MASTERRANJEET.COM

Code : 100811

B.Tech 8th Semester Exam., 2022

(New Course)

INTRODUCTION TO COMMUNICATION SYSTEMS

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct answer of the following (any *seven*) : 2×7=14

(a) A binary PCM system with 256 quantizing levels has a sampling frequency of 7 kHz. The bit rate of the system is

(i) 56 Kbps

(ii) 96 Kbps

(iii) 112 Kbps

(iv) 168 Kbps

(b) For an 8-bit binary PCM, if the sampling frequency is 8000 samples per second, the bit rate of the PCM signal is

(i) 256 Kbps

(ii) 128 Kbps

(iii) 64 Kbps

(iv) 32 Kbps

(c) Consider a signal

$$x(t) = 3 + 5\cos^2(4500\pi t)$$

intervals of T seconds. The maximum value of T for which $x(t)$ may be recovered from the sampled version without any distortion, is equal to

(i) 0·111 ms

(ii) 0·222 ms

(iii) 0·333 ms

(iv) 0·444 ms

(d) A signaling system in which each letter of the alphabet is represented by a different symbol is not used because

(i) it would be too difficult for an operator to memorize

(ii) it is redundant

(iii) noise would introduce too many errors

(iv) too many pulses per letter are required

(e) Indicate the false statement.

In order to combat noise

(i) the channel bandwidth may be increased

(ii) redundancy may be used

(iii) the transmitted power may be increased

(iv) the signaling rate may be reduced

(f) Pulse-width modulation system is used for telegraphy

(i) by differentiating pulse-position modulation

(ii) with a monostable

(iii) by integrating the signal

(iv) with a free-running multivibrator

(g) Which is the greatest disadvantage of PCM?

(i) Highly prone to noise

(ii) Cannot travel long distances

(iii) Its inability to handle analog signal

(iv) Large bandwidth is required for it

(h) In digital communication system, in order to increase noise immunity, it is necessary to increase

(i) signal power

(ii) signal amplitude

(iii) signal frequency

(iv) signal magnitude

(i) Quantization is _____ process(es).

(i) non-linear

(ii) reversible

(iii) non-linear and reversible

(iv) None of the above

(j) A PAM signal can be detected using

(i) low-pass filter

(ii) high-pass filter

(iii) band-pass filter

(iv) all-pass filter

2. *(a)* The low-pass signal $x(t)$ with a bandwidth of W is sampled with a sampling interval of T_s, and the signal

$$X_p(t) = \sum_{n=-\infty}^{\infty} x(nTs)\, p(t - nTs)$$

is reconstructed from the samples, where $p(t)$ is an arbitrary-shaped pulse (not necessarily time limited to the interval $[0, T_s]$).

(i) Find the Fourier transform of $X_p(t)$.

(ii) Find the conditions for perfect reconstruction of $x(t)$ from $X_p(t)$.

(iii) Determine the required reconstruction filter. 7

(b) Determine the tap weight coefficients of a three-tap zero forcing equalizer if the ISI spans three symbols and is characterised by the values $x(0) = 1$, $x(-1) = 0 \cdot 3$, and $x(1) = 0 \cdot 2$. Also determine the residual ISI at the output of the equalizer for the optimum tap coefficients. 7

3. *(a)* A signal $m(t)$ of bandwidth $B = 4$ kHz is transmitted using a binary companded PCM with $\mu = 100$. Compare the case of $L = 64$ with the case of $L = 256$ from the point view of transmission bandwidth and the output SNR. 7

(b) Draw block diagram and explain the difference between delta modulation and adaptive delta modulation with example. 7

4. *(a)* A source emits three equiprobable messages m_1, m_2 and m_3 encoded by signals $s_1(t)$, $s_2(t)$ and $s_3(t)$ respectively, where

$$s_1(t) = 20\sqrt{2} \sin \frac{2\pi}{T_M} t$$

$$s_2(t) = 10\sqrt{2} \cos \frac{2\pi}{T_M} t$$

$$s_3(t) = -10\sqrt{2} \cos \frac{2\pi}{T_M} t$$

and $T_M = \frac{1}{20}$. Each of these signal durations is $0 \le t \le T_M$ and is zero outside this interval. The signals are transmitted over AWGN channels.

(i) Represent the signal in a signal space.

(ii) Determine the decision region.

(iii) Obtain an equivalent minimum energy signal set. 7

(b) Explain Gram-Schmidt orthogonalization process with example. 7

5. *(a)* Explain ASK, PSK and FSK. With the help of signal space diagram, explain which one is the best among these three. Also, write its probability of error equation. 7

(b) In a binary data transmission using duobinary pulses, sample values of the received pulses were read as follows :

12000–200–20200–20220–2

(i) Explain if there is any error in detection.

(ii) Can you guess the correct transmitted digit sequence? 7

6. *(a)* Given the data stream 1110010100, sketch the transmitted sequence of pulses for each of the following line codes : 7

(i) Unipolar non-return-to-zero

(ii) Polar non-return-to-zero

(iii) Unipolar return-to-zero

(iv) Bipolar return-to-zero

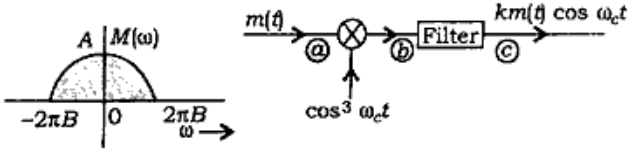
(v) Manchester code

(b) Consider a test signal $m(t)$ defined by a hyperbolic tangent function :

$$m(t) = A \tanh(\beta t),$$

where A and β are constants. Determine the minimum step size Δ for delta modulation of this signal, which is required to avoid slope overload. 7

7. *(a)* Design a DSB-SC modulator to generate a modulated signal $k\, m(t)\cos \omega_c t$, where $m(t)$ is a signal band-limited to B Hz. Figure shows DSB-SC modulator available in the lab. The carrier generator available generate not $\cos \omega_c t$ but $\cos^3 \omega_c t$. Explain whether you would be able to generate the desired signal using only these available equipments. You are free to select any kind of filter :



(i) Find the type of filter required to get DSB-SC signal $k\, m(t)\cos \omega_c t$.

(ii) Determine the signal spectra at points b and c in figure mentioned above and mention the frequency band occupied by these spectra.

(iii) Would this scheme work if the carrier generator output were $\cos^2 \omega_c t$? Explain.

(iv) Would this scheme work if the carrier generator output were $\cos^n \omega_c t$? For any integer $n \geq 2$. 7

(b) Discuss the generations of PPM, PAM and PWM in detail with applications. 7

8. *(a)* What is equalizer? Enlist the type of equalizer and describe the working of eye diagram. 7

(b) A low-pass filter transfer function $H(\omega)$ is given by

$$H(\omega) = \begin{cases} (1 + K\cos T\omega)e^{-j\omega t_d}, & |\omega| \le B \\ 0 \quad , & \text{otherwise} \end{cases}$$

A pulse $g(t)$ band limited to B Hz is applied at the input of this filter. Find the output $y(t)$. If the width of the input $g(t)$ pulse is δ, find the width of the pulse received at output. 7

9. *(a)* State and prove sampling theorem. What is the criterion to remove aliasing effect? 7

(b) Given that the bit sequence given below is to be transmitted :

Bit sequence : 10110010

Draw the resulting waveform, if the sequence is transmitted using—

(i) unipolar RZ;

(ii) polar RZ;

(iii) AMI;

(iv) split face Manchester;

(v) M-ary where $m = 4$ (polar quaternary). 7

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