Paper / Subject Code: 49301 / APPLIED MATHEMATICS-III

Time: 3 Hours **Marks: 80**

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

Q1. a) Find the Laplace transform of $e^{-t}t \cosh 2t$. **[5]**

b) Find the half-range cosine series for $f(x) = \begin{cases} 1 & , o < x < \frac{a}{2} \\ -1 & , \frac{a}{2} < x < a \end{cases}$ **[5]**

c) Find $\nabla\left(\bar{a}.\nabla\frac{1}{r}\right)$ where $\bar{a}$ is a constant vector. **[5]**

d) Show that the function $f(z) = z^3$ is analytic and find $f'(z)$ in terms of z. **[5]**

Q2. a) Find the inverse Z-transform of $F(z) = \frac{3z^2-18z+26}{(z-2)(z-3)(z-4)}$, $3 < z < 4$. **[6]**

b) Find the analytic function whose imaginary part is $\tan^{-1}\left(\frac{y}{x}\right)$. **[6]**

c) Obtain Fourier series for the function $f(x) = \begin{cases} \frac{\pi}{2} + x & , -\pi < x < 0 \\ \frac{\pi}{2} - x & , 0 < x < \pi \end{cases}$, **[8]**

Hence ,deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots$ and $\frac{\pi^4}{96} = \frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \cdots$

Q3. a) Find $L^{-1}\left[\frac{s^2}{(s^2+1)(s^2+4)}\right]$ using convolution theorem. **[6]**

b) Show that the set of functions $\phi_n(x) = \sin\left(\frac{n\pi x}{l}\right), n = 1, 2, 3 \ldots$ is orthogonal in $[0, l]$. **[6]**

c) Using Green's theorem evaluate $\oint_C \left(e^{x^2} - xy\right)dx - (y^2 - ax)dy$ where C is the circle $x^2 + y^2 = a^2$. **[8]**

Q4. a) Find Laplace transform of $f(t) = \begin{cases} \frac{t}{a} & , o < t \le a \\ \frac{(2a-t)}{a} & , a < t < 2a \end{cases}$ and $f(t) = f(t + 2a)$. **[6]**

b) Prove that a vector field $\bar{f}$ is irrotational and hence find its scalar potential $\bar{f} = (y\sin z - \sin x)i + (x\sin z + 2yz)j + (xy\cos z + y^2)k$. **[6]**

c) Obtain the Fourier expansion of $f(x) = \left(\frac{\pi-x}{2}\right)^2$ in the interval $0 \le x \le 2\pi$ and $f(x + 2\pi) = f(x)$ .Also deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots$ **[8]**

Q5.a) Use Gauss's Divergence Theorem to evaluate $\iint_S \bar{N}.\bar{F}ds$ where $\bar{F} = 4xi + 3yj - 2zk$ and S is the surface bounded by x=0, y=0, z=0 and 2x+2y+z=4. **[6]**

b) Find the Z-transform of $f(k) = ke^{-ak}$, k≥ 0 . **[6]**

c) i) Find $L^{-1}\left[\frac{s+2}{s^2(s+3)}\right]$. **[8]**

ii) Find $L^{-1}\left[\log\left(\frac{s+a}{s+b}\right)\right]$.

Q6.a) Solve using Laplace transform
$(D^2 + 3D + 2)y = 2(t^2 + t + 1)$, with $y(0) = 2$ and $y'(0) = 0$. **[6]**

b) Find the bilinear transformation which maps the points Z=1, i, -1 onto the points W=i, 0, -i . **[6]**

c) Find Fourier sine integral of $f(x) = \begin{cases} x & , 0 < x < 1 \\ 2 - x & , 1 < x < 2 \\ 0 & , x > 2 \end{cases}$ **[8]**

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Q. P. Code: 35354

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

N.B. : 1. Question **ONE** is **Compulsory.**
     2. Solve any **THREE** out of remaining.
     3. **Draw** neat and **clean** Diagrams.
     4. Assume suitable **data** if required

Q.1.   Attempt the following
     a) Explain the construction of n-channel JFET   5
     b) List the ideal Characteristics of Op-amp   5
     c) What is modulation in communication?What is the need for modulation?   5
     d) Compare TDM and FDM   5

Q.2.   A. Explain Barkhausen Criteria for Oscillation. Calculate the frequency of oscillations
       of Colpitt's oscillator with $C_1 = C_2 = 500$ pF and $L = 1$mH   10
    B. Derive the equations for Z_i, Z_o, A_v for common source configuration using
       voltage divider network   10

Q.3.   A. Explain how op-amp can be used as averaging amplifier in inverting configuration   10
    B. Explain generation of SSB using phase shift method.   10

Q.4.   A. Explain Superheterodyne reciever in detail and show waveforms at each stage   10
    B. State and proof Sampling theorem for Low pass Signal.   10

Q.5.   A. Discuss Delta Modulation and Adaptive Delta Modulation   10
    B. Write short note on TDM-PCM System   10

Q.6 . Write Short note on
     a) PLL   10
     b) Op-amp as Comparator   10

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Paper / Subject Code: 49303 / DATA STRUCTURES

Duration: **3 hrs**   Total Marks: **80**

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

1. (a) What is a data structure? Explain with examples.   **(05)**
    (b)What are the advantages of using dynamic memory allocation over static memory
    allocation?   **(05)**
    (c) Describe Multiway Search Tree with an example.   **(05)**
    (d) Write a function in C to implement Shell Sort.   **(05)**

2. (a) Discuss file I/O operations in C programming language.   **(10)**
    (b)Explain sparse matrix as application of linked list with examples.   **(10)**

3. (a) How can we use the QUEUE data structure for simulation? Explain with an example.   **(10)**
    (b)Write a function to implement Radix Sort. Sort the following numbers using Radix Sort:
            25, 10, 68, 19, 75, 43, 22, 31, 11, 59. Show output after each pass.   **(10)**

4. (a) Write a C program to implement a Circular Linked List which performs the following
    operations: **(12)**
            (i)   Inserting element in the beginning
            (ii)   Inserting element in the end
            (iii)   Inserting element after an element
            (iv)   Deleting a particular element
            (v)   Displaying the list
    (b) Apply Huffman Coding for the word "MALAYALAM". Give the Huffman code for each
    symbol.   **(08)**

5. (a) Explain any one application of stack with an example.   **(08)**
    (b)Write a program in C to delete a node from a Binary Search Tree. The program should
    consider all the possible cases.   **(12)**

6. (a) Write a program in C to implement the BFS traversal of a graph. Explain the code with an
    example.   **(10)**
    (b) Hash the following in a table of size 11. Use any two collision resolution techniques: **(10)**
            23, 55, 10, 71, 67, 32, 100, 18, 10, 90, 44.

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Page **1** of **1**

Time: 3 Hours   **Marks: 80**

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

(2) Assume suitable data if necessary

(3) Attempt any three questions from remaining questions

1

(a) Convert $(47.3)_7$ to BCD, Excess-3 and gray code.   (3)

(b) Perform $(2F9)_H - (1AD)_H$ without converting to any other base.   (3)

(c) Subtract $(64)_{10} - (31)_{10}$ using 2's complement.   (4)

(d) Explain race around condition.   (4)

(e) Prove OR-AND configuration is equivalent to NOR-NOR configuration.   (4)

(f) Obtain hamming code for data 1101.   (2)

2 (a) Simplify following function using Quine McCluskey method and realize circuit   (10)
using basic gates.
$F(A,B,C,D) = \sum m (0,1,3,5,7,9,11,15) + d(2,14)$

(b) Design 1-bit magnitude comparator.   (10)

3 (a) Compare different logic families with respect to fan in, fan out, speed,   (5)
propogation delay and power dissipation.

(b) Simplify $Y = \overline{A}\,\overline{B}\,\overline{C} + A\,\overline{B}\,\overline{C} + A\,\overline{B}\,C$ (5)

(c) Implement the following using only one 8:1 Mux and few gates.   (10)
$F(A,B,C,D) = \sum m (0, 1, 5, 7, 9,10,15)$

4 (a) Convert D flip-flop to JK flip-flop and JK flip-flop to D flip-flop.   (10)

(b) Design a full adder using only NAND gates.   (10)

5 (a) Design mod -6 asynchronous UP counter.   (10)

(b) Write short note on VHDL .   (10)

6 (a) Explain Astable and Bistable multivibrators.   (10)

(b) Explain 4-bit bidirectional shift register.   (10)

(3 hours)

Total Marks: 80

N.B.
1. Question No 1 is compulsory
2. Solve any three question out of remaining five questions
3. Assumption made should be clearly stated
4. Figure to the right indicates full marks

1 (a) If function f is an isomorphism from semigroup $(S, *)$ to $(T, *')$, then prove that f^{-1} is an isomorphism from $(T, *')$ to $(S, *)$ 5

(b) Find the generating function for the following sequence   5
    i)   1, 2, 3, 4, 5, ……………
    ii)   0,0,0,3,3,3,3,3, …………

(c) Find the truth table of $(p \implies q) \wedge ((q \implies r) \implies p)$ 5

(d) For $x, y \in Z$, xRy if and only if $2x + 5y$ is divisible by 7. Is R an equivalence relation?   5

2. (a) The college catering service must decide if the mix of food that is supplied for receptions is appropriate. Of 100 people questioned, 37 say they eat fruits, 33 say they eat vegetables, 9 say they eat cheese and fruits, 12 eat cheese and vegetables, 10 eat fruits and vegetables, 12 eat only cheese, and 3 report they eat all three offerings. How many people surveyed eat cheese? How many do not eat any of the offerings?   8

(b) Prove by laws of logic (do not use truth table) that the following statement is a tautology   6

$$((p \implies q) \wedge (q \implies r)) \implies (p \implies r)$$

(c) Let $S = \{1, 2, 3, 4, 5\}$ and $A = S \times S$. Define the following relation R on $A (a, b) \ R \ (c, d)$ if and only if $ad = bc$. Show that R is an equivalence relation and compute A/R.   6

3. (a) Show that the set $G = \{f_1, f_2, f_3, f_4, f_5, f_6\}$ where the functions are defined by   8

$$f_1(x) = x \qquad f_2(x) = 1 - x \qquad f_3(x) = \frac{x}{x - 1} \qquad f_4(x) = \frac{1}{x}$$
$$f_5(x) = \frac{1}{1-x} \qquad \text{and} \quad f_6(x) = 1 - \frac{1}{x}$$

is a group under composition of two functions. Frame the multiplication table.

(b) Solve $a_n - 7a_{n-2} + 6a_{n-3} = 0$, where $a_0 = 8$, $a_1 = 6$ and $a_2 = 22$ 6

(c) Consider the lattices $L1 = \{1, 2, 4\}$, $L2 = \{1, 3, 9\}$ under divisibility. Draw the lattice $L1 \times L2$.   6

4. (a)   8

Let $H = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ be parity check matrix.

Determine the group code $e_H : B^2 \rightarrow B^5$

(b) Prove the following using Mathematical induction $6^{n+2} + 7^{2n+1}$ is divisible by 43 **6**

(c) If 11 numbers are chosen from a set $A = \{1, 2, 3, 4, \dots \dots \dots, 20\}$, then one of them is multiple of the other. **6**

5 (a) Determine the Eulerian and Hamiltonian path/circuit, if any, in the following graphs. **8**
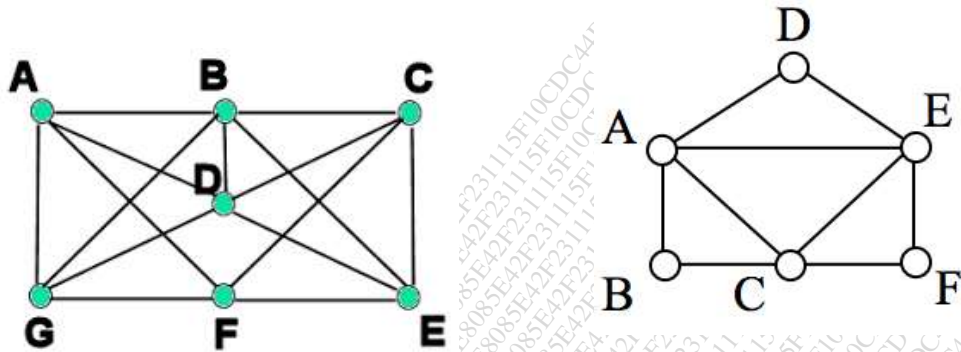
(b) Draw the Hasse diagram of the following poset (i) D_{72} (ii) D_{105} **6**

(c) Let $(G, *)$ is an Abelian group, then for all $a, b \in G$ show that $(a * b)^n = a^n * b^n$ (use mathematical induction) **6**

6. (a) Determine whether following graphs are isomorphic **8**
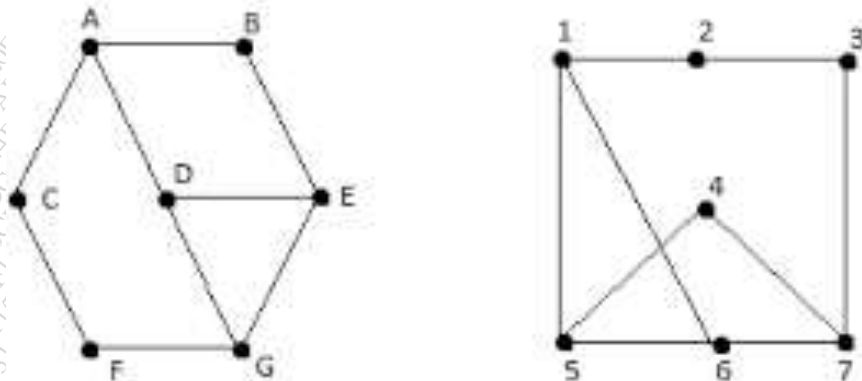
(b) Solve the recurrence relation : $a_k - 3a_{k-1} = 2$ with initial conditions $a_0 = 1$ using generating function **6**

(c) A connected planar graph has g vertices having degree 2,2,2, 3,3,3, 4,4 & 5. How many edges are there? **6**

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

N.B   1) Question **no. 1 is compulsory.**

2) Attempt **any three from remaining** questions.

Q. 1   **a**   Explain any five features of JAVA language   **[5]**

b   Differentiate between abstract class and interface   **[5]**

c   Write a program to find the largest of three integers accepted from command   **[5]**
line

d   Explain various access specifiers in JAVA.   **[5]**

Q. 2   **a**   Explain different types of relationships among entities.   **[10]**
Define the relationships among the objects of given sentences:

1)   Employee works on project.

2)   Customer places order.

3)   WebOrder, TelephoneOrder is a kind of order.

b   What is the advantage of clause "finally"   **[10]**
List any 2 exceptions defined in Java. Explain use of try, catch and use of
multiple catch block .

Q. 3   **A**   Create class Student (roll number, name).   **[10]**
Class Test (mark1, mark2) inherit student class.
Create interface Sport with data member as sports_mark and method
set_sportMark().
Create class Result which extends Test and implements Sport and has a
method   named   calculate   which   finds   total   as
(total=marks1+marks2+sports_mark) and method which display all the
details.
Create an object of Result class and show result.

b   What   role   does   "interface"   play   in   multiple   inheritance.   Explain   with   **[10]**
example.
Demonstrate use of interface to achieve polymorphism with example.

Q. 4   **a**   Write a JAVA program to count the number of upper case, lower case, blank   **[10]**
spaces and digits in a string.

      b   Which are the two different ways to create a thread? Write a multithreaded   **[5]**
program to show inter-leaving of actions from 2 threads and display
ABABABABABABAB

      c   Write an applet program to display   **[5]**
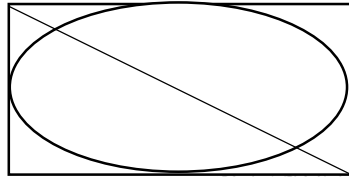
Q. 5   **a**   What is applet? Draw and explain lifecycle of an applet.   **[10]**

      b   Write a program to check if the year entered is leap or not.   **[5]**

      c   Compare Method Overloading and Method Overriding   **[5]**

Q. 6   **a**   Explain Vectors and its operations (any four) with suitable example /   **[10]**
program.

      b   Explain System.arraycopy() method with example.   **[5]**

      c   Write a program to implement bubble sorting algorithm for sorting numbers   **[5]**
in descending order.

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