Reg. No. :

Question Paper Code : 71729

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Fourth Semester

Electronics and Communication Engineering

EC 6402 — COMMUNICATION THEORY

(Regulations 2013)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Do the modulation techniques decide the antenna height?

2. Define carrier swing.

3. State the Carson's rule.

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

5. List the necessary and sufficient conditions for the process to be WSS.

6. State Wiener Khintchine theorem.

7. Specify the cause of threshold effect in AM systems.

8. Comment the role of pre-emphasis and de-emphasis circuit in SNR improvement.

9. State the properties of entropy.

10. What is Shannon's limit?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Derive an expression for output voltage of a balanced modulator to generate DSB-SC and explain its working principle. (5)

(ii) Discuss the detection process of DSB-SC and SSB-SC using coherent detector. Analyze the drawback of the suggested methodology. (8)

Or

(b) (i) Comment the choice of IF selection and image frequency elimination. (5)

(ii) Elucidate the working principle of super heterodyne receiver with the neat block diagram. (8)

12. (a) (i) Obtain the mathematical expression for WBFM. Also compare and contrast its characteristics with NBFM. (6)

(ii) Suggest and discuss the method for the generation of FM using direct method. (7)

Or

(b) (i) Analyze and brief how the ratio detector suppresses the amplitude variation caused by the communication media without using amplitude limiter circuit. (7)

(ii) Explain the detection of FM wave using PLL detector. (6)

13. (a) Consider two linear filters connected in cascade as shown in Fig. 1. 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 $Y(t)$. (13)

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

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

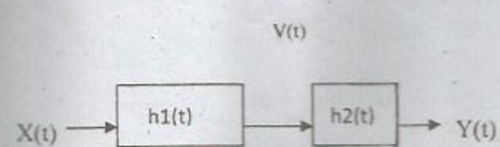

Fig. 1

Or

(b) The amplitude modulated signal is defined as $XAM(t) = A\,m(t)\cos(\omega_c t + \theta)$ 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. (13)

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

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

14. (a) (i) Classify the different noise sources and its effect in real time scenario. (7)

(ii) Discuss the effects of noise in cascaded system. (6)

Or

(b) Derive an expression for signal to noise ratio for an AM signal, with assumption that the noise added in the channel is AWGN. Compare its performance with FM system. (13)

15. (a) (i) Consider a binary memoryless source X with two symbols x_1 and x_2 Prove that $H(X)$ is maximum when both x_1 and x_2 equiprobable. (6)

(ii) Given a telegraph source having two symbols dot and dash. The dot duration is 0.2 sec. The dash duration is 3 times the dot duration. The probability of the dot's occurring is twice that of the dash, and the time between symbols is 0.2 Sec. Calculate the information rate of the telegraph source. (7)

Or

(b) (i) Find the channel capacity of the binary r = erasure channel as shown in Fig. 2. (7)

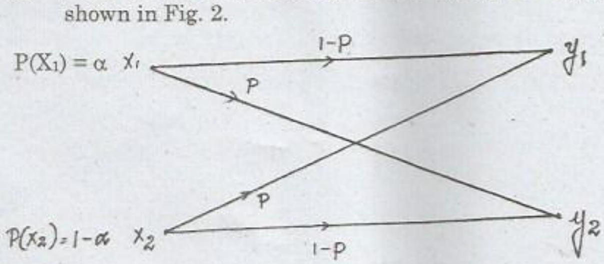

Fig. 2

(ii) A source is emitting equiprobable symbols. Construct a Huffman code for source. (6)

PART C — (1 × 15 = 15 marks)

16. (a) The AM signal $s(t) = A_c\ [1 + k_a\, m(t)]\cos(2\pi f_c t)$ is applied to the system shown in Fig.3. Assuming that $|k_a m(t)| < 1$ for all t and the message signal $m(t)$ is limited to the interval $-W \leq f \leq W$ and that the carrier frequency $f_c > 2W$ show that $m(t)$ can be obtained from the square-rooter output $v_3(t)$. (15)

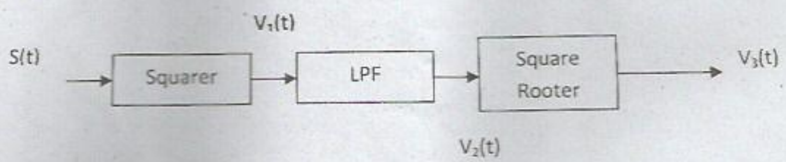

Fig. 3

Consider a square law detector, using a non linear device whose transfer characteristics is defined by $v_2(t) = a_1 v_1(t) + a_2 v_1^2(t)$ where a_1 and a_2 are constants, $v_1(t)$ is the input and $v_2(t)$ is the output. The input consists of the AM wave $v_1(t) = A_c[1 + k_a m(t)]\ \cos(2\pi f_c t)$.

(i) Evaluate the output $v_2(t)$

(ii) Find the conditions for which the message signal $m(t)$ may be recovered from $v_2(t)$.

Or

(b) The discrete Hilbert Transform is a process by which a signal's negative frequencies are phase-advanced by 90 degrees and the positive frequencies are phase-delayed by 90 degrees. Shifting the results of the Hilbert Transform (+j) and adding it to the original signal creates a complex signal as mentioned in the equation. If $m_i[n]$ is the Hilbert transform of $m_r[n]$, then : $m_c[n] = m_r[n] + jm_i[n]$. Apply the concept of Hilbert transform to generate and detect SSB-SC signal. (15)

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