Q. P. Code: 37687

Total Marks: 80 **Time Duration: 3Hr**

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.

Maximum Marks

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

b) Find the half-range sine series for $f(x) = x(\pi - x)$ in $(0, \pi)$. **[5]**

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

b) Prove that $\nabla\left\{\nabla.\frac{\bar{r}}{r}\right\} = -\frac{2}{r^3}\bar{r}$. **[5]**

Q2. a) Find the inverse Z-transform of $F(z) = \frac{z}{(z-1)(z-2)}$ $|z| > 2$. **[6]**

b) Find the analytic function whose real part is $\frac{\sin 2x}{\cosh 2y + \cos 2x}$. **[6]**

c) Obtain Fourier series for the function $f(x) = \begin{cases} 1 + \frac{2x}{\pi} & , -\pi \le x \le 0 \\ 1 - \frac{2x}{\pi} & , 0 \le x \le \pi \end{cases}$, **[8]**

deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots$

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

b) Show that the set of functions $\cos nx, n = 1, 2, 3 \ldots$ is orthogonal on $[0, 2\pi]$. **[6]**

c) Using Green's theorem evaluate $\int_c \left(\frac{1}{y}dx + \frac{1}{x}dy\right)$ where C is the boundary of the region defined by $x = 1, x = 4, y = 1 \; and \; y = \sqrt{x}$. **[8]**

Q4. a) Find Laplace transform of $f(t) = k\frac{t}{T}$ for 0 < t < T and $f(t) = f(t + T)$. **[6]**

b) Show that $\bar{f} = (x^2 + xy^2)\, i + (y^2 + x^2 y)$ j is irrotational and find its scalar potential. **[6]**

c) Find half – range cosine series for $f(x) = x$, 0 < x < 2. Using Parseval's identity deduce that **[8]**

i) $\frac{\pi^4}{96} = \frac{1}{1^4} + \frac{1}{3^4} - \frac{1}{5^4} + \cdots$

ii) $\frac{\pi^4}{90} = \frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \cdots$

Q5.a) Use divergence theorem to show that $\iint_S \nabla r^2 \overline{ds} = 6v$ where S is any closed surface enclosing a volume V. **[6]**

b) Find the Z-transform of $f(k) = k\alpha^k$, k≥ 0. **[6]**

c) i) Find $L^{-1}\left[\frac{(s+2)^2}{(s^2+4s+8)^2}\right]$ **[8]**

ii) Find $L^{-1}[2\tanh^{-1} s]$

Q6.a) Solve using Laplace transform **[6]**
$(D^2 - 3D + 2)y = 4e^{2t}$, with $y(0) = -3, y'(0) = 5$.

b) Find the bilinear transformation which maps the points 1, -i, 2 on z-plane onto 0, 2, -i respectively of w-plane. **[6]**

c) Express the function $f(x) = \begin{cases} \sin x & , 0 < x \le \pi \\ 0 & x < 0, x > \pi \end{cases}$ as Fourier integral and deduce that $\int_0^\infty \frac{\cos\left(\frac{w\pi}{2}\right)}{1-w^2}\, dw = \frac{\pi}{2}$. **[8]**

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(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 concept of virtual ground in op-amp 5
b) Explain block diagram of PCM 5
c) Compare FET and BJT 5
d) What is ZCD? 5

Q.2. A. Explain the construction and working of n-channel JFET with help of characteristic curves. 10
B. Explain op-amp as integrator 10

Q.3. A. List down various parameters of op-amp with their practical values and ideal values for IC741. 10
B. Explain working of PLL as frequency as frequency multiplier with diagram. 10

Q.4. A. Explain Superheterodyne Receiver along with waveforms at each stage . 10
B. What are power amplifiers .what are the types of power amplifiers .Explain class C power amplifiers. 10

Q.5. A. Derive the equations for Zi, Zo, Av for common source configuration using voltage divider network 10
B. Discuss Delta Modulation and Adaptive Delta Modulation

Q.6. Write short note: 20
a) TDM-PCM System
b) Generation of FM
c) Comparators.
d) op-amp as summing amplifier

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Q.P. Code: 36285

[Time: Three Hours] **[Marks:80]**

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

1. (a) Explain ADT with an example. (5)
   (b) Differentiate between Static and Dynamic Data Structure (5)
   (c) Write a 'C' program to implement Binary Search using recursion (5)
   (d) Discuss practical applications of Queues (5)

2. (a) Write a 'C' program to implement STACK using arrays (10)
   (b)What are the different methods of File I/O in 'C' language? What library functions are supported by 'C' language to do this? (10)

3. (a) What are the advantages of Linked list over array? Write a 'C' program to implement Queue ADT using Linked List (10)

   (b)Explain indexed Sequential search with a suitable example. What are the advantages and disadvantages of Indexed Sequential search (10)

4. (a) Write a 'C program to create a "Singly Linked List" ADT. The ADT should support the following: (10)

   (i) Creating a Linked List
   (ii) Inserting a node after a specific node
   (iii) Deleting a node
   (iv) Displaying the list

   (b)Explain the method of Huffman Encoding. Apply Huffman encoding method for the sentence "MAHARASHTRA". Give Huffman code for each symbol. (10)

5. (a) Write a 'C' program to create Binary Search Tree. Show BST for the following Input: 10,5,14,22,17,1,8 (10)

   (b)What is the use of hashing? Show hash table entries for the given dataset using Linear Probing and Quadratic Probing: 12,45,67,88,27,78,20,62,36,55. (10)

6. Write Short notes on (any two) (20)
   (a) Threaded Binary Tree
   (b) Explain BFS algorithm with example
   (c) Doubly Linked list.

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(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) Prove by mathemathical induction that $11^{n+2} + 12^{2n+1}$ is divisible by 133. **5**

(b) Show that if a relation on set A is transitive an irreflexive, then it is asymmetric. **5**

(c) Function $f(x) = (4x + 3)/(5x - 2)$. Find f^{-1} **5**

(d) What is the total number of vertices in a full binary tree with 20 leaves? **5**

2. (a) Let $f(x) = x + 2$, $g(x) = x - 2$ and $h(x) = 3x$ for all $x \in R$. (R is the set of real number). Find i) $f \circ g \circ h$ ii) $h \circ g \circ f$ iii) $f \circ f \circ f$ **8**

(b) Let R be a relation on the set of integers Z defined by aRb if and only if $a \equiv m(mod\ 5)$. Prove that R is an equivalence relation. Find Z/R. **8**

(c) Is it possible to draw a graph with 5 vertices of degree 1,1, 2, 2, 4 **4**

3 (a) Let $A = \{1, 2, 3, 4\}$ and $R = \{(1,2), (2,3), (3, 4), (2, 1)\}$. Find the transitive closure using Warshall's algorithm. **6**

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

(c) Solve the recurrence relation $a_n = -3(a_{n-1} + a_{n-2}) - a_{n-3}$ with $a_0 = 5$, $a_1 = -9$ and $a_2 = 15$ **8**

4 (a) Show that a group G is abelian if and only if $(ab)^2 = a^2b^2$ for all $a, b \in G$ **6**

(b) Prove that the set $G = \{1, 2, 3, 4, 5, 6\}$ is an abelian group under multiplication modulo 7. **6**

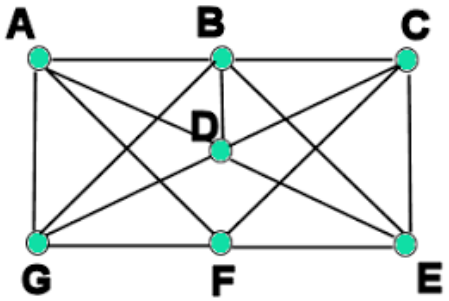
(c) Find the generating function for the following series **8**
i) $\{0, 1, 2, 3, 4, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\}$
ii) $\{1, 2, 3, 4, 5, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\}$
iii) $\{2, 2, 2, 2, 2, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\}$
iv) $\{0, 0, 0, 1, 1, 1, 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\}$

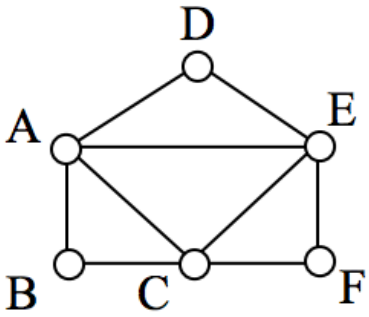
5 (a) **8**

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.

Decode the following words relative to maximum likelyhood decoding function.
i) 011001 ii) 101011 iii) 111010 iv) 110110

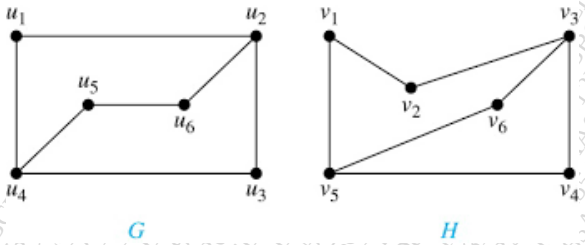
(b) Determine the Eulerian and Hamiltonian path/circuit, if any, in the following graphs. **6**





(c) Let G be the set of real numbers and let Let G be the set of real numbers and let $a * b = ab/2$. Showthat $(G,*)$ is a abelian group. **6**

6 (a) Determine whether following graphs are isomorphic **8**



(b) Use the laws of logic to determine the following expression as tautology or contradiction. **6**

$$[p \wedge (p \Rightarrow q)] \Rightarrow q$$

(c) Draw the Hasse Diagram of the following: **6**

a) D_{48} b) D_{105} c) D_{72}

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