Registration No: | | | | | | | | | | |

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-1) 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)**

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

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

j) 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 × 8)**

a) 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**

b) Explain the process of coherent demodulation in DSB-SC modulation with neat diagram and derivation. **6**
c) What is the Sampling Theorem? Derive it and explain what happens in the case of under sampling. **6**
d) What is Inter Symbol Interference (ISI)? Explain its cause and method to mitigate it. **6**
e) 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**

$$fx(x) = \begin{cases} \frac{1}{2\,\pi}, & for \quad 0 \le x \le 2\pi \\ 0, & otherwise \end{cases}$$

Determine the mean value and mean square vale.

Part-III

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

Q3 **(12+4)**

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?

b) Compare the frequency modulation (FM) and Amplitude Modulation (AM)

Q4 **(10+6)**

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?

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 **(8+8)**

a) Explain equalization technique and uses.

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 **(8+8)**

a) Prove that signal to noise ratio, $\left(\frac{S}{N}\right)_o = \frac{2\,E}{\eta}$

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).