

(3 Hours)

[Total 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** but **justify** your assumptions.(4) **Figures** to the **right** indicate **full** marks.

1. (a) Explain linear and non-linear data structures with examples. 5
 (b) Explain various techniques of graph representations. 5
 (c) Write a 'C' program to convert decimal to binary using any appropriate data structure you have studied. 7
 (d) Define ADT with an example. 3
2. (a) What is Huffman Coding. Construct the Huffman Tree and determine the code for the following characters whose frequencies are as given :- 10

Characters	A	B	C	D	E
Frequency	20	10	10	30	30

- (b) Write a program in 'C' to evaluate a postfix expression. 10
3. (a) Write a program in 'C' to implement a circular queue. The following operations should be performed by the program :- 12
- Creating the queue.
 - Deleting from the queue.
 - Inserting in the queue.
 - Displaying all the elements of the queue.
- (b) Sort the following elements using Radix Sort :- 8
- 121, 70, 965, 432, 12, 577, 683.

What is the limitations of Radix Sort?

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4. (a) Write a 'C' program to create a "Single Linked List" ADT. The ADT should support the following functions :- **12**
- (i) Creating a Linked List.
 - (ii) Inserting a node after a specific node.
 - (iii) Deleting a node.
 - (iv) Displaying the list.
- (b) Explain various graph traversal techniques with examples. **8**
5. (a) Discuss AVL trees. Insert the following elements in a AVL search tree :- **10**
- 27, 25, 23, 29, 35, 33, 34
- (b) Using linear probing and quadratic probing insert the following values in a hash table of size 10. Show how many collisions occur in each technique :- **10**
- 99, 33, 23, 44, 56, 43, 19
6. (a) Explain indexed sequential search with a suitable example. What are the advantages and disadvantages of indexed sequential search? **10**
- (b) Write a program in 'C' for deletion of a node from a Binary Search Tree. The program should consider all the cases. **10**

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- N. B. :** (1) Question No. 1 is **compulsory**.
 (2) Solve any **three** questions from the remaining.
 (3) **All** questions carry **equal** marks—(20)
 (4) **Figures** to the **right** indicate **Marks**.
 (5) Assume suitable data if required.

1. (a) State De-morgan's Theorems. Convert the following $(761.514)_8$ to binary and hexadecimal 5
 (b) Subtract the following using method given below: 5
 (i) $(11)_{10} - (22)_{10}$ using 2's complement.
 (ii) $(33)_{10} - (44)_{10}$ using one's complement.
 (c) Write short note on Ring Counter using 'D' FF. 5
 (d) Compare FPGA and CPLD. 5
2. (a) Perform the following directly without converting to any other base. 5
 (i) $(63)_8 * (21)_8$
 (ii) $(D9)_H - (80)_H$
 (b) (i) Simplify the Boolean expression 5
 $Y = \overline{A}BC + A\overline{B}C + AB\overline{C} + ABC$
 (ii) Express it in standard POS Form
 $Y = (A + B)(A + C)(B + \overline{C})$
 (c) Simplify the logic function using k-map 5
 $f(A, B, C, D) = \sum m(4, 5, 6, 7, 8, 10, 12) + d(2, 9, 11)$
 Draw the logic diagram using NAND gates only.
 (d) Explain Astable multivibrator using op-amp with neat waveforms. 5
3. (a) Design a sequence generator to generate the sequence using 'D' FF 1101001 and repeat. Draw neat state diagram and ckt. diagram. 10
 (b) Implement the following logic function using all 4:1 multiplexers with select inputs as 'B', 'C', 'D', 'E' only 10
 $F(A, B, C, D, E) = \sum m(0, 1, 2, 3, 6, 8, 9, 10, 13, 15, 17, 20, 24, 30)$
4. (a) Explain 3 bit Bidirectional shift register using JK Flip Flop. Draw the neat waveforms. 10
 (b) What is FPGA. Explain basic architecture. What are its advantages over CPLD. 10
5. (a) Design Full adder using 3:8 decoder with active low outputs and NAND gates. 5
 (b) Use Quine Mc-Cluskey method to simplify the logic function as given below. 15
 $F(A, B, C, D, E) = \sum m(0, 1, 8, 10, 11, 12, 20, 21, 30) + d(14, 19)$
 Realize the above function using NAND gates.
6. (a) Design mod-10 synchronous counter using JK Flip Flops. Check for the lock out condition. If so, how the lock-out condition can be avoided? Draw the neat state diagram and circuit diagram with Flip Flops. 15
 (b) Explain the transfer characteristics of TTL NAND gate and hence define Fan-in and Fan out. 5

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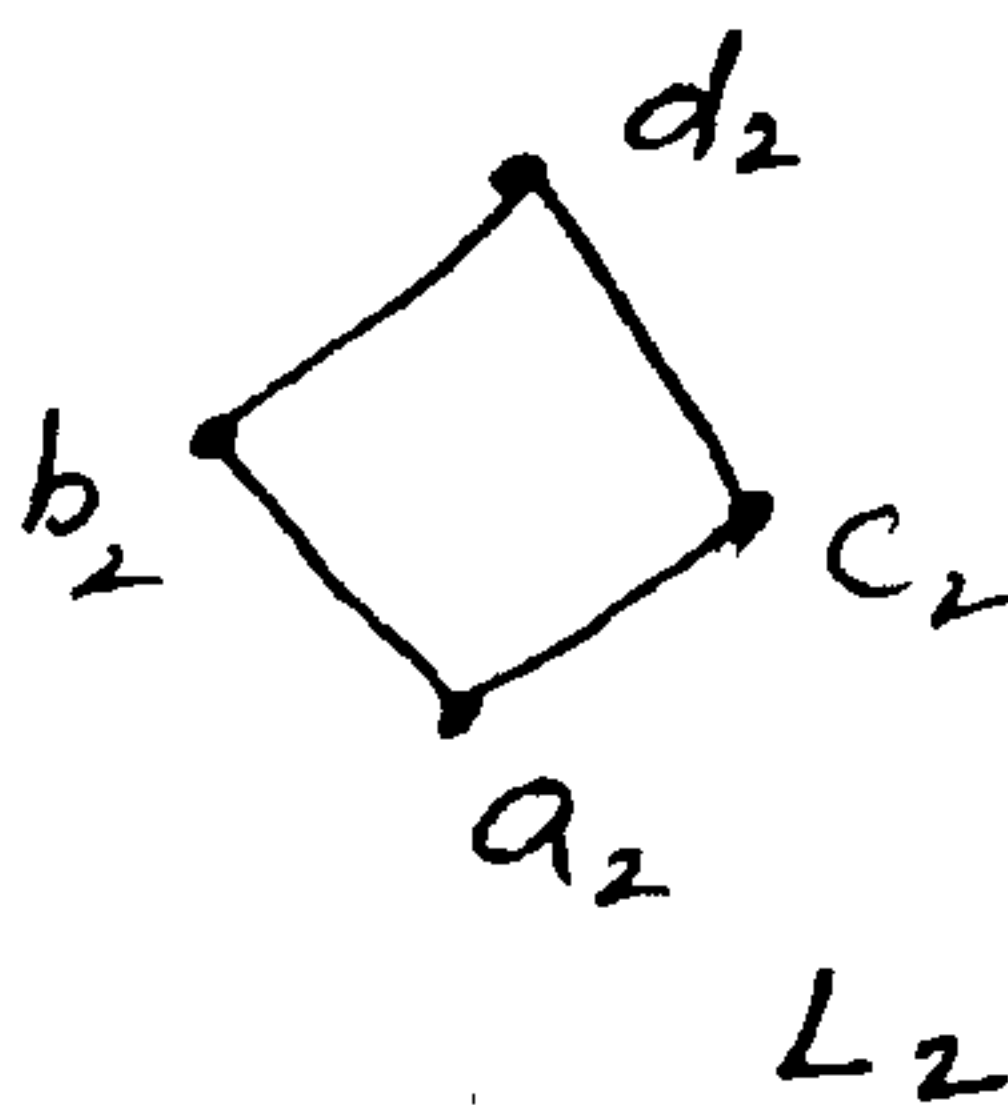
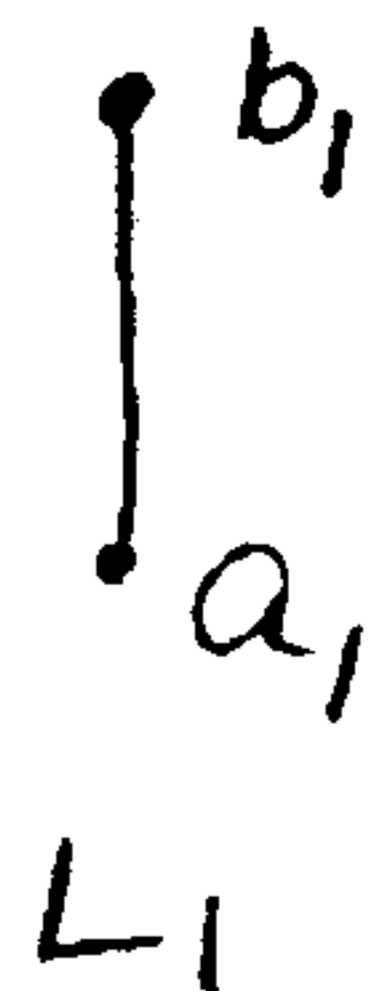
[Total Marks : 80]

N.B. : (1) Question no. 1 is compulsory.(2) Attempt any **three** questions out of remaining **four** questions.

(3) Assumptions made should be clearly stated.

(4) **Figures** to the **right** indicate **full** marks.(5) Assume suitable data wherever **required** and justify it.

1. (a) Prove that in a full binary tree with n vertices, the number of pendant vertices is $(n + 1) / 2$. 4
- (b) Let G be the set of rational numbers other than 1. Let define an operation $*$ on G by $a * b = a + b - ab$ for all $a, b \in G$. Prove that $(G, *)$ is a group. 6
- (c) Find the number of integers between 1 and 1000 which are 5
 (i) Divisible by 2, 3 or 5.
 (ii) Divisible by 3 only but not by 2 nor by 5.
- (d) Find all solutions of the recurrence relation 5
 $a_n = 5a_{n-1} + 6a_{n-2} + 7^n$
2. (a) Prove by mathematical induction $x^n - y^n$ is divisible by $x - y$. 4
- (b) Let m be the positive integers greater than 1. Show that the relation $R = \{(a, b) \mid a \equiv b \pmod{m}\}$, i.e. aRb if and only if m divides $a-b$, is an equivalence relation on the set of integers. 6
- (c) Let $s = \{1, 2, 3, 4\}$ and $A = S \times S$. Define the following relation :- 6
 R on A : $(a, b) R (a', b')$ if and only if $a + b = a' + b'$.
 (i) Show that R is an equivalence relation.
 (ii) Compute A/R .
- (d) If $f : A \rightarrow B$ be both one-to-one and onto, then prove that $f^{-1} : B \rightarrow A$ is also both one-to-one and onto. 4
3. (a) Consider an equilateral triangle whose sides are of length 3 units. If ten points are chosen lying on or inside the triangle, then show that at least two of them are no more than 1 unit apart. 5
- (b) Let L_1 and L_2 be lattices shown below :- 7

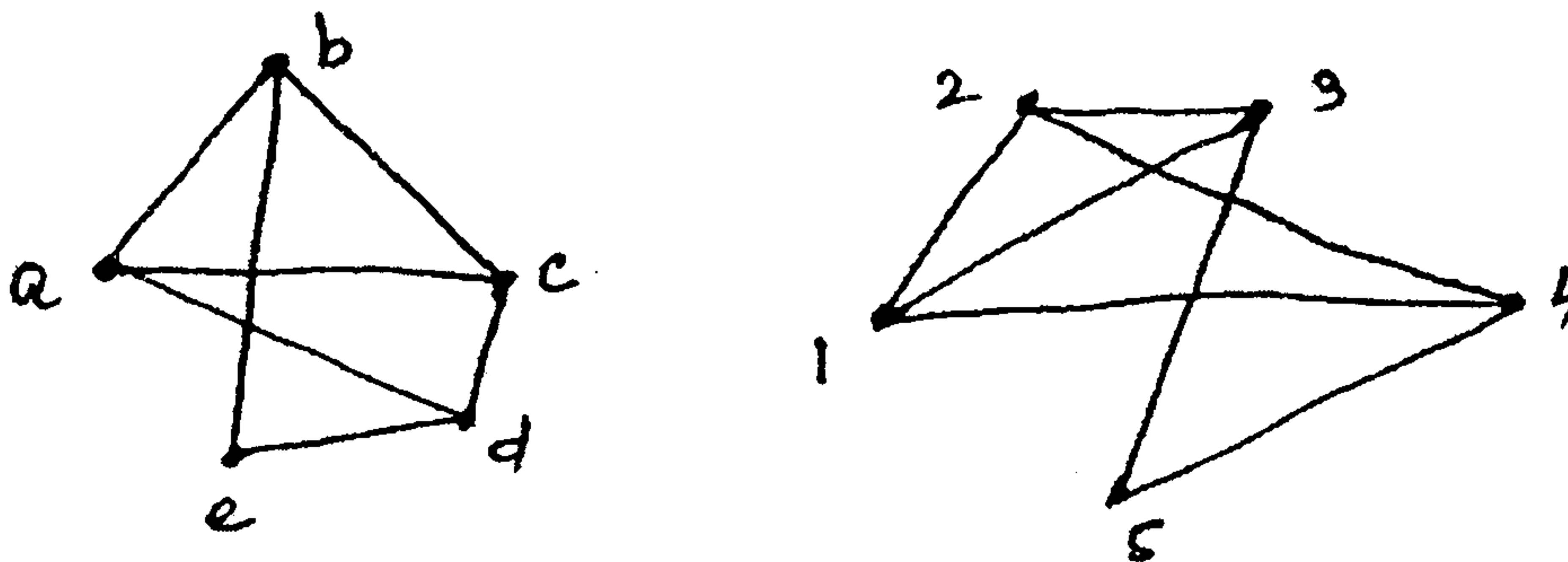
Draw the Hasse diagram of $L_1 \times L_2$ with product partial order.

- (c) Let $A = \{a, b, c\}$. Show that $(P(A), \subseteq)$ is a poset. Draw its Hasse diagram. $P(A)$ is the power set of A . 4
- (d) How many vertices are necessary to construct a graph with exactly 6 edges in which each vertex is of degree 2. 4

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4. (a) Show that if every element in a group is its own inverse, then the group must be abelian. 4
- (b) If $(G, *)$ is an abelian group, then for all $a, b \in G$, prove that by mathematical induction $(a * b)^n = a^n * b^n$. 5
- (c) If f is a homomorphism from a commutative group $(S, *)$ to another group $(T, *')$, then prove that $(T, *')$ is also commutative. 4
- (d) Consider the $(3, 5)$ group encoding function 7
 $e : B^3 \rightarrow B^5$ defined by
 $e(000) = 00000$ $e(100) = 10011$
 $e(001) = 00110$ $e(101) = 10101$
 $e(010) = 01001$ $e(110) = 11010$
 $e(011) = 01111$ $e(111) = 11100$
 Decode the following words relative to a maximum likelihood decoding function.
 (i) 11001 (ii) 01010 (iii) 00111

5. (a) Find the generating function for the following sequence 5
 1, 2, 3, 4, 5, 6,
- (b) Solve the recurrence relation $a_r = 3a_{r-1} + 2$, $r \geq 1$ with $a_0 = 1$, using generating function. 6
- (c) Show that the following graphs are isomorphic 5



- (d) Use the laws of logic to show that 4
 $[(p \Rightarrow q) \wedge \neg q] \Rightarrow \neg p$
 is a tautology
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[Total Marks : 80

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

(2) Attempt any three from remaining.

1. (a) Write a Program in Java to find ${}^n C_r$ and ${}^n P_r$. 5
- (b) What are the applications of wrapper classes? Explain. 5
- (c) Write an applet program to draw circle rectangle and line. 5
- (d) Write a detail note on System · arraycopy (). 5

2. (a) Assume that a bank maintains two kinds of accounts for customers, one called as savings account and the other as current account. The savings account provides compound interest and withdrawal facilities but no cheque book facility. The current account provides cheque book facility but no interest. Current account holders should also maintain a minimum balance and if the balance falls below this level, a service charge is imposed. 8
 Class account stores customer name, account number, and the type of account. Include member functions :-
 - Accept deposit from a customer and update the balance.
 - Display the balance.
 - Compute and deposit interest.
 - Permit withdrawal and update balance.
 - Check for minimum balance, impose penalty and update the balance.
 Draw class diagram for above senario.
- (b) For above problem statement, implement class account, current account and savings account. 8
- (c) Exam association and aggregation with suitable example. 4

3. (a) Write a program to display area of square and rectangle. Make use of interface to define templates of methods to be there in the derive classes. 10
- (b) With the help of suitable example explain multithreading in terms of following:- 10
 - (i) Creating threads, extending the thread class.
 - (ii) Life-cycle of thread.

4. (a) Write a detailed note on exception handling in terms of following :- 10
 - (i) Try-catch.
 - (ii) Finally keyword.
 - (iii) Cathing multiple exception.
 - (iv) Throwing exception.
- (b) Write a java program to find out no. of uppercase and lowercases characters, blank spaces and digits and special characters from string. 10

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5. (a) Write an interactive program to create a vector object and populate it with names of cities. Program should display and implement following menu choices :- **7**
- Add city : if city name already exists in the vector then program should display appropriate message.
 - Remove city : If city does not exists in vector then program should display appropriate message.
 - Display all : should display contents of vector.
- (b) Compare and contrast overriding method and overloading method with suitable examples. **8**
- (c) Draw a sequence diagram that shows the interaction between caller, customer and creditcard for the statement "Customer uses a credit card for doing the payment". **5**
6. Write a short notes on (any **four**) :- **20**
- (a) JVM.
 - (b) Abstract methods and classes.
 - (c) Method overloading.
 - (d) Package.
 - (e) Static data, member and methods.
 - (f) Difference between C++ and Java.
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S.E. Comp & I.T. Sem III

CBQS Nov. 13

25/11/13

Sub - A.M. III

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Con. 7854-13.

GX-12040

(3 Hours)

[Total Marks : 80

- N. B. : (1) Question No. 1 is compulsory.
 (2) Answer any three questions from Q. 2 to Q. 6.
 (3) Each question carry equal marks.
 (4) Non-programmable calculator is allowed.

1. (a) Find $L^{-1} \left\{ \frac{e^{4-3s}}{(s+4)^{5/2}} \right\}$ 9 5

(b) Find the constant a, b, c, d and e If. 5

$f(z) = (ax^4 + bx^2y^2 + cy^4 + dx^2 - 2y^2) + i(4x^3y - exy^3 + 4xy)$ is analytic.

(c) Obtain half range Fourier cosine series for $f(x) = \sin x$, $x \in (0, \pi)$. 5

(d) If r and \bar{r} have their usual meaning and a is constant vector, prove that 5

$$\nabla \times \left[\frac{a \times \bar{r}}{r^n} \right] = \frac{(2-n)}{r^n} a + \frac{n(a \cdot \bar{r}) \bar{r}}{r^{n+2}}$$

2. (a) Find the analytic function $f(z) = u + iv$ If $3u + 2v = y^2 - x^2 + 16xy$. 6

(b) Find the z - transform of $\{a^{|k|}\}$ and hence find the z - transform of $\left\{ \left(\frac{1}{2} \right)^{|k|} \right\}$ 6

(c) Obtain Fourier series expansion for $f(x) = \sqrt{1 - \cos x}$, $x \in (0, 2\pi)$ and hence 8

deduce that $\sum_{n=1}^{\infty} \frac{1}{4n^2 - 1} = \frac{1}{2}$.

3. (a) Find :-

(i) $L^{-1} \left\{ \frac{s}{(2s+1)^2} \right\}$ 3

(ii) $L^{-1} \left\{ \log \frac{s^2 + a^2}{\sqrt{s+b}} \right\}$ 3

(b) Find the orthogonal trajectories of the family of curves $e^{-x} \cos y + xy = \alpha$ 6
 where α is the real constant in xy - plane.

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(c) Show that $\vec{F} = \left(y e^{xy} \cos z \right) \mathbf{i} + \left(x e^{xy} \cos z \right) \mathbf{j} - \left(e^{xy} \sin z \right) \mathbf{k}$ is irrotational and 8

find the scalar potential for \vec{F} and evaluate $\int_c \vec{F} \cdot d\mathbf{r}$ along the curve joining the points $(0, 0, 0)$ and $(-1, 2, \pi)$.

4. (a) Evaluate by Green's theorem. $\int e^{-x} \sin y dx + e^{-x} \cos y dy$ where c is the rectangle 6

whose vertices are $(0, 0)$, $(\pi, 0)$, $(\pi, \frac{\pi}{2})$ and $(0, \frac{\pi}{2})$.

(b) Find the half range sine series for the function. 6

$$f(x) = \frac{2kx}{l}, \quad 0 \leq x \leq \frac{l}{2}$$

$$= \frac{2k}{l}(l-x), \quad \frac{l}{2} \leq x \leq l$$

(c) Find the inverse z-transform of $\frac{1}{(z-3)(z-2)}$ 8

(i) $|z| < 2$

(ii) $2 < |z| < 3$

(iii) $|z| > 3$.

5. (a) Solve using Laplace transform. $\frac{d^2 y}{dx^2} + 4 \frac{dy}{dx} + 3y = e^{-x}$, $y(0) = 1$, $y'(0) = 1$. 6

(b) Express $f(x) = \frac{\pi}{2} e^{-x} \cos x$ for $x > 0$ as Fourier sine integral and show that 6

$$\int_0^{\infty} \frac{w^3 \sin wx}{w^4 + 4} dw = \frac{\pi}{2} e^{-x} \cos x.$$

(c) Evaluate $\iiint_s \vec{F} \cdot \mathbf{n} ds$, where $\vec{F} = x\mathbf{i} - y\mathbf{j} + (z^2 - 1)\mathbf{k}$ and s is the cylinder formed 8

by the surface $z = 0$, $z = 1$, $x^2 + y^2 = 4$, using the Gauss - Divergence theorem.

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6. (a) Find the inverse Laplace transform by using convolution theorem. 6

$$L^{-1} \left\{ \frac{s^2 + 2s + 3}{(s^2 + 2s + 5)(s^2 + 2s + 2)} \right\}.$$

(b) Find the directional derivative of $\phi = 4e^{2x - y + z}$ at the point $(1, 1, -1)$ in the direction towards the point $(-3, 5, 6)$. 6

(c) Find the image of the circle $x^2 + y^2 = 1$, under the transformation $w = \frac{5 - 4z}{4z - 2}$. 8

(3 Hours)

[Total Marks : 80

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

(2) Solve any three questions out of the remaining questions.

(3) Draw neat and clean diagrams.

(4) Assume any suitable data required.

1. (a) What do you understand by "Pinch off" voltage and "cut off" voltage as applied to FET? 5
- (b) With neat block diagram explain how PLL can be used to generate large number of frequencies from a single reference frequency. 5
- (c) For an FM radio receiver, when the consumer changes the channel, the oscillator frequency changes. The frequency of radio signal coming out of the mixer will be always be 10.7 MHz regardless of the channel selected. If the oscillator frequency is 99.2 MHz. What is the frequency of station selected? If a Hartley tuned oscillator is being used with a variable capacitor in the LC tank circuit, what is the value of capacitance if the total inductance is $2.5\mu\text{H}$. 5
- (d) Optical sensor of a package counting system create 1.5 V DC signal when it detects the seal. This voltage need to be amplified and sent to a controller with an input resistance of $5\text{K}\Omega$. Draw block diagram for the system. Choose correct amplifier to drive this low resistance load and select the resistor values to set the gain. The input voltage range for the controller is +10V to +30V DC. 5
2. (a) Determine the V_{GSQ} , I_{DQ} and V_{DSQ} and A_V for a voltage divider circuit with $V_{DD} = 18\text{V}$, $R_D = 2.2\text{K}$, $R_1 = 2.1\text{M}$, $R_2 = 330\text{K}$ and $R_S = 1.2\text{K}$, $I_{DSS} = 10\text{mA}$, $V_P = -8\text{V}$ and $V_{DS} = 40\mu\text{s}$. 10
- (b) Explain how Op-Amp can be used as a summing, scaling and averaging amplifier in the inverting configuration. 10
Inverting configuration
3. (a) Sketch an op-amp integrating circuit together with the circuit waveforms. Explain in brief the circuit operation. 5
- (b) Explain the fly wheel effect in class c amplifier. 5
- (c) Explain why crystal oscillators are considered to be more stable than other oscillators. 5
- (d) Compare different biasing circuits with respect to Q-point? Comment on which biasing circuit is better in stability. 5
4. (a) Draw the block diagram of a phase cancellation SSB generation and explain how the carrier and unwanted side band are suppressed. What change is necessary to suppress the other side band. 10
cancellation
- (b) Draw foster Seeley Discriminator with circuit diagram and explain its working with phasor diagrams. 10

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5. (a) What is multiplexing in communication system? Draw block diagram of TDM-PCM system and explain? **10**
- (b) One input to a conventional AM modulator is a 500 KHz carrier with an amplitude of $20 V_p$. The second input is a 10 KHz modulating signal that is of sufficient amplitude to cause a change in the output wave of $\pm 7.5V_p$. Determine **10**
- (i) Upper and lower side frequencies
 - (ii) Modulation coefficient and percent modulation
 - (iii) Peak amplitude of the modulated carrier and upper and lower side frequency voltages
 - (iv) Expression for the modulated wave
 - (v) Draw the output spectrum.
6. (a) What are the drawbacks of ^{Delta}Data modulation and how are they overcome by ADM? **5**
- (b) Explain in brief the principle of super heterodyne receiver? **5**
- (c) Compare PAM, PPM & PWM. **5**
- (d) What is meant by Nyquist rate in sampling? What is standard frequency for speech signal. **5**
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