APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Examination December 2023 (2019 Scheme)

Course Code: ECT 305

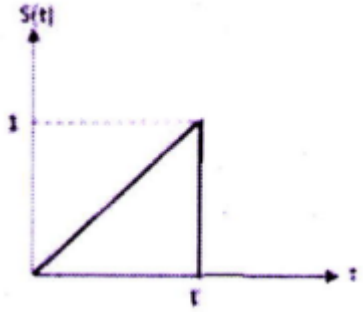
Course Name: ANALOG AND DIGITAL COMMUNICATION

Max. Marks: 100 | Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks)

1. **Discuss the need for modulation in communication system (p. 1).**
2. **Explain narrow band FM and wide band FM (p. 1).**
3. **What is mutual information? Explain any two properties of mutual information (p. 1).**
4. **Define the Power Spectral Density (PSD) of a stationary random process X(t) (p. 1).**
5. **What is waveform coding? What are the three main steps in waveform coding (p. 1)?**
6. **What is the advantage of delta modulation over DPCM (p. 1)?**
7. **The output of a duobinary encoder is -2 0 0 0 2 0 -2. Find the transmitted data sequence (p. 1).**
8. **What is a matched filter? Find the impulse response of the matched filter for the given input.**



(p. 1).

9. Draw the signal constellation diagram of BPSK and explain it briefly (p. 1).
10. Explain the basic concept of QAM (p. 1).

PART B

(Answer one full question from each module, each question carries 14 marks)

Module - 1

11. a) Obtain the bandwidth and frequency spectrum of AM wave, with the help of mathematical equations (9 marks) (p. 1).

b) Calculate the percentage power saving when the carrier and one of the sidebands are suppressed in an AM wave with modulation index equal to (a) 1 and (b) 0.40 (5 marks) (p. 1).

OR

12. a) What is SSB in AM? Explain phase shift method of SSB generation (9 marks) (p. 1).

b) An FM wave is represented as $v = 12\sin(6 \times 10^8 t + 5\sin 1250t)$**. Find its carrier frequency, modulating frequency, modulation index and maximum deviation** (δ_{max}) **(5 marks) (p. 2).**

Module - 2

13. a) Show that for a finite variance σ^2**, the Gaussian random variable has the largest differential entropy attainable by any random variable (7 marks) (p. 2).**

b) A source emits one of the four possible symbols during each signalling interval. The symbols occur with the probabilities

$p_0 = 0.4, p_1 = 0.3, p_2 = 0.2,$ and $p_3 = 0.1.$ Find the amount of information gained by observing the source emitting each of these signals (7 marks) (p. 2).

OR

14. a) State and explain the properties of the autocorrelation function (6 marks) (p. 2).

b) Find the autocorrelation function of a sinusoidal process with random phase X(t) = A $\cos(2\pi f_c t + \theta)$ (8 marks) (p. 2).

Module - 3

15. a) Draw the block diagram of a PCM transmitter and receiver and explain the system (9 marks) (p. 2).

b) State and explain sampling theorem. A PCM system uses a uniform quantizer followed by an 8-bit encoder. If the bit rate of the system is 10^8 bps, then what is the maximum bandwidth of the low-pass message signal for which the system operates satisfactorily (5 marks) (p. 2)?

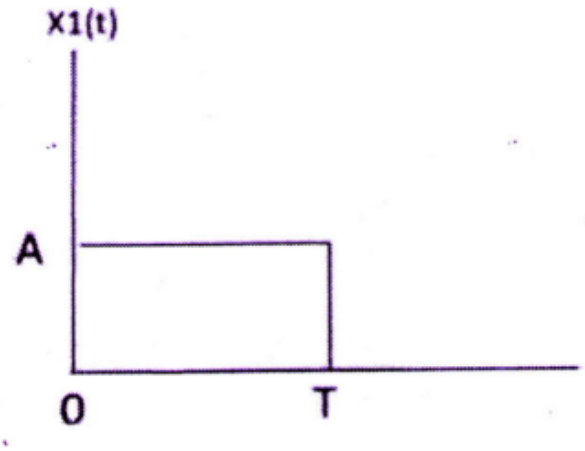
OR

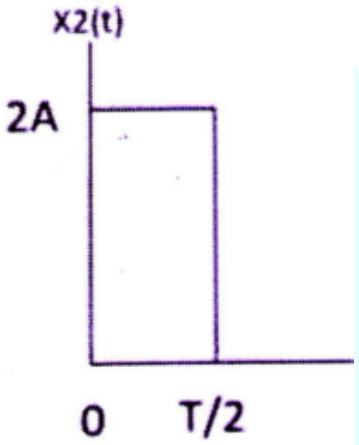
16. a) Draw the block diagram of DPCM transmitter and receiver. Explain each block (9 marks) (p. 2).

b) Explain the format of output code in an 8 bit (15 level) μ-Law compander with $\mu = 255.$ In a practical 8-bit (15 level) μ-Law compander, output code is 00110001. Find its sign, segment value and quantized level (5 marks) (p. 2).

Module - 4

17. a) (i) Using the Gram-Schmidt orthogonalization procedure, find orthonormal functions for the set of given signals x1(t) and x2(t) given below. (ii) Sketch the basis functions





14 marks) (p. 2).

OR

18. a) What are the practical difficulties encountered in ideal Nyquist channel? How can these be overcome by raised cosine filters (8 marks) (p. 3)?

b) Compare Maximum Likelihood receiver and MAP receiver (6 marks) (p. 3).

Module - 5

19. a) Draw the block diagram of BPSK generation and detection system. Explain with relevant equations (10 marks) (p. 3).

b) Draw the signal constellation diagram of QPSK and explain it briefly (4 marks) (p. 3).

OR

20. a) Draw the BER v/s SNR plot for the BPSK system and explain the graph (4 marks) (p. 3).

b) Derive the expression for probability of error in QPSK (10 marks) (p. 3).