

Max. Marks : 80

(Time: 03 hours)

- N.B. : (1) Question No.1 is **compulsory**  
 (2) Attempt **any three** questions from Q.2 to Q.6  
 (3) Figures to the right indicate full marks

Q. 1 (a) Find the Laplace Transform of  $e^{2t} + 4t^3 - \sin 2t \cos 3t$  05

(b) Find the Fourier series of  $f(x) = x, -\pi < x < \pi$  05

(c) Calculate Spearman's coefficient of rank correlation from the following data 05

|    |     |     |     |     |     |
|----|-----|-----|-----|-----|-----|
| X: | 12  | 17  | 22  | 27  | 32  |
| Y: | 113 | 119 | 117 | 115 | 121 |

(d) Find the constants a, b, c, d, e 05

if  $f(z) = (ax^4 + bx^2y^2 + cy^4 + dx^2 - 2y^2) + i(4x^3y - exy^3 + 4xy)$  is analytic

Q.2 (a) Determine whether the function  $f(z) = \frac{1}{2} \log(x^2 + y^2) + i \tan^{-1} \frac{y}{x}$  is analytic and if so, find its derivative. 06

(b) A random variable X has the following probability distribution 06

|        |   |    |    |    |    |     |     |
|--------|---|----|----|----|----|-----|-----|
| X      | 0 | 1  | 2  | 3  | 4  | 5   | 6   |
| P(X=x) | k | 3k | 5k | 7k | 9k | 11k | 13k |

Find (i) k, (ii)  $P(X < 4)$  (iii)  $P(3 < X \leq 6)$

(c) Evaluate  $\int_0^\infty e^{-2t} t \cos t dt$  08

Q.3 (a) Find the Fourier series of  $f(x) = \frac{\pi^2}{12} - \frac{x^2}{4}, -\pi < x < \pi$  06

(b) A continuous random variable has probability density function 06

$f(x) = k(x - x^2); 0 \leq x \leq 1$

Find (i) k, (ii) mean, (iii) variance

(c) Find the inverse Laplace transform of  $\frac{s^2+2s+3}{(s^2+2s+5)(s^2+2s+2)}$  08

Q.4(a) Find the Laplace Transform of  $f(t)$ , 06

where  $f(t) = \cos t$ , for  $0 < t < \pi$  and  $f(t) = \sin t$ , for  $t > \pi$

(b) Calculate the Karl Pearson's coefficient of correlation from the following data 06

|    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|
| X: | 65 | 66 | 67 | 67 | 68 | 69 | 70 | 72 |
| Y: | 67 | 68 | 65 | 68 | 72 | 72 | 69 | 71 |

- (c) Find the Fourier series of  $f(x) = \begin{cases} x, & 0 \leq x \leq \pi \\ 2\pi - x, & \pi \leq x \leq 2\pi \end{cases}$  08

- Q.5 (a) Find the inverse Laplace transform of  $\frac{s}{(2s+1)^2}$  06

- (b) Find the Laplace transform of  $t \left( \frac{\sin t}{e^t} \right)^2$  06

- (c) Find the lines of regression for the following data 08

|    |    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|----|
| X: | 78 | 36 | 98 | 25 | 75 | 82 | 90 | 62 | 65 | 39 |
| Y: | 84 | 51 | 91 | 60 | 68 | 62 | 86 | 58 | 53 | 47 |

- Q.6 (a) Find the mean and the variance of the following distribution 06

|        |     |     |     |     |
|--------|-----|-----|-----|-----|
| X      | 1   | 3   | 4   | 5   |
| P(X=x) | 0.4 | 0.1 | 0.2 | 0.3 |

- (b) Find the inverse Laplace transform of  $\log \left( 1 + \frac{a^2}{s^2} \right)$  06

- (c) Find the analytic function  $f(z) = u + iv$  whose imaginary part is 08  
 $v = x^2 - y^2 + \frac{x}{x^2 + y^2}$

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Time: 3 Hours

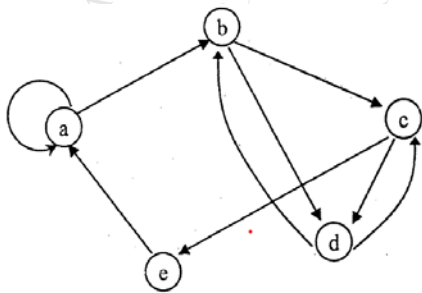
Marks: 80

**N.B. :** (1) Question Number 1 is compulsory

- (2) Solve any three questions from the remaining questions
- (3) Make suitable assumptions if needed
- (4) Assume appropriate data whenever required. State all assumptions clearly.

**Q.1** Solve any four of the following questions.

- a) Prove using Mathematical Induction that  $1+5+9+ \dots + (4n-3) = n(2n-1)$  5
- b) Find the relation set & relation matrix for the following digraph. Determine in degree & out degree of each vertex. 5



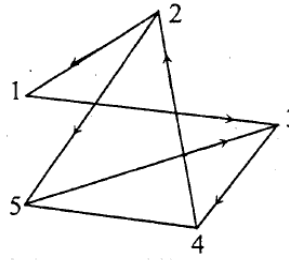
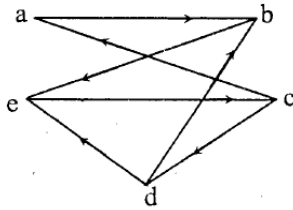
- c) State the pigeon hole principle. If 30 people are assembled in a room, then show that of them must have their birthday on the same day of a week. 5
- d) Explain the following terms with suitable example: 5
  - i) Eulerian graph
  - ii) Quantifier
- e) What is a partial order relation? Determine the hasse diagram for following relation 5  
 $A = \{1, 2, 3, 4\}$  and  $R = \{(1, 1), (1, 2), (1, 3), (1, 4), (2, 2), (2, 4), (3, 3), (3, 4), (4, 4)\}$

**Q.2**

- a) What is a transitive closure? Let  $A = \{a_1, a_2, a_3, a_4, a_5\}$ . Find the transitive closure of R using Warshall's algorithm where relation matrix  $M_R$  is given as follows- 10

$$M_R = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 \end{bmatrix}$$

- b) What are the isomorphic graphs? Determine whether following graphs are isomorphic. 10



**Q.3**

- a) Among the integers 1 to 300, 8  
 i) How many of them are not divisible by 3 nor by 5 nor by 7?  
 ii) How many of them are divisible only by 3?
- b) There are 6 Communication Skills books, 8 Engg. Mathematics books, 10 books on C Programming. How many ways can be used to choose 2 books of different categories from them? 6
- c) What is a partition set? Determine whether each of the following is a partition. Justify your answer. 6

Let  $X = \{1, 2, 3, \dots, 8, 9\}$ . Determine whether or not each of following is a partition

- (a)  $\{\{1, 3, 6, \dots\}, \{2, 8\}, \{5, 7, 9\}\}$   
 (b)  $\{\{2, 4, 5, 8\}, \{1, 9\}, \{3, 6, 7\}\}$   
 (c)  $\{\{1, 5, 7\}, \{2, 4, 8, 9\}, \{3, 5, 6\}\}$   
 (d)  $\{\{1, 2, 7\}, \{3, 5\}, \{4, 6, 8, 9\}, \{3, 5\}\}$

**Q.4**

- a) What is a group? Let  $A = \{5, 10, 15, 20\}$  10  
 i) Prepare the composition table w.r.t. the operation of multiplication modulo 25.  
 ii) Whether it is an abelian group? Justify your answer.  
 iii) Find the inverses of all the elements.  
 iv) Whether it is a cyclic group?
- b) What is a ring? Let  $A = \{0, 1, 2, 3, 4, 5\}$ . Determine whether a set A with addition modulo 6 & multiplication modulo 6 is a commutative ring? Justify your answer. 10

**Q.5**

- a) Define a lattice. Prove that in a distributive lattice the complement of any element is unique. Determine whether  $D_{105}$  is a distributive lattice. Find the complements of all elements. 8
- b) Define the term bijective function. Let  $f: \mathbb{R} \rightarrow \mathbb{R}$  be a function defined by  $f(x) = 2x - 3$ . Determine whether it is a bijective function. 6

c)

6

Draw the graph G corresponding to each adjacency matrix

$$(a) A = \begin{bmatrix} 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

$$(b) A = \begin{bmatrix} 1 & 3 & 0 & 0 \\ 3 & 0 & 1 & 1 \\ 0 & 1 & 2 & 2 \\ 0 & 1 & 2 & 0 \end{bmatrix}$$

Q.6

a)

8

Let  $A = \{2, 5, 9, 13, 16\}$

$R = \{(2, 5), (2, 13), (16, 5), (16, 13), (9, 13), (5, 16)\}$

$S = \{(2, 9), (2, 13), (5, 13), (9, 16), (5, 16)\}$

Compute (i)  $S^{-1}$  (ii)  $(R \cup S) \cap S^{-1}$  (iii)  $\bar{R} \cap S$  (iv)  $\bar{R}$

b) What is a planer graph? A connected planer graph has 8 vertices having degrees 2,2,2,3,3,3,4,4. How many edges are there in this graph? 6

c) Write the following statements in a symbolic form using quantifiers. Assume a suitable data wherever applicable. 6

i) All students have taken a course in mathematics.

ii) There is a girl student in a class who is also a sports person.

iii) Some students are intelligent, but not hardworking.

Time: 3 Hours

Max. Marks: 80

**Instructions:**

- 1) **Question Number 1** is compulsory.
- 2) Solve any **three** questions out of remaining **five** questions.
- 3) Each Question carry 20 marks.
- 4) Illustrate your answers with neat sketches wherever necessary.
- 5) Figures to the right indicate full marks.
- 6) Assume suitable additional data, if necessary and clearly state it.
- 7) All sub-questions of the same question should be grouped together.

- Q.1** (a) Compare Computer Architecture with Computer Organization. **05**
- (b) Draw and explain instruction cycle state diagram. **05**
- (c) Write a microcode for SUB R1, R2 i.e.  $R1 \leftarrow R1 - R2$ . **05**
- (d) Explain the features of PCI Bus. **05**
- Q.2** (a) Perform the following – **10**
- i) Convert  $(340)_{10}$  to excess-3 code.
  - ii) Convert Hexadecimal to decimal: DADA
  - iii) Draw OR gate using NAND gate.
  - iv) Hexadecimal to binary conversion: 3A9D.A0C
  - v) Represent  $(52)_{10}$  into Gray code.
- (b) Draw flowchart of Booth's multiplication algorithm and Multiply (-10) and (-8) using Booth's algorithm. **10**
- Q.3** (a) Design a full adder using half adder and additional gates. Give its Boolean expression for Sum and Carry. Give the truth table of it. **10**
- (b) Compare using suitable parameters between hardwired control unit and Microprogrammed Control unit. **10**
- Q.4** (a) (i) Add  $(448)_{10}$  and  $(489)_{10}$  in BCD. **05**
- (ii) Give the advantages and disadvantages of hardwired control unit design using state-table method and Delay-element method. **05**

- (b) (i) What is Amdahl's Law? Let a program have 40 percent of its code enhanced (so  $f_E = 0.4$ ) to run 2.3 times faster (so  $f_1 = 2.3$ ). What is the overall system speedup  $S$ ? **05**
- (ii) Draw and explain MISD parallel computing architectures that fall under Flynn's taxonomy. **05**
- Q.5** (a) What is Pipeline Hazard? Give the types of pipeline hazards. Write a difference between delayed branch and branch prediction. **10**
- (b) (i) Explain with suitable diagrams, why DRAM cell required refreshing in Computer System? **05**
- (ii) What is locality of reference? Explain different types of locality of reference. **05**
- Q.6** (a) Convert 543.21 to 64 bit double precision IEEE 754 binary Floating-Point standard, from a base 10 decimal number. **10**
- (b) Consider a cache (M1) and memory (M2) hierarchy with following characteristics: **10**
- M1: 16K word, 50 ns Access time.  
M2: 1M word, 400 ns Access time.
- Assume 8-word cache and set size 256 words with set associative mapping.
- (i) Show and explain the mapping between M2 to M1.  
(ii) Calculate the effective memory access time with cache hit ratio = 0.95.
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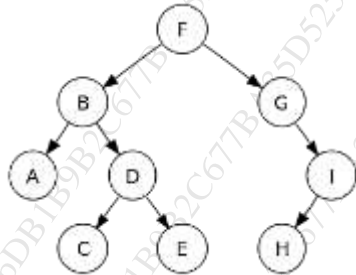
(3 Hours)

Total Marks: 80

**N.B: (1) Question No. 1 is compulsory**

**(2) Attempt any three questions out of the remaining five questions**

- Q.1** (a) Define ADT. Write ADT for Queue data structure. [05]  
 (b) Find the in-order, pre-order, post-order traversal [05]



- (c) Differentiate between Linked list and Array [05]  
 (d) Explain application of Binary tree [05]

- Q.2** (a) Apply Huffman coding for following examples. Determine the code for the following characters. "CONSTRUCTION" [10]

- (b) Consider a hash table with size = 10. Using Linear probing, insert the keys 28, 55, 71, 67, 11, 10, 90, 44 into the table. [10]

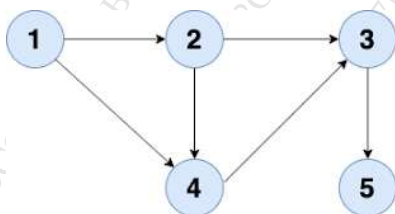
- Q.3** (a) Write an C program to check the well-formedness of parenthesis in an algebraic expression using the Stack data structure. [10]

- (b) Construct AVL for the given elements 27,25,23,29,35,33,34 [10]

- Q.4** (a) Write a program to perform the following operations on the Doubly linked list: [10]

- i. Insert a node at the end
- ii. Delete a node from the beginning
- iii. Search for a given element in the list
- iv. Display the list

- (b) Write DFS algorithm. Show DFS traversal for the following graph with all the steps. [10]





- Q.5** (a) Define Data Structure. Explain its type with an example [10]  
(c) Explain B tree. Draw the B-tree of order 3 created by inserting the following data arriving in sequence: 50, 25, 10, 5, 7, 3, 30, 20, 8, 15 [10]

- Q.6** (a) Draw the Stack structure in each case when the following operations are performed on an empty stack. [10]  
i. PUSH A, B, C, D, E, F  
ii. POP two letters  
iii. PUSH G  
iv. POP H  
v. POP four letters  
vi. PUSH I, J  
vii. POP one letter
- (b) Write a C program for polynomial addition using a Linked-list. [10]

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(Time: 3 Hours)

Marks: 80

- N.B:** 1) Question **number 1** is compulsory.  
 2) Attempt **any three** out of the remaining.  
 3) Assume suitable data if **necessary** and justify the assumptions.  
 4) Figures to the **right** indicate full marks.

**Q 1**

- A** What is computer graphics and discuss its representative uses [5]  
**B** Explain traditional animation techniques [5]  
**C** Describe homogeneous coordinate system [5]  
**D** Explain point clipping method with suitable example [5]

**Q 2**

- A** Given a triangle ABC with coordinates A (0, 0), B (10, 0), C(0,10). Apply [10]  
 following transformations in sequence  
 i. Translate the triangle by translation parameters (20, 30) units.  
 ii. Rotate the triangle by  $90^\circ$ .  
 Find the new coordinates of the triangle.  
**B** Explain Cohen Sutherland line clipping method with suitable example [10]

**Q 3**

- A** Derive midpoint ellipse drawing algorithm with suitable diagrams [10]  
**B** Discuss principles of animation. [10]

**Q 4**

- A** What is window and viewport. Derive the transformation matrix for a window-to- [10]  
 viewport transformation  
**B** Explain and write matrices for 3D rotation about X, Y and Z axes. [10]

**Q 5**

- A** What is aliasing effect? Explain antialiasing techniques [10]  
**B** Calculate all the points on the line from point A(0,0) to point B(8,10) using DDA [10]  
 line drawing method.

**Q 6**

- A** Derive the 2D transformation matrix for scaling with respect to fix point. [10]  
**B** Explain depth buffer method with suitable diagrams [10]

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