

(3 Hours)

Marks: 80

Note: 1. Question no. 1 is compulsory.

2. Attempt any **three** questions out of remaining **five** questions.

Q.1.[a] Determine the constants a, b, c, d so that the function [5]

$f(z) = x^2 + axy + by^2 + i(cx^2 + dxy + y^2)$ is analytic.

[b] Let $A = \{1, 2, 3, 4\}$, $B = \{1, 2, 3, 4\}$ and " aRb if and only if a is not [5]

equal to b". Find R and its digraph.

[c] For the sets A, B, C given that $A \cap B = A \cap C$ and $\bar{A} \cap B = \bar{A} \cap C$. Is [5]
 it necessary that $B = C$? Justify.

[d] Find Laplace transform of [5]

$$f(t) = t \text{ for } 0 < t < 1$$

$$= 0 \text{ for } 1 < t < 2, f(t+2) = f(t).$$

Q.2.[a] 75 Children went to an amusement park where they can ride on [6]

the merry-go-round, roller coaster and ferris wheel. It is known that 20 of them have taken all 3 rides, and 55 of them have taken at least two of the 3 rides. Each ride costs 0.50 Rs and the total receipt of the amusement park was 70 Rs. Determine the number of children who did not try any of the rides.

[b] Evaluate [6]

$$\int_0^{\infty} t e^{-3t} J_0(4t) dt = \frac{3}{125} \text{ if } L\{J_0(t)\} = \frac{1}{\sqrt{s^2 + 1}}.$$

[c] (i) Functions f, g and h are defined as follows : [4]

$$f: \mathbb{R} \rightarrow \mathbb{R}, g: \mathbb{R} \rightarrow \mathbb{R}, h: \mathbb{R} \rightarrow \mathbb{R}, f(x) = x + 4, g(x) = x - 4$$

$$h(x) = 4x \text{ for } x \in \mathbb{R}, \text{ where } \mathbb{R} \text{ is the set of real numbers.}$$

Compute $f \circ g$; $g \circ f$; $f \circ g \circ h$; $h \circ h$.

(ii) Show that using Venn diagram $P \cap (Q - R) = (P \cap Q) - (P \cap R)$. [4]

Q.3.[a] If $f(z)$ and $|f(z)|$ are both analytic then show that $f(z)$ is constant. [6]

[b] Let R be a binary relation on the set of positive integers such that [6]

$R = \{(a, b) / a - b \text{ is an odd positive integer}\}$. Is R reflexive?

Symmetric? Antisymmetric? Transitive? An equivalence relation?

A partial ordering set?

[c] Evaluate (i) $L[te^{3t} \sin 4t]$ (ii) $L\left[\int_0^t \int_0^t \int_0^t t \sin t dt dt dt\right]$ [8]

Q.4. [a] Evaluate using Convolution theorem $L^{-1}\left[\frac{(s+2)}{(s^2+4s+8)^2}\right]$ [6]

[b] Find the transitive closure of R where R be the relation [5]

represented by
$$\begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

[c] Find analytic function $f(z) = u + iv$ where $v = e^x(x \sin y + y \cos y)$. [8]

Q.5.[a] Solve $\frac{dy}{dt} + 2y + \int_0^t y dt = \sin t$ with $y(0) = 1$. [5]

[b] Find bilinear transformation which maps the points $z = 1, i, -1$ onto $w = 0, 1, \infty$. Further show that under this transformation the unit circle in w plane is mapped onto a straight line in the z plane.

[c] In a bolt factory machines A, B, and C manufacture respectively 25%, 35% and 40% of the total. Of their output 5, 4, 2 percent are defective bolts. A bolt is drawn at random from the product and is found to be defective. What are the probabilities that it was manufactured by machines A, B and C? [8]

Q.6. [a] It is known that at the university 60% of the professors play tennis, 50% of them play bridge, 70% jog, 20% play tennis and bridge, 30% play tennis and jog, 40% play bridge and jog. If someone claimed that 20% of the professors jog and play bridge and tennis, would you believe this claim? Why? [6]

[b] Suppose repetitions are not permitted. [6]

(i) How many four-digit numbers can be formed from the digits 1, 2, 3, 5, 7, 8?

(ii) How many of the numbers in part (a) are less than 4000?

(iii) How many of the numbers in part (a) are odd?

(iv) How many of the numbers in part (a) are multiples of 5?

[c] Evaluate (i) $L^{-1}[2 \tanh^{-1} s]$ (ii) $L^{-1}\left[\frac{e^{4-3s}}{(s+4)^{\frac{5}{2}}}\right]$ [8]

Principles of Communication

Q. P. Code: 35136

Time: 3 hours

Total Marks : 80

- N.B. (1). Question No.1 is compulsory.
 (2). Out of remaining attempt any three.
 (3). Assume & mention suitable data wherever required.
 (4). Figures to right indicates full marks.

Q1 Write any **four** of the following

20

- Explain pre-emphasis & de-emphasis
- Explain shot noise & transit time noise in brief
- State drawbacks of delta modulation system & how it is removed
- Explain principles of Sky wave propagation in brief.
- State and prove differentiation property in time domain of Fourier transform

Q2

- Explain PWM generation & degeneration method in detail
- Explain PCM Encoder & PCM decoder with block diagram

10

10

Q3

- a) a sinusoidal carrier has an amplitude of 10 V & a frequency of 100 KHz. It is amplitude Modulated by a sinusoidal voltage of amplitude 3V & a frequency of 500 Hz. Modulated Voltage is developed across 75 Ω .

- Write the equation of modulated wave
- Determine modulation index
- Calculate total average power
- Power carried by sidebands
- Spectrum of modulated wave

10

- b) Explain in detail indirect method of generation of FM with suitable diagram

10

Q4

- What is multiplexing in communication system? Draw and explain transmitter and Receiver of FDM
- Explain with reference to AM receiver (i) fidelity (ii) selectivity (iii) sensitivity
 iv) Image frequency and its rejection. (v) Double spotting

10

10

Q5

- a) Draw the ASK, FSK & PSK waveforms for digital data **11010011**
 b) What do you mean by inter symbol interference & how it is avoided
 c) What do you mean international standards for communication system?
 How frequencies are allocated?

Q6 Write short notes on (any four)

- a) friss formula b) sampling theorem c) line codes d) types of communication channel
 e) Space wave propagation
