CMR
INSTITUTE OF
TECHNOLOGY

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Internal Assesment Test - III

Sub:	PRINCIPLES OF COMMUNICATION SYSTEMS							Code:	15EC45
Date:	25 / 05 / 2017	Duration:	90 mins	Max Marks:	50	Sem:	IV	Branch:	B & C

Answer three question from Part A and all questions in Part B

Part A

		Marks	OBE CO	OBE RBT
1	Consider a communication system that transmits signals using AM. The following are the requirements. The signal to be transmitted is: $m(t)=\sin(100®t)$. The carrier $c(t)=\cos(3600®t)$ is used to generate the DSB – SC AM signal. For the above: (a) Sketch the spectrum of the message signal that is be transmitted. (b) Determine and sketch the spectrum of the resulting DSB – SC – AM signal. Indentify the upper and lower side bands in the spectrum.	[10]	CO3	L3
2	An amplitude modulated signal is given by, $s_{AM} = \lfloor 15+2\cos(80®)+5\sin(120®)\rfloor \cos(4000®t)$ (a) Plot the spectrum of $s_{AM}(t)$ (b) Determine the power in the carrier and side band spectral components.	[10]	CO2	L3
3	In a communication system, the FM modulating signal is given by the following. $m_{FM}(t)=10\cos(2® \times 300t)+ +25\cos(2® \times 600t)$ a. Write an expression for the FM waveform $s_{FM}(t)$ where $A_c = 100$, $f_c = 5\,MHz$ and $k_f = 200\,Hz/V$. b. Determine maximum frequency deviation Δf and maximum phase deviation Δ¤ and the deviation ratio of the modulated signal.	[10]	CO1	L4
4.	An FM signal is generated by modulating a $10\,Mhz$ carrier with a $1\,kHz$ sinusoidal message signal such that the peak frequency deviation is $2.5\,kHz$. a. Determine the BW of the modulated signal. b. If the modulating signal amplitude is doubled, determine the BW of the modulated signal. Determine the BW of the modulated signal if the modulating signal frequency is doubled.	[10]	CO1	L4

Part B

CO5 L3

1. Draw a diagram of a ring modulator and describe its operation Very briefly [10]

2. Briefly describe how wide band FM signals are generated. [10]

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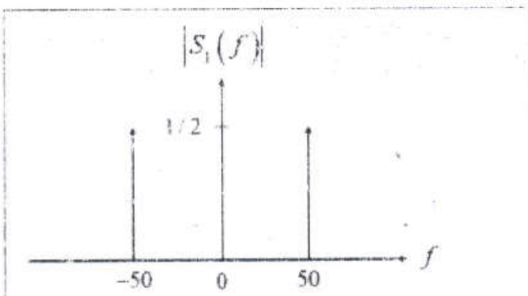
Problem #1

I have used a higher frequency instead of 1800 Hz. I have used 18000Hz. The principle is the same.

a. Sketch the spectrum of message signal

$$S_1(f) = \frac{1}{2j}\left[\delta(f-50) - \delta(f-50)\right]$$



4

b. Determine and sketch the spectrum of the resulting DSB-SC AM signal. Identify the upper and lower sidebands in the spectrum.

Solution:

$$x_1(t) = s_1(t)\cos(36000\pi t) = \sin(100\pi t)\cos(36000\pi t)$$

$$= \frac{1}{2}\left[\sin(36100\pi t) - \sin(35900\pi t)\right]$$

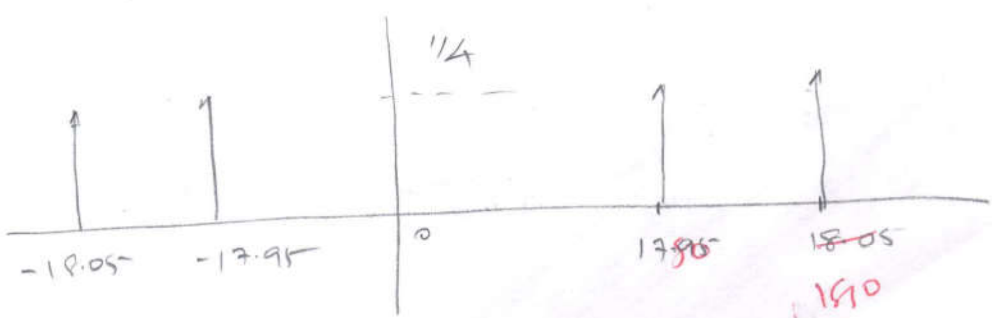
6

3700 3500

Taking the FT of both sides, we obtain

$$X(f) = \frac{1}{4j}\left[\delta(f-18050) - \delta(f+18050) - \delta(f-17950) + \delta(f+17950)\right]$$

1850 1850 1750 1750



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Problem #2

using trignometric identities

$$x_{am}(t) = 15\cos(4000\pi t) + \cos(4080\pi t) + \cos 3920\pi t + 2.5\sin(4120\pi t)$$

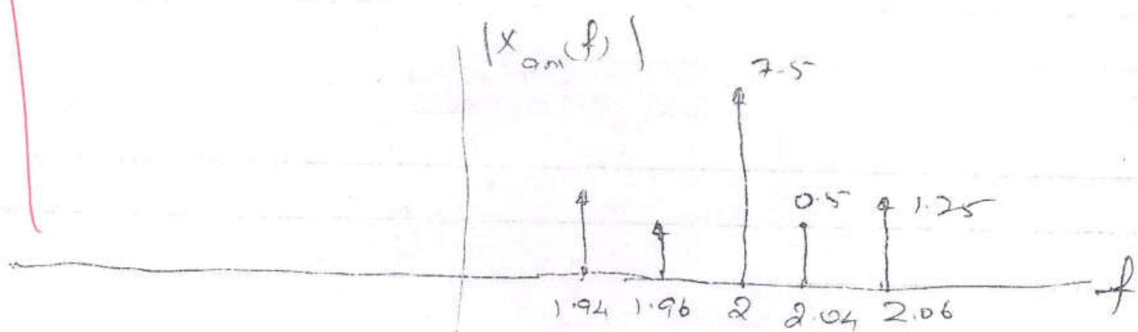
FT

$$X_{am}(f) = 7.5[\delta(f-2000) + \delta(f+2000)]$$
$$+ 0.5[\delta(f-2040) + \delta(f+2040)]$$
$$+ 0.5[\delta(f-1960) + \delta(f+1960)]$$
$$- \frac{1.25}{j}[\delta(f-1940) - \delta(f+1940)]$$
$$+ \frac{1.25}{j}[\delta(f-2060) - \delta(-f+2060)]$$

5

X

2



Similarly on the -ve side

b. Power. Carrier $\frac{(15)^2}{2} = 112.5\ W$

3

Sideband comp $\frac{(1)^2}{2} + \frac{(1)^2}{2} + \frac{(2.5)^2}{2} + \frac{(2.5)^2}{2} = 7.25\ W$

Problem #3

a. $m(t) = 10\cos(2\pi \cdot 300t) + 25\cos(2\pi \cdot 600t)$

given $A_c = 100$ $f_c = 5$ MHz

$k_f = 200$ Hz/v

$s(t) = A_c \cos\left[2\pi f_c t + 2\pi k_f \int_{-\infty}^{t} m(\alpha)\, d\alpha\right]$

$= 100\cos\left[2\pi \cdot 10^6 t + 2\pi \cdot 200 \left\{ 10 \frac{\sin(2\pi \cdot 300t)}{2\pi \cdot 300} + 25 \frac{\sin(2\pi \cdot 600t)}{2\pi \cdot 600} \right\}\right]$

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$= 100\cos\left[2\pi \cdot 10^6 t + \frac{2\pi \cdot 200}{2\pi \cdot 600}\left\{20\sin(2\pi \cdot 300t) + 25\sin(2\pi \cdot 600t)\right\}\right]$

$= 100\cos\left[2\pi \cdot 10^6 t + \frac{1}{3}\left\{\frac{20\sin(2\pi \cdot 300t)}{3} + \frac{25\sin(2\pi \cdot 600t)}{3}\right\}\right]$

b. maximum freq deviation.

$\Delta f_{max} = k_f \cdot \max$ of $m(t)$

$= 200 \times 35 = 7000$ Hz

2

Maximum phase deviation $\Delta\theta_{max}$ -

6

is maximum value of the angle

2

$\phi(t) = \frac{20}{3}\sin(2\pi \cdot 300t) + \frac{25}{3}\sin(2\pi \cdot 600t) = 15$ rad

2

Deviation Ratio $= \frac{\Delta f_{max}}{B} = \frac{7 \times 10^3}{600} = 70/6$

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IAT 3: Solutions: Problem #1

Problem #4

a. Determine the bandwidth of the modulated signal.

Solution:

$$B_T = 2(\Delta f_{max} + f_m)$$

Substituting $f_m = 1$ kHz and $\Delta f_{max} = 2.5$ kHz, we obtain

$$B_T = 2(2.5 + 1) = 7 \text{ kHz}$$

b. If the modulating signal amplitude is doubled, determine the bandwidth of the modulated signal.

Solution:

Doubling the amplitude doubles the peak frequency deviation Δf_{max}. Therefore,

$$\Delta f_{max} = 5 \text{ kHz}$$

Substituting yields

$$B_T = 2(5 + 1) = 12 \text{ kHz}$$

c. Determine the bandwidth of the modulated signal if the modulating signal frequency is doubled.

Solution:

Now $f_m = 2$ kHz and $\Delta f_{max} = 2.5$ kHz. Substituting

$$B_T = 2(2.5 + 2) = 9 \text{ kHz}$$