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

N.B.   (1) Question No. 1 is compulsory.
            (2) Answer any three questions from Q.2 to Q.6.
            (3) Use of Statistical Tables permitted.
            (4) Figures to the right indicate full marks.

Q1. (a) Find the Laplace transform of $t\, e^{-t} \cosh 2t$ [05]

   (b) If $u = -r^3 \sin 3\theta$ find the analytic function $f(z)$ whose real part is u.   [05]

   (c) Calculate the Spearman's rank correlation coefficient R

x	85	74	85	50	65	78	74	60	74	90
y	78	91	78	58	60	72	80	55	68	70

[05]

   (d) Find inverse Laplace transform of $\frac{1}{s} \log\left(1 + \frac{1}{s^2}\right)$.   [05]

Q2. (a) Evaluate by using Laplace transform of $\int_0^\infty e^{-2t}\, \frac{\cos 2t \sin 3t}{t}\, dt$.   [06]

   (b) Find the value of k if the function $f(x) = k\, x\, e^{\frac{-x}{3}}$,   x. > 0
$$f(x) = 0 \qquad\qquad 0 \le x.$$
   Is a probability density function. find mean and variance.   [06]

   (c) Obtain the Fourier series to represent $f(x) = \frac{3x^2 - 6x\pi + 2\pi^2}{12}$ in $(0, 2\pi)$

   Hence show that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} \dots\dots$ [08]

Q3. (a) Find the analytic function whose real part is $u = e^{2x}(x \cos 2y - y \sin 2y)$.   [06]

   (b) Obtain the Fourier series to represent $f(x) = x - x^2$, $-1 \le x \le 1$.   [06]

   (c) Using convolution theorem Find inverse Laplace transform of $\frac{(s+3)^2}{(s^2 + 6s+18)^2}$.   [08]

Q4. (a) Obtain the half range cosine series of $f(x) = x(\pi - x)$ in $(0, \pi)$

   Hence show that $\frac{\pi^4}{90} = \frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \frac{1}{4^4} \dots\dots$ [06]

   (b) Find the lines of regression and coefficient of correlation for the data   [06]

x	65	66	67	67	68	69	70	72
y	67	68	65	66	72	72	69	71

   (c) Evaluate by using Laplace transform of $\int_0^\infty e^{-t} \left(\int_0^t u^2 \sin hu \cos hu\, du\right) dt$ [08]

Q5. (a) Find the orthogonal trajectories of family of curves $e^{-x} \cos y + x\, y = \alpha$
      where α is the real constant in the x y - plane.   [06]

(b) A random variable x has the probability distribution [06]

x	0	1	2	3
P (x = x)	$\frac{1}{6}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{6}$

Find the moment generating function about origin. also find mean and variance.

(c) Fit a second degree parabolic curve to the following: [08]

X year	1965	66	67	68	69	70	71	72
Y profit	125	140	165	195	200	215	220	230

Also estimate the profit in 1973

Q6. (a) Find inverse Laplace transform of $\frac{(2s^2 - 6s + 5)}{(s^3 - 6s^2 + 11s - 6)}$ [06]

(b) Show that the function $v = e^x$ (x sin y + y cos y) satisfies Laplace equation
And find its corresponding analytic function and its harmonic conjugate. [06]

(c) A random variable X has the probability function [08]

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

Find k , p (X < 5) , p (x > 3), P (0 ≤ X ≤ 5).

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Duration: 3 Hours   **[Max Marks: 80]**

N.B. : (1) Question No 1 is Compulsory.
        (2) Attempt any three questions out of the remaining five.
        (3) All questions carry equal marks.
        (4) Assume suitable data, if required and state it clearly.

1	a	Explain different keys in DBMS.	[05]
	b	Strong Vs Weak Entity.	[05]
	c	Explain the aggregate functions in SQL with examples.	[05]
	d	Discuss the role of DBA.	[05]
2	a	Design an ER diagram for a Bank Database System.	[10]
	b	What is a deadlock? Explain the causes of deadlocks? Explain the deadlock prevention methods used in DBMS.	[10]
3	a	Describe the overall architecture of DBMS with a suitable diagram.	[10]
	b	What is Normalization? Explain 1NF, 2NF and 3 NF with examples.	[10]
4	a	Explain different relational algebra operators with examples.	[10]
	b	Explain types of integrity constraints with examples.	[10]
5	a	Explain the ACID properties of transactions.	[10]
	b	Explain database programming with JDBC.	[10]
6		Write short note on:	
	a	Trigger in SQL	[05]
	b	Log based recovery	[05]
	c	Conflict Serializability	[05]
	d	Specialization and Generalization in EER	[05]

(3 Hours)   [Marks: 80]

N.B.: 1) Question No. 1 is compulsory.
      2) Answer any three out of remaining questions.
      3) Assume suitable data if necessary.
      4) Figures to the right indicate full marks.

Q1. (a) Define Graph? Explain different types of graph.   (5)
    (b) Explain first fit, best fit and worst fit method with example.   (5)
    (c) Explain threaded binary tree.   (5)
    (d) Briefly explain memory fragmentation.   (5)
    (e) Differentiate between linear and nonlinear data structures.   (5)

Q2. (a) Design an algorithm to perform the following operations on stack: (10)
            i)   Push
            ii)   Pop
            iii) Display

Q2. (b) Explain insertion sort by giving its algorithm and sort the following data using insertion sort.
                                                                                                   (10)

                        38, 27, 43, 3, 9, 82, 10

Q3. (a) Convert the following expression into postfix expression using stack and write the algorithm
for the same   (10)
A/B-C+D*E-A*C

Q3. (b) Explain Priority Queue and variants of Priority Queue.   (10)

Q4. (a) Construct a minimum spanning tree for the graph shown in figure 1 using Kruskal's and Prim's
Algorithm and find out the cost with all intermediate steps.   (10)
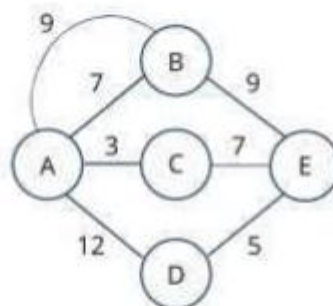

Figure 1: Graph

Q4. (b) Define AVL tree. Step by step construct an AVL tree for the following data: (10)
30,20,10,25,40,50,55,22,23

Q5. (a) Explain different hash functions. Assume a table has 11 slots (m=11). Using Quadratic probing, insert the following elements into the hash table. 36, 18, 72, 43, 6, 10, 5, and 15 are inserted in the order. (10)

Q5. (b) Define Binary Search Tree. Construct the binary search tree from following traversal: (10)

In-order: D B H E A I F J C G

Pre-order: A B D E H C F I J G

Determine the post-order of the tree drawn.

Q6. Solve any Four: (20)

  a) Graph Traversal Algorithm
  b) Game Tree
  c) Radix Sort
  d) B-tree
  e) Round Robin Scheduling

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(3 Hours) [Total Marks: 80]

N.B.
(1) Question No.1 is compulsory.
(2) Out of remaining attempt any three.
(3) Assume & mention suitable data wherever required.
(4) Figures to right indicates full marks

Q.1. Solve any four [20]
a) Define modulation and explain why modulation is required in communication systems.
b) Differentiate between analog and digital communication systems with examples.
c) Explain different types of Noise sources.
d) Explain the role of bandwidth in communication systems.
e) What are the key differences between Phase Modulation (PM) and Frequency Modulation (FM)?
f) Write short note on Quantization process.

Q.2 [20]

a) A 1 MHz carrier is amplitude modulated by a 10 kHz audio signal, resulting in a modulated signal with a modulation index of 0.6. The carrier amplitude is 10V.
Calculate:
   i.   The total power of the modulated signal.
   ii.   The power in the sidebands.

b) Discuss signal-to-noise ratio (SNR) and its importance in communication systems.

Q.3 [20]

a) State and prove the following properties of Fourier Transform:
   1. Time Scaling
   2. Frequency shifting
   3. Convolution in time domain
   4. Time shifting
b) Explain the principle of TDM with neat diagram. Also explain need of synchronization in TDM.

Q.4 [20]

a) With the help of neat circuit diagram explain the generation of AM Wave. Also derive the mathematical expression for AM Wave.
b) Explain the principle of phase modulation (PM). Compare it with frequency modulation (FM).

Q.5 [20]

a) Explain need of sampling. With a neat diagram explain the sampling theorem for low pass band limited signal.
b) Explain the working of fiber optic communication systems with a neat block diagram.

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Q.6 Solve any four [20]

a) Explain Time Division Multiplexing (TDM) and its application in communication systems.
b) Sky Wave propagation
c) What are the different types of noise encountered in communication? Explain their impact.
d) Explain the concept of sampling in Pulse Code Modulation (PCM).
e) Pre-emphasis and De-emphasis
f) Differentiate between Amplitude Shift Keying (ASK) and Frequency Shift Keying (FSK).

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

N.B.:
1. Question No.1 is compulsory.
2. Answer any three out of remaining questions.
3. Assume suitable data if necessary.
4. Figures to the right indicate full marks.

Q1. Solve the following   **(20)**

    a) Define binding. What is static and dynamic binding?
    b) Explain lazy evaluation and eager evaluation with example.
    c) With an example explain process of encapsulation in Object Oriented Programming.
    d) Explain process of unification in logic programming with example.

Q2.   a) Using example explain fact, rule and query in Prolog   **(10)**

      b) Explain different storage allocation mechanisms.   **(10)**

Q3.   a) What do you mean by Programming Paradigm. Explain with example

the difference between declarative and imperative programming paradigm.   **(10)**

b) Write Haskell code to multiply 2 numbers using recursive call to add function which adds 2 numbers. Clearly write the Type Signature of both functions.   **(10)**

Q4.   a) Explain different types of Inheritance supported by Object Oriented

Programming   **(10)**

      b) Discuss Call by value vs. Call by reference with example each.   **(10)**

Q5.   a) What are Scripting Languages? Explain characteristics of scripting languages. **(10)**

      b) Explain encapsulation with example. How does it differ from abstraction?   **(10)**

Q6.   **Write short note on (Any 4)**   **(20)**

    a) Need of thread synchronization.
    b) Gated Expression in Haskell.
    c) Generic Subroutines and modules.
    d) Higher Order Functions.
    e) Lambda Calculus.