WEST BENGAL STATE UNIVERSITY

B.Sc. Honours PART-II Examinations, 2018

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.
All symbols are of usual significance.

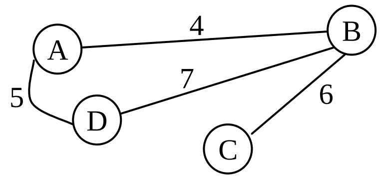
Answer Question **No. 1** and any ***five*** from the rest, taking ***at least one*** from each group

1. Answer any ***ten*** questions from the following: $2\times10 = 20$

(a) Define Path with proper figure.

(b) "Every graph has Hamiltonian circuit"– Justify the statement.

(c) Draw the adjacency matrix for the following graph.



(d) Define tautology with a simple example.

(e) Construct the truth table for $(p \to (q \to r)) \wedge p$.

(f) Find the order of the function $f(x) = 2x^2 + 3$.

(g) Write the set of all strings over {a, b} that will include **abb**.

(h) There are 3 white, 4 black and 3 red balls in a bag. In how many ways 2 white and 1 red ball can be taken out of the bag.

(i) Define conditional probability P(A|B).

(j) Show that $\Delta \equiv E - 1$.

(k) Define planar graphs.

(l) Draw K_8 and K_9 and show that thickness of K_8 is 2 while thickness of $K_9 = 3$.

(m) What is eccentricity?

(n) State Simpson's $\frac{3}{8}$th rule for numerical integration.

Group-A

(Graph Theory)

2. (a) Find the maximum number of nodes in tree of height **h**. 5+5+6

(b) Prove that a graph is a Euler graph if and only if it can be decomposed into circuits.

(c) State and prove Euler's theorem for planarity of a graph.

3. (a) Define a Hamiltonian path. Find an example of a non Hamiltonian graph with a Hamiltonian path. 5+5+6

(b) Prove that every connected graph has at least one spanning tree.

(c) Prove that "A graph is bipartite if and only if it does not contain any cycle of odd length".

Group-B

(Discrete Mathematical Structure)

4. (a) What is the probability that a 10-bit binary string does not contain **110** in it. 4+4+5+3

(b) Define the Big-O, Big-Theta and Omega with proper figure.

(c) Find the order of the function

$$\begin{aligned} f(n) &= 2f(n/2)+nc \quad && \text{for all } n>1 \\ &= c && \text{when } n=1 \end{aligned}$$

(d) What is space complexity?

5. (a) Given $F_0 = 0$, $F_1 = 1$ and 6+4+6

$F_n = F_{n-1} + F_{n-2}$, for all $n >= 2$

Find the generating function for F_n.

(b) Given 2 statements –

Statement 1 : "Good food are not cheap"

Statement 2 : "Cheap food are not good"

Check whether these statements are same or not.

(c) When a relation is termed equivalence relation?

6. (a) State the Pigeon-Hole principle. 2+3+5+6

(b) State the principle of inclusion-exclusion for 3 sets A, B and C.

(c) In a game of n players, each player plays with the rest. Each player win at least one game. Now prove that, there are at least 2 players who win same number of games.

(d) By method of induction, prove that $5^n - 4n - 1$ is divisible by 16 for all $n >= 1$.

Group-C

(Numerical and Optimization Techniques)

7. (a) Write a program for Lagrange's interpolation formula. 4+4+8

(b) Use Runge Kutta's 4th order method to evaluate $y\ (0.2)$ with $h = 0.1$ given $\frac{dy}{dx} = y - x$ and $y\ (0) = 2$.

(c) Solve, $2x - y + 4z = 12$; $8x - 3y + 2z = 23$; $4x + 11y - z = 33$ by Gauss elimination.

8. (a) Evaluate $\int_0^1 (4x - 3x^2)\,dx$ taking 10 intervals by Trapezoidal rule. 6+6+4

(b) By Simpson's $\frac{1}{3}$ rule, evaluate $\int_1^2 \sqrt{1-\frac{1}{x}}\,dx$ with five ordinates.

(c) Fit a second degree parabola of the following data:

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

9. (a) Find the duality of the following LPP: 4+12

Minimize $Z = 2x_1 + 6x_2$

Subject to constraints

$$9x_1 + 3x_2 \geq 20$$
$$2x_1 + 7x_2 = 40$$
$$\text{where } x_1, x_2 \geq 0$$

(b) Consider the following transportation problem:

		1	2	3	4	Availability
	1	5	8	3	6	30
Origin	2	4	5	7	4	50
	3	6	2	4	6	20
Demand		30	40	20	10	

Find an initial basic feasible solution using Vogel Approximation Method (VAM), test the solution for optimality and if not, find an optimal solution.

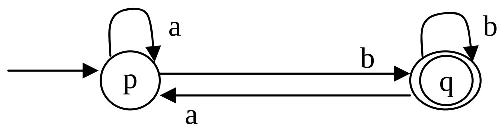
Group-D
(Formal Languages and Automata Theory)

10.(a) Let $M = (Q, \Sigma, \delta, q_0, F)$ be a given DFA. Define $\delta^*(q, w)$, where $q \in Q$ and $w \in \Sigma^*$ and hence define the language L(M) accepted by it. 2+1

(b) Design a DFA M over $\Sigma = \{a, b\}$ which accepts strings over Σ such that each string contains even number of a's and even number of b's. 4

(c) Define a Regular Language. Show that the language $L = \{ww \mid w \in \Sigma^*\}$ over $\Sigma = \{0, 1\}$ is not a Regular Language using Pumping Lemma. 2+5

(d) Convert the following DFA into equivalent Regular Expression: 2



11.(a) Define a Context-Free Grammar. Construct a Context-Free Grammar for all palindromes over {a, b}. 2+4

(b) Construct a DFA M for the regular grammar G = (V, T, P, S), where V={S, A}, T={a, b}, P={S→aS, S→bA, S→b, A→aA, A→bS, A→a}. 4

(c) Define a Turing **Computable** function. Given two positive integers x and y, design a Turing Machine that computes $x + y$. 2+4