Duration: - 3 Hours Marks: 80 Marks

NB: - Question 1 is compulsory

Solve any three questions from the remaining.

1 a) Convert decimal number 576.24 into binary, base-9, octal, hexadecimal system. 04

b) Construct hamming code for 1010 using odd parity. 04

c) Convert $(-89)_{10}$ to its equivalent Sign Magnitude, 1's Complement and 2's Complement Form 04

d) Perform $(BC5)_H - (A2B)_H$ without converting to any other base 04

e) Prove De Morgans theorem 04

2a. Given the logic expression: $A + \overline{B}\overline{C} + AB\overline{D} + ABCD$ 10

1. Express it in standard SOP form.
2). Draw K-map and simplify.
3). Draw logic diagram using NOR gates only.

2b. Reduce using Quine McClusky method & realize the operation using only NAND gates. 10

$F(A,B,C,D) = \prod M(0, 2, 3, 6, 7, 8, 9, 12, 13)$.

3a. Design a 4-bit binary to gray code converter. 10

3b. Design a 4-bit BCD adder using IC 7483 and necessary gates. 10

4a. Implement the following logic function using all 4:1 multiplexers with the select inputs as 'B', 'C', 'D', 'E' only. 10

$F(A,B,C,D,E) = \sum m\,(0, 1, 2, 3, 6, 8, 9, 10, 13, 15, 17, 20, 24, 30)$

4b. Convert a SR flip flop to J K flip flop 10

5a. Design a mod-6 synchronous counter using T FF 10

5b. Explain the operation of 4-bit universal shift register. 10

6 Write short notes on any two 20

a. VHDL
b. TTL and CMOS logic families
c. 4-bit Magnitude comparator
d. 3 to 8 line decoder

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(3 Hours) [Total Marks: 80]

N.B (1) Question **No. 1** is **compulsory**.
(2) Solve any **three** questions out of remaining **five** questions.
(3) Assumptions made should be clearly stated.
(4) Figures to the right indicate full marks.

Q.1 (a) Two dice are rolled, find the probability that the sum is [6M]
(i)Equal to 1 (ii) Equal to 4 (iii) Less than 13

(b) Use the laws of logic to show that
$[(p \rightarrow q) \wedge \sim q] \rightarrow \sim p$ is a tautology [6M]

(c) Determine the matrix of the partial order of divisibility on the set A.Draw the Hasse diagram of the Poset.Indicate those which are chains [8M]
(1) A={1,2,3,5,6,10,15,30}
(2) A={3,6,12,36,72}

Q.2 (a) Find the complement of each element in D_{42}. [6M]

(b) Let Q be the set of positive rational numbers which can be expressed in the form $2^a 3^b$, where a and b are integers .Prove that algebraic structure (Q, .) is a group. Where . is multiplication operation. [6M]

(c) Define isomorphic graphs .Show whether the following graphs are isomorphic or not . [8M]

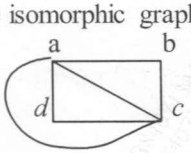

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Fig (a)

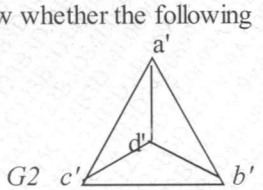
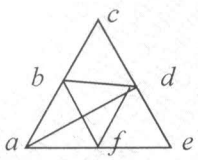
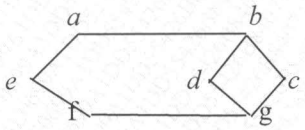


Fig (b)

Q.3 (a) Determine which of the following graph contains an Eulerian or Hamiltonian circuit. [6M]



Fig(a)



Fig(b)

(b) For all sets A, X and Y show that
$A \times (X \cap Y) = (A \times X) \cap (A \times Y)$ [6M]

(c) Let $f(x) = x+2$, $g(x) = x-2$ and $h(x) = 3x$ for $x \in R$,Where R= Set of real numbers. Find [8M]
$(g \circ f)$, $(f \circ g)$, $(f \circ f)$, $(g \circ g)$, $(f \circ h)$, $(h \circ g)$, $(h \circ f)$, $(f \circ h \circ g)$

Q.4 (a) Let R is a binary relation. Let $S = \{(a, b) \mid (a, c) \in R \text{ and } (c, b) \in R \text{ for some } c\}$ Show that if R is an equivalence relation then S is also an equivalence relation. [6M]

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(b) Determine the generating function of the numeric function a_r, where [6M]

(i) $a_r = 3^r + 4^{r+1}$, $r \geq 0$
(ii) $a_r = 5$, $r \geq 0$

(c) Consider the (3, 6) encoding function $e: B^3 \rightarrow B^6$ defined by [8M]
e(000)= 000000 e(001)= 001100 e(010)= 010011 e(011)= 011111
e(100)= 100101 e(101)= 101001 e(110)= 110110 e(111)= 111010
Decode the following words relative to a maximum likelihood decoding function.
(i) 000101 (ii) 010101

Q.5 (a) Determine the number of positive integers n where $1 \leq n \leq 100$ and n is not divisible by 2, 3 or 5. [6M]

(b) Use mathematical induction to show that [6M]
$1+5+9+\ldots\ldots\ldots+(4n-3) = n(2n-1)$

(c) Find the greatest lower bound and least upper bound of the set {3, 9, 12} and {1, 2, 4, 5, 10} if they exists in the poset (z+, /).Where / is the relation of divisibility. [8M]

Q.6 (a) Let A= {1,2,3,4}and Let R = {(1,1) (1,2) (1,4) (2,4) (3,1) (3,2) (4,2) (4,3) (4,4)} .Find transitive closure by Warshall's algorithm. [6M]

(b) Let H= $\{[0]_6, [3]_6\}$ find the left and right cosets in group Z_6. Is H a normal subgroup of group of Z_6. [6M]

(c) Find the complete solution of the recurrence relation [8M]
$a_n + 2a_{n-1} = n+3$ for $n \geq 1$ and with $a_0 = 3$

Q. P. Code : 26300

(3 Hours) **(Total 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. Explain the concept and significance of CMRR and Slew Rate in case of op-amps. **5**

B. Given β=120 and I_E= 3.2 mA for a common-emitter configuration with r_0=∞ Ω, determine:

(a) Z_i

(b) A_v if a load of 2 kΩ is applied.

(c) A_i with the 2 kΩ load. **5**

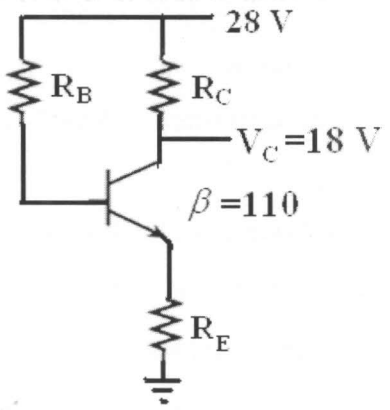
C. Discuss the factors that influence modulation index of an FM wave. **5**

D. Justify that adaptive delta modulation superior to delta modulation. **5**

Q. 2 A. The emitter bias configuration as shown in following figure has the specifications:

$I_{CQ} = \frac{1}{2} I_{Csat}$ $I_{Csat} = 8\,mA$ $V_C = 18\,V$ and $\beta = 110$

Determine R_C, R_E and R_B. **10**



B. Explain how op-am can be used comparator and zero crossing detector. **10**

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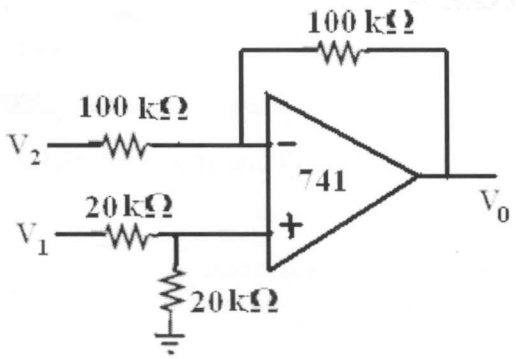
Q. 3 A. What is the source of the leakage current in a transistor?
If the emitter current of a transistor is 8 mA and I_B is 1/100 of I_C, determine the levels of I_C and I_B. **5**

B. Draw and explain Colpitts oscillator. **5**

C. Explain principle of FDM. **5**

D. Determine the output voltage for the circuit if V_1=5V and V_2=3V



5

Q. 4 A. What is DSBSC wave and explain its generation using balanced modulator. **10**

B. What is multiplexing in communication system? Draw block diagram of TDM-PCM system and explain. **10**

Q. 5 A. State Shannon's theorem on channel capacity.
What is the maximum capacity of a perfectly noiseless channel whose bandwidth is 120 Hz, in which the values of the data transmitted may be indicated by any one of the 10 different amplitudes? **10**

B. With respect to neat diagram explain the elements of analog communication system. **10**

Q. 6 A. What is meant by Nyquist rate in sampling and explain its significance. **5**

B. Give the proper definition for entropy and information rate. **5**

C. Write short note on op-amp as differentiator. **5**

D. Differentiate between Class A and Class C power amplifiers with respect to circuit diagram, operating cycle and power efficiency. **5**

Time : 3 hrs **Marks : 80**

NB 1. Question No.I is compulsory
2. Attempt any three from the remaining six questions
3. Figures to the right indicate full marks

Q1a If Laplace transform of $erf(\sqrt{t}) = \frac{1}{s\sqrt{s+1}}$, then find $L\{e^t.erf(2\sqrt{t})\}$ [20]

b Find the Orthogonal Trajectory of the family of curves given by $e^{-x}.\cos y + x.y = c$

c Find Complex Form of Fourier Series for . e^{2x} ; $0 < x < 2$

d. If the two regression equations are $5x - 6y + 90 = 0$, $15x - 8y - 180 = 0$,

find the means of x and y, the Correlation Coefficient and Standard deviation of x if variance of Y is 1

Q2 Show that the function is Harmonic and find the Harmonic Conjugate $v = e^x.\cos y + x^3 - 3xy^2$ [6]

b Find Laplace Transform of $f(t) = \begin{cases} t & ; 0<t<1 \\ 0 & ; 1<t<2 \end{cases}$, $f(t+2) = f(t)$ [6]

c. Find Fourier Series expansion of $f(x) = x - x^2, -1 < x < 1$ [8]

Q3 a Find the Analytic function $f(z) = u + iv$ if $v = \log(x^2 + y^2) + x - 2y$ [6]

b Find Inverse Z transform of $\frac{3z^2 - 18z + 26}{(z-2)(z-3)(z-4)}$, $3 < |z| < 4$ [6]

c Solve the Differential Equation $\frac{d^2y}{dt^2} + 4y = f(t), f(t) = H(t-2), y(0) = 0, y'(0) = 1$ using Laplace Transform [8]

Q4 a Find $Z\{f(k) * g(k)\}$ if $f(k) = \left(\frac{1}{2}\right)^k, g(k) = \cos \pi k$ [6]

b Find the Spearman's Rank correlation coefficient between X and Y. [6]

X	60	30	37	30	42	37	55	45
Y	50	25	33	27	40	33	50	42

c Find the inverse Laplace transform of i) $\frac{3s+1}{(s+1)^4}$ ii) $\frac{e^{4-3s}}{(s+4)^{5/2}}$ [8]

Q5 a Find Inverse Laplace Transform usng Convolution theorem $\frac{1}{(s-4)^2(s+3)}$ [6]

b Show that the functions $f_1(x)=1$, $f_2(x)=x$ are Orthogonal on (-1,1). Determine the constants a, b such that the function $f(x)=-1+ax+bx^2$ is Orthogonal to both $f_1(x), f_2(x)$ on the (-1,1) [6]

c Find the Laplace transform of i) $e^{-3t}\int_0^t t\sin 4t\,dt$ ii) $\int_0^\infty \frac{e^{-t}-e^{-2t}}{t}dt$ [8]

Q6 a Fit a second degree parabola to the given data [6]

X	1	1.5	2	2.5	3	3.5	4
Y	1.1	1.3	1.6	2	2.7	3.4	4.1

bFind the image of $\left|z-\frac{5}{2}\right|=\frac{1}{2}$ under the transformation $w=\frac{3-z}{z-2}$ [6]

c Find Half Range Cosine Series for $f(x)=x\sin x$ in $(0,\pi)$ and hence find $\frac{1}{1.3}-\frac{1}{3.5}+\frac{1}{5.7}-\ldots\ldots=\frac{\pi-2}{4}$ **[8]**

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