Notes:

- $\cos(x+y)= \cos(x).\cos(y) - \sin(x).\sin(y)$ $\cos(x-y)= \cos(x).\cos(y) + \sin(x).\sin(y)$
- $\cos(\theta+\pi/2) = -\sin\theta$ & $\sin(\theta+\pi/2) = \cos\theta$
- Table of Bessel function

$J_n(\beta)$	$\beta=1$	$\beta=2$	$\beta=3$	$\beta=4$	$\beta=5$	$\beta=6$
$n=0$	0.7652	0.2239	−0.2601	−0.3971	−0.1776	0.1506
$n=1$	0.4401	0.5767	0.3391	−0.0660	−0.3276	−0.2767
$n=2$	0.1149	0.3528	0.4861	0.3641	0.0466	−0.2429
$n=3$	0.0196	0.1289	0.3091	0.4302	0.3648	0.1148
$n=4$	0.0025	0.0340	0.1320	0.2811	0.3912	0.3576
$n=5$	0.0002	0.0070	0.0430	0.1321	0.2611	0.3621
$n=6$	0.0000	0.0012	0.0114	0.0491	0.1310	0.2458
$n=7$	0.0000	0.0002	0.0025	0.0152	0.0534	0.1296

B. Consider an FM modulator with frequency deviation constant (k_f) 100Hz/V. Used to modulate a message signal $m(t)=10 \cos 2\pi 10^3 t$, if the total transmitted power is 450 Watt:

a) Find modulation index **[2 mark]**

b) Find transmission bandwidth. **[2 marks]**

c) If FM signal maximum frequency reaches 1500kHz, what is the carrier frequency fc? **[2 marks]**

d) Write the fully mathematical expression for the FM signal. **[2 marks]**

e) Sketch in details amplitude spectrum for FM signal. **[2 marks]**

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a) Sketch the spectrum of signal at pint b. **[3 marks]**

b) Sketch the spectrum of signal at pint c. **[3 marks]**

c) Sketch the spectrum of s(t) signal. **[2 marks]**

d) What is the bandwidth of the signal at the output of the modulator s(t) in Hz? **[2 marks]**

10

Question 3 [13 marks]

A. Draw the block diagram of NBPM generation system. **[3 mark]**

3

8. A PM system with $Kp = \frac{\pi}{2}$ is used to transmit the message signal m(t)=u(t). What is the modulated signal for t>0?

a) $s(t)= A_c \cos(2\pi f_c t)$
b) $s(t)= A_c \sin(2\pi f_c t)$
c) $s(t)= - A_c \sin(2\pi f_c t)$
d) None of the above

12

Question 2 [15 marks]

A. What does modulation mean? Why do we do it? State at least **three** reasons for the necessary of modulation?

[2 marks]

Modulation

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[3 marks]

Need for Modulation

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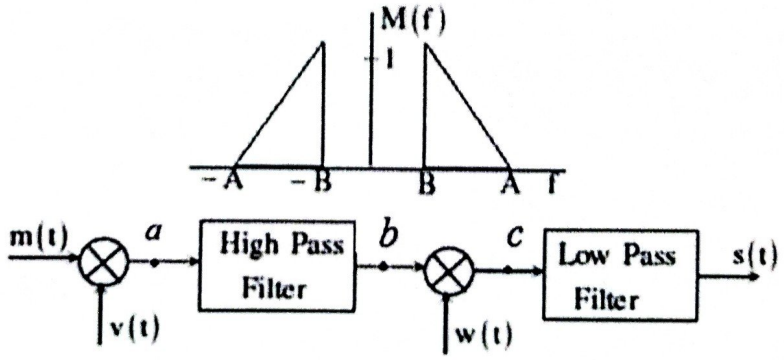
5

B. In the following figure, M(f) is the Fourier transform of the message signal m(t) where A= 100 Hz and B= 40 Hz. Given v(t) = cos (2πfct) and w(t) = cos(2π (fc + A) t) , where fc > A. The cutoff frequencies of both the filters are fc.



أسئلة الامتحان النهائي لمادة: اتصالات 1 قســـم: الاتصالات

التاريخ: 30-05-2021 رمز المادة: CM 201 لطلبة الفصل: الرابع

الزمن: ساعتان اسم الأستاذ : د. امحمد بحيح الفصل الدراسي : خريف 2020

Answer **ALL** questions

40

Question 1 [12 marks]

A. Circle the number of the correct answer

1. Demodulation is done in
   a) Transmitter
   b) Radio receiver
   c) Between transmitter and radio receiver
   d) Both a and b are correct
   e) None of the above
2. For a message signal m(t) = $\cos(2\pi f_m t)$ and the carrier frequency f_c, which of the following represents a single side-band (SSB) signal?
   (a) $\cos(2\pi f_m t)\cos(2\pi f_c t)$
   (b) $\cos(2\pi(f_c - f_m)t$
   (c) $[1 + \cos(2\pi f_m t)]\cos(2\pi f_c t)$
   (d) (c) $\cos(2\pi(f_c + f_m)t$
   (e) Both b & d are correct
3. A message signal m(t) is used to produce AM signal and FM signal. If amplitude of m(t) is increased, its effect on the bandwidth will be:
   a) Bandwidth of AM will not change; bandwidth of FM will increase.
   b) Bandwidth of AM will not change; bandwidth of FM will decrease
   c) Bandwidth of AM will increase; bandwidth of FM will increase.
   d) Bandwidth of AM will increase; bandwidth of FM will not change.
   e) None of the above.
4. A baseband signal m(t) is modulated using carrier frequency 100 kHz. If the spectrum of the modulated signal lies between 97.55 kHz and 100.7 kHz, the modulation scheme used is:
   a) DSB-SC
   b) VSB
   c) SSB
   d) AM
   e) None of the above
5. A device whose output frequency is linearly controlled by its input voltage is called:
   a) Envelop Detector
   b) Band-pass Filter
   c) Square law modulator
   d) Voltage Controlled Oscillator
   e) Both c & d are correct
6. In Frequency modulation
   a) Amplitude of the carrier remains same
   b) Frequency of the carrier varies in accordance with the modulating signal
   c) The number of side bands are infinite
   d) All of the above
   e) None of the above
7. Suppose that the modulating signal is $m(t)=2\cos(2\pi f_m t)$ and the carrier signal is $c(t)=A_c\cos(2\pi f_c t)$, which one of the following is DSB-FC signal without over-modulation?
   a) $s(t)= A_c\, m(t)\cos(2\pi f_c t)$,
   b) $s(t)= A_c\,[1 + m(t)\cos(2\pi f_c t),]$
   c) $s(t)= A_c\cos(2\pi f_m t)\cos(2\pi f_c t) + A_c \sin(2\pi f_m t)\sin(2\pi f_c t)$
   d) $s(t)=A_c\cos(2\pi f_c t) + \frac{Ac}{4} m(t)\cos(2\pi f_c t)$
   e) $s(t)=A_c\cos(2\pi(f_c - f_m)t$