CMR
INSTITUTE OF
TECHNOLOGY

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CMR

Internal Assesment Test - I

Sub:	PRINCIPLES OF COMMUNICATION SYSTEMS							Code:	15EC45
Date:	30 / 03 / 2017	Duration:	90 mins	Max Marks:	50	Sem:	IV	Branch:	B & C
Answer any three questions from Part A and any two questions from Part B									

			OBE	
	PART A	Marks	CO	RBT
1	A message signal, $m(t) = 2\cos(10^4 2®t) + 5\cos(10^3 2®t) + 3\cos(10^4 4®t)$ is Frequency Modulated using a carrier $c(t) = A_c \cos(2®f_c t)$. a. Determine the BW assuming $k_f = 15\times10^3\ Hz/V$. b. Determine the modulation index. .	[10]	CO3	L3
2	In a Frequency Modulation system the carrier frequency used is $25\ MHz$. The transmitted signal is $m(t) = 10\sin(2®10^4 t)$ a. Determine the BW for both phase modulation and Frequency modulation given that he modulation index is 10 and the phase sensitivity k_p is 1. b. If the modulating frequency is doubled, determine the BW for both FM and PM .	[10]	CO2	L3
3	In an Amplitude Modulation scheme using Suppressed Carrier principle, the modulating signal consists of three tones as shown below: $m(t) = \cos(2®f_i t) + 2\cos(2®f_2 t) + 3\cos(2®f_3 t)$. The carrier used in this scheme is $c(t) = 100\cos(2®f_{ci} t)$. Plot the upper side band spectrum showing clearly the amplitude of each component. Assume that $f_3 > f_2 > f_1$.	[10]	CO1	L4
4	If A_{max} and A_{min} be the maximum and minimum amplitudes of a modulated wave, show that the modulation index « is given by: $« = \frac{A_{max} - A_{min}}{A_{max} + A_{min}}$		CO1	L4
5	Consider and Amplitude Modulation transmission scheme in which a carrier of frequency $f_c = 1MHz$ is used. The modulated signal is given by the following expression. $m(t) = 10\cos(2® \times 10^6 t) + 5\cos(2® \times 10^6 t)\cos(2® \times 10^3 t) + 2\cos(2® \times 10^6 t)\cos(4®$ a. Determine the various frequency components present and the corresponding	[10]	CO1	L3

modulation indices.

b. Draw the line spectrum and the determine the bandwidth

Part B

Question No. 1 Describe briefly the principle of superhetrodyning and explain why intermediate frequency is used.	[10]	CO1	L2
		CO2	L2
Question No. 2 State the properties of angle modulation.	[10]	CO3	L3
Question No. 3 With the help of a diagram, briefly explain stereo multiplexing	[10]		

IAT - I

1. If the f_m is doubled new BW

FM = $2\Delta f + 2f_m = 2 \times 10^5 + 40\,kHz = 240\,kHz$

PM: $\Delta f_{PM} = 1 \cdot 10 \cdot 20\,kHz = 200\,kHz$

$BW = (2\Delta f + 2f_m) = 400\,kHz + 2 \cdot 20 = 440\,kHz$

IAT - I

Problem # 1

$x(t) = 2\cos(10^4 \, 2\pi t) + 5\cos(10^3 \cdot 2\pi t) + 3\cos(2\pi \cdot 2\times10^4 t)$

modulated with $A_c \cos(2\pi f_c t)$

- Max freq is 2×10^4 Hz
- 2^{nd} tone max amp 5V

$k_f = 15\,kHz/v$

$\Delta f = 15\times10^3 \times 5 = 75\,kHz = k_f \cdot A_m$

D deviation ratio $= \frac{75\,kHz}{20\,kHz} = 7.5/2$

$BW = 2\Delta f\left[1 + \frac{1}{D}\right] = 2\times75\left[1 + \frac{2}{7.5}\right]$

$= 190\,kHz$

$\beta = \frac{25}{2}$

AZONE

Date No.

$\binom{10}{3} = \frac{\lfloor 10}{\lfloor 3 \lfloor 7}$

10·9·8·7·6·5·4·3·2 / 3·2 7·6·5·4·3·2

10·3·4 × 0·25 × 0·5

120 × ·125 × 0·015625 × ·5

0·25 × ·5 / ·125

·125 × ·125 / 5

AZONE

Problem # 2

$$m(t) = 10 \sin(2\pi \times 10^4)t$$

$A_m = 10V, \; f_m = 10^4 Hz$

FM

$$\Delta f = k_f \cdot A_m$$

$$\beta = 10 = \frac{\Delta f}{f_m} = \frac{k_f \cdot A_m}{f_m} = \frac{k_f \cdot 10}{10^4}$$

$$10 = \frac{k_f \cdot 10}{10^4} \Rightarrow k_f = 10^4$$

$$\Delta f = k_f \cdot A_m = 10^4 \cdot 10 = 10^5 Hz$$

$$BW = 2\Delta f + 2f_m = 2 \times 10^5 + 2 \cdot 10^4 = 220 KHz$$

PM. $k_p = 1$

$$f_i(t) = \frac{1}{2\pi} \frac{d\theta(t)}{dt}$$

$\phi(t) = k_p |m(t)|$

$$\theta(t) = 2\pi f_c t + \phi(t)$$

$$f_i(t) = f_c + k_p \frac{d}{dt} \frac{10 \cdot \sin(2\pi \times 10^4)t}{2\pi}$$

$$= f_c + 1 \cdot 10 \cdot \frac{2\pi \times 10^4}{2\pi} \cos(2\pi \times 10^4)t$$

$$= f_c + 10^5 Hz, \text{ comparing}$$

$\Delta f_p = 10^5 Hz = 1 \cdot 10 \cdot 10^4$ $\quad \Delta f = k_p \cdot A_m \cdot E$

$$BW = 2\Delta f + 2f_m = 2 \times 10^5 + 2 \times 10^4$$

$$= 220 KHz$$

IAT - I

Question no. 5

We Know

$m(t) = [A_c + m(t)] \cos(2\pi f_c t)$

$m(t) = 10 \cos(2\pi \times 10^6 t) + 5 \cos(2\pi \times 10^6 t) \cos(2\pi \times 10^3 t)$
$+ 2 \cos(2\pi \cdot 10^6 t) \cos(4\pi \cdot 10^3 t)$

$m(t) = 10 [1 + 0.5 \cos(2\pi \cdot 10^3 t) + 0.2 \cos(2\pi \cdot 2 \times 10^3 t)]$
$\times \cos(2\pi \cdot 10^6 t)$

Comparing with Standard Eqn

$A_c = 10, \ \mu_1 = 0.5, \ \mu_2 = 0.2$

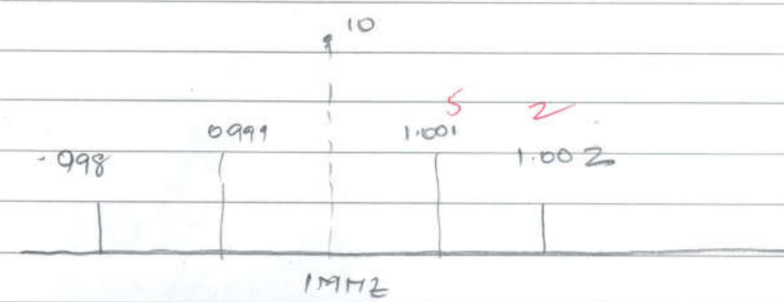
$f_c = 10^6 Hz, \ f_1 = 10^3 Hz, \ f_2 = 2 \times 10^3 Hz$

Carrier freq $= 10^6 Hz$

USB . $f_c + f_1 = 1000000 + 1000 = 1.001 MHz$
LSB $f_c - f_1 = 1000000 - 1000 = 0.999 MHz$] Tone 1

USB . $f_c + f_2 = 1000000 - 2000 = 1.002 MHz$
LSB $f_c - f_2 = 1000000 - 2000 = 0.998 MHz$

Line Spectrum



Problem # 3

$$m(t) = \cos(2\pi f_1 t) + 2\cos(2\pi f_2 t) + 3\cos(2\pi f_3 t)$$

$$c(t) = 100 \cos(2\pi f_c t)$$

given $f_3 > f_2 > f_1$

Modulator output

$$s(t) = m(t) \times \cos(2\pi f_c t)$$

$$= \left[\cos(2\pi f_1 t) + 2\cos(2\pi f_2 t) + 3\cos(2\pi f_3 t)\right] \times \cos(2\pi f_c t)$$

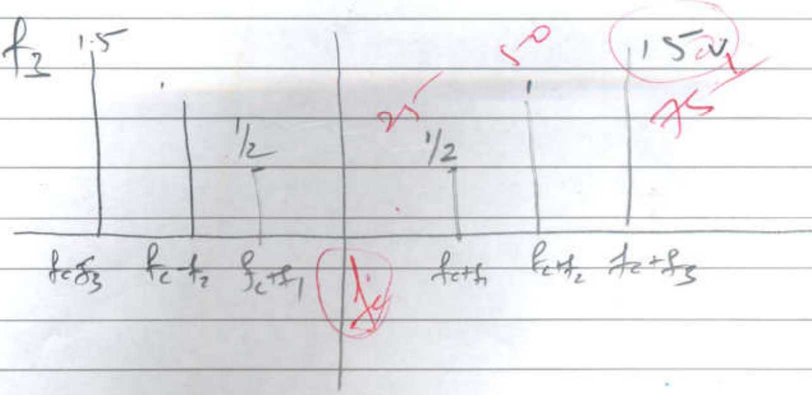
$$= \cos 2\pi f_1 t \cdot \cos(2\pi f_c t) + 2\cos(2\pi f_2 t)\cdot\cos(2\pi f_c t) + 3\cos(2\pi f_3 t)\cdot\cos(2\pi f_c t)$$

$$= \frac{1}{2}\cdot 1\cdot 1\cdot\left[\cos 2\pi(f_1 + f_c)t + \cos (f_c - f_1)t\right]$$

$$+ \frac{1}{2} 1\cdot 2 \left[\cos 2\pi(f_c + f_2)t + \cos (f_c - f_1)t\right]$$

$$+ \frac{1}{2} 1\cdot 3 \left[\cos 2\pi(f_c + f_3)t + \cos 2\pi(f_c - f_3)2\right]$$

BW = $2 f_3$



1. Each side band at $f_1 = \frac{0.5 \times 10}{2} = 2.5V$

2. " " " $f_2 = \frac{0.2 \times 10}{2} = 1V$

$BW = 2f_2 = 4KHz$

Problem # 4

$A_m = A_{max} - A_c = A_c - A_{min}$

By definition $\mu = \frac{A_m}{A_c}$

$\therefore \mu = \frac{A_{max} - A_c}{A_c}$

$\mu = \frac{A_c - A_{min}}{A_c}$

Adding

$2\mu = \frac{A_{max} - A_{min}}{A_c}$

$\mu = \frac{A_{max} - A_{min}}{2A_c}$

Subtract

$0 = \frac{A_{max} - A_c - A_c + A_{min}}{A_c}$

$2A_c = A_{max} - A_{min}$

Sub we have

$\mu = \frac{A_{max} - A_{min}}{A_{max} + A_{min}}$