Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Fifth Semester B.Tech Degree Regular and Supplementary Examination December 2022 (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)*** Marks

| | | |
|---|---|---|
| 1 | A 105 MHz carrier signal is frequency modulated by 7 kHz sine wave. The resultant signal has a frequency deviation of 50 kHz. Determine the modulation index and bandwidth of FM wave. | (3) |
| 2 | Give the advantages and disadvantages of SSBSC systems. | (3) |
| 3 | A continuous random variable X is uniformly distributed in the interval [0,8]. Find the differential entropy h(X)? | (3) |
| 4 | What are the conditions for a stochastic process to be wide sense stationary? | (3) |
| 5 | What is the significance of companding in PCM transmission? | (3) |
| 6 | Interpret the use of pre-filtering done before sampling. | (3) |
| 7 | What is meant by equalization and why is it needed? | (3) |
| 8 | A communication channel of bandwidth 75 kHz is required to transmit binary data at a rate of 0.1Mb/s using raised-cosine pulses. Determine the roll-off factor $\alpha$? | (3) |
| 9 | Draw the signal constellation of M-ary QAM for M=16. | (3) |
| 10 | What are the advantages of QPSK over BPSK? | (3) |

**PART B**

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

**Module -1**

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|---|---|---|---|
| 11 | a) | An AM wave is represented by the expression: $v(t) = 5\,(1 + 0.6 \cos 6280\,t) \sin 157 \times 10^4\,t$ volts<br>(i) What are the minimum and maximum amplitudes of the AM wave?<br>(ii) Determine the frequency components contained in the modulated wave and what is the amplitude of each component?<br>(iii) Draw the frequency spectrum. | (7) |

b) Draw and explain the block diagram of an FM Receiver. What is the purpose of using pre-emphasis and de-emphasis in FM? (7)

12 a) Compare the frequency spectrum, bandwidth and power of SSB-SC systems with DSB-FC and DSB-SC systems. (6)

b) The equation of an angle modulated wave is (8)

$$\emptyset(t) = 10cos\,(10^8 t + 3\sin 10^4 t)$$

(a) Calculate the carrier and modulating frequencies.

(b) Calculate the frequency deviation, bandwidth and the power dissipated in a 100 Ω resistor.

**Module -2**

13 a) Define entropy. A source emits symbols $\{s_1, s_2, s_3, s_4\}$ with probabilities {1/2, 1/4, 1/8, 1/8}. Find the entropy of the source. (5)

b) Consider a random process X(t) = cos (t + A) where A is a random variable that is uniformly distributed over the interval [0,2π]. Find whether X(t) is wide sense stationary or not. (9)

14 a) State and prove any two properties of autocorrelation function of a stationary random process. Explain Wiener-Khinchin's theorem. (8)

b) Let X be a random variable with PDF given by (6)

$$f_X(x) = \begin{cases} x, & 0 < x \leq 1, \\ 2 - x, & 1 < x \leq 2, \\ 0, & elsewhere \end{cases}$$

Find E(X), E($X^2$) and $\sigma_X{}^2$ ?

**Module -3**

15 a) Describe delta modulation system with neat block diagram. Also illustrate the quantization error in delta modulation. (8)

b) A delta modulator with a fixed step size of 0.75 V, is given a sinusoidal message signal. If the sampling frequency is 30 times the Nyquist rate, determine the maximum permissible amplitude of the message signal if slope overload is to be avoided. (6)

16 a) Explain pulse code modulation transmitter with neat block diagram. (6)

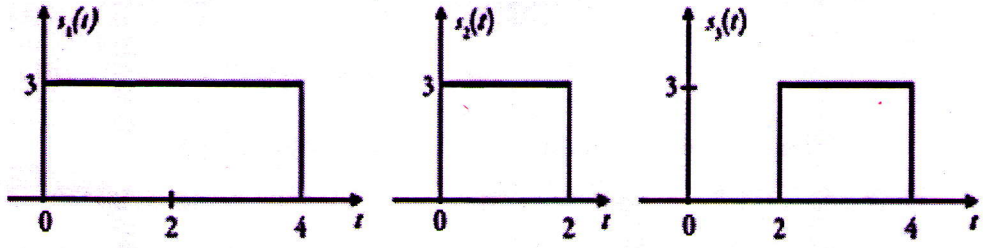
b) What is linear prediction? Derive Wiener-Hopf equation from a linear prediction filter. (8)

## Module -4

17 a) What is a raised cosine spectrum? Discuss how does it help to reduce ISI? (6)

b) Derive an expression for the impulse response of a matched filter. (8)

18 Apply Gram Schmidt orthogonalization to obtain orthonormal basis functions for the signals shown below. Express the signals in terms of orthonormal basis functions. (14)




## Module -5

19 a) Explain the generation and detection of BPSK signals with the help of block diagrams. (8)

b) Draw and explain the signal constellation diagram for QPSK modulation. (6)

20 a) Derive the expression for probability of error in QPSK. (9)

b) What is meant by quadrature amplitude modulation? Draw and explain the block diagram of a QAM Receiver. (5)

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