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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: V**
Branch: Electronics and Telecommunication Engineering **Duration: 3 hrs.**
Course Code: 19ET5PCACM **Max Marks: 100**
Course: ANALOG COMMUNICATION

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably assumed.

UNIT - I

1 a) Consider 2 independent random variables X and Y with probability density functions fx(x) and fY (y). Consider new random variable Z=X+Y. Obtain PDF of Z. **07**

b) Consider the output of an oscillator given by x(t) =A cos(wc+θ) where θ =u(0,2π). Obtain Ex(x), R(τ)and PSD **07**

c) The probability density function(pdf) of a random variable X is given by **06**

e $f_X(X) = \begin{cases} k; a < X < b \\ 0; Otherwise \end{cases}$

Where k is a constant. Determine K and sketch PDF

OR

2 a) In an experiment, a trial consists of four successive tosses of a coin. If we define an RV x as the number of heads appearing in a trial, Determine $P_x(x)$ and $F_x(x)$ **06**

b) i)Define noise equivalent bandwidth. Derive the expression for the same. **08**
ii)Define white noise. Plot power spectral density and auto correlation function of ideal low pass filtered noise.

c) Analyze various sources of noise that affect communication system. **06**

UNIT - II

3 a) Show that the AM signals can be demodulated by a square law detector flowed by a low pass filter. **06**

b) Let $c(t)=A_c\cos(2\pi f_c t)$ and $m(t)=\cos(2\pi f_m t)$. It is given that $f_c >> 5f_m$. The signal c(t)+m(t) is applied to the input of a non-linear device, whose output Vo(t) is related to input $V_i(t)$ as $V_o(t)=aV_i(t)+bV_i^2(t)$, where a and b are positive constants. The output of the non linear device is passed through an ideal band pass filter with center frequency f_c and bandwidth $3f_m$, to produce an amplitude modulated (AM) wave. If it is desired to have the sideband power of the AM wave to be half of the carrier power, then find a/b? **06**

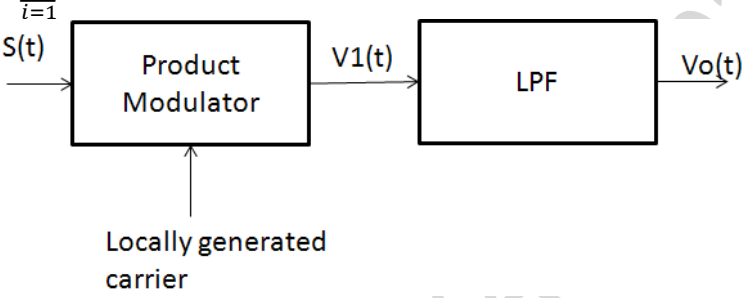
c) A carrier wave C(t)=4 $\sin(2\pi\times500\times10^3 t)$ is amplitude modulated by an audio wave m(t) =0.2 sin 3($2\pi\times500t$)+ 0.1 sin 5($2\pi\times500t$). Determine upper and lower sidebands and sketch the complete spectrum of the modulated wave. Estimate power in sidebands. **08**

UNIT - III

4 a) Derive an expression for SSB modulated wave for which upper side band is retained. **08**

b) As an illustration of phase and frequency discrepancy in synchronous detection of SSB-SC signal shown the following figure, consider the synchronous detection of the signal given by **06**

$$s(t) = \sum_{i=1}^{N} [\cos(2\pi f_c t)\cos(2\pi f_i t + \theta_i) - \sin(2\pi f_c t)\sin(2\pi f_i t + \theta_i)]$$



i)Show that the modulation can be completely recovered if the cutoff frequency of the filter $f_N < fo < 2f_c$

ii)Analyze the recovered signal(Vo(t)) when the multiplying signal is $\cos(2\pi f_c t+\Theta)$ with appropriate equation.

iii)Analyze the recovered signal when the multiplying signal is $\cos\{2\pi f_c +\Delta f)t\}$ with appropriate equation. Given $\Delta f << f_i$.

c) How would you choose the local oscillator frequency f_l, so that the mixer input is translated upward in frequency? Consider the bandwidth of a signal 9 KHz and the mid band frequency range 0.615 – 1.715 MHz. It is required to translate this signal to a fixed frequency band centered at 0.470MHz. Determine the range of tuning that must be provided in the local oscillator to perform necessary frequency translation **06**

OR

5 a) Define Hilbert transform. State and prove the properties of Hilbert transfor **06**

b) Derive an expression for VSB modulated wave for which upper side band is retained **08**

c) Consider a two stage product modulator with a band pass filter after each product modulator, where input signal consists of a voice signal occupying the frequency band 0.3 to 3.4 kHz. The two oscillator frequencies have values f1= 100kHz and f2=10Mhz. specify the following **06**

i) Sidebands of DSB-SC modulated waves appearing at the two product modulator output.
ii) Sidebands of SSB modulated waves appearing at BPF outputs.
iii) The pass bands of the two BPF's.

UNIT - IV

6 a) Show that FM signals has infinite sidebands with appropriate derivation. **08**

b) Explain the generation of WBFM wave using voltage controlled oscillator. **08**

	c)	Determine the permissible range in maximum modulation index for i) Commercial FM that has 30 Hz to 15 Khz modulating frequencies. ii) Narrow band system that allows maximum deviation of 10 KHz and 100Hz to 3KHz modulating frequencies.	**04**

UNIT - V

7	a)	Describe tuned radio frequency receiver with appropriate diagram	**06**
	b)	Derive the FOM of Amplitude modulation technique.	**08**
	c)	Describe superheterodyne receiver with neat block diagram	**06**

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