TEACHING PLAN: DISCRETE MATHEMATICS

SCHOOL: Engineering & Technology	ACADEMIC SESSION: 2022 – 2023	FOR STUDENTS' BATCH: 2022-26 B. Tech. SEM-IV

1	Course code	PCC – CSE 210			
2	Course Title	Discrete Mathematics			
3	Credits	04			
4	Learning Hours		Lectures	03	
			Assessment OR Tutorial	01	
			Guided Study		
			Total hours	04	
5	Course Objective	Uunderstanding of Discrete Mathematics by being able to do each of the following: 1. Use mathematically correct terminology and notation. 2. Investigate functions as relations and their properties 3. Construct correct direct and indirect proofs. 4. Study basic mathematical algebraic structures.			
6	Course Outcomes	1. Use sets for solving applied problems, and use the properties of set operations algebraically. Work with relations and investigate their properties. 2. Introduce concepts of mathematical logic for analyzing propositions and proving theorems. 3. Evaluate combinations and permutations on sets. 4. Analysis of basic and complex algebraic structure with examples.			
7					

	Unit	Section	Introduction	Reference Number	Teaching Methods
	Unit-1	(a)	Definition of Sets, Venn Diagrams, complements, Cartesian products, power sets, counting principle, cardinality and count ability (Countable and Uncountable sets), proofs of some general identities on sets, pigeonhole principle. Types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation. Definition and types of function, composition of functions, recursively defined functions.	TB1: 1.1-3.40	White Board & PPT
	Unit - II	(a)	Proposition logic, basic logic, logical connectives, truth tables, tautologies, contradiction, normal forms (conjunctive and disjunctive), modus ponens and modus tollens,	TB1: 4.1- 4.44	White Board & PPT

			validity, predicate logic, universal and existential quantification. Notion of proof: proof by implication, converse, inverse, contrapositive, negation, and contradiction, direct proof, proof by using truth table, proof by counter example.		
	Unit-III	(a)	Mathematical induction, recursive mathematical definitions, basics of counting, permutations, combinations, inclusion-exclusion, recurrence relations (nth order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation), generating function (closed form expression, properties of G.F., solution of recurrence relation using G.F, solution of combinatorial problem using G.F.)	TB1: 6.1-6.29	White Board & PPT
	Unit-IV	(a)	Binary composition and its properties definition of algebraic structure; Semi group, Monoid Groups, Abelian Group, properties of groups, Permutation Groups, Sub Group, Cyclic Group, Rings and Fields (definition and standard results).	TB2: 50-240	White Board & PPT
	Unit-V	(a)	Graph terminology, types of connected graphs, components of graph, Euler graph, Hamiltonian path and circuits, Graph coloring, Chromatic number. Tree: Definition, types of trees (rooted, binary), properties of trees, binary search tree, tree traversing (preorder, unorder, post order). Finite Automata: Basic concepts of Automation theory, Deterministic finite Automation (DFA), transition function, transition table, Non-Deterministic Finite Automata (NDFA), Mealy and Moore Machine, Minimization of finite Automation.	TB1 8.1-10.44	White Board & PPT

8	**Course Evaluation**	
8.1	**CA: 40%**	
8.1.1	**Attendance**	5%
8.1.2	**Assignment & presentation**	20%
8.1.3	**Class test**	15%
8.1.4	**Any other**	--
8.2	**MTE**	20%
8.3	**End-term examination: 40%**	
9	**Text Books & References**	
9.1	**Text book**	**TB1:** Discrete Mathematics by Seymour Lipschutz & Marc Lars Lipson, Schaum's outlies.

		TB2: Schaum's outlies of theory and application of Group theory by Benjamin Baunslag & Bruce Chandler, McGRAW HILL. **TB3:** Abstract Algebra: Theory and Applications, Thomas W. Judson. **TB4:** The textbook for the course is Discrete Mathematics and its Applications (6th Edition) by Kenneth H. Rosen (McGraw-Hill, Inc., New York, 2007) TB5: "Topics in Algebra" by I.N. Herstein, Wiley.
9.2	**References**	**RB1:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjuxfDAgLv3AhUYzDgGHczIAJQQFnoECDoQAQ&url=https%3A%2F%2Fhome.iitk.ac.in%2F~arlal%2Fbook%2Fmth202.pdf&usg=AOvVaw1ycsenP4rdL2ltBiXeUTRk **RB2:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjJ7Jn6gLv3AhU5wzgGHf2RBjMQFnoECAUQAQ&url=http%3A%2F%2Fdiscrete.openmathbooks.org%2Fpdfs%2Fdmoi-tablet.pdf&usg=AOvVaw3qckwD1F6JlR6GOQUarnb3 **RB3:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjJ7Jn6gLv3AhU5wzgGHf2RBjMQFnoECAoQAQ&url=https%3A%2F%2Fwww.cis.upenn.edu%2F~jean%2Fdiscmath-root-b.pdf&usg=AOvVaw1krX0-4tFUeDm58O4ec1Cj **RB4:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjJ7Jn6gLv3AhU5wzgGHf2RBjMQFnoECAoQAQ&url=https%3A%2F%2Fwww.cis.upenn.edu%2F~jean%2Fdiscmath-root-b.pdf&usg=AOvVaw1krX0-4tFUeDm58O4ec1Cj **RB5:**https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjJ7Jn6gLv3AhU5wzgGHf2RBjMQFnoECA0QAQ&url=https%3A%2F%2Fwww.cs.yale.edu%2Fhomes%2Faspnes%2Fclasses%2F202%2Fnotes.pdf&usg=AOvVaw3SetlGzkZY06JkjGXu2x2X
9.3	**Video References**	[1] https://www.youtube.com/watch?v=HoGNkZclxDU&list=PLs7oDAL8_ouJ5w8wCPtKnK2I09MlKC6kP [2] https://www.youtube.com/watch?v=vqJuFD0GdJA&list=RDCMUCY-ANi3wxkUSGhAel7T0TGw&start_radio=1&rv=vqJuFD0GdJA&t=3 [3] https://www.youtube.com/watch?v=COI0BUmNHT8&list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE [4] https://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PL6C92B335BD4238AB [5] https://www.youtube.com/watch?v=Mwpz1zjPlzI&list=PLbMVogVj5nJS_i8vfVWJG16mPcoEKMuWT

CO-PO Mapping

Course Outcome	Program Outcome												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	1	3	3	3	1	2	1	1	2	2	1	2	3	1	2	2
CO 2	2	3	3	3	2	2	2	1	2	1	2	2	3	2	2	2
CO 3	2	3	3	3	2	2	1	1	2	1	2	3	3	2	2	2
CO 4	2	3	3	3	2	2	2	1	2	2	1	2	3	2	2	2

Question Bank

1) P: Mark is Rich

   Q: Mark is Unhappy

   "Mark is rich or he is rich and happy"

   Which of the following is the symbolic form of above statement

   1. $P \vee (P \wedge Q)$
   2. $P \vee (\sim P \vee Q)$
   3. $P \vee (P \wedge \sim Q)$
   4. $P \vee (P \vee \sim Q)$ Ans 3

2) Which of the following is a contradiction:

   1 . $P \vee P \equiv P$ 2 $P \vee (\sim P)$ 3 $\sim\sim P \equiv P$ 4. $P \wedge (\sim P)$ Ans: 4

3) Negation of the statement "for all $y \in \mathbb{R}$, $y^3 > 0$ "

   1. There exists $y \in \mathbb{R}$ such that $y^3 < 0$

   2 There exists $y \in \mathbb{R}$ such that $y^3 > 0$

   3 For all $y \in \mathbb{R}$, $y^3 < 0$

   4 None of the above Ans: 1

4) For real numbers x and y, $xy < 0$ truthiness for $xy < 0$ is possible in case of
   a) $x = 1, y = 0$
   b) $x = 0, y = 1$
   c) $x = 1, y = -3$
   d) $x = -1, y = -2$

5) x is less than y and z is ____-place predicate.
   a) 1 b) 2 c) 3 d) 0

6) Which of the following expression is for a bi-conditional statement?

   1 If P then Q

   2 Q if P

   3 $P \wedge Q$

   4 $P \rightleftarrows Q$

7) If $P \rightleftarrows Q$ is true then the truth values of P and Q are respectively:

   1 F, F 2 T, F 3. F, T 4. none

8) Consider A={1,2,3} Which of the following is a symmetric relation on A

1 R= $\{(x,y)|\ x<y,\ x,y\in A\}$

2 S= $\{(x,y)|\ x\le y,\ x,y\in A\}$

3 P= $\{(x,y)|\ x>y\ or\ x<y,\ x,y\in A\}$

4 R= $\{(x,y)|\ x\ge y,\ x,y\in A\}$

9) Consider A=$\{2,3\}$ and B=$\{2,3\}$. Which of the following relation is a function from A to B:

1 S= $\{(x,y)|\ x\le y,\ x\in A\ and\ y\in B\}$

2. P= $\{(x,y)|\ x>y,\ x\in A\ and\ y\in B\}$

3 R= $\{(x,y)|\ x<y,\ x\in A\ and\ y\in B\}$

4 None of the above

10) Which of the following is an equivalence relation for the sets A=$\{1,5\}$

1 P= $\{(1,1),(5,5),(1,5)\}$

2 P= $\{(1,1),(1,5),(5,1)\}$

3 P= $\{(1,1),(5,5),(1,5),(5,1)\}$

4 P= $\{(5,5),(1,5),(5,1)\}$

11) Let S $=\ \{1,-1\}$. Which of the following is a binary operation on S.

1 For $x,y\in S,\ xy$

2. For $x,y\in S,\ x+y$

3. For $x,y\in S,\ x-y$

4 Both option 1 and 2.

12) Which of the following is a partition of the set $A=\{2,3,4,5\}$

1 $A_1=\{\{1,2\},\ \{3,4\},\{5\}\}$

2 $A_2=\{\{2\},\ \{3\}\}$

3 $A_3=\{\ \{2\},\ \{2,3,4\}\}$

4 $A_4=\{\ \{2,3\},\ \{3,4,5\}\}$

13) The number of equivalence classes of congruence module 9 are

a) 6

b) 3

c) 9

d) 5

14) Which of the following is a commutative binary operation on set of all irrational numbers?

a. Addition

b. Subtraction

c. Multiplication

1 Both option (c) and (b)

2 Only option (b) Ans: 2

3 Both option (a) and (c)

4 None

15) Which of the following is the multiplicative identity of set of rational numbers with respect to multiplication?

1. 0

2. 2

3 -1

4 1

16) Which of the following algebraic structure is a semi group?

1 (Z, -), Z denotes set of all integers

2 (N,+), N denotes set of all natural numbers

3 (S, +), S={1,-1}

4 (S, -), S={1}

17) Which of the following ring is an integral domain

1 set of all natural numbers

2. set of all integer congruence modulo 4

3 set of all rational numbers

4 none of the above

18) Which of the following algebraic structure is not Monoid

1 (R, -), R denotes set of all real numbers

2 (Z, +), Z denotes set of all integers

3 (N, +), N denotes set of all natural numbers

19) Which of the following ring is a zero divisor

1 set of all integers

2 set of all rational numbers

3 set of real numbers

4 set of all integer congruence modulo 4

20) Which of the following algebraic structure is a abelian

1 $(Q^*, \times)$, Q^* is set of all non zero rational numbers

2. $(R^*, \times)$, R^* is set of all non zero real numbers

3. (S, ×), S={-1,1}

4 all of the above

21) Which of the following is true

1. set of all matrices is an abelian group under addition
2. (S, -), S={1}, is an abelian group
3. (S, ÷), S={-1,2} is a group
4. (Z, ÷) , is a group

21) Find power sets of set $A = \{a, b, c, d\}$.

22) Find the number of mathematics students at a collage taking at least one of the languages French, German and Russian given the following data

- 65 study French
- 45 study German
- 42 study Russian
- 20 study French and German
- 25 study French and Russian
- 15 study German and Russian
- 8 study all the three languages

23) Consider the sets $A_1 = \{2,3,4,...\}$, $A_2 = \{3,4,5,...\}$, $A_3 = \{4,5,6,...\},\ldots,$ $A_n = \{n+1, n+2, n+3,...\}$. Then find the following

I. $\bigcup (A_n : n \in N)$

II. $\bigcap_{i=1}^{20} (A_i : i \in N)$

III. $\bigcup_{i=1}^{20} (A_i : i \in N)$

IV. $\bigcap (A_n : n \in N)$

24) Answer weather the following sentences are True or False. And give reason for your answer.

I. The function $f : (0, 2\pi) \to [-1,1]$ defined by $f(x) = \sin x, x \in (0, 2\pi)$ is one-one and onto.

II. There exist at least one onto map from a set A to its power set $P(A)$.

III. The proposition $p \wedge (p^C \vee q)$ is logically equivalent to $p \wedge q$.

IV. Cardinality of set $(0,1)$ is equal to the cardinality of set of real numbers R .

25) Prove associative and DeMorgan's laws using truth table.

26) Consider the Venn diagram of three arbitrary sets A, B and C and shade the region which describe the following:

$(A \cap B^C) \cap C$ and $(A \setminus B^C) \setminus C$

27) Let $f : (1,5) \to (8,20)$ define by $f(x) = 3x + 5$ show that the given function is one-one and onto.

28) Draw the graph of the function $f:(-3,3)\to R$ define by $f(x)=3x^2$. is the function bijection? Give reason

29) Find cardinality of the following sets

I. $A=\{x\in N: x^2<25\}$

II. $A=\{x\in N: x \text{ is even}\}$

III. Set of real numbers

IV. Set of positive rational numbers

V. $A=\{x\in R: x \text{ is root of } \cos x=0\}$

30) Show that cardinality of set of natural numbers and set of integers are same with bijection map.

31) Draw the graph of $f:(1,5)\to(-2,6)$ define by $f(x)=-2x+8$, show that the given function is one-one and onto.

32) Show that cardinality of set of even natural numbers and set of odd natural numbers are same.