Answer **ALL** questions

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Question 1 [10 marks]

A. Circle the number of the correct answer

1. The instantaneous frequency $s(t)=Ac\cos(100\pi t + \pi t^2)$ is
   a) fi= $100\pi +2\pi$
   b) $50 + t$
   c) fi=$100\pi t+\pi t$
   d) fi=$100\pi t +\pi t^2$
   e) fi=$100\pi t$
2. When the modulation index is equal to zero, the total transmitted power in convential AM system is equal to
   a) One of the sidebands
   b) Carrier
   c) Double sidebands
3. The increase or decrease in the frequency around the carrier frequency is termed as
   a. Bandwidth
   b. Frequency deviation
   c. Modulation index
   d. Frequency spectrum
   e) None of the above
4. With increase in the modulation index of an FM wave, the number of sidebands having significant amplitude will
   a) Increase
   b) Decrease
   c) Remain constant
5. $s(t) = 5[\cos(10^6\pi t) - \sin(10^3\pi t) \times \sin(10^3\pi t)]$ represents :
   (a) DSB suppressed carrier signal
   (b) AM signal
   (c) SSB upper sideband signal
   d) Narrow band FM signal
   e) none of them
6. A carrier wave is modulated by a number of cosine waves with modulation indices 0.1, 0.2, 0.3. The total modulation index (μ) of the wave is:
   a) 0.374
   b) 0.775
   c) 0.3
   d) 0.6
   e) 0.1
7. A message signal $m(t) =\cos(2000\pi t)+ 4\cos(4000\ \pi t)$ modulates the carrier $c(t)=\cos(2\pi f_c t)$ where $f_c = 1MHz$ to produce an AM signal. Using an envelop detector, the time constant RC of the detector circuit should satisfy:
   a) 0.5ms < RC< 1ms
   b) 1μs<< RC<<1 ms
   c) 1μs<< RC<<0.5ms
   d) RC>> 0.5 ms
   e)RC= 1 μs
8. A message signal $m(t) =\frac{1}{2}\cos(w_1 t)- \frac{1}{2}\cos(w_2 t)$ is amplitude modulated with carrier of frequency f_c to generate $s(t)=[1+m(t)]\cos(2\pi f_c t)$. The power efficiency achieved by this AM scheme is:
   a) 8%
   b) 50%
   c) 20%
   d) 33.3%
   e)11.1%

9. Which of the following receiver does not have an amplitude limiter stage?
   a) AM
   b) PM
   c) FM
   d) Both AM and PM
   e) Both FM and PM

10. What is the frequency of modulating signal in FM system, if it has 8 significant sidebands, and the maximum bandwith is 32kHz
    a) 4kHz
    b) 8kHz
    c) 12kHz
    d)AM wave
    d) 2kHz
    e) 6kHz
    e) Zero

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Question 2 [15 marks]

A. Explain the detection of FM wave using balanced frequency discrimination along with circuit diagram. **[5 marks]**

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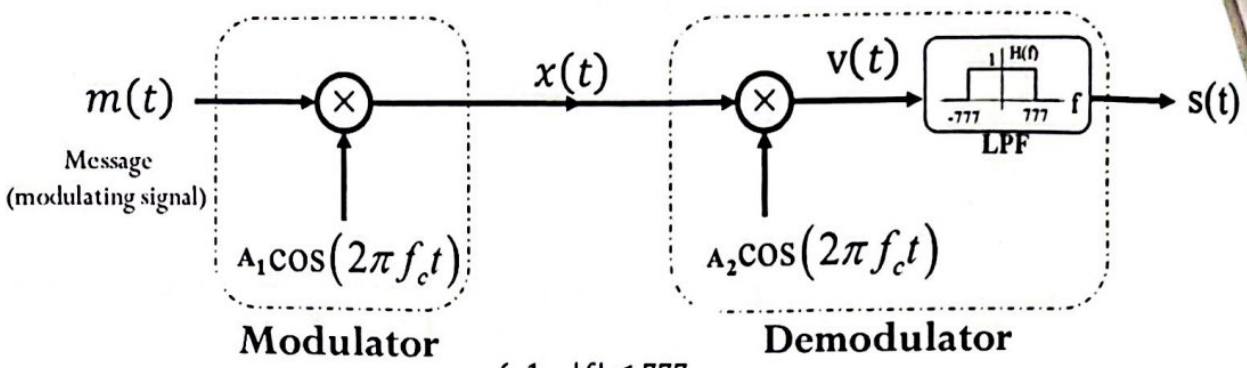
B. Consider the following system. **[10 marks]**



Let A_1=1, A_2=1, fc = 2017 Hz, $H_{LPF}(f)=\begin{cases} 1, & |f| \le 777 \\ 0, & otherwise \end{cases}$

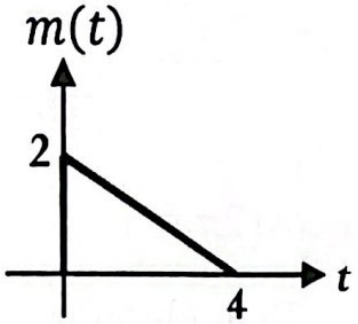
For each of the following m(t), find the corresponding s(t).

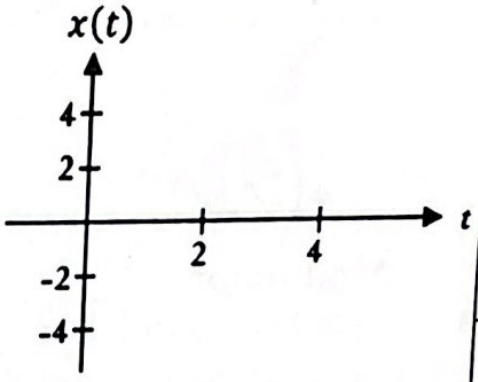
- m(t)= 4cos(456πt) **[2 marks]**

- m(t)= 4cos(3456πt) **[2 marks]**

- m(t)= 4cos(6666πt) **[2 marks]**

- Suppose m(t) is as plotted below, Let A_1=1, A_2=1, fc = 2017 Hz. Sketch x(t) from time t= 0 to time t= 4 in corresponding space below. **[2 marks]**





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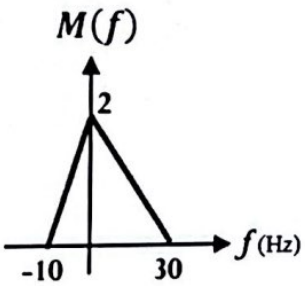
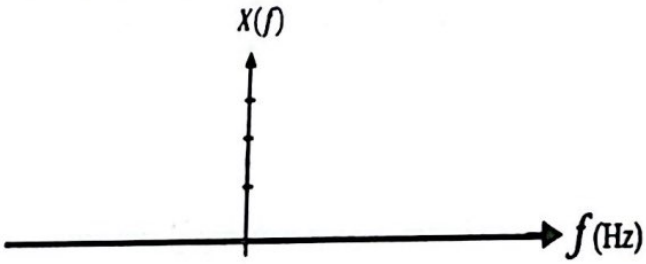
Suppose , fc = 30 Hz, A_1=1, A_2=1 and the Fourier transform of the message is as plotted below. Plot X(f) in the corresponding space below. **[2 marks]**





Question 3 [15 marks]

A. Draw the block diagram and explain generation of DSB-SC signal using balanced modulator. **[5 mark]**

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B. A tone modulated FM signal is given by

$$s(t)= 4\cos(2\pi 10^6 t + 2\sin(2\pi 10^3 t)).$$

1) What is the bandwidth of FM signal in KHz? **[2 marks]**

2)What is the power of the FM signal? **[1 marks]**

3) Determine the maximum frequency deviation and maximum-phase deviation **[2 marks]**

4)What is the power of the carrier component? **[2 marks]**

5) sketch the magnitude spectrum of the FM signal **[3 marks]**

Notes: $\cos(x).\cos(y)=0.5\,[\cos(x+y)+\cos(x-y)]$ $\quad\sin(x)\sin(y)= 0.5[\cos(x-y)-\cos(x+y)]$ $\quad\cos^2(x)= 0.5[1+\cos(2x)]$

- Table of Bessel function

$J_n(\beta)$	$\beta=1$	$\beta=2$	$\beta=3$	$\beta=4$	$\beta=5$	$\beta=6$
J_0	0.7652	0.2239	−0.2601	−0.3971	−0.1776	0.1506
J_1	0.4401	0.5767	0.3391	−0.0660	−0.3276	−0.2767
J_2	0.1149	0.3528	0.4861	0.3641	0.0466	−0.2429
J_3	0.0196	0.1289	0.3091	0.4302	0.3648	0.1148
J_4	0.0025	0.0340	0.1320	0.2811	0.3912	0.3576
J_5	0.0002	0.0070	0.0430	0.1321	0.2611	0.3621
J_6	0.0000	0.0012	0.0114	0.0491	0.1310	0.2458
J_7	0.0000	0.0002	0.0025	0.0152	0.0534	0.1296

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