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10EC53

Fifth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Analog Communications

Time: 3 hrs. Max. Marks: 100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain the terms joint probability density function of random variables x and y; conditional probability density function of y; statistically independent random variables. **(06 Marks)**

b. Define mean, autocorrelation and auto covariance functions. **(06 Marks)**

c. Prove the following two properties of the auto correlation function $R_x(\tau)$ of a random process x(t):

i) If x(t) contains a dc component equal to A, then $R_x(\tau)$ will contain a constant component equal to A^2.

ii) If x(t) contains a sinusoidal component, then $R_x(\tau)$ will also contain a sinusoidal component of the same frequency. **(08 Marks)**

2 a. Explain the generation of AM wave using square law modulator, show the spectrum before and after filtering process. **(07 Marks)**

b. Using the message signal $m(t) = \frac{t}{1+t^2}$. Determine and sketch the modulated wave for amplitude modulation whose percentage modulation equals i) 50%; ii) 100%; iii) 125%. **(05 Marks)**

c. Explain the method of obtaining a practical synchronous receiving system with DSBSC modulated wave using costas loop. **(08 Marks)**

3 a. What is the significance of single side band modulation? Give the frequency domain description of the same. **(04 Marks)**

b. Explain with block diagram a frequency discrimination method (two stage) for generating SSB modulated wave. **(08 Marks)**

c. Consider a message signal m(t) containing frequency components at 100, 200 and 400Hz. This signal is applied to an SSB modulator together with a carrier at 100 kHz, with only the upper side band retained. In the coherent detector used to recover m(t), the local oscillator supplies a sine wave of frequency 100.02 kHz. Determine the frequency components of the detector output. **(08 Marks)**

4 a. Explain the scheme for generation of VSB modulated wave with relevant block diagrams and construct the positive frequency portion of the frequency response of a side band shaping filter for a VSB modulated wave that contains a vestige of lower side band. **(10 Marks)**

b. What is heterodyning? Consider a DSBSC modulated signal as a input to a mixer, specify the parameters of the filter and local oscillator components of a mixer to do the downward frequency translation with spectrum diagram. **(10 Marks)**

PART – B

5 a. With neat block diagram, explain the generation of narrow band FM wave. **(05 Marks)**

b. The sinusoidal modulating wave $m(t) = A_m \cos(2\pi f_m t)$ is applied to a phase modulator with phase sensitivity K_p. The unmodulated carrier wave has frequency f_c and amplitude A_c. Determine the spectrum of the resulting phase-modulated signal, assuming that the maximum phase deviation $\beta_p = K_p A_m$ does not exceed 0.3 radians. **(05 Marks)**

c. With neat circuit diagram, describe the direct method of generating FM. Also explain feedback scheme for frequency stabilization of a frequency modulator in direct method. **(10 Marks)**

6 a. Explain demodulation of FM signal using zero crossing detectors. **(05 Marks)**

b. Write short notes on non-linear effects in FM systems. **(05 Marks)**

c. Explain with relevant mathematical expressions the demodulation of FM signal using PLL. **(10 Marks)**

7 a. Define white noise. Plot Power Spectral Density (PSD) and auto correlation function (ACF) of ideal low pass filtered white noise. **(06 Marks)**

b. Define noise equivalent bandwidth. Derive the expression for the same. **(08 Marks)**

c. Fig.Q.7(c) shows a typical microwave receiver used in satellite communication. Evaluate: i) The overall noise figure of the receiver and ii) The overall equivalent temperature of the receiver. Assume that ambient temperature T = 17°C. **(06 Marks)**

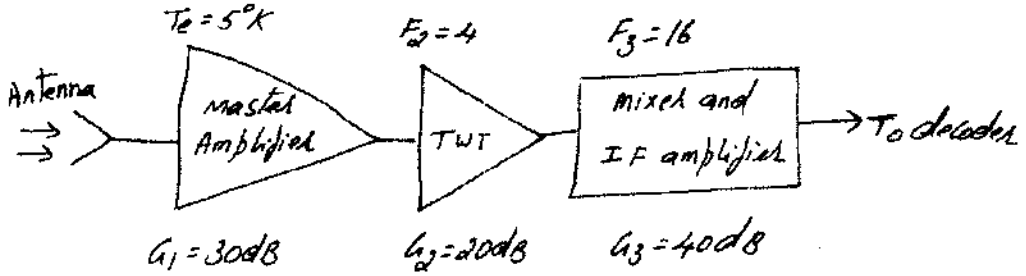

Fig.Q.7(c)

8 a. Derive the expression for figure of merit for SSB receiver. **(10 Marks)**

b. Explain threshold effects in FM. **(06 Marks)**

c. A carrier reaching an envelope detector in an AM receiver has an RMS value equal to 1 volt in the absence of modulation. The noise at the input of the envelope detector has a PSD equal to 10^{-3} watts/Hz. If the carrier is modulated to a depth of 100% and message bandwidth, W = 3.2 kHz. Find out put signal-to-noise ratio. **(04 Marks)**

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