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B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

Fourth Semester

Electronics and Communication Engineering

EC 3491 – COMMUNICATION SYSTEMS

(Common to Computer and Communication Engineering/Electronics and Telecommunication Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. How to derive phase modulation signal from frequency modulated signal?

2. Differentiate envelope detection and square-law detection in AM demodulation.

3. What are the effects of aliasing? State the remedies to control it.

4. What is Companding?

5. What are the advantages of DPCM over PCM?

6. A telephone line of 6 MHz is having an SNR of 40 dB. What is its channel capacity?

7. Compare QPSK vs DPSK in terms of BER and bandwidth.

8. What is non-coherent receiver?

9. What is inter-symbol-interference (ISI)?

10. What are the formats used for representing the data over baseband signal?

PART B — (5 × 13 = 65 marks)

11. (a) An AM signal is generated by modulating the carrier $f_c = 800$ kHz by the signal $m(t) = \sin(2000\pi t) + 5\cos(4000\pi t)$. The AM signal $s(t) = 100[1 + m(t)]\cos(2\pi f_c t)$ is fed to a 50Ω load. Determine the following :

(i) Average power in the carrier and in the sidebands.

(ii) Modulation index

(iii) Bandwidth of the modulated signal

(iv) Peak power delivered to the load.

(v) Carrier power if AM broadcast radio radiates 10 kW of power if modulation index is 60%.

Or

(b) An angle-modulated signal has the form : $s(t) = 100\cos[2\pi f_c t + 4\sin 2\pi f_m t]$, where $f_c = 10$ MHz and $f_m = 1000$ Hz. Determine the following :

(i) Assuming that this is an FM signal, determine the modulation index and the transmitted-signal bandwidth.

(ii) Repeat part (i) if f_m is doubled.

(iii) Assuming that this is a PM signal, determine the modulation index and the transmitted-signal bandwidth.

(iv) Repeat part (iii) if f_m is doubled.

12. (a) (i) Derive the output signal-to-noise ratio of FM receiver using slope-detection and assuming that the noise is additive, white and Gaussian. (10)

(ii) What is need for pre-emphasis and de-emphasis circuits? (3)

Or

(b) (i) Find the Nyquist rate and the Nyquist Interval for the following signals :

(1) $S_1(t) = \sin c(300t) + \sin c(500t)$ (4)

(2) $S_2(t) = 2\sin(4\pi t)\cos(2\pi t)$. (4)

(ii) Compare and distinguish following pulse modulation schemes : PAM, PWM/PDM and PPM. (5)

13. (a) Consider a Delta Modulation (DM) system subjected to a 5 kHz sinusoidal input signal characterized by peak-to-peak amplitude of 2 V. The system operates at a sampling frequency that is tenfold the Nyquist rate, significantly oversampling the input. Based on these parameters, determine

(i) The required step size to ensure the system does not experience slope overload. (5)

(ii) The resulting Signal-to-Noise Ratio (SNR) for the system under these conditions. (5)

(iii) How the limitations are resolved in Adaptive Delta Modulation (ADM)? (3)

Or

(b) Explain the various noise considerations in a PCM system.

14. (a) Draw and explain the BFSK transmitter and receiver system. Also, derive its probability of error under coherent receiver. (9 + 4)

Or

(b) Draw and explain the BPSK transmitter and receiver system. Also, derive its probability of error under coherent receiver. (9 + 4)

15. (a) Derive the probability of error for digital communication system which uses amplitude shift keying. Also write the formulae for its bandwidth requirement. (10 + 3)

Or

(b) Explain the Nyquist's criterion for distortionless baseband binary transmission.

PART C — (1 × 15 = 15 marks)

16. (a) Design a digital Telemedicine system that uses a heart beat ECG signal sampled at the rate of 32,000 samples/sec and characterized by peak value of 2 volts. Assume bandwidth of signal is 4 kHz.

(i) Determine the value of step size to avoid slope-overload. (7)

(ii) What is quantization noise power Nq and corresponding SNR? (8)

Or

(b) Develop a Mission Critical *Chandrayaan-4 Geo*-synchronous *Satellite* signal having a bandwidth of 4.2 MHz is transmitted using a binary PCM system. Given that the number of quantization levels is 512. Determine the following :

(i) Code word length (4)

(ii) Transmission bandwidth (4)

(iii) Final bit rate (4)

(iv) Output signal to quantization noise ratio (3)