

CMR INSTITUTE OF TECHNOLOGY: HYDERABAD
UGC AUTONOMOUS

II – B.Tech. – I – Semester End Examinations– February – 2023
Discrete Mathematics & Graph Theory
(CSE, CSD, CSM, AID, AIM)

[Max. Marks: 70]

[Time: 3 Hours]

- Note:**
1. This question paper contains two parts A and B.
 2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.
 3. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have i, ii, iii as sub questions.
 4. Illustrate your answers with NEAT sketches wherever necessary.

10 X 2M = 20 M

PART-A				
S.No	Question	BTL	CO	PO
1	Find the duals of the following i) $p \rightarrow (q \wedge r)$ ii) $p \vee (r \vee q)$	1	1	1,2,12
2	Explain logical NAND	2	1	1,2,12
3	Define types of Quantifiers	1	2	1,2,12
4	What are Free and Bounded variables with examples	1	2	1,2,12
5	Let A and B be two finite sets such that $n(A) = 20$, $n(B) = 28$ and $n(A \cup B) = 36$, find $n(A \cap B)$.	1	3	1,2,12
6	Let $f(x)=x+2$, $g(x)=x-2$ and $h(x)=3x$ for $x \in \mathbb{R}$, where \mathbb{R} is the set of real numbers. Find $g \circ f$, $f \circ g$	1	3	1,2,12
7	Define sum rule and product rule.	1	4	1,2,12
8	In how many different ways can a committee of 5 teachers and four students be selected from 9 teachers and 15 students	1	4	1,2,12
9	Prove Handshaking Lemma with example	5	5	1,2,12
10	Explain about planar graph and complete graph with examples	2	5	1,2,12

PART-B

5 X 10M = 50 M

11.A	i. List all the connectives using truth tables ii. Show that $\sim(p \leftrightarrow q) \equiv (p \vee q) \wedge \sim(p \wedge q)$ using truth table	4	2	1	1,2,12
OR					
11.B	i. Show that $(\sim p \wedge (\sim q \wedge r)) \vee (q \wedge r) \vee (p \wedge r) \equiv r$ without using truth table ii. a) Change $(p \downarrow q)$ in terms of \uparrow only b) Change $(p \uparrow q)$ in terms of \downarrow only	2	5	1	1,2,12
12.A	i. Show that $\sim P$ is a valid inference from the premises $\sim(P \wedge \sim Q)$, $\sim Q \vee R$, $\sim R$ ii. Construct the PDNF of the following given formula	2	3	2	1,2,12

	a) $P \vee (\neg p \rightarrow (q \vee (\neg q \rightarrow r)))$ b) $[p \rightarrow (q \wedge r)] \wedge [\neg p \rightarrow (\neg q \wedge \neg r)]$			
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OR

12.B	i. a) Build CNF for $(q \rightarrow p) \wedge (\neg p \wedge q)$. b) Build PDNF for $(p \vee r) \wedge (p \vee \neg q)$ ii. a) Using Rule CP show that $p \rightarrow (q \rightarrow r), q \rightarrow (r \rightarrow s) \rightarrow p \rightarrow (q \rightarrow s)$ b) Show that $(x) [P(x) \rightarrow Q(x)] \wedge (x) [Q(x) \rightarrow R(x)] \rightarrow (x) [p(x) \rightarrow R(x)]$	3	2	2	1,2,12
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13.A	i. Define a relation. Explain the properties of relations with example ii. Let $R = \{(1,2), (3,4), (2,2)\}$ $S = \{(4,2), (2,5), (3,1), (1,3)\}$ find $ROS, SOR, RO(SOR), (ROS)OR, ROR, SOS, ROROR$.	2	1	3	1,2,12
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OR

13.B	i. Let $X = \{1, 2, 3, 4\}$ and $R = \{(1, 2), (2, 3), (3, 4), (4, 1)\}$ be a relation on X. Find Transitive closure R^+ ii. Determine whether the following posets are lattices or not a) $(\{1,2,3,4,5\}, /)$ and b) $(\{1,2,4,8,16\}, /)$	1	5	3	1,2,12
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14.A	i. a) How many arrangements are there for the words 'MISSISSIPPI'? b) How many arrangements are there for the words 'TALLAHASSEE' so that no two A's should be adjacent? ii. Explain pigeon hole principle with example	1		4	1,2,12
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OR

14.B	i. Find n if a) $P(n,2)=72$ b) $P(n,4)=42P(n,2)$ c) $2P(n,2)+50=P(2n, 2)$ ii. a) Among 20 members of a team, there are 2 wicket keepers and 5 bowlers. In how many ways can eleven persons be chosen to include only one wicket keeper and at least 3 bowlers? b) Suppose there are many red socks, many white socks and many blue socks in a box what is the least number of socks that one should take out from the box to be sure of getting a matching pair?	1		4	1,2,12
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15.A	i. Define DFS and BFS algorithms and mention the steps followed in defining algorithm. ii. Show that if a planar graph is Self dual then $ E =2 V -2$	1	2	5	1,2,12
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OR

15.B	i. Construct bipartite graph $K_{3,4}$ and prove that $K_{3,4}$ graph does not have a Hamiltonian cycle ii. Select an example of a graph which is Hamiltonian but not Eulerian and viceversa	3	1	5	1,2,12
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Discrete Mathematics & Graph Theory

(Common to CSE, CSD, CSM, AID, AIM)

[Time: 3 Hours]

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PART-A

10 X 2M = 20 M

S.No	Question	Blooms Taxonomy Level	CO	PO
1	Explain about converse, inverse and contra positive of the conditional statement	2	1	1,2
2	Construct the truth table for $\neg p \leftrightarrow (q \wedge r)$	3	1	1,2
3	Define predicate and predicate logic?	1	2	1,2
4	Analyze and symbolize the following statements: a) all men are good b) no men are good	2	2	1,2
5	Find the sets A & B given that $A - B = \{ 1,2,4 \}$ $B - A = \{ 7,8 \}$ and $A \cup B = \{ 1,2,4,5,7,8,9 \}$.	1	3	1,2
6	What is set inclusion and exclusion?	1	3	1,2
7	In how many ways can 8 distinguishable balls be put in to 5 distinguishable boxes if any box can contain more than one ball?	1	4	1,2
8	In how many different ways can a committee of 5 teachers and four students be selected from 9 teachers and 15 students	1	4	1,2
9	What is complete graph? Construct K_5	1	5	1,2
10	Define about walk, trail, path, circuit, cycle?	1	5	1,2

PART-B

5 X 10M = 50 M

11.A	<p>i. Show that $\neg (p \vee (\neg p \wedge q))$ and $(\neg p \wedge \neg q)$ are logically equivalent</p> <p>ii. Prove the principle of Duality for the following</p> <p>a) $\neg (p \wedge q) \rightarrow (\neg p \vee (\neg p \vee q)) \Leftrightarrow (\neg p \vee q)$</p> <p>b) $(p \vee q) \wedge (\neg p \wedge (\neg p \wedge q)) \Leftrightarrow (\neg p \wedge q)$</p>	2	5	1	1,2
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OR

11.B	<p>i. Given the truth values of p and q as True and those of r and s as False ,find the truth value of the following:</p> <p>a) $(p \leftrightarrow r) \wedge (\neg q \rightarrow s)$</p> <p>b) $[\neg(p \wedge q) \vee \neg r] \vee [(q \leftrightarrow \neg p) \rightarrow (r \vee \neg s)]$</p> <p>ii. Prove that $(\neg P \wedge (\neg Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$.</p>	1	5	1	1,2
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12.A	<p>i. Construct the principal disjunctive normal form of $P \rightarrow ((P \rightarrow Q) \wedge \neg(\neg Q \vee \neg P))$.</p> <p>ii. Show that $S \vee R$ is tautologically implied by $(P \vee Q) \wedge (P \rightarrow R) \wedge (Q \rightarrow S)$.</p>	6	2	2	1,2
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OR

12.B	<p>i. Using the indirect method of proof, show that $P \rightarrow Q, Q \rightarrow R, \neg(P \wedge R), P \vee R \Rightarrow R$.</p> <p>ii. Prove by induction $1.2.3+2.3.4+3.4.5+\dots+n(n+1)(n+2) = \frac{1}{4}n(n+1)(n+2)(n+3)$, for all $n \in \mathbb{N}$</p>	2	5	2	1,2
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13.A	<p>i. In a class of 106 students, each student studies at least one of the three subjects Maths, Physics and Chemistry. 48 of them study Maths, 51 studies Physics and 53 Chemistry. 16 studies Maths and Physics, 17 study Maths and Chemistry and 18 study Physics and Chemistry. Find</p> <p>i) the number of students who exactly study two subjects</p> <p>ii) The number of students who study all the three subjects?</p> <p>iii) The number of students who exactly study one subjects?</p> <p>iv) The number of students who study Physics and Maths but not Chemistry?</p> <p>ii. What is an Equivalence Relation. Let $X = \{1,2,3,4\}$ and $R = \{(1,1), (1,4), (4,1), (4,4), (2,2), (2,3), (3,2), (3,3)\}$. Prove that R is an equivalence relation</p>	1	5	3	1,2
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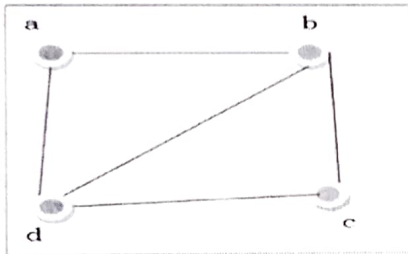
OR

13.B	<p>i. Let $f: R \rightarrow R$ and $g: R \rightarrow R$, where R is the set of real numbers. Find fog and gof, where $f(x) = x^2 - 2$ and $g(x) = x + 4$. Determine whether these functions are injective, surjective, and bijective.</p> <p>ii.a) Select an example of a relation that is neither reflexive nor irreflexive</p> <p>b) Select an example of a relation that is irreflexive and transitive</p>	5	3	3	1,2
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14.A	<p>i. There are four bus lines between A and B and three bus lines between B and C. In how many ways can a man travel</p> <p>a) by bus from A to C via B?</p> <p>b) round trip by bus from A to C via B?</p> <p>c) round trip by bus from A to C via B if he does not want to use a bus line more than once?</p> <p>ii. A certain question paper contains two parts A and B each containing 4 questions. How many different ways a student can answer 5 questions by selecting atleast 2 questions from each part?</p>	1		4	1,2
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OR

14.B	<p>i. Prove the following identities:</p> <p>(a) $C(n+1, r) = C(n, r-1) + C(n, r)$</p> <p>(b) $C(m+n, 2) - C(m, 2) - C(n, 2) = mn$</p> <p>ii. Determine the coefficient of</p> <p>(a) xyz^2 in the expansion of $(2x-y-z)^4$</p> <p>(b) $a^2b^3c^2d^5$ in the expansion of $(a+2b-3c+2d+5)^{16}$</p>	5	4	1,2
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15.A	<p>i. Find the chromatic number for the following graph</p>  <p>ii. a) Define graph and types of graphs with examples</p> <p>b) Is there a simple graph with the degree sequence $\{1, 1, 3, 3, 3, 3, 4, 6, 7\}$</p>	1	5	1,2
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OR

15.B	<p>i. Without constructing graph. Prove that the graph whose adjacency matrix is given by $X = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$</p> <p>ii. Select an example of a graph which is Hamiltonian but not Eulerian and vice versa</p>	5	3	5	1,2
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CMR INSTITUTE OF TECHNOLOGY: HYDERABAD
UGC AUTONOMOUS

II – B.Tech. – I Semester Supply Examinations– February – 2024

Discrete Mathematics

(CSE)

[Time: 3 Hours]

[Max. Marks: 70]

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PART-A

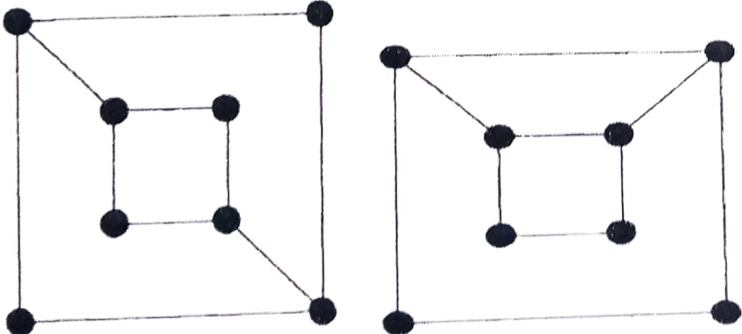
10 X 2M = 20 M

S.No	Question	Blooms Taxonomy Level	CO	PO
1	Define Well-formed formula.	L2	1	1,2,3
2	Write the converse of the statement: "If John is a human then he is mortal"	L2	1	1,2,3
3	Define Predicate and Give an example.	L2	2	1,2,3
4	State Principal disjunctive normal form.	L2	2	1,2,3
5	State Principle of inclusion and exclusion.	L2	3	1,2,3
6	Define a Poset.	L2	3	1,2,3
7	In how many ways can 5 children arrange themselves in a ring?	L2	4	1,2,3
8	State sum rule.	L2	4	1,2,3
9	Define Euler's circuit.	L2	5	1,2,3
10	Define a planar graph and give one example.	L2	5	1,2,3

PART-B

5 X 10M = 50 M

11.A	i. Construct a truth table for the statement $(p \vee q) \wedge (p \rightarrow q)$.	L3	1	1,2,3
	ii. Show that $\neg(p \leftrightarrow q) \Leftrightarrow (p \wedge \neg q) \vee (\neg p \wedge q)$.	L3	1	1,2,3
OR				
11.B	i. Using the statements; R: Mark is Rich, H: Mark is happy Write the following statements in symbolic form: (i) Mark is poor but happy (ii) Mark is rich or unhappy (iii) Mark is neither rich or poor (iv) Mark is poor or he is both rich and unhappy.	L3	1	1,2,3
	ii. Construct a truth table for the statement $(Q \rightarrow P) \wedge (\neg P \wedge Q)$.	L3	1	1,2,3

12.A	Obtain the principal disjunctive and conjunctive normal forms of the following formulas. $P \vee (\neg P \rightarrow (Q \vee (\neg Q \rightarrow R)))$.	L3	2	1,2,3
OR				
12.B	Symbolize the following argument and check for its validity: Every living thing is a plant or an animal. Ravi's dog is alive and it is not a plant. All animals have hearts. Hence, Ravi's dog has a heart.	L3	2	1,2,3
13.A	If there are 200 faculty members that speak French, 50 that speak Russian, 100 that speak Spanish, 20 that speak French and Russian, 60 that speak French and Spanish, 35 that speak Russian and Spanish, while only 10 speak French, Russian, and Spanish, (i) how many speak either French or Russian or Spanish? (ii) How many speak French and Russian but not Spanish.	L3	3	1,2,3
OR				
13.B	Let $X = \{1, 2, 3, 4\}$ and $R = \{(x, y) : x > y\}$. Draw the graph of R and also give its matrix.	L3	3	1,2,3
14.A	Find the number of non-negative integral solutions of the equation $x_1 + x_2 + x_3 + x_4 + x_5 = 20$, where $x_1 \geq 3, x_2 \geq 2, x_3 \geq 4, x_4 \geq 6$, and $x_5 \geq 0$?	L3	4	1,2,3
OR				
14.B	i. A farmer buys 3 cows, 8 pigs, and 12 goats from a man who has 9 cows, 25 pigs, and 75 goats. How many choices does the farmer have?	L3	4	1,2,3
	ii. How many committees of 5 or more can be chosen from 9 people?	L3	4	1,2,3
15.A	Define Isomorphism in Graphs. Check whether the following graphs G_1 and G_2 are Isomorphic? 	L3	5	1,2,3
OR				
15.B	Show that a complete bipartite graph $K_{m,n}$ is planar if and only if $m \leq 2$ or $n \leq 2$.	L3	5	1,2,3

Code No.: 20-ESC-208

R20

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PART - A

10 X 2M = 20 M

S.No	Question	Blooms Taxonomy Level	CO	PO
1	Which of the following formulas are well-formed: a) $\neg(p \rightarrow q)$ b) $p \rightarrow (\neg p \vee q)$ c) $(p \rightarrow q) \rightarrow A$ d) $\neg(p \vee q)$	1	1	1.2,12
2	Explain tautology and contradiction with examples	2	1	1.2,12
3	Simplify the disjunctive normal form of $P \wedge (P \rightarrow \neg Q)$	4	2	1.2,12
4	Apply the contra positive of the statement 'If n is a multiple of 12, then it is a multiple of 4'	3	2	1.2,12
5	Design the Hasse diagram for $\{1, 2, 3, 6\}$ as b if and only if a divides b.	6	3	1.2,12
6	Define a onto function b none to one function	1	3	1.2,12
7	Define permutations and combinations	1	4	1.2,12
8	In how many ways can 8 distinguishable balls be put in to 5 distinguishable boxes if any box can contain more than one ball?	1	4	1.2,12
9	Define planar graph and non planar graphs with example	1	5	1.2,12
10	How many vertices does a regular graph of degree 4 with 10 edges?	1	5	1.2,12

PART - B

5 X 10M = 50 M

S.No	Question	Blooms Taxonomy Level	CO	PO
11.A	1. Illustrate all laws of logical equivalence formulas with proofs. a. Find the negations of the following statements. a) Jan will take a job in industry or go to graduate school b) James will bicycle or run tomorrow c) If the processor is fast then the printer is slow	2	1	1.2,12

OR

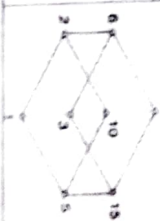
11.B	1. Show that $((P \vee Q) \wedge \neg(P \wedge \neg Q) \vee \neg R) \vee (P \wedge \neg R) \vee 1$ tautology without using truth table 11. Use Demorgan's laws to find the negation of each statement a) I want a car and worth a cycle. b) My cat steps outside or it makes a mess. c) I've fallen and I can't get up. d) You study or you don't get a good grade.	1	1	1.2,12
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OR

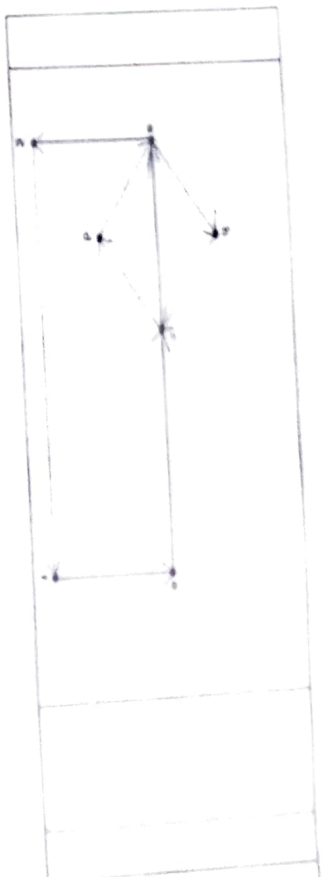
12.A	1. Construct the principal disjunctive normal form of $p \rightarrow ((p \rightarrow Q) \wedge \neg(Q \vee \neg p))$. 11. Show that 5 VR is tautologically implied by $(p \vee Q) \wedge (p \rightarrow Q) \wedge (Q \rightarrow p)$.	6	1	2	1.2,12
12.B	1. Show that the following premises are inconsistent If the contract is valid, then John is liable for penalty. If John is liable for penalty, he will go bankrupt. If the bank will loan him money, he will not go bankrupt. As a matter of fact, the contract is valid, and the bank will loan him money! 11. Simplify conjunctive normal forms of (a) $P \wedge (P \rightarrow Q)$, (b) $\neg(P \vee Q) \vee (P \wedge Q)$	1	4	2	1.2,12

OR

13.A	<p>1. How many natural numbers $n \leq 1000$ are not divisible by any of 2, 3?</p> <p>11. Let n be a positive integer and S_n be the set of all divisors of n if $n = 30$. $S_{30} = \{1, 2, 3, 5, 6, 10, 15, 30\}$ Examine whether the given hasse diagram is lattice or not</p>	1	4	3	1.2,12
OR					
13.B	<p>1. Let $f(x) = x + 2$, $g(x) = x - 2$ and $h(x) = 3x$ for $x \in R$, where R is the set of real numbers. Find $g \circ f$, $f \circ g$, $f \circ f$, $g \circ g$, $f \circ h$, $h \circ g$, $h \circ f$ and $f \circ h \circ g$.</p> <p>11. What is an Compatibility Relation? Let $X = \{\text{ball, ted dog, let, egg}\}$ and $R = \{(x,y) \mid x,y \in X \text{ and } xRy \text{ if } x \text{ and } y \text{ contain some common letter}\}$. Prove that R has Compatibility relation</p>	1	3	1.2,12	



1.4.A	i. Find the term which contains x^{11} and y^4 in the expansion of $(2x^3 + 3xy^2 + y^3)^6$	1	2	4	1,2,12
	ii. Illustrate pigeon hole principle with example?				
OR					
1.4.B	i. How many solutions are there to the equation $x_1 + x_2 + x_3 + x_4 + x_5 = 16$ where each $x_i \geq 2$	1	1	4	1,2,12
	ii. a) if 8 people P, Q, R, S, T, U, V and W are seated around a round table how many different circular arrangements are possible, if arrangements are considered the same when one can be obtained from the other by rotation? b) if 8 people P, Q, R, S, T, U, V and W are seated around a round table if P, Q, R and S are males and T, U, V and W are females, in how many arrangements do the sexes alternate				



1.5.A	i. Discuss about Konigsberg Bridge Problem?	6	5	1,2
	ii. Develop path matrix by using warshall's algorithm for the following matrix $A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}$			
OR				

1.5.B	i. Which of the following graphs are isomorphic?	1	3	5	1,2
	ii. Construct Euler's circuit for the following graphs				

Code No.: ESC-210

R18

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(CSE)

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PART-A

10 X 2M = 20 M

S.No	Question	Blooms Taxonomy Level	CO	PO
1	Explain tautology with an example	5	1	1,2,3
2	Discuss law of duality with an example	1	1	1,2,3
3	Explain normal forms	5	2	1,2,3
4	Discuss proof by contradiction	1	2	1,2,3
5	List out the basic operations on sets	1	3	1,2,3
6	Define bijective function with an example	1	3	1,2,3
7	Explain pigeon hole principle with an example	5	4	1,2,3
8	Find the minimum number of students in a class to be sure that three of them are born in the same month	4	4	1,2,3
9	Discuss planar graphs in detail	1	5	1,2,3
10	Define chromatic number	2	5	1,2,3

PART-B

5 X 10M = 50 M

11.A	i. Obtain DNF and CNF for the following Statements $P \vee (P \rightarrow Q)$	1	4	1	1,2,3
	ii. Discuss duality principle. Write the duality of $(A \cap B) \cup C$				
OR					
11.B	i. Show that R is logically equivalent to $P \rightarrow Q$, $Q \rightarrow R$, and P	5	4	1	1,2,3
	ii. Discuss in details about the importance of predicate calculus				

12.A i) For all $n \geq 1$, prove that, $1 + 3 + 5 + \dots + 2n - 1 = n^2$

ii) Explain why this argument is valid or invalid:

If I go to the movies, I will not do my homework.

I did not go to the movies.

Therefore, I did do my homework.

OR

12.B i) List out all the rules of inference

ii) An employee in my office has not completed his daily work

Everyone in my office completed his monthly files.

Can we conclude, "Someone who completed his monthly files has not completed his daily work"?

13.A Define Relation. Explain the properties of binary relations with examples

13.B i) Assume that there is a function $f(x) = x^2$. Prove that this function is many to one function or not.

ii) Determine the recursive formula for the sequence 4, 8, 16, 32, 64, 128, ...?

14.A i) Each user on a computer system has a password, which is six to eight characters long, where each character is an uppercase letter or a digit. Each password must contain at least one digit. How many possible passwords are there?

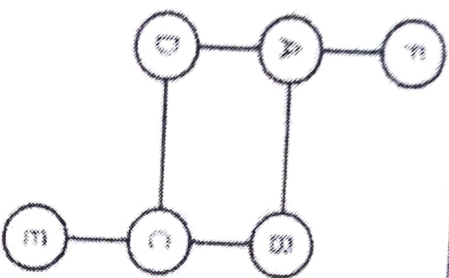
ii) Discuss the importance of permutations and combinations?

OR

14.B i) In how many ways can 7 women and 3 men be arranged in a row if the 3 men must always stand next to each other?

ii) Write a short note on Pigeon Hole Principles and its applications.

15.A i) In the following graph, we have 5 nodes. Now we have to determine whether this graph contains a Hamiltonian path.



2) Discuss a) Bipartite Graphs b) Planar graphs with an example

OR

15.B	i. Discuss in detail properties of graphs	13	5	1,2,3
	ii. When it can be said that two graphs G1 and G2 are isomorphic and show with an example			