(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) Use of Statistical Tables permitted.
        (4) Figures to the right indicate full marks

Q1.

(a) Find the Laplace transform of $\frac{\cos 2t \sin t}{e^t}$ [5]

(b) Find k such that $f (z) = \frac{1}{2}$ $\log (x^2 + y^2)$ + i $tan^{-1} \frac{kx}{y}$ is analytic   [5]

(c) Calculate the Spearman's rank correlation coefficient R   [5]
 X   : 10 , 12 , 18 , 18 , 15 , 40 .
 Y   :   12 , 18, 25 , 25 , 50 , 25 .

(d)   Find the inverse Laplace transform of $\log \left(\frac{s^2 + a^2}{s^2 + b^2} \right)$.   [5]

 Q2.

(a) A continuous random variable has probability density function
            $f (x) = k (x - x^2)$, $0 \leq x \leq 1$.
                            $f (x) = 0$ otherwise
        Find k , mean and variance.   [6]

(b) Find the Laplace transform of $e^{-3t} \int_0^t u \sin 3u \, du.$ [6]

 (c) Obtain the Fourier series to represent f (x) = x^2 in (0, 2π)
        Hence show that $\frac{\pi^2}{12}$ $= \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2}$ ....   [8]

 Q3.

(a) If the imaginary part of the analytic function w = u + i v = f (z) is   [6]
        $V = x^2 - y^2 + \frac{x}{x^2 + y^2}$, then show that u = - 2 x y + $\frac{y}{x^2 + y^2}$.

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

(c) Fit a second-degree parabolic curve and estimate y when x = 10
     x   : 1 ,   2 , 3 , 4 ,   5 ,   6 ,   7 ,   8 ,   9 ,
     y   : 2 ,   6 , 7 ,   8 , 10 ,   11 , 11 , 10 ,   9 .   [8]

 Q4.

 (a)   Obtain the Fourier series to represent f (x) = x^3 in (-π, π).   [6]

 (b) Find (i) the equation of the lines of Regression (ii) coefficient of correlation for
      the following data
      X :   65 ,   66 , 67 ,   67,   68 ,   69 , 70 , 72 .
      Y :   67 ,   68 , 65 , 66 ,   72 ,   72 , 69 , 71 .   [6]

(c) Prove that $\int_0^\infty e^{-\sqrt{2}t} \frac{\sin t \sin ht}{t}$ dt = $\frac{\pi}{8}$.   [8]

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Q5.

(a) Find the orthogonal trajectories of the family of curves $x^3y - xy^3 = c$. [6]

(b) Find the moment generating function of the distribution

X	:	-2	3	1
P X = x)	:	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{6}$

hence find first four central moments . [6]

(c) Obtain the half range cosine series of $f (x) = x$ in $(0, 2)$

Hence show that $\frac{\pi^4}{96} = \frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4}$ …….. [8]

Q6.(a) Using convolution theorem Find the inverse Laplace transform of $\left[\frac{s^2}{(s^2+2^2)^2}\right]$ [6]

(b) The probability density function of a random variable X is

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

Find k , $p (X < 5)$, $P (X > 5)$ [6]

.(c) If $v = 3 x^2 y + 6 x y - y^3$,show that v is harmonic function

And find the corresponding analytic function . [8]

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(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) Explain data structures and Abstract Data Type.   (5)
    (b) What is expression tree? Give examples.   (5)
    (c) What is a Linked List? State the different types of Linked List.   (5)
    (d) What are the different ways to represent Graph.   (5)

Q2. (a) Write an algorithm to implement queue using an array.   (10)

Q2. (b)Explain insertion sort with example by giving its algorithm and comment on its complexity.
                                                                                                 (10)

Q3. (a) Write an algorithm to implement stack using array.   (10)

Q3. (b) What is Doubly Linked List? Write an algorithm to implement following operations on Doubly
        Linked List.
a) Insertion (all cases)
b) Traversal (Forward and Backward)   (10)

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

Figure 1

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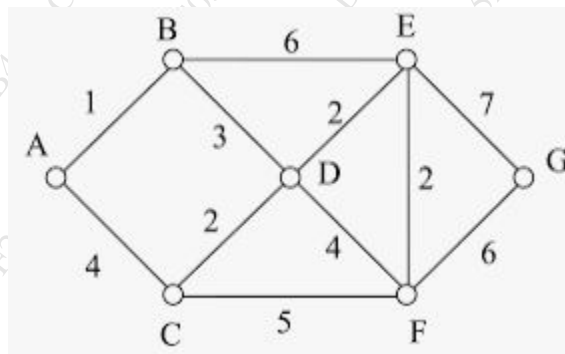Q4. (b) Define AVL tree. Construct an AVL tree from the following data and mention the rotations in each step.   (10)

40,30,20,25,21,50,60,70,65,22,18,15

Q5. (a) What is collision? List down the methods to resolve the collision. Consider a hash table of size 11. Using linear probing, insert keys 54, 26, 93, 17, 77, 60 and 31 into the table.   (10)

Q5. (b) Write the algorithm for deletion of a node (all cases) in a Binary Search Tree.   (10)

Q6. Write Short note on any **four**:   (20)

a) Breadth First Search
b) Expression Tree
c) Selection Sort
d) Double Ended Queue (De-Queue)
e) Binary Search

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Time:3Hours   **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). Explain need of modulation. Justify it with example.
b). Define the following terms.
i) . Noise figure   ii). Noise temperature
iii). Noise bandwidth   iv) Noise voltage   v) Modulation.
c). Compare AM and FM.
d). Explain in short pre-emphasis and De-emphasis.
e). What is PSK signal. Draw the PSK signal for the following binary signal 111010011.
f). Explain the principle of reflection and refraction.

Q.2 a) Define signal to noise ratio. Explain the effect of cascade connection   **[10]**
on a signal to noise ratio. Derive Friss formula for two stage cascade amplifier.
b) Derive the expression for total power in AM.   **[10]**

Q.3 a) The AM Transmitter develops an unmodulated power o/p of 400 Watts across a
50Ω resistive load. The carrier is modulated by a sinusoidal signal with a modulation
index of 0.8. Assuming f_m= 5KHz and f_c= 1MHz.
(i) Obtain the value of carrier amplitude Vc and hence write the expression for AM
signal.
(ii) Find the total sideband power.
(iii) Draw the AM wave for the given modulation index.   **[10]**
b) Explain quantization process in PCM with suitable diagram.   **[10]**

Q.4 a) What are the limitations of TRF receiver? Explain how these
limitations are avoided using super-heterodyne receiver.   **[10]**
b) Compare ground wave, sky wave, space wave and tropospheric
scatter propagation..   **[10]**
Q.5 a) Explain FDM transmitter & receiver with block diagram   **[10]**
b) Draw the block diagram of PAM generator and detector. Explain the working
giving waveforms at the output of each block.   **[10]**

Q6.   a) Explain slope overload error and hunting error in Delta modulation. Derive the
condition to avoid slope overload distortion.   **[10]**
b) Explain the generation of SSB with phase shift method.   **[10]**

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Time: (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.   a) Explain Encapsulation and Abstraction with suitable examples from C++ or Java.   **(05)**

      b) List various characteristics of scripting languages?   **(05)**

      c) Explain how infinite lists are supported in Haskell. Give suitable example.   **(05)**

      d) What are different programming paradigms?   **(05)**

Q2.   a) Explain database manipulation commands in Prolog with an example.   **(10)**

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

Q3.   a) What is the role of an Exception Handler in a programming language? Briefly explain important tasks it performs.   **(10)**

      b) Explain lifecycle of a thread.   **(10)**

Q4.   a) What is logic programming? Explain Facts and Rules along with an example.   **(10)**

      b) Discuss Call by value vs Call by reference with example code in C or C++.   **(10)**

Q5.   a) Explain Type and Type classes in Haskell.   **(10)**

      b) What is Inheritance in OOP? Explain different types of Inheritance in OPP.   **(10)**

Q6.   Short note on: **(Any 4)**   **(20)**

      a)   Static Scoping vs. Dynamic Scoping
      b)   Need for thread synchronization in concurrent programming
      c)   Curried Function in Haskell
      d)   Lambda Calculus
      e)   Backtracking in Logic Programming

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Time: 3Hrs **Marks: 80**

Q1 is compulsory.
Attempt any three questions out of remaining five questions.

Q1. Attempt All questions 20M
(a) Explain role of DBA.
(b) Explain generalization in EER.
(c) Explain concept of log-based recovery.
(d) Explain DML commands with example.

Q2.
   (a) Explain Conflict and View Serializability in detail 10M
   (b) Write SQL Queries for the following. Assume data wherever required. 10M
      Employee (Eid, Ename, Salary, Experience, Dept_name, Location)
  I. Find maximum salary of employees Dept_name wise.
  II. Change department to 'Testing' of employees who experience is less than 5 years.
 III. Create view from employee table as employee_record containing first 3 columns
     of employee table.
 IV. Delete all entries from employee table working in 'production' Department.

Q3
(a) Draw EER diagram for hospital management system 10M
(b) Write relational algebra queries for. Assume data wherever required.
  I. Find names of employees whose location is 'Mumbai' 10M
  II. Find maximum salary of employee from employee table,
 III. Find names of the employees whose Eid is greater than 3.

Q4.
(a) Explain concept of sub queries with example 10M
(b) Draw and explain DBMS system architecture. 10M

Q5
(a) Define Normalization. Explain 2NF in detail 10M
(b) Draw and explain generalization ad specialization in detail 10M

Q6. Write short note on 20M
(a) Binary Relational operation
(b) Types of attributes
(c) Foreign key with example
(d) Recursive Queries

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