WEST BENGAL STATE UNIVERSITY

B.Sc. Honours PART-II Examinations, 2017

COMPUTER SCIENCE-HONOURS

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.

Answer Question No. 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 do you mean by Bipartite graph?

   (b) What do you mean by Strong Mathematical Induction?

   (c) What is meant by III- conditional system?

   (d) When is a grammar said to be ambiguous?

   (e) What are the limitations of a finite state automata?

   (f) Design a DFA that accepts strings defined over $\sum = \{0, 1\}$ whose decimal representation is divisible by 2.

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

   (h) Find the relative percentage error in approximate representation of $4/3$ by 1.33.

   (i) When is a graph called universal graph? Give a suitable example of it.

   (j) State the Konnisberg bridge problem in Graph Theory.

(k) What do you mean by complexity of an algorithm? What are the two cases that are usually investigated in complexity theory?

(l) Give the analytical definition of a non-deterministic finite automata (NDFA).

(m) What are the advantages of using R-K method for numerical solutions of differential equation over Taylor's Series method?

(n) What is the relation between the total number of vertices and the number of pendant vertices of a tree with at least two vertices? – Justify.

(o) What is the main disadvantage of Newton-Raphson method?

Group-A

(Graph Theory)

2. (a) Show that the maximum number of edges in a simple graph with n vertices is $\frac{n*(n-1)}{2}$. 3+5+(2+6)

(b) Prove that a tree with n vertices has exactly $n-1$ edges.

(c) Define a connected graph. Let G be a graph with n vertices and let A denote its adjacency matrix. Prove that G is connected if and only if $A + A^2 + \ldots\ldots + A^{n-1}$ has non-zero entries off the main diagonal.

3. (a) Prove that a given connected graph G is an Euler graph if and only if all vertices of G are of even degree. 4+4+(6+2)

(b) Distinguish between Vertex Connectivity and Edge Connectivity of a given graph with suitable examples.

(c) Describe Prim's algorithm to find Minimum Spanning Tree of a given weighted connected graph. Give an example.

Group-B

4. (a) What are the universal and existential quantifiers of a predicate $P(x)$? What are their negations? 5+5+3+3

   (b) Check whether $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are logically equivalent or not.

   (c) Show that by Pigeon Hole principle in any set of six classes there must be two that meet on the same day, assume that no classes are held on weekends (i.e. Saturday and Sunday).

   (d) Consider functions $f(x)$, $g(x)$ and $h(x)$ such that $f(x) = O(g(x))$ and $g(x) = O(h(x))$. Show that $f(x) = O(h(x))$.

5. (a) If $f : A \to B$ and $g : B \to C$ are one-to-one functions, then prove that $(g \circ f)^{-1} = f^{-1} \circ g^{-1}$ 4+4+4+4

   (b) In a group of 6 Samurai, 7 Lords and 8 Ninjas, how many 10 member teams with 3 Samurai, 2 Lords and 5 Ninjas would be possible?

   (c) The member of operations $f(n)$ required by an algorithm is given by $f(n) = f(n-1) + (n-1) f(n-2)$,

   where $f(1) = 1$. Show that $f(n) = O(n^2)$

   (d) What do you mean by NP-Hard and NP-Complete problems?

6. (a) Show that $3^n > 2n; \quad \forall n = 1, 2, \cdots$ 4+4+4+4

   (b) State the principle of Inclusion and Exclusion for four sets *A, B, C, D.*

   (c) If three dice are rolled, find the probability that exactly one face shows a number less than or equal to 4.

   (d) If $f(x) = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_1 x + a_0$ where $a_0, a_1, \cdots, a_n$ are real numbers, then show that $f(x) = O(x^n)$.

Group-C

(Numerical and Optimization Techniques)

7. (a) Derive the Iteration formula for Newton-Raphson Method. What is a Convergence criterion of this method? (4+2)+(2+8)

   (b) What is the Diagonally Dominant Condition for a system of linear equations? Find the solutions of the following system of linear equations by Gauss-Seidel method (correct up-to three decimals):

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

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

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

8. (a) Find the missing terms in the following table: 6+5+5

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.

   (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 $x = 0.2$.

9. (a) Use simplex algorithm to solve the following LPP: 8+8

   Max $Z = 3x + 2y$

   Subject to constraints $2x + y \le 2$

$$3x + 4y \ge 12$$

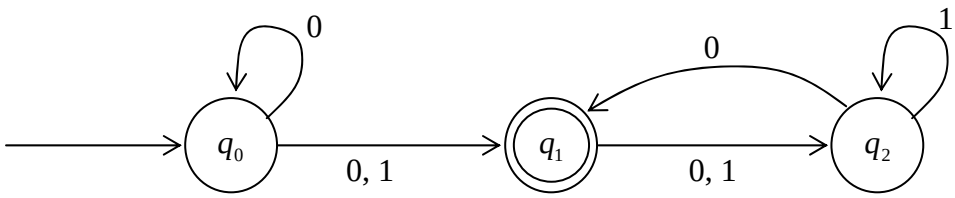
   where $x, y \ge 0$

(b) Find the optimal assignments to find the minimum cost for the assignment problem with the following cost matrix :

	M_1	M_2	M_3	M_4
J_1	18	24	28	32
J_2	8	13	17	18
J_3	10	15	19	22

Group-D

10.(a) Convert the following NFA into its equivalent DFA. 6



(b) Consider the following grammar 6

$a = (V, T, S, P)$, when $V = \{s\}, T = \{a, b\}$ and

$P = \{S \to aSa,\ \ S \to bSb,\ \ S \to \in\}$

Find $L(a)$.

(c) Write a regular expression for each of the following regular sets: 2+2

(i) The set of all strings over {0, 1} which has at-most two zeros.

(ii) The set of all strings over {0, 1} not containing the substring "00".

11.(a) Discuss Chomsky classification of Grammars. 6+6+4

(b) Design a Turing machine over {1, *b*} which can compute concatenation function over $\sum = \{1\}$. If a pair of words (w_1, w_2) is the input, the output has to be w_1w_2.

(c) Construct a DFA from the following grammar.

$S \rightarrow OSI \mid OAI$

$A \rightarrow IA \mid I$