**2021**

COMPUTER SCIENCE

PAPER-I

*Time Allowed—3 Hours*                                                                      *Full Marks—200*

*If the questions attempted are in excess of the prescribed number, only the questions attempted*
*first up to the prescribed number shall be valued*
*and the remaining ones ignored.*
*Answer may be given either in **English** or in **Bengali** but all answers*
*must be in one and same language.*

*Answer* any five *questions.*

1. (a) How is the efficiency of an algorithm measured? Differentiate between lower bound and upper bound with examples.                                                    4+6=10

   (b) Describe the quick sort algorithm and sort the following elements using it:          10

   26, 18, 42, 14, 36, 64, 6, 58, 17, 65, 82, 12

   (c) Explain divide-and-conquer algorithm with a suitable example.                        10

   (d) State and explain the Dijkstra's shortest path algorithm with examples. Also find the time complexity of this algorithm.                                                    10

2. (a) Distinguish between a linear and non-linear data structure. What is Doubly Linked List? Write an algorithm to insert and delete a node from a Doubly Linked List.     3+2+5=10

   (b) Write an algorithm for evaluating of postfix expression and show the contents of stack for the following postfix expression:                                            5+3=8

   6 2 3 + – 3 8 2 / + * 2 + 3 +

   (c) What is Queue? Why is it known as FIFO? Write an algorithm to insert and delete an element from a simple Queue.                                                           2+1+5=8

   (d) Construct a tree for the given inorder and postorder traversals:                     6

   Inorder: DGBAHEICF     Postorder: GDBHIEFCA

   (e) Explain Breadth First Search traversal of Graph using an example.                    8

3. (a) Convert the $(2A8)_{16}$ hexa decimal into decimal equivalent. What is the 2's complement of $(11001010)_2$? 5

(b) Explain the operation of a full subtractor with necessary diagrams. What is the difference between half and full subtractor? 5+2=7

(c) Find a minimal SOP representation for

$$f(A,B,C,D,E) = \Sigma m\ (1,4,6,10,20,22,24,26) + d\ (0,11,16,27)$$ using K-map method. Draw the circuit of the minimal expression using only NAND. 6+4=10

(d) What is the difference between multiplexer and demultiplexer? Explain the operation of a 8 to 1 multiplexer. 5+3=8

(e) Design a counter with the following binary sequence:

0,4,2,1,6 and repeat using JK flip-flops. 10

4. (a) Apply Gauss elimination method to solve the equations: 5

$$x + 4y - z = -5;\ x + y - 6z = -12;\ 3x - y - z = 4$$

(b) From the following table, estimate the number of students who obtained marks between 40 and 45. 5

| Marks: | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 |
|---|---|---|---|---|---|
| No. of students: | 31 | 42 | 51 | 35 | 31 |

(c) Evaluate $\int_0^6 \dfrac{dx}{1+x^2}$ by using Simpson's 1/3rd rule. 6

(d) Determine $f(x)$ as a polynomial in $x$ for the following data: 10

| $x$ : | −4 | −1 | 0 | 2 | 5 |
|---|---|---|---|---|---|
| $f(x)$: | 1245 | 33 | 5 | 9 | 1335 |

(e) Calculate correlation coefficient $r$ from the following data: 8

| □ : | 40 | 44 | 42 | 43 | 44 | 45 |
|---|---|---|---|---|---|---|
| □ : | 56 | 54 | 60 | 64 | 62 | 58 |

(f) The velocity $V$ (km/min) of a moped which starts from rest, is given at fixed intervals of time $t$ (min) as follows:

| $t$ : | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|
| $V$ : | 10 | 18 | 25 | 29 | 32 | 20 | 11 | 5 | 2 | 0 |

Estimate approximately the distance covered in 20 minutes. 6

5. (a) In a full wave rectifier, the input is from 30-0-30V transformer. The load and diode forward resistances are $100\,\Omega$ and $10\,\Omega$ respectively. Calculate the average voltage, dc output power, ac input power, rectification efficiency and percentage regulation.        2+2+2+3+3=12

   (b) With a neat circuit diagram, explain the Voltage Divider Bias circuit by giving its exact analysis.        8

   (c) Explain the characteristics of an Ideal Op-Amp. Mention some of the applications of Op-Amp.        4+1=5

   (d) Explain how Op-Amp can be used as (i) Integrator (ii) Inverting Summer and (iii) Voltage follower.        4+3+3=10

   (e) What is a Transducer? Distinguish between active and passive transducers.        3+2=5

6. (a) Explain the different types of transmission modes.        6

   (b) What is Nyquist signalling rate for noiseless channel?        4

   (c) What is Shannon capacity for Noisy Channel?        5

   (d) Explain ASK, FSK and PSK.        10

   (e) What is an error in data communication? Explain the various types of errors that are commonly affects data communication.        2+8=10

   (f) Explain the concept of ALOHA.        5

7. (a) Define Feasible and Infeasible solution.        5

   (b) What is the difference between Assignment Problem and Transportation Problem?        5

   (c) Write the steps for solving an Assignment Problem by Hungarian method.        10

   (d) A department has five employees with five jobs to be performed. The time (in hours) each man will take to perform each job is given in the effectiveness matrix. How should the jobs be allocated one per employee, so as to minimize the total man-hours?        10

| jobs | 1 | 2 | 3 | 4 | 5 |
|------|----|----|----|----|----|
| a | 10 | 5 | 13 | 15 | 16 |
| b | 3 | 9 | 18 | 13 | 6 |
| c | 10 | 7 | 2 | 2 | 2 |
| d | 7 | 11 | 9 | 7 | 12 |
| e | 7 | 9 | 10 | 4 | 12 |

(e) An automobile dealer wishes to put four repairmen to four different jobs. The repairmen have somewhat different kinds of skills and they exhibit different levels of efficiency from one job to another. The dealer has estimated the number of man-hours that would be required for each job-man combination. This is given in the matrix form. Find the optimum assignment that will result in minimum man-hours needed.          10

|   | A | B | C | D |
|---|---|---|---|---|
| 1 | 5 | 3 | 2 | 8 |
| 2 | 7 | 9 | 2 | 6 |
| 3 | 6 | 4 | 5 | 7 |
| 4 | 5 | 7 | 7 | 8 |

8. Write short notes on *any four*:          10×4=40

   (a) Maximum Clique Finding Problem

   (b) Poles and Zeros of a System

   (c) Programmable Logic Array

   (d) Multiple Access Techniques in Data Communication

   (e) Infix to postfix conversion

   (f) Hashing techniques