing ,

Relevant Websites (RW)		
Sr No	**(Web address) (only if relevant to the course)**	**Salient Features**
RW-1	https://www.khanacademy.org/computing/computerscience/cryptography/modarithmetic/a/equivalence-relations	It explain the concept of number theory
RW-2	http://www.cse.ust.hk/~dekai/271/notes/L10/L10.pdf	Explain the Dijkstra's algorithm
RW-3	https://nptel.ac.in/courses/106106094/	The course comprises of some counting and proof techniques for a computer science students.

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RW-4	https://nptel.ac.in/courses/106106183/	The course is an introduction to Discrete Mathematics which comprises of some essentials for a computer science students.

Audio Visual Aids (AV)		
Sr No	**(AV aids) (only if relevant to the course)**	**Salient Features**
AV-1	https://www.mathsisfun.com/games/towerofhanoi.html	Explain the visuals of tower of Hanoi game

LTP week distribution: (LTP Weeks)	
Weeks before MTE	7
Weeks After MTE	7
Spill Over (Lecture)	7

Detailed Plan For Lectures

Week Number	Lecture Number	Broad Topic(Sub Topic)	Chapters/Sections of Text/reference books	Other Readings, Relevant Websites, Audio Visual Aids, software and Virtual Labs	Lecture Description	Learning Outcomes	Pedagogical Tool Demonstration/ Case Study / Images / animation / ppt etc. Planned	Live Examples
Week 1	Lecture 1	Logic and Proofs (Propositional logic)	T-1	RW-3	Zero lecture and Propositional logic(conjunction,dis junction and negation of propositions,conditional and bi-conditional statements)	Students will be familiar with the course content by Zero lecture ppt and will get the understanding of logical statements	Discussion	The truth table of a conditional statement if Sandeep learns discrete Mathematics then he will find a good job.
	Lecture 2	Logic and Proofs (propositional equivalences)	T-1	RW-3	Propositional equivalences(tautology, contradiction ,contingency and logical equivalences) their truth tables ,De Morgan's law	Student will be able to express the truth table of propositional equivalences	Brainstorming problems with white board	
	Lecture 3	Logic and Proofs (quantifiers)	T-1		Quantifiers (universal,existential,quantifiers with restricted domain, precedence of quantifiers,Negating quantified expressions)	Students will be able to understand the different types of quantifier	Discussion	
Week 2	Lecture 4	Logic and Proofs (Introduction to proof, direct proof,proof by contraposition)	T-1		Introduction to proof, direct proof,proof by contraposition	Students will be able to learn different types of proofs techniques	Brainstorming problems with white board	

Week 2	Lecture 5	Logic and Proofs(vacuous and trivial proof, proof strategy, proof by contradiction)	T-1		Vacuous and trivial proof, proof strategy, proof by contradiction	Students will be able to learn different types of proofs techniques	Brainstorming problems with white board	
	Lecture 6	Logic and Proofs(proof of equivalence and counterexamples, mistakes in proof)	T-1		Proof of equivalence and counterexamples, mistakes in proofs	Students will be able to learn different types of proofs techniques and identify the mistakes in the proofs	Brainstorming problems with white board	
Week 3	Lecture 7	Recurrence relations (recurrence relation)	T-1 R-1	AV-1	Introduction to recurrence relation, modelling with recurrence relations	Students will be able to understand the concept of recurrence relation and formation	Brainstorming problems with white board	Solution of Tower of Hanoi game can be obtained by first order linear recurrence relation [A(k +1) - 2A(k)=1, under A(0)=0]. For more details please visit https://www.mathsisfun.com/games/towerofhanoi.html
		Recurrence relations (modelling with recurrence relations)	T-1 R-1	AV-1	Introduction to recurrence relation, modelling with recurrence relations	Students will be able to understand the concept of recurrence relation and formation	Brainstorming problems with white board	Solution of Tower of Hanoi game can be obtained by first order linear recurrence relation [A(k +1) - 2A(k)=1, under A(0)=0]. For more details please visit https://www.mathsisfun.com/games/towerofhanoi.html
	Lecture 8				Online Assignment			
	Lecture 9	Recurrence relations (homogeneous linear recurrence relations with constant coefficients)	T-1 R-1		Homogeneous linear recurrence relations with constant coefficients	Students will be able to understand the different cases for solutions of homogeneous linear recurrence relation with constant coefficients	Lecture delivery with white board	

Week 4	Lecture 10	Recurrence relations (Method of inverse operator to solve the non-homogeneous recurrence relation with constant coefficient)	T-1 R-1		Method of inverse operator to solve the non-homogeneous recurrence relation with constant coefficient	Students will be able to find the solution of non-homogeneous recurrence relation with constant coefficient via inverse operator methods	Students will be able to find the solution of non-homogeneous difference equation with constant coefficient via different methods	
	Lecture 11	Recurrence relations (generating functions, solution of recurrence relation using generating functions)	T-1		Lecture 11: Introduction of generating functions, Lecture 12 : solution of recurrence relation using generating functions	Students will explore the generating functions to solve the recurrence relations	Brainstorming problems with white board	
	Lecture 12	Recurrence relations (generating functions, solution of recurrence relation using generating functions)	T-1		Lecture 11: Introduction of generating functions, Lecture 12 : solution of recurrence relation using generating functions	Students will explore the generating functions to solve the recurrence relations	Brainstorming problems with white board	
Week 5	Lecture 13	Counting principles and relations(principle of Inclusion-Exclusion)	T-1		Principle of Inclusion-Exclusion, an alternative form of Inclusion - Exclusion, computation of the number of onto functions	Students will be able to learn the principle of Inclusion-Exclusion for more than two sets	Brainstorming problems with white board	
	Lecture 14	Counting principles and relations(Pigeonhole, generalized pigeonhole principle)	T-1		Pigeonhole, generalized pigeonhole principle	Students will be able to solve the problems based on understand the pigeonhole, generalized pigeonhole principle	Lecture delivery and white board	
	Lecture 15	Counting principles and relations(relations and their properties, combining relation)	T-1		Relations and their properties, combining relation	Students will be able to understand the relation, their properties and types		
Week 6	Lecture 16	Counting principles and relations(composition, representing relation using matrices and graph)	T-1		Composition, representing relation using matrices and graph	Students will be able to find the composition of relations and represent them in form of matrices and graphs	Lecture delivery with white board	
	Lecture 17				Online Assignment			

Week 6	Lecture 18	Counting principles and relations(equivalence relations, partial and total ordering relations)	T-1		Equivalence relations, partial and total ordering relations	Students will be able to understand the relation, their properties and types	Discussion	The relation (height of a student is greater than another one) on a set of students of the class is not reflexive, symmetric,equivalence
Week 7	Lecture 19	Counting principles and relations(lattice, sub lattice, Hasse diagram and its components)	T-1		Hesse diagram and its components(maximal , minimal, greatest, least elements, upper,lower bounds,superimum and infimium), lattice	Student will be able to understand the graphical rendering of a partially ordered set displayed via the cover relation and also able to identify different components of it	Brainstorming problems with white board	
		SPILL OVER						
Week 7	Lecture 20				Spill Over			
	Lecture 21				Spill Over			
		MID-TERM						
Week 8	Lecture 22	Graphs theory I(graph terminologies)	T-1	OR-2 OR-3 RW-4	Graph undirected (Simple,multi,loop and pseudo-graphs), directed graph,basic terminology (adjacent, isolated and pendant vertex,incident edge, degree)	Students will be able to understand graph terminologies and visualise special types of graphs	Discussion with white board	
	Lecture 23	Graphs theory I(special types of graphs(complete, cycle, regular, wheel, cube, bipartite and complete bipartite))	T-1	OR-2 OR-3 RW-4	Special types of graphs (complete, cycle, regular, wheel, cube, bipartite and complete bipartite)	Students will analyze different type of graph and also able to classify the number of vertices, edges, degree sequence for each type	Discussion with white board	
	Lecture 24	Graphs theory I(representing graphs, adjacency and incidence matrix)	T-1	OR-2 OR-3 RW-4	Sub graph, union, intersection and complement of graph, adjacency and incidence matrices of graphs	Students will be able to explore the representation of graphs	Discussion with white board	
Week 9	Lecture 25	Graphs theory I(graph-isomorphism)	T-1	OR-1 OR-2 RW-4	Graph isomorphism	Student will be able to describe that whether two graphs are isomorphic	Discussion with white board	

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Week 9	Lecture 26	Graphs theory I(path and connectivity for undirected and digraphs)		OR-2 OR-3 RW-4	Graph connectivity (Path, circuit, connected graph and component, cut edge and vertices , strongly and weakly connectivity of directed graph, Path isomorphism)	Students will be able to visualise the transportation network through the graph connectivity	Discussion with white board	
	Lecture 27	Graphs theory I(Dijkstra’s algorithm for shortest path problem)	T-1	RW-2	Shortest path by Dijkastra's algorithm	Students will be able to calculate the shortest path between two vertices of the graph	Problem solving with white board	Least fare between two city
Week 10	Lecture 28	Graphs theory II(planner graphs)	T-1	RW-4	Planner graphs, Euler's formula for planner graph	Students will be able to draw the planner representation of a graph and also able know that whether the planner representation is possible	Lecture delivery	The architecture of petrol pump, fire cracker factory should be designed in such a way that there should not be any edge crossing
		Graphs theory II(Euler formula)	T-1	RW-4	Planner graphs, Euler's formula for planner graph	Students will be able to draw the planner representation of a graph and also able know that whether the planner representation is possible	Lecture delivery	The architecture of petrol pump, fire cracker factory should be designed in such a way that there should not be any edge crossing
	Lecture 29	Graphs theory II(colouring of a graph and chromatic number)	T-1	OR-2 OR-3	Graph colouring, Chromatic number, Chromatic number of special graphs(complete, cycle, regular, wheel, cube, bipartite and complete bipartite) the four colour theorem	Students will be able to calculate the chromatic number of different types of graph	White board teaching with discussion	Teacher needs to prepare minimum number of assignments for the class of 60 students such that no two consecutive can get the same
	Lecture 30	Graphs theory II(tree graph and its properties)	T-1	OR-2 OR-3	Tree graph and its properties	Student will be able to determine whether the give graph is a tree	White board teaching with discussion	

Week 11	Lecture 31	Graphs theory II(rooted tree)	T-1		Introduction of rotted tree and its properties, m-array and full m-array tree	Students will be able to get the idea of rooted tree and its results	White board teaching with discussion	
	Lecture 32	Graphs theory II(spanning and minimum spanning tree)	T-1		Spanning tree and its properties , minimum spanning tree- Prims and Krushkal algorithm	Students will be able to find the minimum spanning tree from the weighted graph	Lecture delivery with white board	You have a business with several offices; you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. It should be a spanning tree.
	Lecture 33	Graphs theory II(decision tree, infix, prefix, and postfix notation)	T-1		Infix, prefix, and post-fix notation	Students will be able to calculate the value by the the pre, in and post fix expression	Lecture delivery with white board	
Week 12	Lecture 34				Online Assignment			
	Lecture 35	Number theory and its application in cryptography (divisibility and modular arithmetic)	T-1	OR-1 RW-1	Divisibility definition,properties,The division algorithm, Modular arithmetic	Students will learn the concept of division algorithm and modular arithmetic	Lecture delivery with white board	
	Lecture 36	Number theory and its application in cryptography (primes, greatest common divisors and least common multiples)	T-1	OR-1 RW-1	Primes, fundamental theorem of arithmetic, greatest common divisor, least common multiple and Euclidean algorithm	Student will be familiar with the primes , least common multiple and greatest common divisor and also able to find the the G.C.D. using Euclidean algorithm .	Lecture delivery with white board	

Week 12	Lecture 36	Number theory and its application in cryptography (Euclidean algorithm)	T-1	OR-1 RW-1	Primes, fundamental theorem of arithmetic, greatest common divisor, least common multiple and Euclidean algorithm	Student will be familiar with the primes , least common multiple and greatest common divisor and also able to find the the G.C.D. using Euclidean algorithm .	Lecture delivery with white board	
Week 13	Lecture 37	Number theory and its application in cryptography (Bezout's lemma)	T-1	OR-1 RW-1	Bezout's theorem of G.C.D. (G.C.D. of positive integers as linear combination)	Students will be able to find the Bezout's coefficients of positive integers using Euclidean algorithm	Lecture delivery with white board	
	Lecture 38	Number theory and its application in cryptography (linear congruence, inverse of (a modulo m))	T-1	OR-1 RW-1	Inverse of (a modulo m), solutions of linear congruence's and properties	Students will be able to find the inverse using Bezout's theorem and use it to solve linear congruence's	Lecture delivery with white board	
	Lecture 39	Number theory and its application in cryptography (encryption and decryption by Ceasar cipher and affine transformation)	T-1	OR-1 RW-1	Encryption and decryption by Ceasar cipher and affine transformation	Students will be able encode and decode the messages by Ceasar cipher and affine transformation	Problem solving	Encrypt the messages by changing each letter to a different letter
Week 14	Lecture 40	Number theory and its application in cryptography (Chinese remainder theorem)	T-1	OR-1	System of linear concordances and solutions by Chinese remainder theorem, Fermat’s little theorem	Students will be able to find the solutions of system of linear concordances using Chinese remainder theorem and also understand the Fermat’s little theorem	Lecture delivery with white board	
		Number theory and its application in cryptography (Fermat’s little theorem)	T-1	OR-1	System of linear concordances and solutions by Chinese remainder theorem, Fermat’s little theorem	Students will be able to find the solutions of system of linear concordances using Chinese remainder theorem and also understand the Fermat’s little theorem	Lecture delivery with white board	
		SPILL OVER						
Week 14	Lecture 41				Spill Over			

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Week 14	Lecture 42				Spill Over			
Week 15	Lecture 43				Spill Over			
	Lecture 44				Spill Over			
	Lecture 45				Spill Over			

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