

Code No: X0522

**R07**

SET - 1

**II B.Tech I Semester, Supplementary Examinations, May – 2012**  
**MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE**  
 (Com. to CSE, IT)

Time: 3 hours

Max Marks: 80

Answer any **FIVE** Questions  
 All Questions carry **Equal** Marks

1. a) Find the truth table for the propositional formula:  $(P \leftrightarrow Q) \leftrightarrow (Q \rightarrow P)$   
 b) What is the canonical sum of products of the following propositional formula:  
 $(\sim X \wedge Y) \vee \sim Z \vee (X \wedge Y \wedge Z)$  (8M+8M)
  
2. a) Consider the statement: "If you study hard, then you will excel". Write its converse, contra positive and logical negation in predicate logic.  
 b) Show that  $(\forall x)(P(x) \vee Q(x)) \Rightarrow (\forall x)P(x) \vee (\exists x)Q(x)$ . (8M+8M)
  
3. a) Find the value of  $f(5861, 7)$  for the following recursive function definition:  

$$f(x, y) = \begin{cases} 0, & x < y \\ f(x - y, y) + 1, & y \leq x \end{cases}$$
 b) Draw the Hasse diagram for the relation R on  $A = \{1, 2, 3, 4, 5\}$ , whose relation matrix is given below: (8M+8M)

$$M_R = \begin{pmatrix} 1 & 0 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$
  
4. a) What is a group? What are properties of a group? Explain them with an example each.  
 b) Show that any group G is abelian iff  $(ab)^2 = a^2b^2$  for all  $a, b \in G$  (8M+8M)
  
5. a) What is the coefficient of  $x^{12}y^{13}$  in the expansion of:  $(2x - 3y)^{25}$ ?  
 b) How many integers between 1 and 250 are divisible by 2, 3, 5, or 7? (8M+8M)

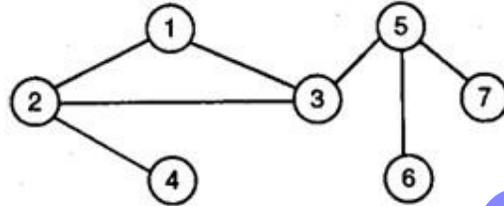
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6. a) Explain how to solve the recurrence relation by generating function.  
 b) Find the generating function of the Fibonacci sequence. (8M+8M)

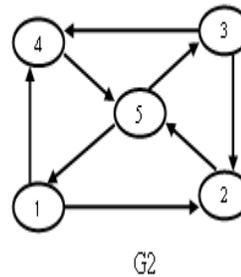
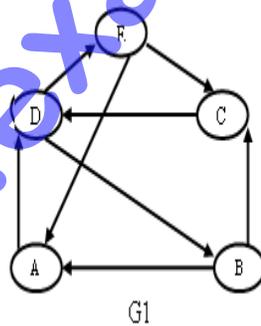
7. a) What is an articulation point? Find the number of articulation points of the following graph:



- b) Consider a weighted undirected graph with vertex set  $V = \{a, b, c, d, e, f, g, h, i, j\}$  and edge set  $E = \{(a, b, 6), (a, c, 1), (a, d, 2), (a, e, 8), (b, d, 3), (b, g, 2), (c, d, 2), (d, h, 15), (e, f, 11), (e, h, 8), (e, i, 2), (f, h, 4), (f, i, 9), (g, h, 8), (g, i, 14), (g, j, 19), (h, i, 4), (i, j, 5)\}$ . The third value in the tuple represents the weight of the edge specified in the tuple. What is the weight of a minimum spanning tree of the weighted undirected graph? (6M+10M)

8. a) Consider an undirected graph with vertex set  $V = \{n_1, n_2, n_3, n_4, n_5, n_6, n_7, n_8\}$  and edge set  $E = \{(n_1, n_2), (n_1, n_3), (n_1, n_4), (n_1, n_7), (n_2, n_3), (n_2, n_4), (n_2, n_5), (n_3, n_5), (n_3, n_6), (n_3, n_7), (n_4, n_5), (n_4, n_7), (n_5, n_6), (n_5, n_7), (n_5, n_8), (n_6, n_8), (n_7, n_8)\}$ . What is the chromatic number of the above undirected graph?

- b) Find whether the following graphs:  $G_1$  and  $G_2$  are isomorphic or not: (8M+8M)



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1. a) Show that  $(A \oplus B) \vee (A \downarrow B)$  is equivalent to  $(A \uparrow B)$   
b) Obtain the canonical product of sums of the following propositional formulas: (8M+8M)  
 $\sim X \wedge (\sim Y \vee Z)$
  
2. a) Show that  $(\forall x)(H(x) \rightarrow M(x)) \wedge (\exists x)H(x) \Rightarrow (\exists x)M(x)$   
b) Determine the validity of the following arguments using propositional logic: “Smoking is healthy. If smoking is healthy, then cigarettes are prescribed by physicians. Therefore, cigarettes are prescribed by physicians”. (8M+8M)
  
3. a) List all partitions of the set,  $S = \{a, b, c, d\}$ .  
b) What is lattice? Show that the set of all divisors of 70 forms a Lattice.  
c) Find the values of  $f(513, 2)$  for the following recursive function definition:  
$$f(n, r) = \begin{cases} n \bmod r + f\left(\frac{n}{r}, r\right), & \text{if } n > 0 \\ 0, & \text{otherwise} \end{cases} \quad (5M+5M+6M)$$
  
4. a) Consider the group,  $G = \{1, 5, 7, 11, 13, 17\}$  under multiplication modulo 18. Construct the multiplication table of  $G$  and find the values of:  $5^{-1}$ ,  $7^{-1}$  and  $17^{-1}$ .  
b) Consider the algebraic system  $(G, *)$ , where  $G$  is the set of all non-zero real numbers and  $*$  is a binary operation defined by:  $a * b = \frac{ab}{4}$ ,  $\forall a, b \in G$ . Show that  $(G, *)$  is an abelian group. (8M+8M)
  
5. a) Out of a group of 21 persons, 9 eat vegetables, 10 eat fish and 7 eat eggs. 5 persons eat all three. How many persons eat at least two out of the three dishes?  
b) What is the coefficient of  $x^{11}y^4$  in the expansion of:  $(2x^3 - 3xy^2 + z^2)^6$ ? (8M+8M)

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6. a) Solve the following recurrence relation:

$$T(k) - 9T(k-1) + 26T(k-2) - 24T(k-3) = 0 \text{ for } K \geq 3, \text{ with } T(0) = 0, T(1) = 1 \text{ and } T(2) = 10.$$

b) Explain the methods of solving recurrence relations with suitable examples. (10M+6M)

7. a) What is a Spanning Tree? How many Spanning Trees are there in a complete graph of 6 vertices?

b) What is a planar graph? Show that  $K_5$  and  $K_{3,3}$  are not planar graphs.

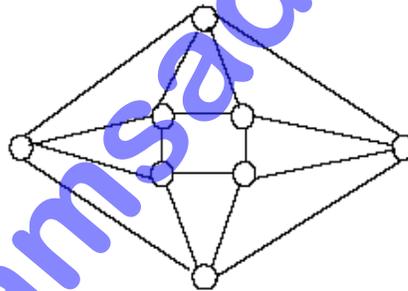
c) What is the maximum number of edges possible in a planar graph with 8 vertices?

(6M+6M+4M)

8. a) What is Hamiltonian graph? What is Euler graph? Explain with an example

b) Find the Chromatic Number of the following undirected graph:

(8M+8M)



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- Find the truth table for the propositional formula:  $(P \leftrightarrow Q) \leftrightarrow (Q \rightarrow P)$ .
  - Obtain the principle conjunctive normal form of:  $(\sim P \rightarrow R) \wedge (Q \leftrightarrow P)$  (8M+8M)
- Show that  $\sim P$  is a valid conclusion from the following premises:  
 $(P \rightarrow Q) \wedge (R \rightarrow S), (Q \rightarrow T) \wedge (S \rightarrow U), \sim(T \wedge U), P \rightarrow R$
  - Using propositional logic, show that the following premises are inconsistent: "If 'X' misses many classes through illness, then he/she fails MFCS. If 'X' fails MFCS, then he/ she is useless. If 'X' reads lot of books, then he/she is not useless. Therefore, 'X' misses many classes through illness and reads a lot of books". (8M+8M)
- What is a lattice? Draw the Hasse diagrams of all the lattices with 5 elements.
  - What is a compatibility relation? Let the compatibility relation on a set  $\{x_1, x_2, x_3, x_4, x_5, x_6\}$  be given by the following matrix. Draw the graph and find the maximal compatibility blocks of the relation. (8M+8M)

$x_2$	1				
$x_3$	1	1			
$x_4$	0	0	1		
$x_5$	0	0	1	1	
$x_6$	1	0	1	0	1
	$x_1$	$x_2$	$x_3$	$x_4$	$x_5$

- Give an example of a *monoid* which is not a *group*.
  - Explain the following algebraic systems:
    - Homomorphism
    - Monomorphism
    - Endomorphism
    - Epimorphism
    - Isomorphism
 (6M+10M)

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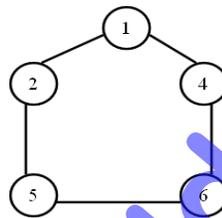
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5. a) Explain, in detail, about the Binomial theorem and Multinomial theorem.  
 b) How many terms will be there in the expansion of:  $(x + y + z)^5$  ? (8M+8M)

6. a) Solve the following recurrence relation:  
 $T(k) - 9T(k-1) + 26T(k-2) - 24T(k-3) = 0$  for  $K \geq 3$ , with  $T(0) = 0$ ,  $T(1) = 1$  and  $T(2) = 10$ .  
 b) Find the generating function of the Fibonacci sequence. (8M+8M)

7. a) What is a complement of a graph? Find the complement of the following graph:



- b) Consider a weighted undirected graph with vertex set  $V = \{a, b, c, d, e, f, g, h, i, j\}$  and edge set  $E = \{(a, b, 6), (a, c, 1), (a, d, 2), (a, e, 8), (b, d, 3), (b, g, 2), (c, d, 2), (d, h, 15), (e, f, 11), (e, h, 8), (e, i, 2), (f, h, 4), (f, i, 9), (g, h, 8), (g, i, 14), (g, j, 19), (h, i, 4), (i, j, 5)\}$ . The third value in the tuple represents the weight of the edge specified in the tuple. What is the weight of a minimum Spanning Tree of the weighted undirected graph? (6M+10M)
8. a) Explain all the rules to be followed to find the *chromatic number* of a given graph.  
 b) Consider an undirected graph with vertex set  $V = \{n1, n2, n3, n4, n5, n6, n7, n8\}$  and edge set  $E = \{(n1, n2), (n1, n3), (n1, n4), (n1, n7), (n2, n3), (n2, n4), (n2, n5), (n3, n5), (n3, n6), (n3, n7), (n4, n5), (n4, n7), (n5, n6), (n5, n7), (n5, n8), (n6, n8), (n7, n8)\}$ . What is the *chromatic number* of the above undirected graph? (6M+10M)

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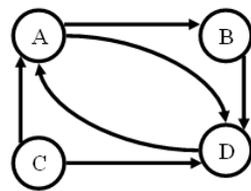
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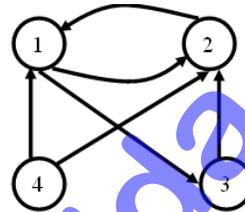
1. a) Show that  $((P \rightarrow Q) \rightarrow R) \rightarrow ((P \rightarrow Q) \rightarrow (P \rightarrow R))$  is a universally valid formula.  
b) Obtain the canonical product of sums of the following propositional formula:  
 $(P \wedge Q) \vee (\sim Q \wedge R)$  (8M+8M)
2. a) Show that the following set of premises are inconsistent using proof by contradiction:  
 $P \rightarrow (Q \vee R), Q \rightarrow \sim P, S \rightarrow \sim R, P \Rightarrow P \rightarrow \sim S$   
b) What is the first order predicate calculus statement equivalent to the following?  
“Every teacher is liked by some student “ (8M+8M)
3. a) How many edges are presented in the Hasse diagrams of lattices,  $\langle L_1, \leq \rangle$  and  $\langle L_2, \leq \rangle$ , where  $L_1 = \{1, 2, 3, 4, 6, 12\}$  and  $L_2 = \{2, 3, 6, 12, 24\}$  and  $a \leq b$  if and only if  $a$  divides  $b$ ?  
b) What is 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  $g(x) = 2x - 3$ .  
Find the composition of functions: i)  $f \circ f$  ii)  $f \circ g$  iii)  $g \circ f$  (8M+8M)
4. a) Explain the algebraic systems: group, abelian group and monoid with suitable examples.  
b) Consider the algebraic system:  $(Z, *)$ , where  $*$  is defined by  $a * b = a + b - ab$ . Find whether  $(Z, *)$  is a group or monoid. (8M+8M)
5. a) What is the coefficient of  $x^{12}y^{13}$  in the expansion of:  $(x + y)^{25}$ ?  
b) How many integers between 1 and 1000 are *not* divisible by 2, 3, 5, or 7? (8M+8M)
6. a) Explain the methods of solving recurrence relations with suitable examples.  
b) Solve the following recurrence relation:  
 $T(k) + 3T(k-1) - 4T(k-2) = 0$  for  $K \geq 2$ , with  $T(0) = 3$  and  $T(1) = 2$ . (8M+8M)

7. a) Compare depth first search and breadth first search with suitable examples.  
 b) Consider a weighted undirected graph with vertex set  $V = \{n_1, n_2, n_3, n_4, n_5, n_6\}$  and edge set  $E = \{(n_1, n_2, 2), (n_1, n_3, 8), (n_1, n_6, 3), (n_2, n_4, 4), (n_2, n_5, 12), (n_3, n_4, 7), (n_4, n_5, 9), (n_4, n_6, 4)\}$ . The third value in the tuple represents the weight of the edge specified in the tuple. What is the weight of a minimum spanning tree of the weighted undirected graph? (8M+8M)

8. a) Find whether the following graphs: G1 and G2 are isomorphic or not:



G1



G2

- b) Consider an undirected graph with vertex set  $V = \{n_1, n_2, n_3, n_4, n_5, n_6, n_7, n_8\}$  and edge set  $E = \{(n_1, n_2), (n_1, n_3), (n_1, n_4), (n_1, n_7), (n_2, n_3), (n_2, n_4), (n_2, n_5), (n_3, n_5), (n_3, n_6), (n_3, n_7), (n_4, n_5), (n_4, n_7), (n_5, n_6), (n_5, n_7), (n_5, n_8), (n_6, n_8), (n_7, n_8)\}$ . What is the chromatic number of the above undirected graph? (8M+8M)