

Printed Pages : 3

Roll No. ....

Questions : 7

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Exam. Code : 

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B.Engg. (Computer Science & Engg.) 3<sup>rd</sup> Semester

1125

**DISCRETE STRUCTURES**

**Paper : CS-303**

**Time Allowed : Three Hours]**

**[Maximum Marks : 50**

**Note :-** Question No. 1 is compulsory. Attempt any **two** questions from Section A and any **two** questions from Section B.

1. Answer in brief only :

- (a) What is the Cartesian product of  $A = \{10, 11\}$  and  $B = \{c, d\}$  ?
- (b) What is the cardinality of the set of even positive integers less than 10 ?
- (c) Let  $f$  and  $g$  be the function from the set of integers to itself, defined by  $f(y) = 2y + 1$  and  $g(y) = 3y + 4$ . Then the composition of  $f$  and  $g$  is ?
- (d) Let  $G = (V, E)$  be a graph. Define a path.
- (e) The number of leaf nodes in a binary tree of  $n$  nodes, with each node having 0 or 2 children is ?
- (f) The father of function from People to People is neither injective nor subjective why ?

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Question IV (a) Determine the eigen values and corresponding eigen

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

(g) Why the set  $A^*$  of all strings over a finite alphabet is countably infinite?

(h) Given the algebraic expression  $a*(b+c) - (d/e)$  draw its expression binary tree.

(i) If  $f(n) = f(n-1) + n$  if  $n > 0$ . Find the value of  $f(4)$ .

(j) Construct a recursive definition for  $f(n, k) = k + (k + (k + 2) + \dots + (k + n))$ .

### SECTION-A

2. (a) Find integers  $a$  and  $b$  such that the function  $f : N_{12} \rightarrow N_{12}$  defined by  $f(x) = (ax + b) \bmod 12$  is bijective and  $f^{-1} = f$ .

(b) What is Pigeonhole Principle? Discuss with the help of suitable example.

3. (a) Give the converse, contrapositive and inverse of the following implications: "if it rains today, I will go to college tomorrow".

(b) Show that the premises "Everyone in this college has purchased a Mobile Phone" and "Hari is a student in this college" imply the conclusion "Hari has purchased a Mobile Phone."

4. (a) What is a Predicate? Discuss. A horse that is registered for today's race is not a thoroughbred. Every horse registered for today's race has won a race year. Therefore a horse that has won a race this year is not a thoroughbred. Model this statement symbolically.



gs over a finite alphabet  
 $a*(b+c) - (d/e)$

find the value of  
 for  $f(n, k) = k + (n-1)k$   
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function  $f: N_{12} \rightarrow N_{12}$   
 bijective and  $f^2$   
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Define intersection and union set. Show that  
 $(A \cap B) \cup C = A \cap (B \cup C)$  if and only if  $C \subseteq A$ . 5+5

### SECTION-B

Consider the recurrence relation  $a_n = -a_{n-1} + n$ .

- Write the associated homogeneous recurrence relation.
- Find the general solution to the associated homogeneous recurrence relation.
- Find a particular solution to the given recurrence relation.
- Write the general solution to the given recurrence relation.
- Find the particular solution to the given recurrence relation when  $a_0 = 1$ . 2×5=10

- What is Ring? Discuss with the help of suitable example.
  - Let  $R$  be a commutative ring with unit. Show that if  $R$  contains an idempotent element  $e$ , then there exist ideals  $S, T$  of  $R$  such that  $R = S \oplus T$ . 5+5

- Write short notes on the following. Use suitable example in support of your answer :

- Graph Coloring
- Hamiltonian Path
- Binary Search Tree 2½×4=10
- Monoids.

(a) Determine the eigen values and corresponding

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

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Pages : 2

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CSE  
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B.Engg. (Computer Science & Engg.) 5<sup>th</sup> Semester

1125

DISCRETE STRUCTURES AND COMPUTATIONAL LOGIC

Paper : CSE-517

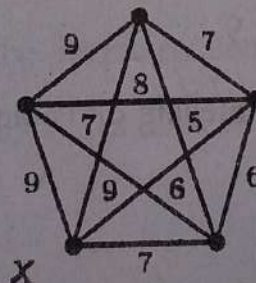
Time Allowed : Three Hours]

[Maximum Marks : 50

**Note :-** Attempt five questions in all, including Q. No. 1 which is compulsory, selecting two questions each from Sections A and B.

1. Attempt the following :

- If  $A = \{1, 2, 3, 4, 5, 6\}$  and  $B = \{3, 5, 7, 9\}$  then find  $A-B$  and  $A \times B$ .
- Let  $A = \{1, 2, 3, 4\}$  and  $R = \{(1, 1), (1, 3), (2, 2), (2, 4), (3, 1), (3, 3), (4, 2), (4, 4)\}$ . Show that  $R$  is an Equivalence relation.
- For the function  $f(x) = y = 2x + 1$ , find the range when domain =  $\{-3, -2, -1, 0, 1, 2, 3\}$ .
- How many Hamiltonian Cycles are there in following graph ?



X

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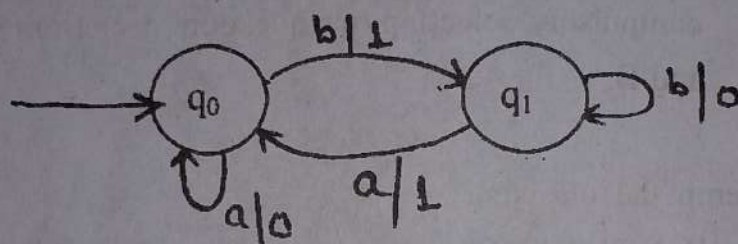
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[Turn over

- VI. a) How inheritance's implemented in C++? Explain.  
b) Define function. How Higher-order functions are defined and implemented in functional programming?
- VII. a) How 'Type checking' and 'Type inference' is carried out in functional programming?



- (e) "Everywhere that John goes, Rover goes. John is at school." Prove using refutation resolution that Rover is at school.
- (f) Construct a Finite Automata equivalent to the regular expression  $(0 + 1)^* (00 + 11) (0 + 1)^*$ .
- (g) Prove that  $(p \rightarrow q) \leftrightarrow (\sim q \rightarrow \sim r)$  is a tautology.
- (h) Give the Regular Expression for the set of all strings over  $\{a, b\}$  having at least one double letter.
- (i) Differentiate between DFA and N DFA.
- (j) Convert the following Mealy Machine into Moore Machine.



1×10=10

### SECTION-A

2. (a) Among the first 1000 positive integers :
- Find the integers which are not divisible by 5, nor by 7, nor by 9.
  - Find the integers divisible by 5, but not by 7, not by 9.

- i) (b) If  $f(x) = \sqrt{x+1}$  and  $g(x) = x^2 + 2$ , calculate fog and gof.
- (c) Determine the sets A and B given that  $A - B = \{1, 3, 7, 11\}$ ,  $B - A = \{2, 6, 8\}$  and  $A \cap B = \{4, 9\}$ . 5+3+2

3. (a) If R is a relation 'is greater than' from A to B, where  $A = \{1, 2, 3, 4, 5\}$  and  $B = \{1, 2, 6\}$ . Find :
- R in the roster form.
  - Domain of R.
  - Range of R.
- (b) Consider  $f: \mathbb{R} \rightarrow \mathbb{R}$  defined by  $f(x) = 3x - 7$ . Show that f is both injective and surjective.
- (c) A graph G has adjacency matrix :

$$A = \begin{pmatrix} 0 & 1 & 1 & 2 & 0 \\ 1 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 & 1 \\ 2 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 \end{pmatrix}$$

- Is G a Simple Graph ? Give reason.
- What is the degree sequence of G ?
- How many edges does G have ? 3+4+3

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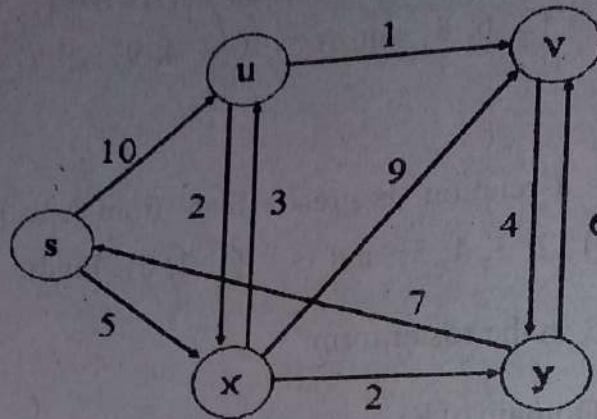
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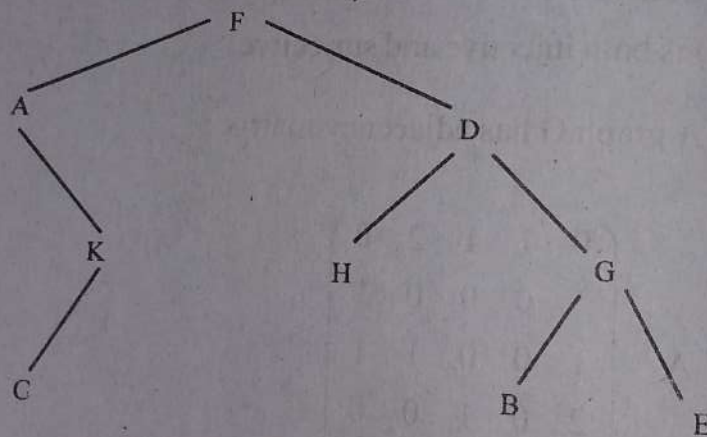
- VI. a) How inheritance's implemented in C++? Explain.
- b) Define function. How Higher-order functions are implemented in functional programming?
- How 'Type checking' and 'Type inference' is carried out



4. (a) Determine the shortest path between the vertices  $s$  to  $v$  in the graph given in following figure :



- (b) Consider the binary tree  $T$  in following figure :



- (i) Find the depth  $d$  of  $T$ .
- (ii) Traverse  $T$  using the preorder algorithm.
- (iii) Traverse  $T$  using the inorder algorithm.
- (iv) Traverse  $T$  using the postorder algorithm.

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(v) Find the terminal nodes of T, and the order they are traversed in (ii), (iii) and (iv).

(c) Define the following terms in respect of graph with the help of suitable example :

(i) Isomorphic graph

(ii) Planar graph.

3+5+2

### SECTION-B

5. (a) Consider the following arguments :

S1 : If the Violinist plays the concerto, then crowds will come if the prices are not too high.

S2 : If the Violinist plays the concerto, the prices will not be too high.

S : If the Violinist plays the concerto, crowds will come.

Is this argument valid i.e. does the conclusion S follow logically from the premises S1 and S2 ?

(b) "All Romans who know Marcus either hate Caesar or think that anyone who hates anyone is crazy." Convert the given statement into clause form using a nine-step process.

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[Turn over

VI. a) How inheritance's implemented in C++? Explain.  
b) Define function. How Higher-order functions are implemented in functional programming?

VII. a) How 'Type checking' and 'Type inference' is carried out in programming?  
b) Characteristics of "Prolog" with ex



- (c) Write the formula which is equivalent to the form  $\neg(p \leftrightarrow (q \rightarrow (r \vee p)))$  and contain the connectives  $\wedge$  and  $\neg$  only.

4+4

6. Consider the following sentences :

- (i) John likes all kinds of food.
- (ii) Apples are food.
- (iii) Chicken is food.
- (iv) Anything anyone eats and isn't killed by is food.
- (v) Bill eats peanuts and is still alive.
- (vi) Sue eats everything Bill eats.

Answer the following :

- (a) Translate these sentences into formulas in predicate logic.
- (b) Prove that John likes peanuts using backward chaining.
- (c) Convert the formulas of part (a) into clause form.
- (d) Prove that John likes peanuts using resolution.
- (e) Use resolution to answer the question, "What food does Sue eat?"

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(ii)

(ii)

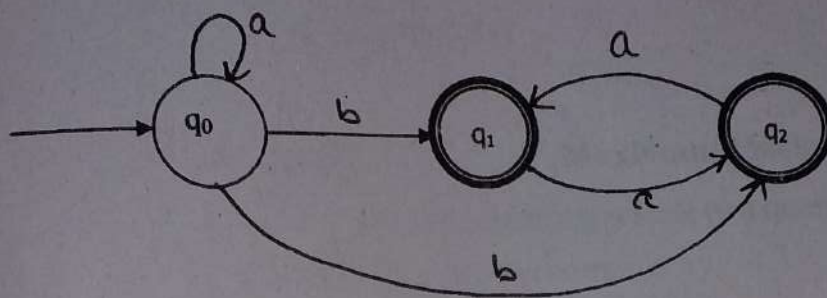
Question

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4+4

- (a) Design a Turing Machine which converts '11' to '10' in a string.
- (b) Construct a PDA for the language  $L = \{a^4 b^n c^n \mid n \geq 0\}$ .
- (c) Find the regular expression for given transition diagram.



3+4+3

400

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7

- VI. a) How inheritance's implemented in C++? Explain.  
b) Define function. How Higher-order functions are implemented in functional programming?
- VII. a) How 'Type checking' and 'Type inference' is carried out in programming?  
b) List various important characteristics of "Prolog" with



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B.E./B.E.M.B.A. (Computer Science and Engineering) Fifth Semester  
CSE-517: Discrete Structures and Computational Logic

Time allowed: 3 Hours

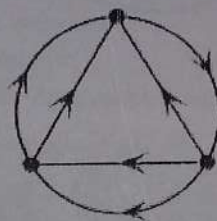
Max. Marks: 50

**NOTE:** Attempt five questions in all, selecting atleast two questions from each Section.

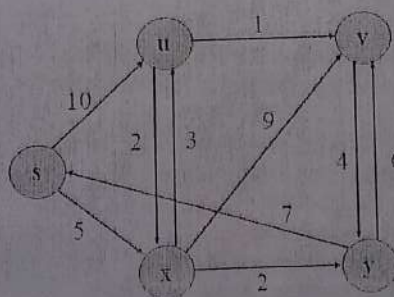
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**SECTION-A**

- Q1. (a) Blood samples of 100 people were tested. The A, B and Rh antigens were found in the blood of 32, 33, and 74 people, respectively. None of the antigens was found in 13 samples. Ten samples contained the A and Rh antigens only, 9 contained the B and Rh antigens only, 6 contained the B antigen only and 3 contained the A and B antigens only.
- (i) Draw a Venn diagram displaying the given data and the number of elements on each basic region.
- (ii) How many samples contained the A and B antigens?
- (iii) How many samples do not contain the Rh antigen?
- (b) Let  $f(x) = x + 3x + 1$ ,  $g(x) = 2x - 3$  are functions. Determine the composition function  $g \circ f$  and  $f \circ g$ .
- Q2. (a) Show that  $A \cup (B - C) = (A \cup B) - (C - A)$  using algebra of sets.
- (b) Consider  $f: \mathbb{R} \rightarrow \mathbb{R}$  defined by  $f(x) = 3x - 7$ . Show that  $f$  is both injective and surjective.
- Q3. (a) Explain and compare different Graph Traversal technique.
- (b) Consider the following graph



- (i) Is this digraph simple?
- (ii) Is it Eulerian?
- (iii) Is it Hamiltonian?
- (iv) Is it strongly connected?
- Q4. (a) Find the shortest path between  $s$  and  $z$  in the graph shown in following figure.



- (b) What are Euler circuit and Hamiltonian circuit? Draw a graph which has a Hamiltonian circuit but not an Euler circuit with proper justifications.

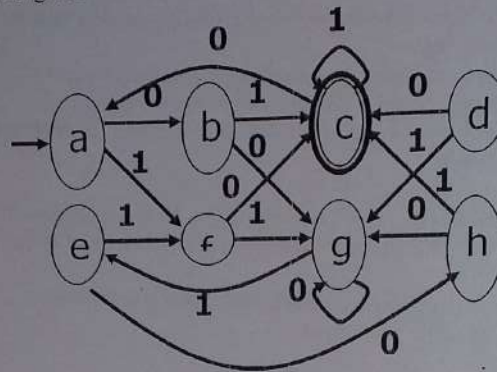
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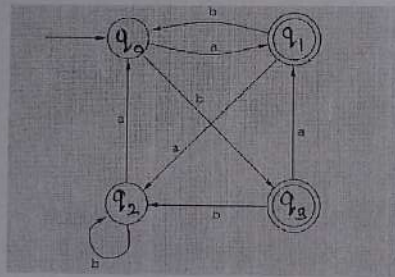
- (i) Find the depth  $d$  of  $T$ .
- (ii) Traverse  $T$  using the preorder algorithm.
- (iii) Traverse  $T$  using the inorder algorithm.
- (iv) Traverse  $T$  using the postorder algorithm.
- (v) For each vertex, list the vertices they are traversed in (ii), (iii), (iv).

SECTION-B

- Q5. (a) Consider the following arguments.  
 S1: If Shivam has completed B.E. (Computers) or MBA, then he is assured of a good job.  
 S2: If Shivam is assured of a good job, he is happy.  
 S : Shivam is not happy. So Shivam has not completed MBA.  
 Is this argument valid i.e. does the conclusion S follow logically from the premises S1 & S2?
- (b) Prove or disprove the following equivalence, (05+05)  
 $\sim(p \leftrightarrow q) \equiv ((p \wedge \sim q) \vee (q \wedge \sim p))$
- Q6. (a) Construct a minimum state Automaton equivalent to a DFA whose transition diagram is given below.



- (b) Find the regular expression using Arden's theorem for the given deterministic finite automata.



- Q7. (a) Write a short note on Turing Machine. (05+05)  
 (b) Construct a pushdown automata for the  $L = \{ a^m, b^n \mid m > n \geq 1 \}$ . (04+06)
- Q8. Consider the following sentences:
- John likes all kinds of food.
  - Apples are food.
  - Chicken is food.
  - Anything anyone eats and isn't killed by is food.
  - Bill eats peanuts and is still alive.
  - Sue eats everything Bill eats.
- (i) Translate these sentences into formulas in predicate logic.  
 (ii) Use backward chaining to prove that John likes peanuts.  
 (iii) Convert the formulas of part (i) into clause form.  
 (iv) Use resolution to prove that John likes peanuts.  
 (v) Use resolution to answer the question, "What food does Sue eat?" (10)