WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-II Examination, 2019

COMPUTER SCIENCE

PAPER: CMSA-III

Time Allotted: 4 Hours | Full Marks: 100

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Answer Question Number 1 and any *five* from the rest taking at least *one* from each group

1. Answer any ***ten*** questions from the following: 2×10 = 20

   (a) What is tautology?

   (b) Define power set of a set.

   (c) What is Equivalence Class?

   (d) What do you mean by regular expression?

   (e) What are the limitations of Newton-Raphson method?

   (f) What is a Hamiltonian Circuit?

   (g) State the relations between languages and the corresponding automata.

   (h) What is a recurrence relation?

   (i) State the condition for convergence of Gauss-Jacobi method.

   (j) What is Null graph?

   (k) State satisfiability problem.

   (l) Give an example of an induced sub-graph.

   (m) State Cook's theorem.

   (n) Define Euler graph.

GROUP-A

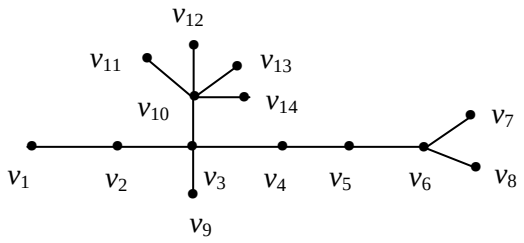
(Graph Theory)

2. (a) Define Edge-connectivity and vertex-connectivity of a graph. Give examples. 4

   (b) Prove that a connected graph with n vertices and $(n-1)$ edges is a tree. 5

(c) Prove that if n is an odd number ≥ 3, then in a complete graph with n vertices there are $\frac{(n-1)}{2}$ edge-disjoint Hamiltonian circuits. 7

3. (a) Find out the center of the following Graph G. 3



G

(b) Define spanning tree. Prove that a pendant edge (an edge whose one end vertex is of degree one) in a connected graph G is contained in every spanning tree of G. 1+4

(c) Describe Dijkstra's algorithm with a suitable example for finding the shortest path between two vertices in a weighted connected graph. Also deduce the space and time complexity of the algorithm. 5+3

GROUP-B

(Discrete Mathematical Structures)

4. (a) Define cardinality of a finite set. 2

(b) Let A and B be two finite sets, then prove that $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ 5

(c) Show that $\neg p \to (q \to r)$ and $q \to (p \vee r)$ are logically equivalent. 5

(d) Give an example of 2+2

(i) a function which is injective but not surjective, and

(ii) a function which surjective but not injective.

5. (a) Write the general form of homogeneous recurrence relation. 2

(b) Determine whether the sequence $\{a_n\}$ is a solution of the recurrence relation 2+2

$a_n = 2a_{n-1}$ for $n = 2, 3, 4.....,$ where $a_n = 3n$ for every non-negative integer n.

What happens when $a_n = 2^n$?

(c) State two principles of mathematical induction. Prove by one principle that every positive integer $n \geq 2$ is either a prime or can be written as a product of the primes. 3+3

(d) Explain universal quantifier with example. 2

(e) State the pigeon hole principle. 2

6. (a) Determine the number of integers between 1 and 250 that are divisible by any one of the integers 2, 3, 5 and 7. 5

(b) Three students are selected at random from a class of 12 boys and 8 girls. Find out the probability that they are all boys. 5

(c) Solve the recurrence relation 6

$$x_n = 2x_{n-1} + 15x_{n-2} \text{ for } (n \geq 2) \text{ and } x_0 = 0,\ x_1 = 1.$$

GROUP-C

(Numerical and Optimization Techniques)

7. (a) Find the solution to three decimals of the system of equations 8

$$-4x + 11y + 83z = 95$$

$$13x + 52y + 7z = 104$$

$$29x + 8y + 3z = 71$$

Using Gauss-Seidel method.

(b) Use the table to find (i) $\log_{10} 2.02$ and (ii) $\log_{10} 2.91$. 4+4

Clearly write the formula used.

x	2.0	2.2	2.4	2.6	2.8	3.0
$F(x) = \log_{10} x$	0.30103	0.34242	0.38021	0.41497	0.44716	0.47721

8. (a) Solve the following equation by Euler's method. 4

$$\frac{dy}{dx} = 2xy,\ y(0) = 0.5.$$

Find the solution for $0 \leq x \leq 1$. Pick appropriate step size.

(b) Find the least-square parabola for the four points (–3, 3), (0, 1), (2, 1) and (4, 3). 6

(c) Solve the equation $x^3 - 9x + 1 = 0$ for the root lying between 2 and 3, correct upto 3 significant figures using any suitable numerical method. 6

9. (a) Find the missing terms in the following table: 6

x	0	5	10	15	20	25
y	6	10	?	17	?	31

(b) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Simpson's $\frac{1}{3}$rd rule taking $n=6$. Hence find the value of π. 5

(c) Using Runge-Kutta method of 4th order solve $\frac{dy}{dx}=\frac{y^2-x^2}{y^2+x^2}$, $y(0)=1$ at $x=0.2$. 5

GROUP-D
(Formal Language and Automata Theory)

10.(a) Write a brief note on Chomsky Classification of grammars. 6

(b) Design a DFA over $\Sigma=\{a, b\}$ which accepts strings over Σ such that each string starts and ends with a different symbol. 5

(c) Context Free Grammar is ambiguous —Explain with suitable example. 5

11.(a) Design a Regular Expression over $\Sigma=\{a, b\}$ for a Regular Language in which the 23rd symbol from the right end of each string is a. 4

(b) Distinguish between Mealy machine and Moore machine. 3

(c) State and prove Arden's theorem. 5

(d) Find the language generated by the following grammar. 4

$S\rightarrow 0S1/0A1, A\rightarrow 1A/1$

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