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Total Number of Pages: 02

B.Tech/IDD (B.Tech and M.Tech)
REC5C002

6th Semester Regular/Back Examination: 2024-25
ANALOG AND DIGITAL COMMUNICATION
CSE, CSEAIML, CSEDS, CSIT, CST, IT

Time: 3 Hour

Max Marks: 100

Q.Code : S200

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions:

(2 x 10)

- What is modulation? What is the need of modulation?
- Define Cumulative Density Function (CDF) and Probability Density Function (PDF).
- What is TDM in digital communication?
- Explain Differential Pulse Code Modulation (DPCM).
- Draw the constellation diagram for QAM system.
- What do you mean by Eye diagram?
- What is Nyquist criterion?
- What are the disadvantages of delta modulation?
- A signal $x(t) = A \text{rect}\left(\frac{t}{T}\right)$ is transmitted over an AWGN noise channel. Design the matched filter for this signal.

$$\text{rect}\left(\frac{t}{T}\right) = \begin{cases} 1, & |t| \leq \frac{T}{2} \\ 0, & \text{otherwise} \end{cases}$$

- An analog signal is expressed by the equation $x(t) = 3 \cos(500 \pi t) + 10 \sin(3000 \pi t) - \cos(1000 \pi t)$. Calculate the Nyquist rate of this signal.

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)

(6 x 8)

- What is the bandwidth (BW) required for a FM signal if the modulating frequency is 1KHz and the maximum deviation is 10 KHz. What is BW required for standard AM transmission. **6**
- Explain the process of coherent demodulation in DSB-SC modulation with neat diagram and derivation. **6**
- What is the Sampling Theorem? Derive it and explain what happens in the case of under sampling. **6**
- What is Inter Symbol Interference (ISI)? Explain its cause and method to mitigate it. **6**
- What is Maximum Likelihood Sequence Detection (MLSD)? Explain its implementation using the Viterbi algorithm. **6**

- f) Explain the principle of Binary Phase Shift Keying (BPSK) with necessary diagrams and equations. 6
- g) Discuss carrier recovery techniques used in digital communication systems. 6
- h) Derive the Figure of Merit for a Single Sideband Suppressed Carrier (SSB-SC) system. 6
- i) Explain the threshold effect in angle modulation. What are its implications on system performance? 6
- j) Determine the power content of the carrier and each of the sidebands for an AM signal having percentage modulation of 80% and a total power of 2500 W. 6
- k) Compare Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), and Pulse Position Modulation (PPM). 6
- l) The PDF of a random variable X is given by, 3+3

$$f_x(x) = \begin{cases} \frac{1}{2\pi}, & \text{for } 0 \leq x \leq 2\pi \\ 0, & \text{otherwise} \end{cases}$$

Determine the mean value and mean square value.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3 a) Draw the magnitude spectrum of standard amplitude modulation system when the message signal is sinusoidally modulated with the message signal $A_m \cos(2\pi f_m t)$. What is the power of the above modulated signal? (12+4)
- b) Compare the frequency modulation (FM) and Amplitude Modulation (AM)
- Q4 a) Explain the Quantization error and derive the expression for signal to noise ratio (dB) in PCM system when the baseband signal is sinusoidal signal? (10+6)
- b) In a binary PCM system, the output signal-to-quantizing noise ratio is to be held to minimum value of 60 dB. Determine the number of required levels, and find the corresponding output signal-to-quantization-noise ratio?
- Q5 a) Explain equalization technique and uses. (8+8)
- b) A delta modulator system is designed to operate at five times the Nyquist rate for a signal with a bandwidth of 3 kHz. Calculate the maximum amplitude of a 2 kHz sinusoidal input for which the delta modulator does not exhibit slope overload distortion.
- Q6 a) Prove that signal to noise ratio, $\left(\frac{S}{N}\right)_o = \frac{2E}{\eta}$ (8+8)
- Where E is the energy of the input signal s(t) and $\frac{\eta}{2}$ is the power spectral density of the input noise n(t).
- b) Describe the working principle of Frequency Shift Keying (FSK).