Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIFTH SEMESTER B.TECH DEGREE EXAMINATION (Regular), DECEMBER 2022

ELECTRONICS AND COMMUNICATION ENGINEERING
(2020 SCHEME)

Course Code : 20ECT305

Course Name: Analog and Digital Communication

Max. Marks : 100 **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Plot the frequency spectrum of AM wave using the equation of the wave.
2. Calculate the percentage power saving and bandwidth saving when the carrier and one of the sidebands are suppressed in an AM modulated wave, modulated to a depth of 50%.
3. It is known that there is a defective chip on a computer board that contains 8 chips. A technician tests the chips one at a time until the defective chip is found. Assume that the chip to be tested is selected at random without replacement. Let the random variable X denote the number of chips tested. Find the PMF of X.
4. State and explain the relation between autocorrelation and power spectral density function.
5. How DPCM is different from PCM?
6. State source coding theorem and channel coding theorem.
7. Briefly explain the principle of a correlation receiver.
8. State the Nyquist criteria for zero ISI for baseband transmission in the absence of noise.
9. Draw and interpret the BER Vs SNR plot of QPSK system.
10. In a BPSK system, the bit rate of a polar NRZ data sequence is 1Mbps and carrier frequency of transmission is 100MHz. Determine the symbol rate of transmission and the minimum bandwidth of channel.

PART B

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

MODULE I

11. a) Differentiate between amplitude and angle modulation schemes. Derive the modulation index of AM wave in terms of the maximum and minimum amplitudes of the wave. (7)

b) A 1.4-MHz carrier is modulated by a music signal that has frequency components from 20 Hz to 10 kHz. Determine the range of frequencies generated for the upper and lower sidebands and draw the spectrum of AM wave. (7)

OR

12. a) Explain the indirect method of wideband FM generation using block diagram. (8)

b) An FM signal, $2000\,(\sin 2\pi \times 10^8 t + 2\sin \pi \times 10^4 t)$, is applied to a 50Ω antenna. Determine (a) carrier frequency (b) transmitted power (c) modulation index (d) information frequency (e) bandwidth. (6)

MODULE II

13. a) Consider five samples of a random variable, {x} = {0.5, 0.8, 0.3, 0.01, 0.95}, having a Gaussian probability distribution with a mean of 0.5 and a variance of 1.0.
(a) What is the sample average or mean value of samples, $\bar{x}$?
(b) Find the statistical average or the mean value of $\bar{x}$,
(c) Find the variance of $\bar{x}$, (6)

b) i) Define entropy. How is it related with mutual information?
ii) Find entropy of a binary memoryless source producing two equally probable messages. (8)

OR

14. a) Explain the conditions for a random process to be SSS and WSS. (7)

b) Differentiate between differential entropy and conditional entropy with properties of each. (7)

MODULE III

15. a) Draw the block diagram of a PCM system. Justify the need of sampler, quantizer and encoder in the PCM transmitter. (7)

b) A PCM system is used for an analog signal with maximum frequency of 4 kHz. If the minimum dynamic range of quantizer used is 46 dB, and the maximum decoded voltage at the receiver is ±2.55 V, determine (a) minimum sampling rate (b) minimum number of bits used in the PCM code (c) the maximum quantization error (d) coding efficiency. (7)

OR

16. a) What is meant by companding? Briefly describe is the necessity of that in PCM systems? (7)

b) A delta modulator system is designed to operate at five times the Nyquist rate for an analog information signal band-limited to 3 kHz. The quantizing step size is 40 mV. Determine the maximum allowable amplitude of input analog signal for which the delta modulator does not experience slope overload distortion. (7)

MODULE IV

17. a) Examine critically the effects of inter-symbol interference on the performance of digital transmission with the help of illustrations. (7)

b) What is duobinary signalling? Obtain the impulse response of duobinary encoder. (7)

OR

18. a) What is a matched filter? How is it different from conventional filters? Derive the equation for peak pulse signal-to-noise ratio of a matched filter. (8)

b) Estimation of channel capacity plays a significant role in the design of a communication system. Justify this statement. (6)

MODULE V

19. a) Explain BPSK system with necessary waveforms and constellation diagram of signal. (6)

b) With the help of the block diagrams, explain QPSK transmitter and receiver. (8)

OR

20. a) Consider a QPSK system having a bit rate of 9600bps. Determine the bandwidth required by the QPSK signal using raised cosine filter with roll-off factor of 0.35 and 0.5. (6)

b) What is QAM? Explain the system with mathematical expression. Also give constellation diagram for 16-QAM signal. (8)

****