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2022/TDC/ODD/SEM/CSCHCC-102T/083

TDC (CBCS) Odd Semester Exam., 2022

COMPUTER SCIENCE

(Honours)

(1st Semester)

Course No. : CSCHCC–102T

(Discrete Structures)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

UNIT—I

1. Answer any *two* of the following questions : 2×2=4

(a) Define symmetric difference with example.

(b) What are the properties of binary relations?

(c) What is the composition of function? Give example.

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Answer any *one* (*either* **2** *or* **3**) :

2. *(a)* Prove that—

(i) $A \times (B \cap C) = (A \times B) \cap (A \times C)$

(ii) $A - (B \cap C) = (A - B) \cup (A - C)$

2½+2½=5

(b) Let $A = \{1, 2, 3, 4, 5, 6\}$ and let R be the relation on A defined by 'x divides y', written as x / y.

(i) Write R as a set of ordered pairs.

(ii) Also, find the inverse relation R^{-1} of R.

(iii) Can R^{-1} be described in words?

2+2+1=5

3. *(a)* For any two sets A and B, prove the De Morgan's laws

(i) $(A \cup B)' = A' \cap B'$

(ii) $(A \cap B)' = A' \cup B'$ 2+2=4

(b) Given the relation R in A as

$R = \{(1, 1), (2, 2), (2, 3), (3, 2), (4, 2), (4, 4)\}$

(i) Is R (1) reflexive, (2) symmetric and (3) transitive?

(ii) Is R anti-symmetric?

(iii) Determine M_R.

(iv) Determine R^2. (1+1+1)+1+1+1=6

UNIT—II

4. Answer any *two* of the following questions : 2×2=4

(a) Write down the characteristics of an algorithm.

(b) Differentiate between Ω and O notation.

(c) Prove that $\log n! = O(n \log n)$.

Answer any *one* (*either* **5** *or* **6**) :

5. Define asymptotic notation. Write down the properties of asymptotic notation. Also, discuss the different types of asymptotic notation. 2+2+6=10

6. *(a)* Write a short note on bounding summations. 4

(b) Show that $2^{2n} \neq O(2^n)$. 3

(c) Is $2^{n+1} = O(2^n)$? Explain. 3

UNIT—III

7. Define any *two* of the following with example : 2×2=4

(a) Recurrence relation

(b) Master theorem

(c) Generating function

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Answer any *one* (*either* **8** *or* **9**) :

8. *(a)* Determine whether the sequence $\{a_n\}$ where $a_n = 3n$ for every non-negative integer n is a solution of the recurrence relation $a_n = 2a_{n-1} - a_{n-2}$ for $n = 2, 3, 4, \dots$. 2

(b) What is the solution of the recurrence relation $a_n = 6a_{n-1} - 9a_{n-2}$ with initial condition $a_0 = 1$, $a_1 = 6$? 6

(c) Define recurrence relation for Fibonacci series. Also write the sequence of this relation. 2

9. *(a)* Find the solution of the recurrence relation $a_n = (n+1)a_{n-1}$ with initial condition $a_0 = 2$. 3

(b) What is generating function of

$1, 1, 1, 1 \dots$? 2

(c) Solve the recurrence relation $2a_n - 5a_{n-1} + 2a_{an-2} = 0$ with initial condition $a_0 = 0$ and $a_1 = 1$. 5

UNIT—IV

10. Answer any *two* of the following questions : 2×2=4

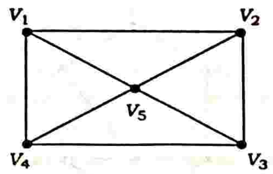
(a) What is bipartite graph? Give example.

(b) What is spanning sub-graph? Give example.

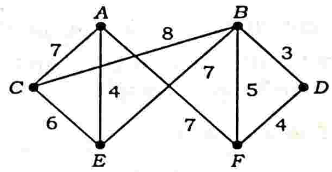
(c) Is a complete graph always regular? Justify.

Answer any *one* (*either* **11** *or* **12**) :

11. *(a)* Explain graph colouring algorithm. Use Welch-Powell algorithm to colour the following graph : 3+3=6



(b) Find a minimal spanning tree of the weighted graph G in the following figure : 4



12. *(a)* Draw the graph $K_{2,5}$. 3

(b) Draw the graph G corresponding to each adjacency matrix : 2

$$A = \begin{bmatrix} 1 & 3 & 0 & 0 \\ 3 & 0 & 1 & 1 \\ 0 & 1 & 2 & 2 \\ 0 & 1 & 2 & 0 \end{bmatrix}$$

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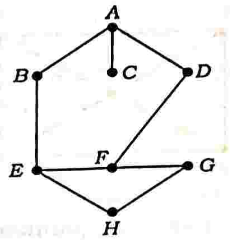
(c) Find the order of the vertices of the graph G in the following figure as processed using BFS algorithm beginning at vertex A : 5



UNIT—V

13. Answer any *two* of the following questions : 2×2=4

(a) What are tautologies and contradictions? Give example.

(b) Define arguments.

(c) What is predicate calculus? Give example.

Answer any *one* (*either* **14** *or* **15**) :

14. (a) Rewrite the following statements without using the conditional : 2+2=4

(i) If it is cold, he wears a hat.

(ii) If productivity increases, then wages rise.

(b) Show that following argument is a fallacy : 3

$$P \to Q,\ \neg P \vdash \neg Q$$

(c) Use law of proposition to show that

$$\neg(P \vee Q) \vee (\neg P \wedge Q) \equiv \neg P$$ 3

15. (a) Determine the contrapositions of the following statements : 2+2=4

(i) If John is a poet, then he is poor.

(ii) Only if Marc studies well he pass the test.

(b) Show that the following arguments are valid : 3

All men are mortal.

Socrates is a man.

So, Socrates is mortal.

(c) Prove that $Q \vee (P \wedge \neg Q) \vee (\neg P \wedge \neg Q)$ is a tautology. 3

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