(Time: 3 hours) **Max. Marks: 80**

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

(2) Answer any three questions from Q.2 to Q.6.

(3) Figures to the right indicate full marks

Q.1 a) Find $L(t + e^t + \cos t)^2$ [5]

Q.1 b) Find the Fourier series for $f(x) = x\ sinx$ in $(-\pi, \pi)$ [5]

Q.1 c) Find Karl Pearson's coefficients of correlation between X and Y from the following data [5]

X	100	200	300	400	500
Y	30	40	50	60	70

Q.1 d) If $f(z) = (x^3 + axy^2 + bxy) + i(3x^2y + cx^2 + y^2 + dy^3)$ is analytic, then find a, b, c, d [5]

Q.2 a) A random variable X has the following probability function [6]

X	1	2	3	4	5	6	7
P(X=x)	k	2k	3k	k^2	k^2+k	$2k^2$	$4k^2$

Find i) k, ii) P(X≥ 4), iii) P(X < 5)

Q.2 b) Determine the analytic function whose real part is $u = e^x \cos y$ [6]

Q.2 c) Evaluate $\int_0^\infty e^{-t} \cosh t\ \cos 2t\ dt$. [8]

Q.3 a) Obtain the Fourier series for $f(x) = \left(\frac{\pi - x}{2}\right)^2$ in the interval $(0, 2\pi)$ [6]

Q.3 b) A continuous random variable X has the p.d.f. $f(x) = kx^2e^{-x},\ x \geq 0$ [6]

Find i) k, ii) $P(1 \leq x \leq 2)$

Q.3 c) Find $L^{-1}\left[\frac{s+29}{(s+4)(s^2+9)}\right]$ using partial fraction method [8]

Q.4 a) Find $L[f(t)],\ where\ f(t) = \cos t, 0 < t < \pi\ \ and\ f(t) = 0,\ t > \pi$ [6]

Q.4 b) Compute Spearman's rank correlation coefficient for the following data [6]

X	18	20	34	52	12
Y	39	23	35	18	46

Q.4 c) Obtain the Fourier series for [8]

$$f(x) = \begin{cases} 1, & 0 \le x \le \pi \\ 2 - \dfrac{\pi}{x}, & \pi \le x \le 2\pi \end{cases}$$

Q.5 a) Find $L^{-1}\left[\frac{4s+13}{s^2+8s+13}\right]$ [6]

Q.5 b) Find $L[(1 + sin2t)^2]$ [6]

Q.5 c) Find the line of regression of Y on X for the following data [8]

X	5	6	7	8	9	10	11
Y	11	14	14	15	12	17	16

Q.6 a) Find mean and variance for the following distribution [6]

X	8	12	16	20	24
P(X = x)	1/8	1/6	3/8	1/4	1/12

Q.6 b) Find $i)\ L^{-1}[cot^{-1}2s]$ $ii)\ L^{-1}\left[\log\left(1 + \frac{4}{s^2}\right)\right]$ [6]

Q.6 c) Prove that the function $f(z) = e^{2z}$ is analytic. Also, find its derivative. [8]

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Time:3Hours **Max. Marks: 80**

N.B.
1) **Q.1 is compulsory.**
2) Solve any 3 questions out of remaining 5 questions.
3) Assumptions made should be clearly stated.
4) Draw the figures wherever required.

Q.1 Solve any four of the following questions.

a) Check if $(p \rightarrow q) \rightarrow [(\sim p \rightarrow q) \rightarrow q]$ is a tautology? **5**

b) Draw the Hasse diagram for [{2,4,5,8,10,12,20,25}, /]. Is it a Poset? **5**

c) Define Eulerian and Hamiltonian Graph. Give examples of following type of graph **5**
i) Eulerian but not Hamiltonian
ii) Not Eulerian but Hamiltonan

d) Explain types of Quantifiers . Represent the following sentences using Quantifiers **5**
i) All hardworking students are clever.
ii) There is a student who can speak Hindi but does not know Marathi

e) State the Pigeonhole principle and prove that in any set of 29 persons at least five persons must have been born on the same day of the week **5**

Q.2

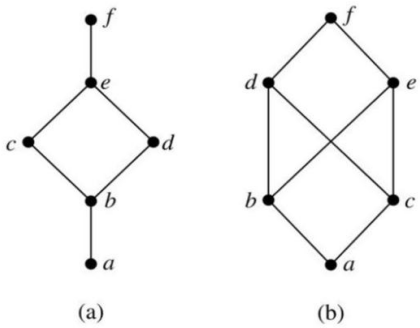
a) Show that the set of all positive rational numbers forms an abelian group under the composition * defined by a*b=(ab)/2 **10**

a) What is a transitive closure? Explain Warshall's algorithm for finding transitive closure with an example. **10**

Q.3

a) By using mathematical induction, prove that the given equation is true for all positive integers. **6**
$1 \times 2 + 3 \times 4 + 5 \times 6 + \ldots + (2n - 1) \times 2n = n(n+1)(4n-1)/3$

b) Define Lattice? Which of the following is lattice? **8**



c) Determine the sequence of which recurrence relation is $a_n = 2a_{n-1} - a_{n-2}$ with initial conditions $a_1 = 1.5$, $a_2 = 3$. **6**

Q.4

a) Let A={1, 3,6,9,15,18,21} & R be the relation of divisibility. **8**

i) Write the pairs in a relation set R.
ii) Construct the Hasse diagram.
iii) What are the Maximal and Minimal elements?
iv) Is this poset a distributive lattice? Justify your answer.

b) **6**

Let $H = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ be a parity check matrix. Determine (3, 6) group code $e_H : B^3 \rightarrow B^6$

c) Write a short note on Types of Graphs. **6**

Q.5

a) Let(Z,*) be an algebraic structure, where Z is set of integers and the operation * is defined by a*b= maximum of (a,b). Is (Z,*) a Semigroup? Is (z,*) a Monoid? Justify your answer. **8**

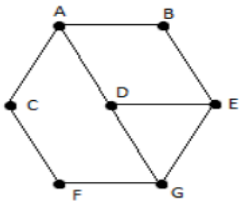
b) Define the term Surjective function. Let E be the set of all even numbers then f: N-->E:f(x)=2x , check if it is surjective,bijective?Justify your answer. **4**

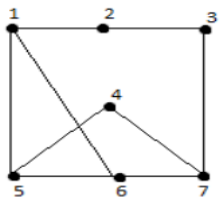
c) Give the examples of relation R on S = {a, b, c,d} having stated property. **8**

i) R is an equivalence relation.
ii) R is symmetric but not transitive
iii) R is both symmetric and antisymmetric
iv) R is neither symmetric nor antisymmetric.

Q.6

a) Define Isomorphic graphs and check whether the following graphs are Isomorphic ? **8**





b)In a group(G,*) , Prove that the inverse of any element is unique and identity element is also unique. **6**

c) Define Relation. Let **6**

f: R→R is defined as $f(x) = x^2$
g: R→R is defined as $g(x) = 3x^2+1$
h: R→R is defined as $h(x) = 9x-2$

find (hof)og, go(foh).

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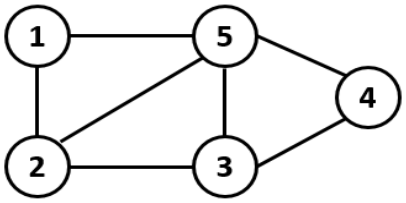
(3 Hours) **Total Marks: 80**

N.B: (1) Question No. 1 is compulsory
(2) Attempt any three questions out of the remaining five questions
(3) Figures to the right indicate full marks
(4) Make suitable assumptions wherever necessary with proper justifications

Q1	A	What is Hashing? Explain Hash collision with example.	[05]
	B	Explain types of Double Ended Queue with example.	[05]
	C	Differentiate between arrays and linked list.	[05]
	D	List different data structures along with one application.	[05]
Q2	A	Construct Binary Search Tree by inserting the following elements in sequence 45, 28, 34, 63, 87, 76, 31, 11, 50, 17.	[10]
	B	Write a program in C to implement Queue using singly linked list.	[10]
Q3	A	Write a program to perform the following operations on doubly linked list: i) Insert a node at the front of the list ii) Delete a node from the front of the list iii) Count the number of nodes in the list iv) Display the list	[10]
	B	Define Graph. Show the adjacency matrix and adjacency list representation for the following graph	[05]
			
	C	Explain stack overflow and underflow conditions with example.	[05]
Q4	A	Write an algorithm to check the well-formedness of parenthesis.	[10]
	B	Show the result of inserting the elements 16, 18, 5, 19, 11, 10, 13, 21, 8, 14 one at a time into an initially empty AVL tree.	[10]
Q5	A	Define tree traversal. Explain binary tree traversal techniques with example.	[10]
	B	A hash table of size 10 uses linear probing to resolve collisions. The key values are integers and the hash function used is key%10. Draw the table that results after inserting in the given order the following values: 28, 55, 71, 38, 67, 11, 10, 90, 44, 9	[10]
Q6	A	Explain Depth First Search and Breadth First Search traversal of a graph with example.	[10]
	B	Construct Huffman tree and determine the code for each symbol in the string "PROGRAMMING".	[10]

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(3 hours) **Total Marks: 80**

N.B. 1. Question No. 1 is compulsory
2. Attempt any three questions from remaining five questions
3. Assume suitable data if necessary and justify the assumptions
4. Figures to the right indicate full marks

Q1	A	Differentiate between Computer organization and computer architecture	05
	B	Draw the flow chart for of Restoring division algorithm	05
	C	Differentiate between Hardwired control unit and Micro programmed control unit	05
	D	Explain IEEE 754 floating point representations.	05
Q2	A	Draw the flow chart Booths algorithm for multiplication and Perform 6 **X** 2	10
	B	Describe the detailed Von-Neumann Model with a neat block diagram	05
	C	Explain Cache coherence	05
Q3	A	Explain the different addressing modes.	10
	B	Define Instruction cycle and draw the state diagram of instruction cycle	05
	C	Explain Bus arbitrations	05
Q4	A	Explain Micro instruction format and write a micro program for the instruction MUL R_1 , R_2	10
	B	Explain Hardwired Control Unit and the various design methods associated with it.	10
Q5	A	Explain various Memory mapping techniques	10
	B	Explain the concept of Locality of reference	05
	C	List & Explain the Characteristics of Memory	05
Q6	A	Explain Flynn's classification.	10
	B	Describe Instruction Pipelining and its hazards.	10

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(3 Hours) **Total 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	Explain image space and object space	**[5]**
B	What is computer graphics and explain its applications	**[5]**
C	What are homogeneous coordinates and discuss its use in computer graphics	**[5]**
D	Explain point clipping with suitable example	**[5]**

Q 2

A	Explain mid point ellipse drawing method for region I with suitable diagrams	**[10]**
B	Given a triangle ABC with coordinates A (10,10), B (100,10), C(10,100). Rotate the triangle by 90^0 Find the new coordinates of the triangle.	**[10]**

Q 3

A	Explain area subdivision method with suitable example.	**[10]**
B	Explain antialiasing techniques in detail	**[10]**

Q 4

A	Explain Liang Barsky line clipping method with suitable example	**[10]**
B	Explain and write matrices for 3D rotation about X, Y and Z axes	**[10]**

Q 5

A	Derive the 2D transformation matrix for rotation with respect to fix point.	**[10]**
B	Calculate all the points on the line from point A(8,10) to point B(16,14) using DDA line drawing method	**[10]**

Q 6

A	What is window and viewport. Derive the transformation matrix for a window-to-viewport transformation	**[10]**
B	Discuss traditional animation techniques	**[10]**