

This question paper contains 4+2 printed pages]

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S. No. of Question Paper : 6066

Unique Paper Code : 234103

D

Name of the Paper : Discrete Structures (CSHT-102)

Name of the Course : B.Sc. (H) Computer Science

Semester : I

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. 1 (Section A) is compulsory.

Attempt any four questions from Section B.

Parts of a question should be attempted together.

### Section A

1. (a) In a class of 25 students, 12 have taken economics, 8 have taken economics but not political science. Find the number of students who have taken economics and political science and those who have taken politics but not economics. 4

(b)  $f(x) = x^2$  and  $g(x) = 2^x$

Find  $f \circ f(x)$ ,  $g \circ g(x)$ ,  $f \circ g(x)$ ,  $g \circ f(x)$ . 4

P.T.O.

- (c) Use the master method to find the running time for the given recurrence relation :

$$T(n) = 125 T(n/5) + n^3. \quad 4$$

- (d) How many numbers of different messages that can be represented by sequences of three dashes and two dots ? 2

- (e) Suppose that a connected planar simple graph has 20 vertices, each of degree 3. Into how many regions does a representation of this planar graph split the plane ? 3

- (f) If  $G$  is a connected planar simple graph with  $e$  edges and  $v$  vertices, where  $v \geq 3$ , then  $e \leq 3v - 6$ . 5

- (g) Let  $a$  be a numeric function such that : 4

$$a_r = \begin{cases} 2 & 0 \leq r \leq 3 \\ 2^{-r} + 5 & r \geq 4 \end{cases}$$

Determine  $\Delta a$  and  $\nabla a$ .

- (h) Find the particular solution for the given difference equation : 5

$$a_r + a_{r-1} = 3r 2^r.$$

- (i) Show that :

$$\neg(p \vee (\neg p \wedge q)) \text{ and } \neg p \wedge \neg q$$

are logically equivalent by (without using truth table method). 4

## Section B

2. (a) Give an example of a relation that is reflexive but neither symmetric nor transitive. 3

(b) Show that :

$$1.2.3 + 2.3.4 + 3.4.5 + \dots + n(n+1)(n+2) = \frac{n(n+1)(n+2)(n+3)}{4} \quad 4$$

(c) Let

$$A = \{1, 2, 3, 4\} \text{ and } B = \{a, b, c, d\}.$$

Let  $f : A \rightarrow B$  such that :

$$f : 1 \rightarrow a, 2 \rightarrow a, 3 \rightarrow a, 4 \rightarrow a.$$

Verify whether  $f$  is an onto or one to one function. 3

3. (a) In how many ways can a cricket team of eleven be chosen out of a batch of 14 players ? How many of them will : 6

(i) include a particular player ?

(ii) exclude a particular player ?

(b) Show that :

$$3x^2 + 8x \log x \text{ is } \Theta(x^2). \quad 4$$

P.T.O.

4. (a) List all the steps used to search for 9 in the sequence 1, 3, 4, 5, 6, 8, 9, 11 using :

(i) a linear search

(ii) a binary search.

- (b) Give big-O estimates for the factorial function and the logarithm of the factorial function.

5. (a) Determine the discrete numeric function for the given generating function :

$$A(z) = 7z^2 / (1 - 2z)(1 + 3z).$$

- (b) Solve the recurrence relation :

$$a_r - 7a_{r-1} + 10a_{r-2} = 3^r,$$

given that  $a_0 = 0$  and  $a_1 = 1$ .

6. (a) Let  $p$  denote the statement, "The material is interesting" and  $q$  denotes the statement, "The exercises are challenging" and  $r$  denotes the statement, "The course is enjoyable".

Write the following statements in symbolic form :

- (i) The material is interesting and the exercises are challenging.

(ii) If the material is not interesting and the exercises are not challenging then the course is not enjoyable.

(iii) Either the material is interesting or the exercises are not challenging, but not both. 3

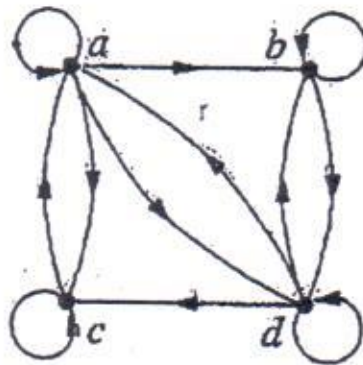
(b) Given the value of  $p \rightarrow q$  is true, determine the value of :

$\bar{p} \vee (p \leftrightarrow q).$  3

(c) Show that  $\bar{p}$  is tautologically implied by :

$\overline{(p \wedge \bar{q})}, \bar{q} \vee r, \bar{r}.$  4

(a) Find the adjacency matrix for the given directed multigraph. 4



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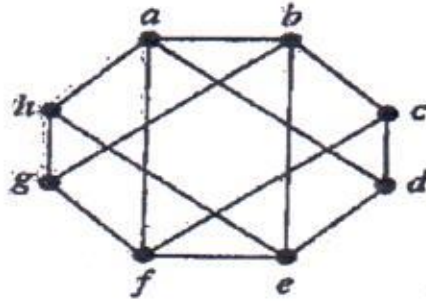
4

P.T.O.

4

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- (b) Determine whether the given graph is planar, if so, draw it so that no edges cross. 3
- cross.



- (c) How many vertices does a full 5-ary tree with the 100 internal vertices have ? 3