



**GEETHANJALI INSTITUTE OF SCIENCE & TECHNOLOGY**  
**(AN AUTONOMOUS INSTITUTION)**  
 (Approved by AICTE, New Delhi & Affiliated to JNTUA, Ananthapuramu)  
 (Accredited by NAAC with “A” Grade, NBA (EEE,ECE &ME) &  
 ISO9001:2008 Certified Institution)

### QUESTIONBANK(DESCRIPTIVE)

**Subject Name with Code: DISCRETE MATHEMATICS AND GRAPH THEORY**  
**(23A54301)**

**Course & Branch: B.TECH CSE&CSE(CS&DS)**

**Year& Semester: II-I**

**Regulation: RG23**

### UNIT - I

S.No.	Question	[BT Level] [CO][Marks]
<b>2 Marks Questions (Short)</b>		
1.	Define existential quantifier with example.	[L1][CO1][2]
2.	Symbolize the statement “everyone in the final year class has a cellular phone”.	[L1][CO1][2]
3.	Define Tautology and Contradiction.	[L1][CO1][2]
4.	Use quantifier and write the following statement in symbolic form “All students in the class have taken a course in discrete mathematics”.	[L2][CO1][2]
5.	Find the negation of the following statement. “If Cows are Crows then Crows are four legged”.	[L1][CO1][2]
6.	Explain WFF and duality with examples?	[L2][CO1][2]
7.	Define converse, contrapositive and inverse of an implication?	[L1][CO1][2]
8.	Explain about PDNF with examples?	[L2][CO1][2]
9.	What is duality law? Give suitable example?	[L1][CO1][2]
10.	Construct the Truth table for $\sim(\sim p \wedge \sim q)$ ?	[L3][CO1][2]
<b>Descriptive Questions (Long)</b>		
1.	Check the validity of the following argument. If I go to school, then I attend all the classes. If I attend all classes, then I get A grade. I do not get grade A and I do not feel happy. Therefore, if I do not go to school then, I do not feel happy.	[L3][CO1][10]
2.	Using indirect method of proof, derive $P \rightarrow \neg S$ from the premises $P \rightarrow (Q \vee R)$ , $Q \rightarrow \neg P$ , $S \rightarrow \neg R$ and $P$ .	[L3][CO1][10]
3.	a) Show that $(p \rightarrow q) \wedge (q \rightarrow r) \rightarrow (p \rightarrow r)$ is a Tautology. b) What do you mean by equivalent statements? Show that $P \rightarrow (Q \rightarrow R) \equiv (P \wedge Q) \rightarrow R$ .	[L2][CO1][5] [L2][CO1][5]
4.	a) Define Well Formed Formula and Tautology with examples?	[L2][CO1][5]

	b) Construct the truth table of the compound proposition $(q \rightarrow \neg p) \leftrightarrow (p \leftrightarrow q)$	[L2][CO1][5]
5.	a) Find the truth value of $[(P \vee Q) \wedge (\sim R)] \leftrightarrow Q$ using truth table. b) Illustrate the principal disjunctive and conjunctive normal forms of $(P \rightarrow (Q \wedge R)) \wedge (\neg P \rightarrow (\neg Q \wedge \neg R))$ using Truth table.	[L1][CO1][5] [L2][CO1][5]
6.	a) Define Well Formed Formula and Tautology with examples? (5m) b) Explain in detail about the Connectives with Examples? (5m)	[L2][CO1][5] [L2][CO1][5]
7.	1. Check the Validity of the Following argument: —All dogs are barking. Some animals are dogs. Therefore, some animals are barking. 2. Check the Validity of the Following argument: —Some cats are animals. Some dogs are animals. Therefore, some cats are dogs.	[L3][CO1][5] [L3][CO1][5]
8.	Obtain PCNF and PDNF of the formula $P \rightarrow [(P \rightarrow Q) \wedge \sim(\sim Q \vee \sim P)]$	[L3][CO1][10]
9.	a) Define converse, contrapositive and inverse of an implication? (5m) b) show that $(p \rightarrow q) \rightarrow q = p \vee q$ without constructing the Truth Table?(5M)	[L2][CO1][5] [L2][CO1][5]
10.	a) Illustrate that $((P \rightarrow R) \vee (Q \rightarrow R)) \leftrightarrow ((P \wedge Q) \rightarrow R)$ is tautology without using truth table?(5M) b) Explain in detail about the Connectives with Examples?(5M)	[L2][CO1][5] [L2][CO1][5]

## UNIT - II

S.No.	Question	[BT Level] [CO][ Marks]
<b>2 Marks Questions (Short)</b>		
1.	Give an example of a relation which is neither symmetric nor antisymmetric on any set A.	[L2][CO2][2]
2.	Find how many integers below 100 are not divisible by 5 and 7.	[L2][CO2][2]
3.	State the Pigeonhole principle.	[L2][CO2][2]
4.	Define semigroup and monoid. Give an example of a semigroup which is not a monoid.	[L2][CO3][2]
5.	State the principle of Inclusion-Exclusion.	[L2][CO2][2]
6.	If $f(x) = x^2 - 6 = y$ , then find $f^{-1}(y)$ .	[L1][CO2][2]
7.	Let $A = \{a, b, c\}$ . Draw the Hasse diagram $(P(A), \subset)$ for where $P(A)$ is the power set of A.	[L2][CO2][2]
8.	Define POSET.	[L2][CO2][2]

Descriptive Questions (Long)		
Q.No.	UNIT-II	[BT Level] [CO][ Marks]
1.	<p>In a class of 50 students, there are 2 choices for optional subjects. If it is found that 18 students have physics as an optional subject but not chemistry and 25 students have chemistry as optional subject not physics, then How many students</p> <p>(i) have both optional subjects?</p> <p>(ii) have chemistry as an optional subject?</p> <p>(iii) have physics as an optional subject?</p>	[L2][CO2][10]
2.	Show that $(S, \leq)$ is a Lattice, where $S = \{1, 2, 5, 10\}$ and $\leq$ is for divisibility. Prove that it is also a Distributive Lattice?	[L2][CO2][10]
3.	<p>Simplify the given data using Principle of Inclusion and Exclusion:</p> <p>In A survey of 100 students, it was found that 30 studied Mathematics, 54 studied Statistics, 25 studied Operations Research, 1 studied all the three subjects, 20 studied Mathematics and Statistics, 3 studied Mathematics and Operations Research and 15 studied Statistics and Operation Research. a) Find how many students studied none of these subjects b) Find how many students studied only Mathematics?</p>	[L2][CO2][10]
4.	<p>Let <math>G = \{0, 1, 2, 3, 4, 5\}</math> i. Develop the Composition Table with respect to '+6' (Addition Modulo 6) ii. Show that "G" is an Abelian Group iii. Find the inverse of each and every element in G. iv. Find the order of each and every element in a Group</p>	[L2][CO3][10]
5.	<p>a) Interpret the value of <math>f(2, 4)</math> for function <math>f(x, y) = x + y</math> is primitive recursive. (5m)</p> <p>b) Explain atleast 3 types of functions with suitable examples?(5M)</p>	[L2][CO2][5] [L2][CO2][5]
6.	<p>Let <math>A = \{1, 2, 3, 4, 6, 12\}</math> on A define the relation R by <math>aRb</math> if and only if a divides b.</p> <p>a) show that R is a partial order on A?</p> <p>b) construct the Hasse Diagram for this relation?</p>	[L2][CO2][5] [L2][CO2][5]
7.	<p>Solve the inverse of the following functions with the proper steps:</p> <p>a) <math>X = \{1, 2, 3\}, Y = \{p, q, r\}</math>, and <math>F = \{(1, p), (2, r), (3, q)\}</math></p> <p>b) <math>F(x) = (3x+2)/(2x+1)</math></p> <p>c) <math>F(x) = \sqrt{x+4} - 3</math></p>	[L2][CO2][10]
8.	<p>a) Let <math>X = \{1, 2, 3\}</math> and f, g, h and s be the functions from X to X given by <math>f = \{(1, 2), (2, 3), (3, 1)\}</math> <math>g = \{(1, 2), (2, 1), (3, 3)\}</math> <math>h = \{(1,</math></p>	[L2][CO2][5] [L2][CO2][5]

	1), (2, 2), (3, 1)} $s = \{(1, 1), (2, 2), (3, 3)\}$ Solve $g \circ f$ ; $f \circ h \circ g$ ; $s \circ g$ . b) Define Lattice and list any 3 types of Lattices.	
9.	a) Explain GLB(Greatest Lower Bound) and LUB(Lowest Upper Bound) with proper example. b) Write the operation table for GLB, LUB for $L = \{1, 2, 3, 5, 30\}$ under divisibility relation and conclude whether the relation is a Lattice or not?	[L2][CO2][5]  [L2][CO2][5]
10.	a) Define pigeon hole principle and what is the minimum no. of students required in a class to be sure that atleast 6 students will receive the same grades if there are 5 grades(A,B,C,D,E,F)?(5m) b) Explain composition of functions? Let $f$ and $g$ be functions from $R$ to $R$ , where $R$ is a set of real numbers defined by $f(x) = x^2 + 3x + 1$ and $g(x) = 2x - 3$ . Interpret the composition of functions: i) $f \circ f$ ii) $f \circ g$ iii) $g \circ f$ .(5M)	[L2][CO2][5] [L2][CO2][5]
11.	a) Define Monoid? Explain why $\langle W, + \rangle$ is a Monoid & $\langle N, + \rangle$ is not a Monoid. b) Explain General Properties of Algebraic Structure with examples.	[L2][CO3][5] [L2][CO3][5]
12.	Show that the set $G = \{1, 2, 3, 4\}$ is an abelian with respect to multiplication modulo 5 and develop composition table.	[L2][CO3][10]

### UNIT - III

S.No.	Question	[BT Level] [CO][Marks]
<b>2 Marks Questions (Short)</b>		
1.	Find the coefficient of $10x$ in the expansion of $1/(1-2x)$ .	[L1][C04][2]
2.	How many 3-digit numbers can be formed using the 6 digits 2, 3, 4, 5, 6 and 8, if the number is to be odd and repetitions are not allowed?	[L1][C04][2]
3.	In how many ways can 6 persons occupy 3 vacant seats?	[L1][C04][2]
4.	State binomial theorem.	[L2][C04][2]
5.	Find the number of different permutations of the letters in the word GROUP.	[L1][C04][2]
6.	Compute the number of distinct five-card hands that can be dealt from a deck of 52 cards.	[L2][C04][2]
7.	State sum rule and product rule of counting.	[L2][C04][2]
8.	In how many ways can 5 children arrange themselves in a ring?	[L1][C04][2]

9.	Differences between permutation and combination?	[L2][C04][2]
10.	State the Multinomial theorem.?	[L2][C04][2]

### Descriptive Questions (Long)

Q.No.	UNIT-III (Elementary Combinatorics)	[BT Level] [CO][ Marks]
1.	From a committee consisting of 6 men and 7 women in how many ways can be select a committee of a) 3men and 4 women. b) 4 members which has atleast one women. c) 4 persons of both sexes. d) 4 person in which Mr. And Mrs kannan is not included	[L2][C04][10]
2.	In a town council there are 10 democrats (6 men, 4 women) and 11 republicans (7 men, 4 women). Find the number of committees of 8 councilors which have equal number of men and women and equal number of members from both parties	[L2][C04][10]
3.	Compute the coefficients using Multinomial Theorem: I. $x^5y^5z^5w^5$ in $(x-3y+2z-5w)^{20}$ II. $xyz^2$ in $(2x-y-z)^4$	[L3][C04][5] [L3][C04][5]
4.	Compute the coefficients using Binomial Theorem: (i) $a^2b^3c^2d^4$ in $(a+b)^5(c+d)^6$ (ii) $a^3b^2$ in $(a+b)^5+(c+d)^4$ . (ii) $X^3Y^7$ in (i) $(X+2Y)^{10}$ (ii) $(2X-9Y)^{10}$	[L3][C04][5] [L3][C04][5]
5.	Predict the number of ways in which the complete collection of letters that appear in TALLAHASSEE can be arranged in a row so that: (i) T appears at the beginning and E appears at the end. (ii) There are no adjacent A's	[L3][C04][5] [L3][C04][5]
6.	I. Compute the coefficient of $x^5y^{10}z^5w^5$ in $(x-7y+3z-2w)^{25}$ II. Interpret many non-negative integral solutions are there to the inequality $x_1 + x_2 + x_3 + x_4 + x_5 \leq 19$ .	[L3][C04][5] [L3][C04][5]
7.	If two indistinguishable dice are rolled, then a) How many ways can we get a sum of 4 or of 8? b) How many ways we get an even sum?	[L2][C04][5] [L2][C04][5]

8.	Compute the number of ways in which the complete collection of letters that appear in MISSISSIPPI can be arranged in a row so that: (i) S appears at the beginning (ii) There are no adjacent I's	[L3][C04][5] [L3][C04][5]
9.	(a) How many ways can 5 days be chosen from each of the 12 months of an ordinary year of 365 days? (b) How many 10-digit binary numbers are there with exactly six 1's?	[L2][C04][5] [L2][C04][5]

#### UNIT - IV

S.No.	Question	[BT Level] [CO][ Marks]
<b>2 Marks Questions (Short)</b>		
1.	Find the generating function of $a_r = 5 \cdot 2^r$	[L1][CO5][2]
2.	Write the recursive definition of the sequence: 1, 3, 5, 7, 9, 11, ...,	[L1][CO5][2]
3.	Find the recurrence relation of the Fibonacci sequence.	[L1][CO5][2]
4.	Find the closed form of the generating function for the sequence "s" with terms 1, 2, 3, 4, .....	[L2][CO5][2]
5.	Find f (1), f (2), f (3), and f (4) if f (n + 1) = f (n) + 2 is defined recursively by f (0) = 1 and for n = 0, 1, 2, ....	[L2][CO5][2]
6.	Solve the recurrence relation $a_n = a_{n-1} + n$ , where $a_0 = 2$ .	[L3][CO5][2]
7.	Find a recurrence relation for the number of ways to make a pile of n chips using garnet, gold, red, white, and blue chips such that no two gold chips are together.	[L2][CO5][2]
8.	Solve the following recurrence relation using generating functions: $a_n - 6a_{n-1} = 0$ for $n \geq 1$ and $a_0 = 1$ .	[L3][CO5][2]
9.	Find the coefficient of $X^{14}$ in $(1+X+X^2+X^3)^{10}$ .	[L2][CO5][2]
10.	Find the coefficient of $y^{17}$ in $(1-y+y^2-4y^3)^{16}$ .	[L2][CO5][2]
<b>Descriptive Questions (Long)</b>		
So.No.	UNIT-IV (Recurrence Relations)	[BT Level] [CO][ Marks]
1.	Identify is the solution of the recurrence relation $a_n = a_{n-1} + 2a_{n-2}$ with $a_0 = 2$ and $a_1 = 7$ ?	[L3][CO5][10]

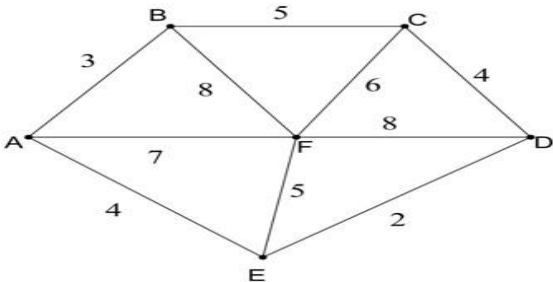
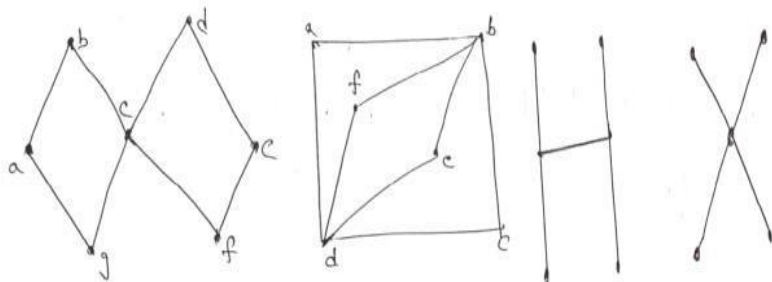
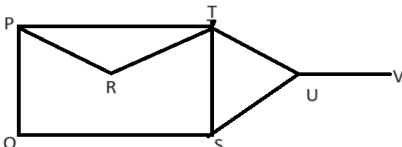
2.	Find Fibonacci recurrence relation satisfy the recurrence relation $f_n = f_{n-1} + f_{n-2}$ with initial conditions $f_0 = 0$ and $f_1 = 1$ .	[L2][CO5][10]
3.	Solve recurrence relation $a_n = 6a_{n-1} - 9a_{n-2}$ with $a_0 = 1$ and $a_1 = 6$ ?	[L3][CO5][10]
4.	Find the Coefficient of a Generating Function I. $x^{12}$ in $x^3(1-2x)^{10}$ II. $x^0$ in $(3x^2-(2/x))^{15}$	[L2][CO5][10]
5.	i. Solve recurrence relation $4a_n - 3a_{n-1} = 0, n \geq 1, a_0 = 1$ ii. If $a_n$ is the solution of a recurrence relation $a_{n+1} = k \cdot a_n$ and $a_3 = 153/49$ and $a_5 = 1377/2401$ . What is $k$ ?	[L3][CO5][5] [L1][CO5][10]
6.	Solve the recurrence relation $a_n - 3a_{n-2} + 2a_{n-3} = 0, n \geq 3, a_0 = 1, a_1 = 0$ , and $a_2 = 0$ using character root functions	[L3][CO5][10]
7.	Solve the following Recurrence relation by Substitution method. i. $a_n = a_{n-1} + (1/n(n+1))$ where $a_0 = 1$ ii. $a_n = a_{n-1} + n \cdot 3^n$ given $a_0 = 1$	[L3][CO5][10]
8.	Find the coefficient of $x^{27}$ in the following function $(x^4 + x^5 + x^6 + \dots)^5$ .	[L2][CO5][10]
9.	i. Find the sequence of Generating Function $(3+x)^3$ . ii. Find the generating function for the sequence 0,1,-2,3,-4,.....	[L2][CO5][5] [L2][CO5][5]
10.	Solve the recurrence relation $2a_{n+3} = a_{n+2} + 2a_{n+1} - a_n$ with $a_0 = 0, a_2 = 2$ and $a_1 = 1$ ?	[L3][CO5][10]
11.	Solve the recurrence relation $a_n - 9a_{n-1} + 20a_{n-2} = 0$ with $a_0 = 0, a_1 = -10$ using generating function method?	[L3][CO5][10]
12.	Solve the recurrence relation $a_n + 4a_{n-1} + 4a_{n-2} = 8$ for $n \geq 2$ where $a_0 = 1, a_1 = 2$ .	[L3][CO5][10]

### UNIT - V

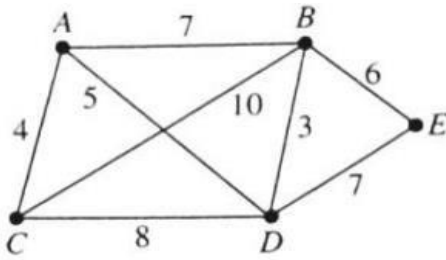
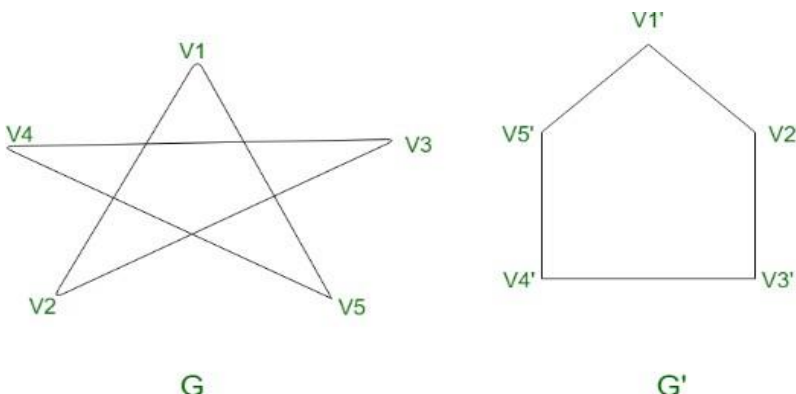
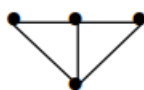
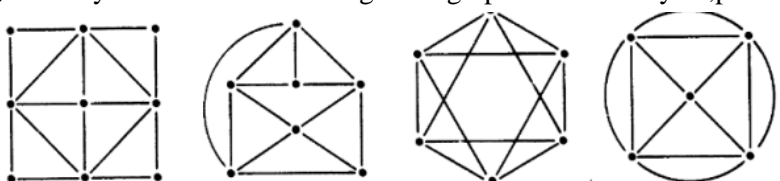
S.No.	Question	[BT Level] [CO][Marks]
<b>2 Marks Questions (Short)</b>		
1.	Define Bipartite graph and give an example.	[L1][CO6][2]
2.	When do you say that a graph is minimally connected?	[L1][CO6][2]
3.	How many edges are there in a graph with 10 vertices each of degree	[L1][CO6][2]

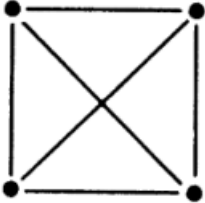
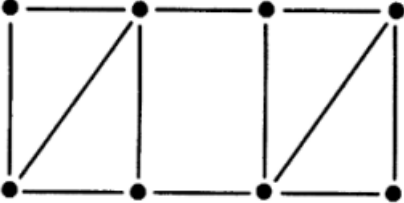
	six?	
4.	Give an example of a graph which has a Hamiltonian circuit but not an Eulerian circuit.	[L2][CO6][2]
5.	A complete binary tree has 125 edges. How many vertices does it have?	[L1][CO6][2]
6.	Define a planar graph.? Give suitable example.	[L1][CO6][2]
7.	Explain Euler formula? Give suitable example	[L2][CO6][2]
8.	Define Binary tree? Give suitable example	[L1][CO6][2]

### Descriptive Questions (Long)

1.	Show that the maximum number of edges in a simple graph with n vertices is $n*(n-1)/2$	[L2][CO6][10]
2.	Construct all regular binary trees: (i) With exactly 7 vertices. (ii) With exactly 9 vertices.	[L3][CO6][10]
3.	<p>I. Write Kruskal's algorithm for finding a minimal spanning tree. Find the minimum spanning tree using Kruskal's algorithm</p> 	[L2][CO6][10]
4.	<p>I. Explain about Euler circuit, Euler walk, Euler graph</p> <p>II. Explain about Hamiltonian circuit, Hamiltonian walk, Hamiltonian graph</p> <p>III. Identify whether the following graphs are Euler or Hamiltonian.</p> 	[L2][CO6][3] [L2][CO6][3] [L3][CO6][4]
5.	<p>1. Explain Euler's Formula or Euler's Theorem?</p> <p>2. For the given planar graph shown below,</p> 	[L2][CO6][5]  [L3][CO6][5]



	<p>a) Apply Euler's formula and find the degree of each region.</p> <p>b) Show that sum of these degrees is equal to the twice the no.of edges.</p> <p>Show that following graph is verified by Euler's formula.</p>	
6.	<p>1. Explain minimum spanning tree.</p> <p>2. Build a minimum spanning tree of the following graph with proper steps.</p> <p>3.</p> 	<p>[L2][CO6][5]</p> <p>[L3][CO6][5]</p>
7.	<p>i. List the conditions involved in Isomorphism of two graphs</p> <p>ii. Identify whether the given graphs are isomorphic to each other or not?</p> 	<p>[L1][CO6][5]</p> <p>[L3][CO6][5]</p>
8.	<p>(a) show that a connected graph <math>G</math> is Eulerian if and only if every vertex of <math>G</math> has even degree.</p> <p>(b) Show that a connected graph is a tree if and only if there is a unique, simple path between any two vertices.</p>	<p>[L3][CO6][5]</p> <p>[L3][CO6][5]</p>
9.	<p>(a) Explain a planar graph, show that <math>K_5</math> is non-planar.</p> <p>(b) Explain spanning tree of a graph of <math>G</math>. Find all the spanning trees of a following graph.</p> 	<p>[L2][CO6][5]</p> <p>[L2][CO6][5]</p>
10.	<p>a) Identify whether the following Multigraphs are Euler cycle, path or neither.</p> 	<p>[L3][CO6][5]</p> <p>[L3][CO6][5]</p>

	<p>b) Identify whether the following graphs are Hamiltonian cycles or not.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div>	
--	---	--

**Signature of the Staff:**

**Signature of Department Academic Committee Member 1:**

**Signature of Department Academic Committee Member 2:**

**Signature of Department Academic Committee Member 3:**