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10EC53

Fifth Semester B.E. Degree Examination, December 2012

Analog Communication

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define random variables and differentiate between discrete and continuous random variables. **(07 Marks)**

b. Define mean, correlation and covariance functions. **(07 Marks)**

c. Define Gaussian process. List the properties. **(06 Marks)**

2 a. Explain the generation of AM wave using square law modulator and show that the output of square law modulator $V_2(t) = a_1 A_C\left[1+\frac{2a_2}{a_1}m(t)\right]\cos 2\pi f_C t$. **(07 Marks)**

b. Explain the operation of coherent detection of DSB-SC modulating wave and show that the overall output $V_0(t) = \frac{1}{2}A_C \cos\phi\, m(t)$. **(07 Marks)**

c. The AM wave is given by $S(t) = A_C[1+K_a m(t)]\cos 2\pi f_C t$ is applied to the system shown in Fig.Q2(c). Assume that the message signal m(t) is limited to the interval $|w| \le f$ and that $f_C >> w$. Show that m(t) can be obtained from the square rooter output. **(06 Marks)**

Fig.Q2(c)

3 a. Derive an expression for SSB modulated wave for which upper side band is retained. **(10 Marks)**

b. Fig.Q3(b) shows the block diagram of a two stage SSB modulator. The input signal m(t) consists of a voice signal occupying the frequency band 0.3 to 3.0 kHz. The two carrier frequencies are f_1 = 100 kHz and f_2 = 10 MHz.

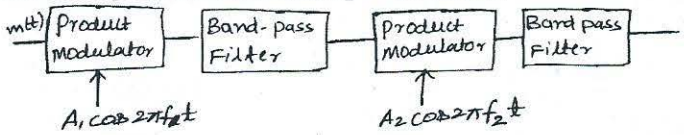

Fig.Q3(b)

Evaluate the following:

i) The sidebands of DSB-SC modulated waves at the output of the product modulators.
ii) The sidebands of the SSB modulators at the output of band pass filters.
iii) The passbands and the guardbands of the two bandpass filters.
iv) Sketch the spectrum of the signal at each stage. [Assume suitable m(f)] **(10 Marks)**

4 a. What is vestigial sideband? Explain the process of generation and detection of VSB modulated wave using a carrier $A_C \cos 2\pi f_C t$. **(09 Marks)**

b. With a block diagram, explain how downward and upward frequency translation is achieved. **(07 Marks)**

c. The incoming signal has a midband frequency that may lie in the range of 530 kHz to 1650 kHz. The associated a bandwidth is 10 kHz. This signal is to be translated to a fixed frequency band centered at 470 kHz. Determine the tuning range provided by the local oscillator. **(04 Marks)**

PART – B

5 a. Derive an expression for single tone sinusoidal FM wave; Determine frequency deviation and modulation index. **(06 Marks)**

b. A carrier wave of frequency 100 MHz is frequency modulated by a sinusoidal wave of amplitude 20 volts and frequency 100 kHz. The frequency sensitivity of the modulator is 25 kHz per volt.

i) Find the approximate bandwidth pf the FM signal using Carson's rule.

ii) Find the bandwidth by transmitting only those side frequencies whose amplitude exceed 1 percent of the unmodulated carrier amplitude. Use universal curve shown in Fig.Q5(b) for this calculation.

iii) Repeat the calculations, assuming that the amplitude of the modulating signal is doubled.

iv) Repeat the calculations, assuming the modulation frequency is doubled. **(08 Marks)**

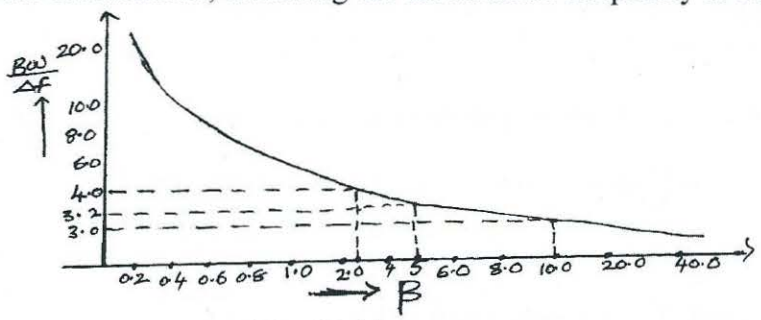

Fig.Q5(b)

c. Explain the generation of narrow band FM wave using indirect method. **(06 Marks)**

6 a. Explain how foster-Seelay discriminator is used for FM demodulation. **(08 Marks)**

b. Explain non-linearity and its effect in FM system. **(06 Marks)**

c. For a WBFM if narrow band carrier $f_1 = 0.1$ MHz, second carrier $f_2 = 9.5$ MHz, output carrier frequency is 100 MHz and $\Delta f = 75$ kHz. Calculate multiplying factors n_1 and n_2 if NBFM deviation is 20 Hz. Draw the suitable block diagram of the modulator. **(06 Marks)**

7 a. Explain the following terms:

i) Shot noise ii) Thermal noise **(06 Marks)**

b. Derive and show that the noise equivalent band width for RC low pass filter is $\frac{1}{4RC}$.

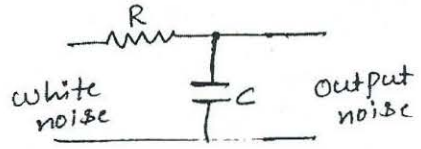

Fig.Q7(b)

(08 Marks)

c. An amplifier of power gain 20 dB has an input consisting of 100 μω signal power and 1 μω noise power. If the amplifier contributes an additional 100 μω of noise determine:

i) The output signal to noise ratio

ii) The noise factor and

iii) The noise figure. **(06 Marks)**

8 a. Find the figure of merit in AM when the depth of modulation is (i) 100%, (ii) 50%, (iii) 30%. **(06 Marks)**

b. Show that the figure of merit of a noisy FM receiver for single tone modulation is $3/2\ \beta^2$. **(10 Marks)**

c. Write a short note on pre-emphasis and de-emphasis. **(04 Marks)**

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