

Name :

Roll No. :

Invigilator's Signature :

CS/MCA/SEM-1/M(MCA)-101/2010-11

2010-11

DISCRETE MATHEMATICAL STRUCTURES

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

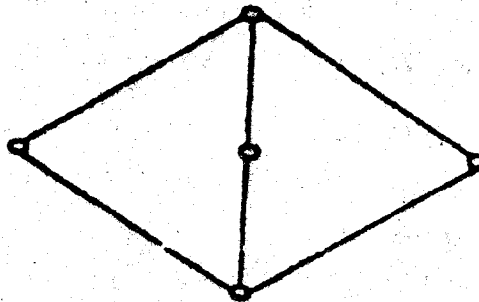
10 × 1 = 10

- i) A relation R is called an equivalence relation if
- a) R is reflexive and transitive
 - b) R is reflexive and symmetric
 - c) R is reflexive, transitive and symmetric
 - d) R is reflexive, anti-symmetric and transitive.
- ii) If A and B are nonempty sets. Then cardinality of A and B are 2 & 3 respectively then cardinality of $A \times B$ is
- a) 6
 - b) 5
 - c) 13
 - d) 4.
- iii) The coefficient of $x^3y^2z^2$ in $(x+y+z)^9$ is
- a) $(9!)/(7!)$
 - b) $(9!)/(3! 2! 2!)$
 - c) $(7!)/(7!)$
 - d) $(3! 2! 2!)/(7!)$.

1214

[Turn over

- x) The proposition $P \wedge (\sim p \vee q)$ is
- a tautology
 - logically equivalent to $p \wedge q$
 - logically equivalent to $p \vee q$
 - a contradiction.
- xi) Which of the following is/are tautology ?
- $a \vee b \rightarrow b \wedge c$
 - $a \wedge b \rightarrow b \vee c$
 - $a \vee b \rightarrow (b \rightarrow c)$
 - $a \rightarrow b \rightarrow (b \rightarrow c)$.
- xii) The following is the Hass diagram of the poset $\{a, b, c, d, e\}$. The poset is



- not a lattice
- a lattice but not a distributive lattice
- a distributive lattices but not a Boolean algebra
- a Boolean algebra.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Prove that for a simple graph having n vertices and k components, the maximum number of edges is $\frac{(n-k)(n-k+1)}{2}$.
3. Prove that in a bounded distributive lattice, complement of an element is unique.
4. Obtain a conjunctive normal form of $p \wedge (p \vee q)$.
5. Design a finite state machine that performs serial addition.
6. Draw the transition diagram for the FSA with $I = \{ a, b \}$,

$Q = \{q_0, q_1, q_2\}$, $F = \{q_0, q_1\}$ and δ is given by

δ	a	b
q_0	q_0	q_1
q_1	q_0	q_2
q_2	q_2	q_2

GROUP - C

(Long Answer Type Questions)

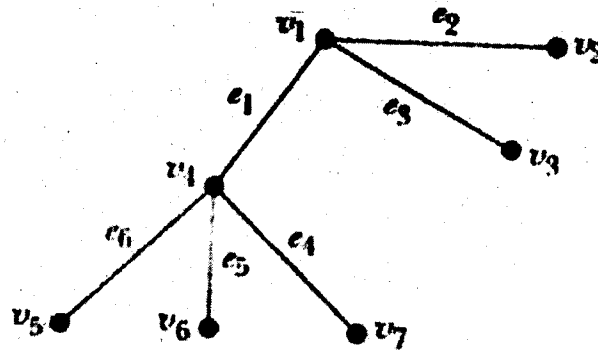
Answer any *three* of the following. $3 \times 15 = 45$

7. a) In a set A , a relation R is defined as follows

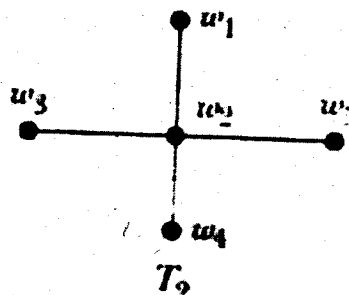
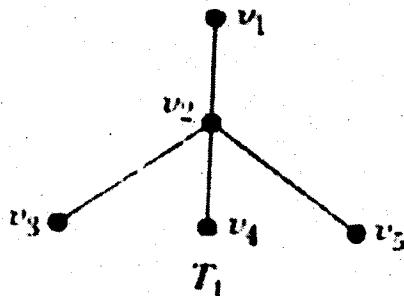
$$R = \{(a_1, a_1), (a_1, a_2), (a_1, a_4), (a_2, a_3), (a_3, a_3), \\ (a_3, a_5), (a_4, a_4), (a_5, a_2)\}$$

Determine the transitive closure of R using Warshall's algorithm.

- b) Determine the adjacency matrix for the following graph.

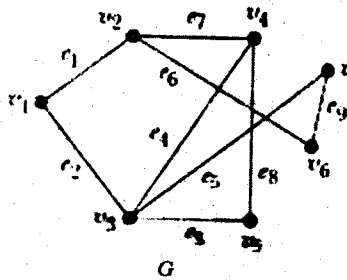


- c) Examine whether the following trees are isomorphic



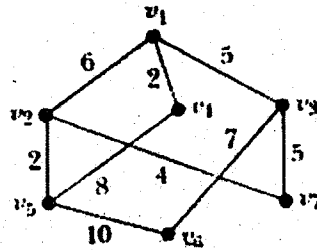
9 + 3 + 3

8. a) Evaluate the following postfix expression
 $24\ 4 + 3 \cdot 7 / 26\ 4 - +$
- b) Draw the tree for the following infix expression and find the corresponding prefix expression
 $((A + B) / (C - D) + E) \cdot F - G.$
- c) Draw a spanning tree of the following graph :

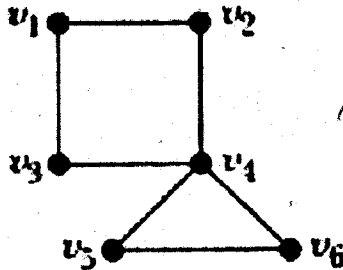


4 + 8 + 3

9. a) Apply Prim's algorithm to find a minimum spanning tree from the following weighted graph.



- b) Apply BFS algorithm to find a spanning tree of the following graph



c) Draw the transition diagram from the DFA given by

$$M = (\{q_0, q_1, q_2\}, \{0, 1\}, q_0, \delta, \{q_2\})$$

$$\delta(q_0, 0) = q_1, \quad \delta(q_1, 1) = q_2,$$

$$\delta(q_0, 1) = q_0, \quad \delta(q_2, 0) = q_0,$$

$$\delta(q_1, 0) = q_2, \quad \delta(q_2, 1) = q_1, \quad 5 + 5 + 5$$

10. a) What is Language and what is Grammar ? Why Language & Grammar is needed for computer science ?

b) Construct the grammar for the language $L = a^n b^n c^m d^m$, $m, n, > 0$.

c) Construct a Moore machine equivalent to the Mealy machine M given by the following table :

Present state	Next State			
	a = 0		a = 1	
	state	output	state	output
-> q1	q1	1	q2	0
q2	q4	1	q4	1
q3	q2	1	q3	1
q4	q3	0	q1	1

d) Construct a Mealy machine which is equivalent to the Moore machine given by the following table :

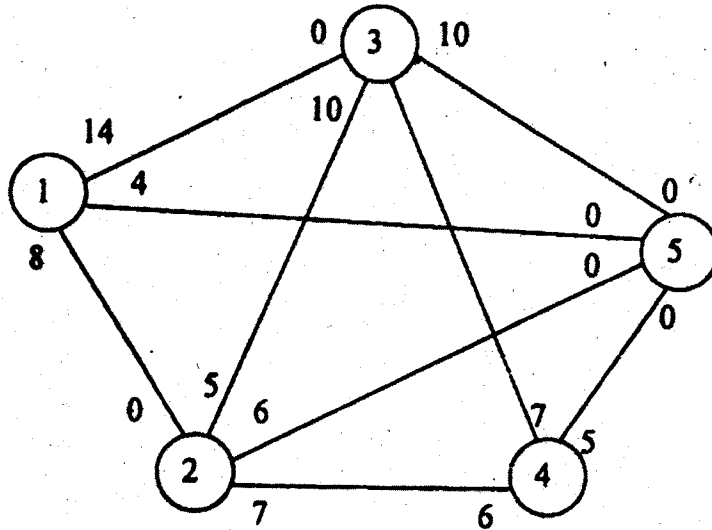
Present state	Next State		Output
	a = 0	a = 1	
-> q0	q1	q2	1
q1	q3	q2	0
q2	q2	q1	1
q3	q0	q3	1

302

MCA (18)

CS/MCA/SEM-1/M(MCA)-101/2010-11

11. a) Determine the maximal for in the following network :



b) Show that $f : \mathbb{R} \rightarrow (-1, 1)$ given by $f(x) = \frac{x}{1+|x|}$ is injective.

c) Prove that in a simple graph with n vertices and m components can have at most $\frac{(n-m)(n-m+1)}{2}$ edges. 7 + 2 + 6