

Time: 3 Hours

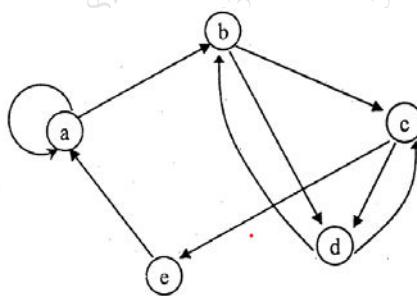
Marks: 80

**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  $R = \{(1, 1), (1, 2), (1, 3), (1, 4), (2, 2), (2, 4), (3, 3), (3, 4), (4, 4)\}$

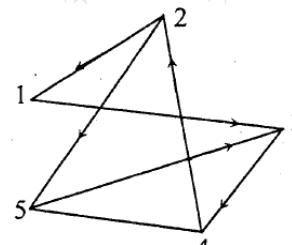
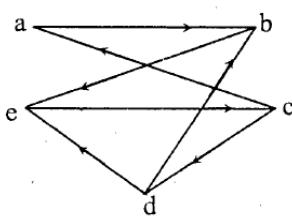
**Q.2**

- 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,
  - 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?8
  
- 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)  $[\{1, 3, 6\}, \{2, 8\}, \{5, 7, 9\}]$
- (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  $f: R \rightarrow R$  be a function defined by  $f(x) = 2x - 3$ . Determine whether it is a bijective function.  
6

6

c)

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.
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**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  
 if  $f(z) = (ax^4 + bx^2y^2 + cy^4 + dx^2 - 2y^2) + i(4x^3y - exy^3 + 4xy)$  is analytic 05
- 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  $f(x) = k(x - x^2); 0 \leq x \leq 1$  06  
 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  $f(t)$ ,  
 where  $f(t) = \cos t$ , for  $0 < t < \pi$  and  $f(t) = \sin t$ , for  $t > \pi$  06
- (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  
 $v = x^2 - y^2 + \frac{x}{x^2 + y^2}$  08
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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-viewport transformation [10]  
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 line drawing method. [10]

**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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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  $f_I = 2.3$ ). 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)

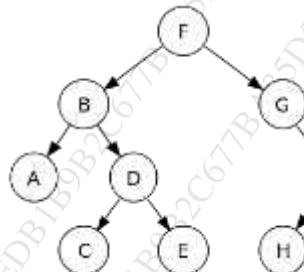
Total Marks: 80

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.  
(b) Find the in-order, pre-order, post-order traversal

[05]  
[05]



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

[05]  
[05]

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

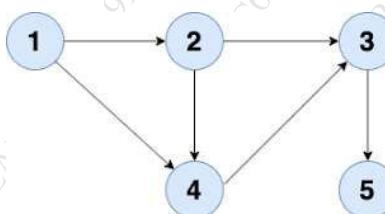
[10]  
[10]

- Q.3** (a) Write an C program to check the well-formedness of parenthesis in an algebraic expression using the Stack data structure.  
(b) Construct AVL for the given elements 27,25,23,29,35,33,34

[10]  
[10]

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