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

N.B:
1) Question No. 1 is compulsory.
2) Attempt any three of the remaining.
3) Figures to the right indicate full marks.

1.
a) Find the Laplace transform of $te^{3t} \sin 4t$.   05
b) Find half-range cosine series for $f(x)=e^x$, $0<x<1$.   05
c) Is $f(z) = \frac{z}{\bar{z}}$ analytic?   05
d) Prove that $\nabla \times (\bar{a} \times \nabla \log r) = 2 \frac{(\bar{a}.\bar{r})\bar{r}}{r^4}$, where $\bar{a}$ is a constant vector.   05

2.
a) Find the Z-transform of $\frac{1}{(z-5)^3}$ if $|z|<5$.   06
b) If $V=3x^2y + 6xy-y^3$, show that V is harmonic & find the corresponding analytic function.   06
c) Obtain Fourier series for the function   08
$$f(x) = \begin{cases} 1 + \frac{2x}{\pi}, & -\pi \le x \le 0 \\ 1 - \frac{2x}{\pi}, & 0 \le x \le \pi \end{cases}$$
hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots$

3.
a) Find $L^{-1}\left[\frac{(s+2)^2}{(s^2+4s+8)^2}\right]$ using convolution theorem.   06
b) Show that the set of functions   06
$1, \sin\left(\frac{\pi x}{L}\right), \cos\left(\frac{\pi x}{L}\right), \sin\left(\frac{2\pi x}{L}\right), \cos\left(\frac{2\pi x}{L}\right), \dots$
Form an orthogonal set in $(-L, L)$ and construct an orthonormal set.
c) Verify Green's theorem for $\int_C (e^{2x} - xy^2) dx + (ye^x + y^2)dy$ 08

Where C is the closed curve bounded by $y^2 = x$ & $x^2 = y$.

4.
a) Find Laplace transform of $f(x) = K\frac{t}{T}$ for $0<t<T$ & $f(t) = f(t+T)$.   06
b) Show that the vector, $\bar{F} = (x^2 - yz)i + (y^2 - zx) j + (z^2 - xy) k$ is irrotational and hence, find ϕ such that $\bar{F} = \nabla \phi$.   06
c) Find Fourier series for $f(x)$ in $(0, 2\pi)$,   08
$$f(x) = \begin{cases} x, & 0 \le x \le \pi \\ 2\pi - x, & \pi \le x \le 2\pi \end{cases}$$
hence deduce that
$\frac{\pi^4}{96} = \frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \dots$

5.
a) Use Gauss's Divergence theorem to evaluate   06
$\iint_s \bar{N}.\bar{F}\, ds$ where $\bar{F} = 2xi + xyj + zk$ over the region bounded by the cylinder x^2
$+ y^2 = 4$, $z = 0$, $z = 6$.
b) Find inverse Z – transform of $f(x) = \frac{z}{(z-1)(z-2)}$, $|z| > 2$ 06

TURN OVER

c) (i) Find $L^{-1}\left[\log\left(\frac{s+1}{s-1}\right)\right]$ 08

(ii) Find $L^{-1}\left[\frac{s+2}{s^2-4s+13}\right]$

6. a) Solve $(D^2+3D+2)\ y = 2(t^2+t+1)$ with $y(0) = 2$ & $y'(0) = 0$.   06

b) Find the bilinear transformation which maps the points 0, i, -2i of z-plane onto   06
the points -4i, ∞, 0 respectively of w-plane. Also obtain fixed points of the
transformation.

c) Find Fourier sine integral of   08
$$f(x) = \begin{cases} x, & 0 < x < 1 \\ 2-x, & 1 < x < 2 \\ 0, & x > 2 \end{cases}$$

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

Note: Q. 1 is compulsory.
Attempt any **THREE** questions from **Q. 2 to Q. 6**

Q. 1 **a** Explain Java Virtual Machine.   [5]

   b Write a program to display factorial of given number. Take input from command   [5]
line arguments.

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

   d Explain Thread life cycle.   [5]

Q. 2 **a** Explain different ways to create Thread in JAVA with example.   [10]

   b Differentiate between method overloading and overriding. Write a program to   [10]
override **area()** method of **Shape** class into its subclasses **Rectangle** and **Square**.
Shape is an abstract class.

Q. 3 **a** Explain different types of relationships among the entities.   [10]
Define the relationships among the objects of given sentences:
   1) Manager is an Employee.
   2) Teacher teaches OOPM subject to students.
   3) Merry owns a car.
   4) Engine is a part of car.

   b Explain the steps to create package in JAVA to add class and interface with   [10]
example.

Q. 4 **a** Explain bitwise operators in JAVA.   [4]

   b Explain use of **final** keyword when it is prefix with variable, method and class.   [4]

   c Explain Cohesion and Coupling.   [4]

   d Write an applet program to display   [4]
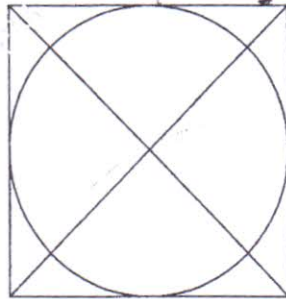
   e What is abstract class? Explain with example.   [4]

{TURNOVER

Q. 5   **a**   Explain exception handling mechanism with the help of **try, catch, throw, throws**   [7] and **finally**.

     b   Department of Computer Engineering wants to maintain record of books. If any   [8] new book is purchased then it is added to the list. Also if any book is damaged or misplaced it can be deleted from the list. Write a program to perform above operations and display list of books available in the department.

     c   Differentiate between String and StringBuffer class.   [5]

Q. 6   **a**   Explain inheritance and its types in JAVA.   [5]

     b   Explain wrapper class.   [5]

     c   Write a program to display sum of main diagonal elements of a matrix.   [5]

     d   Explain Applet lifecycle methods.   [5]

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(3 Hours)   Total Marks: 80

N.B.: (1) Question no. 1 is compulsory.
      (2) Attempt any 3 from the remaining questions.
      (3) Assume suitable data if necessary.
      (4) Figures to right indicate full marks.

1. a) Explain linear and non- linear data structure with example   05
   b) Write ADT for stack. Give application of stack.   05
   c) Explain practical applications of trees.   05
   d) What is file? Explain various file handling operations in C.   05

2. a) Write a program in C to perform Quick sort. Show steps with example.   10
   b) Explain Circular queue and Double ended queue with example.   10

3. a) Write a program to convert an expression from infix to postfix using stack.   10
   b) Write a function for BFS traversal of graph.   10

4. a) Write a program in C to create a singly linked list and perform the following   10
operations :
         (i) Insert into list
         (ii) Search for data
         (iii) Delete from list
         (iv) Display data.
   b) Insert the following elements in a AVL search tree: 10
       40, 23, 32, 84, 55, 88, 46, 71, 57
Explain different rotations used in AVL trees

5. a) Write a program to construct binary tree for the following pre-order and in-order   10
traversal sequences.
     Pre-Order : A B D G C E H I F
     In-Order : D G B A H E I C F
   b) What is hashing? What is mean by collision? Using modulo division method insert   10
the following values in a hash table of size 10. Show how many collisions occurred.
     99, 33, 23, 44, 56, 43, 19

6. Write short notes on any four of the following :-   20
     1. Huffman coding
     2. Iteration VS Recursion
     3. Various techniques of Graph representation
     4. Threaded binary tree
     5. Heap Sort

_____

(3 Hours) [Total Marks : 80]

N.B.
1) Question number 1 is compulsory.
2) Attempt any 3 questions from the remaining 5 questions.
3) Each question carries 20 marks.
4) Within a question, each sub-question carries equal marks.

1. a) Convert decimal number 151.33 into binary, base-4, octal, hexadecimal system.
   b) A 7 bit even parity hamming code is received as 1000010. Correct it for any errors & extract 4 bit data.
   c) Express the equation in standard SOP form: $F(A, B, C) = \Pi M (0, 2, 5, 7)$.
   d) Compare TTL & CMOS with respect to speed, power dissipation, fan-in & fan-out & also define these terms.
   e) Draw JK flip-flop using SR flip-flop & additional gates. Explain briefly the race around condition in JK flip-flop.

2. a) Simplify the following equation using K-map to obtain minimum SOP equation & realize the minimum equation using two level NAND gates only.
   $F(A, B, C, D) = \Pi M (1, 3, 4, 6, 9, 11, 12, 14)$
   b) What is Multiplexer? Implement the following function using 4:1 multiplexer and few gates.
   $F(A, B, C, D) = \Sigma m (0, 1, 2, 3, 6, 7, 9, 10, 13, 15)$

3. a) Reduce using Quine McClusky method & realize the equation using only NAND gates.
   $F(P, Q, R, S) = \Sigma m (0, 1, 2, 8, 10, 11, 14, 15)$
   b) Prove using boolean algebra: "NAND gate is universal gate".

4. a) Develop the truth table for 2-bit binary multiplier & design it using a suitable decoder & additional gates.
   b) Design MOD-7 synchronous up-counter. Show all the design steps.

5. a) Develop the truth table of 3 bit binary to gray code converter and design it by using 3:8 decoder with active low outputs & additional gates.

    b) Draw a circuit diagram for MOD-10 asynchronous binary up counter using master-slave JK flip-flops. Show the output of each of the flip-flop with respect to the clock applied, write the state transition table and explain the operation in brief.

6. a) What is shift register? Draw a 4-bit universal shift register & explain PISO & SIPO operations.

    b) Draw & explain the working of 4-bit twisted ring counter with timing diagram.

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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)　Consider the set A={1,2,3,4,5,6} under the multiplication modulo 7.　　08
　　　　　(i) Find the multiplication table for the above
　　　　　(ii) Find the inverse of 2,3 and 5,6
　　　　　(iii) Prove that it is a cyclic group
　　　　　(iv) Find the orders and the subgroups generated by {3,4} and {2,3}

　　(b)　Determine the number of integers between 1 and 250 that are divisible by　　06
　　　　　any of the integers 2,3,5 and 7.

　　(c)　Suppose that A is non empty set ,and f is a function that has A as it's　　06
　　　　　domain. Let R be the relation on A consisting of all ordered pairs (x, y)
　　　　　where f (x) =f (y). Show that R is an equivalence relation on A .

2.　(a)　Given S={1,2,3,4} and a Relation R on S given by　　08
　　　　　R = {(4,3),(2,2),(2,1),(3,1),(1,2)}
　　　　　(i) Show that R is not transitive
　　　　　(ii) Find transitive closure of R by Warshall's algorithm

　　(b)　Show that n (n^2 -1) is divisible by 24 ,where n is any odd positive integer.

　　(c)　Prove that a connected graph with n vertices must have at least n-1 edges.　　06
　　　　　Can a single undirected graph of 8 vertices have 40 edges excluding self　　06
　　　　　loop.

3.　(a)　Find the ordinary generating functions for the given sequences :　　08
　　　　　(i) {0,1,2,3,4, ... } (ii) {1,2,3,4, ... }
　　　　　(ii) {0,3,32 ,33, •••• } (iv){2,2,2,2, ... }

　　(b)　Functions f, g, h are defined on a set, X= {1,2,3}as [6]　　06
　　　　　f={(1,2),(2,3),(3,1)}. g ={(1,2),(2,1)(3,3)}. h ={(1,1),(2,2),(3,1)}.
　　　　　(i) Find f o g , go f, are they equal?
　　　　　(ii) Find f o go h and f o h o g

TURN OVER

(c) For each of the following sets of weights construct an optimal binary   06
prefix code. For each weight in the set give the corresponding code
word:

(i) 1,2,4,6,9,10,12 (ii) 10,11,14,16,18,21 (iii) 5,7,8,15,35,40.

4.   (a) Show that the (2,5) encoding function e: $B^2 \longrightarrow B^5$ defined by   08
e(00)=00000 e(01)=01110

e(10)=10101 e(11)=11011 is a group code .How many errors will it detect?   06

(b) Prove the following (A-B) U (B-A) =(A U B)- (A n B)

(c) Let T be the set of all even integers. Show that (Z,+) and (T,+) are   06
isomorphic.

5.   (a) Determine the matrix of the partial order of divisibility on the set   08
A = {1,3,5,15,30}. Draw the Hasse diagram of the poset. Indicate whether
it is a chain or not?

(b) Define Hamiltonian path and circuit with example . what is the necessary   06
and sufficient condition to exist Hamiltonian circuit?

(c) Find the solution of $a_{r+2} + 2a_{r+1} - 3a_r = 0$ that satisfies $a_0 = 1, a_1 = 2$ 06

6.   (a) Determine whether the following posets are Boolean algebras .Justify your   08
answers.

(i)A={1,2,3,6} with divisibility

(ii) D20: divisors of 20 with divisibility

(b) Define Universal and Existential quantifiers? Explain with examples.   06

(c) Prove that the set G = {0,1,2,3,4,5} is an Abelian group of order 6 with   06
respect to addition modulo 6.

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Q. P. Code : 540800

1

Time:-3 Hrs   **Marks: 80**

N.B. : 1. Question **ONE** is **compulsory**

2. Solve any **THREE** out of remaining questions

3. Draw neat and clean diagrams

4. Assume suitable data if required.

Q. 1.   A.Mention important specifications of ADC and DAC required for communication.   5

B. A difference amplifier is to be designed to amplify the difference between two voltages by a factor of 20. The inputs each approximately equal to 2V. Determine suitable resistor values for the circuit shown in fig.1 using a 741 opamp.   5
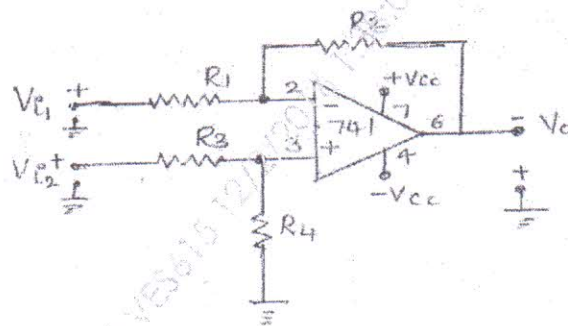

Fig.1

C. With neat block diagram explain how PLL can be used to generate large number of frequencies from a single reference frequency.   5

D. When a broadcast AM transmitter is 50% modulated, its antenna current is 12A. What will be the current, when the modulation depth is increased to 0.9?   5

Q.2   A. For the common source circuit shown in fig.2. Calculate the gate input impedance, the drain output impedance, the circuit input and output impedance and the voltage gain. Use the typical parameters for the FET.   10
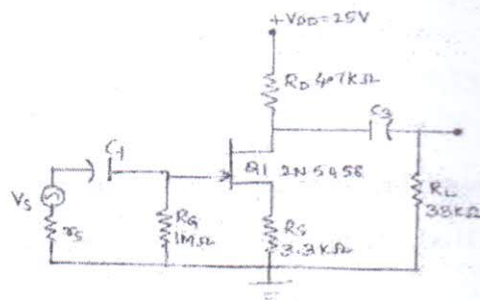
[TURN OVER]

fig 2.

B. With suitable waveforms explain how op-amp can be used differentiator.

Q. 3   A. Explain the concept of virtual ground in operational amplifier.

B. Compare Hartley and Colpitts Oscillator along with neat diagrams.

C. Compare various pulse modulation techniques.

D. Explain the mathematical model for JFET in various regions of operation.

Q. 4   A. Explain the generation of DSBSC using balanced modulator.

B. With neat diagram explain the operating principle of PLL and it's use as a phase shifter.

Q. 5   A. With neat diagram and waveforms, explain the principle of operation of super heterodyne receiver.

B. One input to a conventional AM modulator is a 500 KHz carrier with an amplitude of 20. The second input is 10 KHz modulating signal that is of sufficient amplitude to cause a change the output wave of ±7.5 Vp. Determine:

    (i) upper and lower side frequencies

    (ii) modulation coefficient and percentage modulation

    (iii) peak amplitude of the modulated carrier and upper and lower side frequency volt

    (iv) expression for the modulated wave

    (v) draw the output spectrum

Q. 6   A. Explain the detection of pulse code modulation

B. Discuss delta modulation and adaptive delta modulation.

C. Write short note on generation of FM by Armstrong method

D. Compare n-channel and p-channel JFET with respect to their device features and voltage current characteristics.