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10EC53

Fifth Semester B.E. Degree Examination, Jan./Feb.2021
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. What is cumulative distribution function? List the properties. **(07 Marks)**

b. The pdf of a random variable is given as $f_x(x) = \begin{cases} K \text{ for } a \le x \le b \\ 0 \quad \text{otherwise} \end{cases}$

where K is constant

(i) Sketch the pdf and determine the value of K.

(ii) If a = –1 and b = 2, calculate $P(1 \times 1 \le C)$ for $C = \frac{1}{2}$. **(06 Marks)**

c. What is Gaussian process? List the properties of Gaussian process. **(07 Marks)**

2 a. Show that the output of the switching modulator is $V_0(t) = \frac{A_C}{2}\left[1 + \frac{4}{\pi A_C} m(t)\right] \cos 2\pi f_c t$ by considering m(t) is the message signal and $C(t) = A_C \cos 2\pi f_c t$ is the carrier signal. **(07 Marks)**

b. A 250 W carrier of 1000 kHz is simultaneously modulated by sinusoidal signals of 2 kHz, 6 kHz and 8 kHz with modulation index of 35%, 55% and 75% respectively. What are the frequencies present in the modulated wave and what is the radiated power. **(06 Marks)**

c. With block diagram, explain the generation of DSBSC waves using balanced modulator and show that output of the subtractor is $s(t) = 2K_a A_c m(t) \cos 2\pi f_c t$. **(07 Marks)**

3 a. What is Hilbert transform? Show that if $\hat{x}(t)$ is the Hilbert transform of x(t) then the Hilbert transform of $\hat{x}(t)$ is –x(t). **(06 Marks)**

b. Derive an expression for SSB modulated wave for which upper sideband is retained. **(08 Marks)**

c. Explain the process of demodulation of SSB waves and show that the output of the filter is $\frac{A_C}{4} m(t)$ (scaled message signal). **(06 Marks)**

4 a. Show that a VSB modulated wave s(t) containing,

$$s(t) = \frac{A_C}{2}\left[m(t)\cos 2\pi f_c t - m_Q(t)\sin 2\pi f_c t\right].$$

using time domain description. **(10 Marks)**

b. With block diagram and expression, explain the process of frequency translation. **(06 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 in 10 kHz. This is to be translated to a fixed frequency band centered at 470 kHz. Determine the range must be provided by the local oscillator. **(04 Marks)**

PART – B

5 a. Sketch the FM and PM waves for the modulating signal m(t) shown in Fig. Q5 (a)-(i) and Fig. Q5 (a)-(ii). The constants $K_f = 10^5$ Hz/volt and K_p = 5 radians/volt. The carrier frequency $f_C = 100$ MHz. **(06 Marks)**

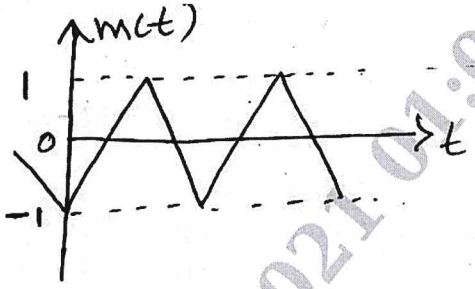

Fig.Q5 (a) – (i)

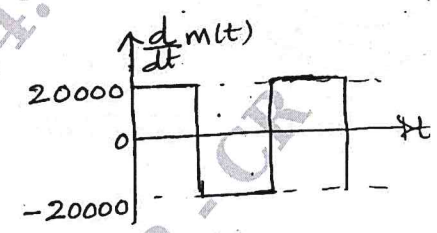

Fig.Q5 (a) – (ii)

b. With block diagram and necessary equations, explain the generation of Narrowband frequency modulation. **(07 Marks)**

c. Explain the generation of frequency stabilized FM wave using Direct FM method. **(07 Marks)**

6 a. With circuit diagram, explain FM stereo transmitter and receiver system. **(08 Marks)**

b. What is phase locked loop? With necessary mathematical equations and equivalent non-linear and linear model of PLL show that output of the PLL is the scaled version of the original message signal m(t). **(12 Marks)**

7 a. Write a short note on white noise. **(06 Marks)**

b. Define noise-factor. Derive the expression for noise factor for cascade connection of two port networks. **(06 Marks)**

c. Consider a receiver system consisting of an antenna with lead in cable having a loss factor of L = 1.5 dB = F_1 an RF pre-amplifier with a noise figure of F_2 = 7 dB and a gain of 20 dB followed by a mixer with a noise figure F_3 = 10 dB and a conversion gain of 8 dB and finally an integrated circuit IF amplifier with a noise figure of F_4 = 6 dB and a gain of 60 dB. [Assume Room temperature 25°C],

(i) Find the overall noise figure and noise temperature of the system.

(ii) Find the noise figure and noise temperature of the system with preamplifier and cable interchanged. **(08 Marks)**

8 a. Derive the expression for the figure of merit for DSBSC receiver. **(08 Marks)**

b. The carrier reaching an envelope detector in an AM receiver has an RMS value equal to 1 V 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 at a depth of 100% and message bandwidth, W = 3.2 KHz, find $[SNR]_0$. **(04 Marks)**

c. Write a short notes on pre-emphasis and de-emphasis. **(08 Marks)**

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