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Question Paper Code : 70431

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fourth Semester

Electronics and Communication Engineering

EC 6402 — COMMUNICATION THEORY

(Regulations 2013)

(Also Common to PTEC 6402 – Communication Theory for B.E. Part Time – Third Semester – Electronics and Communication Engineering – Regulations 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Draw the AM modulated wave for modulation index = 0.5 and its spectra.

2. Define heterodyning.

3. State the Carson's rule.

4. Distinguish the features of Amplitude Modulation (AM) and Narrow Band Frequency Modulation (NBFM).

5. State Central Limit Theorem.

6. Write Einstein — Wiener — Khintchine relation.

7. Define noise figure.

8. What is threshold effect?

9. Define mutual information and channel capacity.

10. A Source is emitting symbols x_1, x_2 and x_3 with probabilities, respectively 0.6, 0.3 and 0.1. What is the entropy of the source?

PART B — (5 × 13 = 65 marks)

11. (a) Derive the expression for amplitude modulated wave and explain any one method to generate and demodulate it.

Or

(b) Derive the expression for DSB-SC AM. Explain a method to generate and detect it.

12. (a) (i) Derive an expression for a single tone FM signal with necessary diagrams and draw its frequency spectrum. (8)

(ii) An angle modulated wave is described by $v(t) = 100 \cos (2 * 10^6 \pi t + 10 \cos 2000 \pi t)$. Find (1) Power of the modulating signal, (2) Maximum frequency deviation, (3) Band width. (5)

Or

(b) (i) Explain the Armstrong method of FM generation. (6)

(ii) Draw the circuit diagram of a Foster — Seeley discriminator and explain its working with relevant phasor diagrams. (7)

13. (a) Consider two linear filters connected in cascade as shown in Fig. 13 (a). Let $X(t)$ be a stationary process with a auto correlation function $R_x(\tau)$, the random process appearing at the first input filter is $V(t)$ and the second filter output is $Y(t)$.

(i) Find the autocorrelation function of $Y(t)$

(ii) Find the cross correlation function $R_{vy}(\tau)$ of $V(t)$ and $Y(t)$.

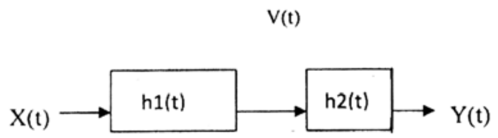

Fig. 13 (a)

Or

(b) The amplitude modulated signal is defined as $XAM(t) = Am(t)\cos(\omega_c t + \theta)$ where $m(t)$ is the baseband signal and $A\cos(\omega_c t + \theta)$ is the carrier. The baseband signal $m(t)$ is modeled as a zero mean stationary random process with the autocorrelation function $Rxx(\tau)$ and the PSD $Gx(f)$. The carrier amplitude A and the frequency ω_c are assumed to be constant and the initial carrier phase θ is assumed to be a random uniformly distributed in the interval $(-\pi, \pi)$. Furthermore, $m(t)$ and θ are assumed to be independent.

(i) Show that $X_{AM}(t)$ is Wide Sense Stationary

(ii) Find PSD of $X_{AM}(t)$.

14. (a) (i) Let X and Y be real random variables with finite second moments. Prove the Cauchy-Schwarz inequality. $\left(E[XY]^2\right) \leq E\left[X^2\right]E\left[Y^2\right]$. (7)

(ii) Differentiate the strict-sense stationary with that of wide sense stationary process. (6)

Or

(b) (i) Let $X(t)$ and $Y(t)$ be both zero-mean and WSS random processes. Consider the random process $z(t) = X(t) + Y(t)$. Determine the auto correlation and power spectrum of $z(t)$ if $X(t)$ and $Y(t)$ are jointly WSS. (7)

(ii) Let $X(t) = A\cos(\omega t + \Phi)$ and $Y(t) = A\sin(\omega t + \Phi)$, where A and ω are constants and Φ is a uniform random variable [0, 2π}. Find the cross correlation of $x(t)$ and $y(t)$. (6)

15. (a) (i) The two binary random variables X and Y are distributed according to the joint PMF given by $P(X = 0, Y = 1) = 1/4$; $P(X = 1, Y = 1) = 1/2$; $P(X = 1, Y = 1) = 1/4$; Determine $H(X, Y)$, $H(X)$, $H(Y)$, $H(X / Y)$ and $H(Y / X)$. (8)

(ii) Define entropy and plot the entropy of a binary source. (5)

Or

(b) Explain the Huffman coding algorithm with a flow chart and illustrate it using an example.

PART C — (1 × 15 = 15 marks)

16. (a) (i) Give brief account of discrete memoryless channel. (8)

(ii) Derive expression for channel capacity using Hartley law. (7)

Or

(b) Comment and explain on the role of pre-emphasis and de-emphasis circuit on SNR improvement.

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