



# VIDYA JYOTHI INSTITUTE OF TECHNOLOGY

## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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### Question Bank

Subject: **Mathematical Foundations of Computer Science**

Yr: **II** Sem: **I**

Name of the Faculty: **K.SR.K.SARMA** and **Ch. DEEPIKA**

### **UNIT: I**

#### **BIG Answers Type Questions: (5 questions)**

1. Construct truth table for  $(P \rightarrow Q) \wedge (R \rightarrow Q) \leftrightarrow (P \vee R) \rightarrow Q$
2. Show that  $R \wedge (P \vee Q)$  is a valid conclusion from premises  
 $P \vee Q, Q \rightarrow R, P \rightarrow M$  and  $\neg M$ .
3. Explain the logical connectives with their truth tables.
4. Show that  $P \rightarrow \neg S$  follows from the set of premises  
 $P \rightarrow Q \vee R, Q \rightarrow \neg P, S \rightarrow \neg R, P$  using indirect method of proof.
5. Prove or disprove the validity of the following argument:  
Every living thing is a plant or an animal.  
David's dog is alive and it is not a plant.  
All animals have hearts.  
Hence, David's dog has a heart.

#### **Short Answer Questions: (20 questions)**

1. Define Converse, Contra positive, Inverse of a conditional statement
2. Define Tautology, Contradiction and Contingency
3. State the following rules
  - i. Modus Ponens's rule
  - ii. Modus Tollens's rule
  - iii. Transitivity rule
  - iv. Hypothetical syllogism rule
4. State the Set operations with Venn diagrams.
5. Explain the conditional logical connective with its truth tables.



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6. Explain the conditional bi-logical connective with its truth tables.
7. Construct the truth table for the compound statement:  $p \wedge (\sim q \vee r)$
8. Prove that  $p \rightarrow [q \rightarrow (p \wedge q)]$  is a tautology.
9. Restate the following implication,  $p \rightarrow q$  in the equivalent form  $(\sim p) \vee q$ .  
If triangle ABC is isosceles, then the base angles A and B are equal.
10. State the converse, inverse and contrapositive of the following statement:  
If the triangle is equiangular, then it is equilateral.
11. Test the validity of the following argument:  
If 7 is a prime number, then 7 does not divide 35  
7 divides 35  
 $\therefore$  7 is not a prime number
12. Test the validity of the following argument:  
If sachin hits a century, then he gets a free car.  
Sachin hits a century.  
 $\therefore$  Sachin gets a free car.
13. Negate and simplify :  $\exists x, [p(x) \vee q(x)]$
14. Evaluate the following open statements for  $p = 2, q = 0$   
 $P(x) : x \leq 3$                        $q(x) : x+1$  is odd
15. Write the following quantified statement in symbolic form for the given predicates:  
 $P(x) : x > 0$                        $q(x) : x$  is even  
“There exists a positive integer that is even”
16. Write down the following proposition in symbolic form, and find its negation.  
“If all triangles are right angled, then no triangle is equiangular”
17. Give a direct proof of the statement “The square of an odd integer is an odd integer”



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18. Prove that if  $n^2$  is even, then  $n$  is even using indirect method.
19. Give an indirect proof of the statement “The product of two even integers is an even integer”
20. Prove that the following argument is valid:
- All men are mortal.
- Rahul is a man.
- $\therefore$  Rahul is mortal.

### UNIT : II

#### BIG Answers Type Questions : (5 questions)

1. How many ways are there to select the 2 cards such that:
  - (a) the first card is an ace and the second card is a king?
  - (b) the first card is an ace and the second is not a king?
  - (c) the first card is a heart and the second is a club?
  - (d) the first card is a heart and the second is a king?
  - (e) the first card is a heart and the second is not a king?
2. Consider only 8-letter words with 3 different vowels and 5 different consonants.
  - (a) How many such words can be formed?
  - (b) How many such words contain the letter  $a$ ?
  - (c) How many contain the letters  $a$  and  $b$ ?
  - (d) How many contain the letters  $b$  and  $c$ ?
  - (e) How many contain the letters  $a, b$ , and  $c$ ?
3. Consider only 8-letter words with 3 different vowels and 5 different consonants.
  - (a) How many such words can be formed?
  - (b) How many such words contain the letter  $a$ ?
  - (c) How many contain the letters  $a$  and  $b$ ?
  - (d) How many contain the letters  $b$  and  $c$ ?
  - (e) How many contain the letters  $a, b$ , and  $c$ ?
4.
  - (a) How many ways are there to distribute 20 chocolate doughnuts, 12 cherry-filled doughnuts, and 24 cream-filled doughnuts to 4 different students?
  - (b) How many ways can the different kinds of doughnuts be distributed to the students if each student receives at least 2 of each kind of doughnut?
5. How many integral solutions are there of  $x_1 + x_2 + x_3 + x_4 + x_5 = 30$  where for each  $i$ 
  - (a)  $x_i \geq 0$ ;
  - (b)  $x_i \geq 1$ ;



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(c)  $x_1 \geq 2; x_2 \geq 3; x_3 \geq 4; x_4 \geq 2; x_5 \geq 0;$

(d)  $x_i > i.$

### Short Answers Type Questions : (20 qsns)

- Find the generating function for  $a_n$  = the number of nonnegative integral solutions to  $e_1 + e_2 + e_3 + \dots + e_n = r$  where  $0 \leq e_i \leq 1$ .
- Find the value of  $n$  in  $P(n, 2) = 90$
- How many among the first 100,000 positive integers contain exactly one 3, one 4 and one 5 in their decimal representation?
- How many positive integers can be formed using the digits 3, 4, 4, 5, 5, 6, 7 if we want to exceed 5,000,000?
- Find the number of ways of placing 20 identical balls into 5 boxes with at least one ball in each box.
- In how many ways can 5 similar books be placed on 3 different shelves?
- How many different license plates are there that involve 1, 2 or 3 letters followed by 4 digits.
- Find the number of distinguishable permutations of the letters in the following words  
I. Flower II. Mathematics
- In how many ways can seven people be seated at a round table if two particular persons must sit next to each other?
- Build a generating function for  $a_r$  = the number of integral solutions to the equation  
$$e_1 + e_2 + e_3 = r$$
  
if: (i)  $0 \leq e_i \leq 3$  for each  $i$ . (ii)  $2 \leq e_i$  for each  $i$ .
- Find a generating function for the number of  $r$  – combinations of  
 $\{3.a, 5.b, 2.c\}$
- How many ways can we distribute 12 white balls and 2 black balls into 9 numbered boxes each box contains at least 1 white ball



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13. Find the number of distinguishable permutations of the letters in the following words
- I. Banana 2. Calculus 3. Basic
14. In how many ways can 10 boys and 10 girls sit around a circular table, if boys and girls sit alternatively.
15. How many integral solutions are there to  $x_1 + x_2 + x_3 + x_4 + x_5 = 20$  where each  $x_i \geq 2$ ?
16. i) In how many ways can a hand of 5 cards be selected from a deck of 52 cards?
- ii) How many 5 card hands consist only of hearts?
17. The results of 50 football games (Win, lose, Tie) are to be predicted. How many different forecasts can contain exactly 28 correct results?
18. Find the total number of positive Integers that can be formed from the digits 1, 2, 3, 4, & 5 if no digit is repeated in any one integer
19. In how many ways can 10 people arrange themselves
- i. In a row of 10 chairs
- ii. In a row of 7 chairs
- iii. In a Circle of 10 chairs
20. How many possible telephone numbers are there when there are seven digits, the first two of which are between 2 and 9 inclusive, the third digit between 1 and 9 inclusive, and each of the remaining may be between 0 and 9 inclusive?

### UNIT : III

#### BIG Answers Type Questions : (5 questions)

1. Solve recurrence relations by Generating Functions
- $$a_n - 9a_{n-1} + 20a_{n-2} = 0 \text{ for } n \geq 2 \text{ and } a_0 = -3, a_1 = -10$$
2. Solve the recurrence relations using the characteristic roots
- $$a_n - 3a_{n-1} - 4a_{n-2} = 0 \text{ for } n \geq 2 \text{ and } a_0 = a_1 = 1$$
3. Solve the recurrence relations using the characteristic roots
- $$a_n - 4a_{n-1} - 12a_{n-2} = 0 \text{ for } n \geq 2 \text{ and } a_0 = 4, a_1 = 16/3$$



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4. Solve the recurrence relations for a particular solution

$$a_n - 5a_{n-1} - 8a_{n-2} - 4a_{n-3} = n.$$

5. Find a particular solution to

$$a_n - 6a_{n-1} + 8a_{n-2} = 3^n \text{ where } a_0 = 3 \text{ and } a_1 = 7.$$

### Short Answers Type Questions : (20 qsns)

- Find the coefficient of  $x^{10}$  in  $(1+x+x^2+\dots)^2$
- Write the formal power series expression for the following
  - $1/(3-x)$
  - $1/(3+x)^4$
- Write the generating function for the sequence  $\{a_r\}_{r=0}$  defined by
  - $a_r = (-1)^3 r$
  - $a_r = 6(r+1)$
- In  $(1 + x^5 + X^9)^{10}$  find
  - the coefficient of  $x^{23}$
  - the coefficient of  $x^{32}$ .
- Find the coefficient of  $X^{16}$  in  $(1 + x^4 + x^8)^{10}$ .
- Write the formal power series expression for the following
  - $1/(1-5x)$
  - $1/(1-5x)^2$
- Write the generating function for the sequence  $\{a_r\}_{r=0}$  defined by
  - $a_r = 5^r$
  - $a_r = c(r+3, r)$
- Find the coefficient of  $x^{12}$  in  $(1-4x)^{-5}$
- Find the coefficient of  $x^{10}$  in  $1/(1+x)^5$
- Solve the following recurrence relation by substitution
$$a_n = a_{n-1} + n \quad \text{where } a_0 = 2.$$
- Solve the following recurrence relation by substitution
$$a_n = a_{n-1} + n^2 \quad \text{where } a_0 = 7.$$
- Find a general expression for  $a_n$  using generating functions
$$a_n - 7a_{n-1} + 12a_{n-2} = 0 \text{ for } n \geq 2.$$
- Find the characteristic roots of  $a_n + a_{n-1} - 6a_{n-2} = 0$  for  $n \geq 2$ .
- Find the general form of  $a_n + a_{n-1} - 6a_{n-2} = 0$  for  $n \geq 2$ .
- Find the characteristic roots of  $a_n - 3a_{n-1} + 2a_{n-2} = 0$  for  $n \geq 2$ .
- Solve  $a_n - 5a_{n-1} + 6a_{n-2} = 0$  where  $a_0 = 2$  and  $a_1 = 5$
- Write the general form of the solution to  $a_n - 6a_{n-1} + 9a_{n-2} = 0$ .



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18. Find the characteristic roots of the recurrence relation

$$a_n - 7a_{n-1} + 16a_{n-2} - 12a_{n-3} = 0$$

19. Find the characteristic polynomial for the homogenous recurrence relations

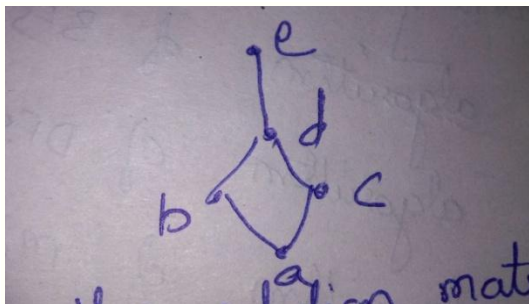
whose general solution has the form  $a_n = B_1 + nB_2$

20. Find the generating for the sequence 1, -1, 1, -1, .....

### UNIT-IV

#### BIG Answers Type Questions : (5 questions)

1. Draw the Hasse Diagram for the poset  $(p(s), \subseteq)$  where  $s = \{1, 2, 3, 4\}$
2. Draw the Hasse Diagram for the set  $A = \{2, 3, 5, 30, 60, 120, 180, 360\}$ .
3. Draw the Hasse Diagram for the divisibility relation on the set A in each of the following case:  
a)  $A = \{1, 2, 3, 4, 6, 8, 9, 12, 18, 24\}$     b)  $A = \{2, 3, 6, 12, 24, 36\}$
4. For  $A = \{a, b, c, d, e\}$  the Hasse Diagram for the poset  $(A, R)$  is as shown below
  - a) Determine the relation for R.
  - b) Construct the digraph for R



5. Draw the Hasse Diagram for the
  - i) divisors of 6
  - ii) Divisors of 12

#### Short Answers Type Questions : (20 qsns)

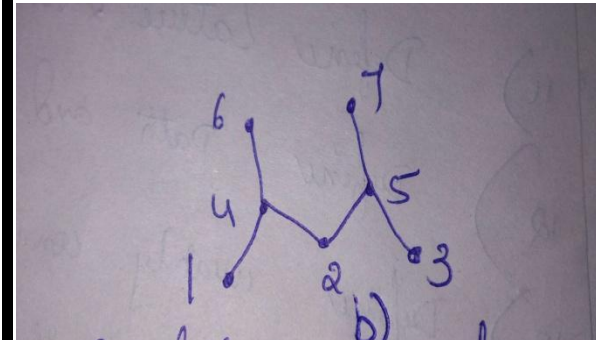
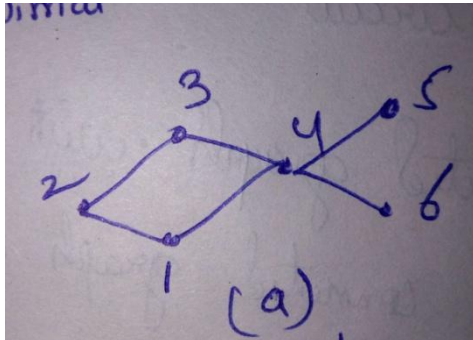
1. Define Isomorphism for a Directed Graph with Example
2. What are the properties of binary relation?
3. Define Equivalence relation and partial ordering relation.
4. Draw a digraph relation
  - a) Symmetric, Transitive, but not Reflexive
  - b) Transitive, Reflexive, but not symmetric
5. What are the characteristics of POSET
6. Explain the Special elements in POSET



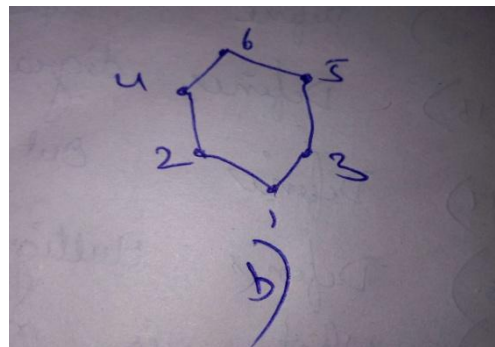
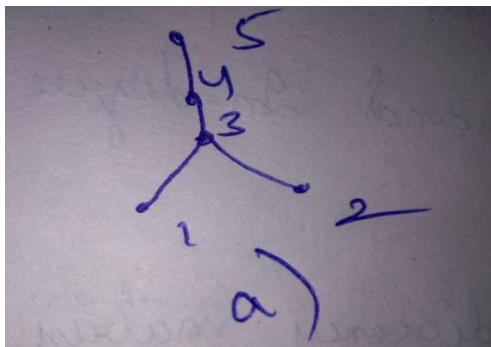


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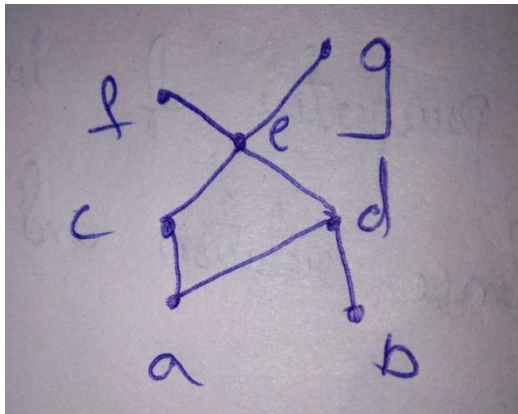
7. For the posets shown in the following Hasse diagrams, find all maximal elements and all minimal elements



8. For the Posets shown in the following Hasse diagrams, Find the greatest and least elements, if such exists



9. Consider the poset whose Hasse diagrams is shown below. Find LUB and GLB of  $B = \{c, d, e\}$



10. For the poset  $(A, R)$  defined on the set  $A = \{2, 3, 6, 12\}$  as represented by the following Hasse diagram. Find if they exist i)  $LUB = \{2, 3\}$  ii)  $GLB = \{3, 6\}$

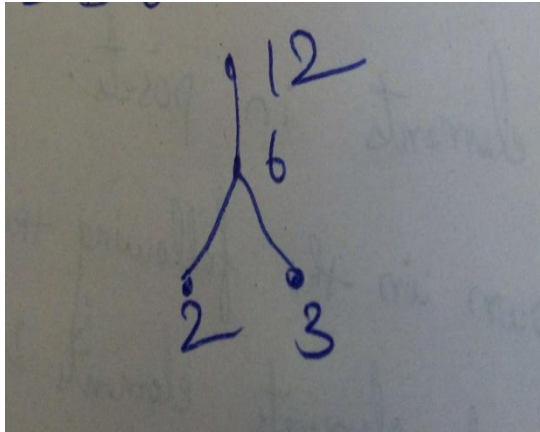




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11. Define LATTICE.
12. Define Path and circuit with Example.
13. Define weakly connected graph with Example
14. Define Unilaterally connected graph with Example.
15. Define Strongly connected graph with Example
16. Define digraph with Example.
17. Define IN-degree and OUT –degree of a vertex
18. Define Multigraph.
19. What is meant by Adjacency matrix With Example?
20. Draw the Hasse Diagram on the set  $A=\{2,4,8,16,32\}$

### UNIT-V

#### **BIG Answers Type Questions: (5 questions)**

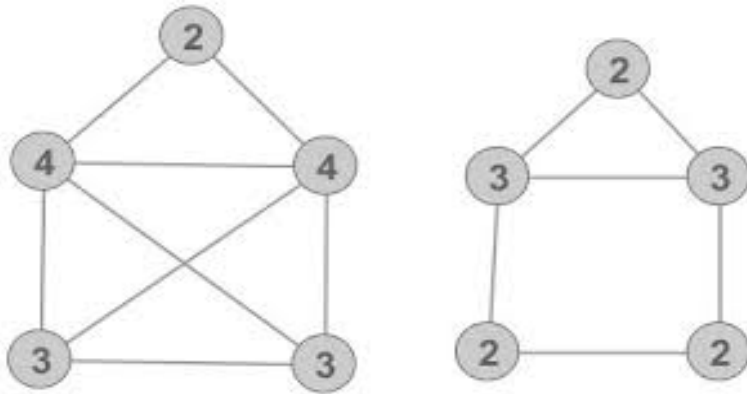
1. Define the following terms
  - i) Cycle
  - ii) Wheel
  - iii) Path
  - iv) Null Graph
  - v) Trivial tree
2. Show that the following graphs are Hamiltonian graphs



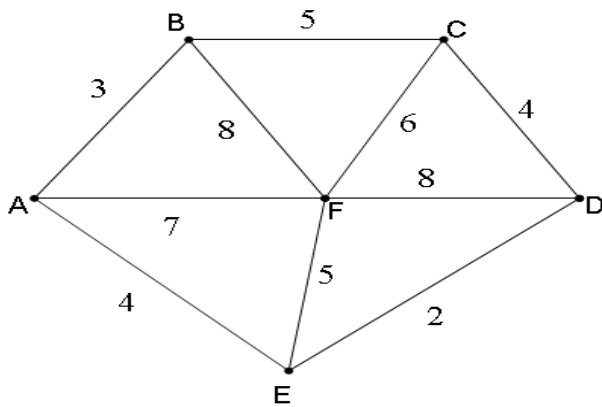
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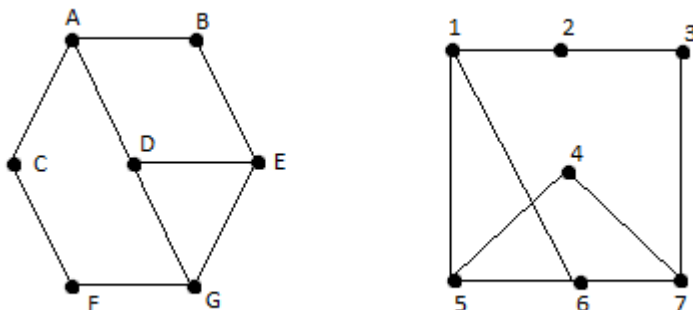
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3. Using Krushkal's algorithm, find the minimum cost spanning tree for the following weighted graph



4. Prove that the regions of a planar graph  $G$  can be colored with 2 colors if and only if  $G$  is an Euler graph.
5. Show that the following graphs are isomorphic:



### Short Answers Type Questions : (20 qsns)

1. Define non-directed graph with example.



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2. Define the degrees of a non-directed graph with example.
3. What are the properties of Isomorphism for non directed graphs?
4. Define Sub graph, Spanning Sub graph and Induced graph
5. Define a Complement graph and Complement Subgraph
6. Draw a complete graph with 5 vertices
7. Draw  $K_{2,4}$  graph
8. Explain bipartite graph
9. Explain complete graph with Example.
10. What are the properties of trees?
11. Define spanning tree, BFS and DFS.
12. Write an algorithm of BFS
13. Write an algorithm of DFS
14. Write an algorithm of MINIMUM Spanning Tree.
15. Define planar graph with example.
16. Define Eulers formula
17. Define Euler path and Eulerian Multipgraph.
18. What are the rules of Hamiltonian paths and cycles.
19. What is the chromatic number of a) a cycle    b) a tree
20. What are the types of tree traversals? Explain with Example