2022

COMPUTER SCIENCE — HONOURS

Paper : CC-6

(Computational Mathematics)

Full Marks : 50

The figures in the margin indicate full marks.

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

Answer ***question no.*** **1** and ***any four*** questions from the rest.

1. Answer ***any five*** questions : 2×5

(a) If $\pi = \frac{22}{7}$ is approximated as 3.14, find the absolute and relative errors.

(b) What do you mean by minimum spanning tree?

(c) Why is Newton-Raphson method called a second-order iterative process?

(d) When is a set A said to be partitioned into n sets $A_1, A_2, \ldots, A_n$? Let $X = \{a, b, c\}$, show all the partitions of X.

(e) Suppose there are two simple graphs G_1 and G_2. How do you verify whether G_1 and G_2 are isomorphic?

(f) A simple connected graph has 7 vertices and 14 edges. Find the rank and nullity of the graph.

(g) Find the minimum number of students to be present in a class such that at least nine students are there who are born in the same month.

(h) What is the Cartesian product of $A \times B \times C$, where $A = \{0, 1\}$, $B = \{1, 2\}$ and $C = \{0, 1, 2\}$?

2. (a) What do you understand by big - O and big - θ notations? Find the big - θ estimate of the function $f(n) = 5n^4 - 37n^3 + 13n - 4$.

(b) Determine whether or not a given pair of well formed propositions are logically equivalent :

(i) $\sim((A \wedge B) \vee C)$ and $\sim A$

(ii) $((A \to B) \to C) \to \sim(A \vee B)$ and $\sim(\sim(A \wedge C))$. (2+2+3)+(1½+1½)

3. (a) Define a recurrence relation. Give a suitable example.

(b) What is the solution of the recurrence relation together with initial conditions

$$a_n = a_{n-1} + 2a_{n-2} \text{ for } n \geq 2,\ a_0 = 2,\ a_1 = 7?$$

(2+3)+5

4. (a) Prove that the number of internal vertices in a binary tree is one less than the number of pendent vertices.

(b) State and prove generalized principle of Inclusion and Exclusion.

(c) Find the number (m) of ways that nine toys can be divided among four children, if the youngest child is to receive three toys and each of the others two toys each. 3+3+4

5. (a) Write down the composite expression for Simpson's $\frac{1}{3}$rd rule.

Evaluate $\int_0^1 \sqrt{(1-x^3)}dx$ by taking six equal intervals using this rule.

(b) State the condition for convergence of Gauss-Jacobi method. (2+6)+2

6. (a) Consider the set $\{P, Q, R, S\}$. In how many ways can we select two of these letters if —

(i) order matters and repetition is allowed,

(ii) order doesn't matter but repetitions are allowed?

(b) Find the number of primes less than 200 using the Principle of Inclusion and Exclusion. 4+6

7. (a) Define K-connected graph with an example.

(b) Find the positive roots of the equation $x^3 - 3x + 1.06 = 0$, by any method, correct to three decimal places.

(c) Represent the algebraic expression E by means of a binary tree, $E = (a - b) / ((c * d) + e)$. 2+6+2

8. (a) Write an algorithm for finding the solution of differential equation by fourth order $R - K$ method.

(b) Given the following table, find $f(x)$ assuming it to be a polynomial of degree three in x. Use Lagrange's Interpolation formula.

x	0	1	2	3
y	1	2	11	34

5+5