المعهد العالي للمهن الالكترونية / طرابلس

امتحان النهائى ربيع 2005 ف المادة: مبادى اتصالات1 الزمن : ساعتان

Q1:-The signal m (t) =2 cos 200π t is modulated by the carrier c(t)= cos 2000 π t using DSB-FC modulation. If the modulation index is (m = 1)

a) Find the power of the sidebands.
b) Find the power of the carrier (after modulation).
c) Find the efficiency using only m.
d) Find the efficiency using the Power of the carrier and sidebands.
e) Plot the time signal *m(t)*
f) Plot the time signal, *c(t)*
g) Plot the time signal s(t) *DSB*-FC.
h) Plot the spectrum of *m(t). i.e.* M(f).
i) Plot the spectrum of *c(t). i.e. C*(f).
j) Plot the spectrum of s(t). i.e. S(f).

Q2:-I) Compare between AM, DSB and SSB

II) The Transmitted Carrier Amplitude Modulation signal has the following value:

$s(t) = (A + m(t))\cos 200\pi t$

$A = 4$

$m(t) = 4\sin 20\pi t$

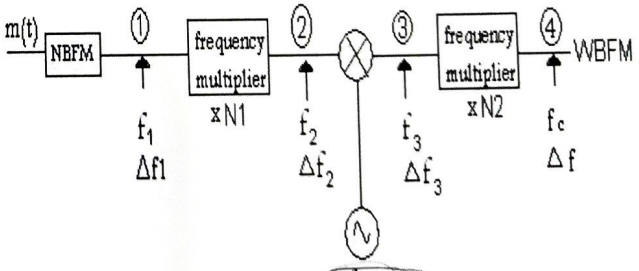
a) Find the power of A
b) Find the power of $m(t) = 4\sin(20\pi t)$
c) Find the power of $s(t) = (A + m(t))\cos 200\pi t$

Q4:- An angle modulated signal is described by $s_{EM}(t) = 10\cos(2000\pi t + 20\sin 20\pi t)$.

Suppose the modulation is PM

a) What is the modulating signal $m(t)$ if $k_p = 2$.
b) Find the average power of the modulated signal.
c) Find the frequency deviation.
d) Find the bandwidth of the modulated waveform (Carson's Rule).
e) Find the modulation index
f) Is this NBPM or WBPM? Explain your answer.

Q4: Block diagram of an indirect (Armstrong) FM transmitter is shown in Fig (1). Compute the unknown parameter at points (1,3,4) in this figure if the f_2=12.8MHz, Δf_2=1.6kHz, f_{LO}=10.8MHz, N1=64 and N2=48



Fig(1)

An angle modulated signal is described by $s_{EM}(t) = 10\cos(2000\pi t + 20\sin 20\pi t)$

1. Suppose the modulation is PM

a) What is the modulating signal $m(t)$ if $k_p = 2$. $m(t) =$ _____

ANSWER: In this case the modulation follows this formula

$\varphi_{PM}(t) = A\cos(\omega_c t + k_p m(t))$

Therefore $k_p m(t) = 20\sin 20\pi t$

$$m(t) = \frac{1}{k_p} 20\sin 20\pi t = \frac{1}{2} 20\sin 20\pi t = 10\sin 20\pi t$$

$$m(t) = 10\sin 20\pi t$$

b) Find the average power of the modulated signal. P_{PM} = _____

ANSWER: In angle modulation of the signal $\varphi_{EM}(t) = A\cos(\omega_c t + k_p m(t))$ *the power is always*

$$P_{FM} = \frac{A^2}{2} = \frac{100}{2} = 50W$$

c) Find the frequency deviation. Δf_{PM} =_____

ANSWER: By the formula $\Delta f_{PM} = \frac{1}{2\pi} k_p m'_p$ *where* m'_p *is the max value of the first derivative of the modulating signal* $m(t) = 10\sin 20\pi t$

$\frac{dm(t)}{dt} = 10 * 20\pi\cos(20\pi t)$ Therefore: $m'_p = 200\pi$

$$\Delta f_{PM} = \frac{1}{2\pi} k_p m'_p = \frac{1}{2\pi}(2)(200\pi) = 200$$

d) Find the maximum frequency content of the modulating signal $B_{m(t)}$ = _____

ANSWER: Because the modulating signal is a tone its maximum frequency is the tone itself

$\omega_m = 20\pi = 2\pi f_m$

$$B_{m(t)} = f_{m(t)} = 10Hz$$

e) Find the bandwidth of the modulated waveform (Carson's Rule). B_{PM} _____

ANSWER: Carson's Rule says: $B_{PM} = 2(\Delta f_{PM} + B_{m(t)})$. *Therefore*

$$B_{PM} = 2(200 + 10) = 420Hz$$

f) Find the modulation index β =_____

ANSWER: $\beta = \frac{\Delta f_{PM}}{B_{m(t)}}$

$$\beta = \frac{200}{10} = 20$$

g) Is this NBPM or WBPM? Explain your answer.

ANSWER: To be Narrow Band PM the frequency deviation has to be small with respect the bandwidth of the modulating signal. in this case $\Delta f_{PM} = 200$ *and* $B_{m(t)} = 10Hz$. *In this case is just the opposite, the Bandwidth of the transmission can be approximated to* $B_{FM} = 2(\Delta f_{PM}) \cong 400Hz$

Therefore it is Wide Band PM.

e) What will happen to Δf_{PM}, $B_{m(t)}$, B_{PM} and β if the amplitude of the modulating signal $m(t)$ is now $m_p = 0.01$. In this case we have NBPM or WBPM?

ANSWER: In this case $m(t) = \frac{1}{100}\sin 20\pi t$

Therefore: $\frac{dm(t)}{dt} = \frac{1}{100}20\pi\cos(20\pi t)$ *Then:*

$m_p' = \frac{2}{10}\pi$. *Hence:*

$$\Delta f_{PM} = \frac{1}{2\pi}k_p m_p' = \frac{1}{2\pi}(2)(\frac{2}{10}\pi) = \frac{2}{10}$$

$B_{m(t)}$ is the same because the frequency of $m(t)$ *did not change* $B_{m(t)} = 10\,Hz$

In this case $B_{PM} = 2(\Delta f_{PM} + B_{m(t)}) = 2(\frac{2}{10} + 10) = 20.04$

And $\beta = \frac{\Delta f_{PM}}{B_{m(t)}} = \frac{0.2}{10} = 0.02$

This is a case of NBPM where $B_{PM} \cong 2(B_{m(t)}) = 2(10) = 20$

The TCAM (Transmitted Carrier Amplitude Modulation) signal in this problem has the following value:

$$\varphi(t) = (A + m(t))\cos 200\pi t$$
$$A = 4$$
$$m(t) = 4\sin 20\pi t$$

a) Find the power of A
b) Find the power of $m(t) = 4\sin 20\pi t$
c) Find the power of $\varphi(t) = (A + m(t))\cos 200\pi t$
d) Discuss your results.

SOLUTION

a) Find the power of A

The power of A is A^2

$P_A = 16$

b) Find the power of $m(t) = 4\sin 20\pi t$

The power of any single tone is $\frac{4^2}{2} = 8$

$P_{m(t)} = 8$

c) Find the power of $\varphi(t) = (A + m(t))\cos 200\pi t$

We have to rearrange the expression to have only linear terms in cos

$$\varphi(t) = (A + 4\sin 20\pi t)\cos 200\pi t$$
$$\varphi(t) = A\cos 200\pi t + 4\sin 20\pi t\cos 200\pi t$$

Because

$$\sin x\cos y = \frac{1}{2}[\sin(x - y) + \sin(x + y)]$$

$$\varphi(t) = A\cos 200\pi t + 4\left(\frac{1}{2}(\sin(-180\pi t) + \sin 220\pi t)\right)$$

$$\varphi(t) = A\cos 200\pi t + 2\sin(-180\pi t) + 2\sin 220\pi t$$

The power is the amplitude squared over two

$$P_{\varphi} = \frac{A^2}{2} + \frac{(2)^2}{2} + \frac{(2)^2}{2} = \frac{A^2}{2} + \frac{4}{2} + \frac{4}{2} = \frac{A^2}{2} + 4$$

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القســـم الاتصالات

أسئلة الامتحان النهائي لمادة: اتصالات1
لطلبة الفصل: الرابع. رمز المادة CM201 التاريخ 2018/07/18

الفصل الدراسي: ربيع 2018 اسم الأستاذ: مصطفى الشاطر الزمن: ساعتان

اسم الطالب :..... ..... رقم القيد ..... المجموعة : .....

(الاسئلة من (1) الى (10)) ضع علامة (√) أو علامة خطاء(X) درجة واحدة لكل سؤال. البقية عشرة درجات لكل سؤال.

Q1- Any scheme that can be used to generate DSB-SC can also generate AM. X

Q2- Any scheme that can be used to demodulate DSB-SC can also demodulate AM. ✓

Q3- If the signal $g(t)$ is not bandlimited, then any sampling rate will result in aliasing.

Q4- Quantization is the second step to convert a digital signal to analog one. analog to digital

Q5- PWM is the technique of varying the width of the constant amplitude pulse proportional to the frequency of the modulation signal.

Q6- The bandwidth of a narrowband FM signal is approximately 200Hz, if the message signal has a bandwidth of 200Hz.

Q7- In a wideband FM, doubling the peak value of the message signal approximately doubles the bandwidth of the FM signal.

Q8- The Nyquist frequency for a signal of bandwidth 8 kHz is 16 kHz.

Q9-In QAM system, we usually use the Hilbert Transform to transmit two signals to reduce the required bandwidth.

Q10- PWM still works if synchronization between transmitter and receiver fails,

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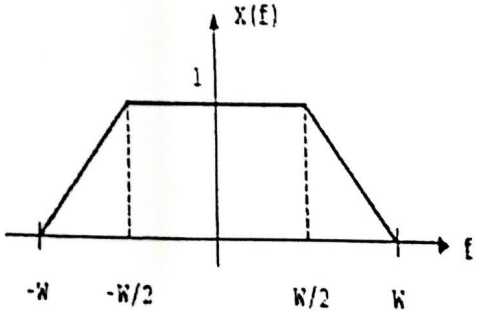
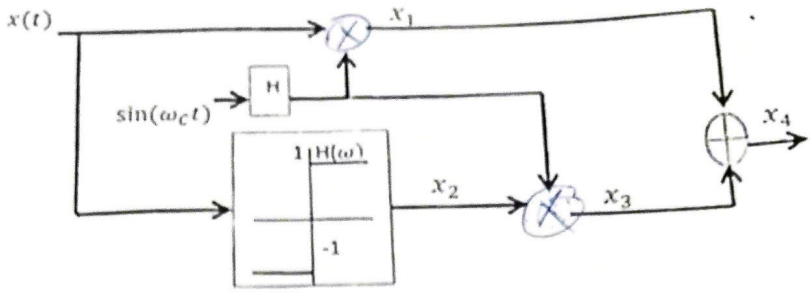
Q11- A signal $x(t)$ has the Fourier transform as shown, the signal is applied to the shown system,. The block marked (H) represents Hilbert transform block, Assume $\omega_C \gg w$

a. Sketch the signal spectra of x1, x2, x3, and x4.
b. What is the modulation scheme.





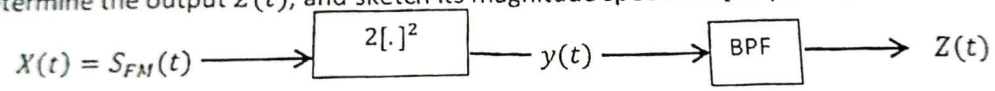
Q12- A normalized sinusoidal signal *a(t)* has a bandwidth of 5,000 Hz and its average power is 0.5W. The carrier $A\cos 2\pi fct$ has an average power of 50W. Determine the bandwidth and the average power of the modulated signal if the following analog modulation scheme is employed:

(a) single-side band modulation with suppressed carrier modulation (SSBSC), which is generated by phase-shift method with the given carrier ;

(b) double-side band with suppressed carrier modulation (DSB-SC) ;

(c) AM or double-side band with large carrier (DSB-LC) with a modulation index of 0.8.

Q13- - $S_{FM}(t) = 5\cos(2\pi \times 10^6\, t + \sin(50000\pi t))$ is input to a square-law nonlinearity (with the characteristic: $y(t) = 2X^2(t)$, where $X(t)$ is the input, $y(t)$ is the output and filtered by an ideal bandpas fillter. The bandpass filter has a center frequency 0f 2.025 MHz and bandwidth of 50kHz. Determine the output $Z(t)$, and sketch its magnitude spectrum.[10 points]



تمنياتي بجميع بالتوفيق

β	J0	J1	J2	J3	J4	J5	J6	J7	J8
0	1								
0.25	0.98	0.12							
0.5	0.94	0.24	0.03						
1.0	0.77	0.44	0.11	0.02					
2.0	0.22	0.58	0.35	0.13	0.03				
3.0	-0.26	0.34	0.49	0.31	0 13	0.04	0.01		
4.0	-0.40	-0.07	0.36	0.43	0.28	0.13	0.05	0.02	
5.0	-0.18	-0.33	0.05	0.36	0.39	0.26	0.13	0.05	0.02

$$\cos^2\theta = \frac{1}{2}[1 + \cos 2\theta] \qquad \sin^2\theta = \frac{1}{2}[1 - \cos 2\theta]$$

$$\sin\theta\sin\varphi = \frac{1}{2}[\cos(\theta - \varphi) - \cos(\theta + \varphi)] \qquad \sin(\theta \pm \varphi) = \sin\theta\cos\varphi \pm \cos\theta\sin\varphi$$

$$\cos\theta\cos\varphi = \frac{1}{2}[\cos(\theta - \varphi) + \cos(\theta + \varphi)] \qquad \cos(\theta \pm \varphi) = \cos\theta\cos\varphi \mp \sin\theta\sin\varphi$$

$$\sin\theta\cos\varphi = \frac{1}{2}[\sin(\theta - \varphi) + \sin(\theta + \varphi)]$$

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القســـم الاتصالات | أسئلة الامتحان النهائي لمادة: اتصالات1 لطلبة الفصل: الرابع. رمز المادة CM201 | التاريخ 2018/01/30

الفصل الدراسي: خريف 2018/2017 | اسم الأستاذ: مصطفى الشاطر | الزمن: ساعتان

اسم الطالب :..... ..... | رقم القيد ..... | المجموعة : .....

س1- بين أي من الاشارات التالية مناسبة كموجة حاملة للأرسال اللاسلكي مع بيان السبب: (2)

I. $m(t) = 8\cos(2\pi \times 10^3 t)$
II. $s(t) = 2\cos(2\pi \times 10^6 t)$

س2- عرف وتحدث باختصار عن كل من: (3)

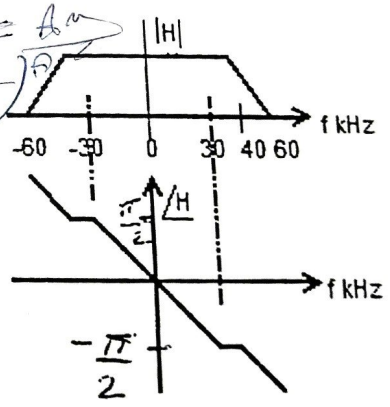
I. 'Modulation.
II. Multiplexing.

س3- ارسم المخطط الصندوقي لأنظمة التضمين التالية: (3)

I. Standard AM.
II. SSB-SC

Q4) A certain AM transmitter of single- tone modulation has a transmission power efficiency of 25% and carrier power of 200w. The modulating signal has a frequency of 1kHz and the carrier of 50kHz.[10-points]

a) Determine the modulation index.
b) Compute the power in the sidebands.
c) Sketch the spectrum of this AM signal.
d) Sketch this AM signal in time domain, indicating Its maximum and minimum values.
e) If we want to send this AM signal through the Shown channel. What should the maximum Frequency carrier frequency be used instead of 50 kHz to avoid distortion.

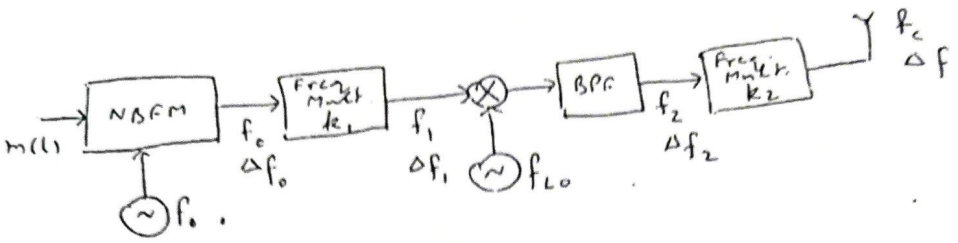


Q5) Consider the following DSB signal:[8- points]

$$s_{DSB}(t) = \cos(495 \times 10^3\, t) + \cos(505 \times 10^3\, t)$$

a. Sketch the spectrum of this DSB signal.
b. Draw a block diagram of DSB demodulator to recover the baseband message, indicating the carrier frequency value and the ideal filter characteristics.
c. Sketch the spectrum of the recovered baseband signal after demodulation process.
d. What is minimum channel bandwidth required to pass this DBS signal through it.

Q6) A wideband FM signal is generated from a narrowband FM generator by Armstrong's indirect method as shown below.[8- points]



The desired (target) carrier frequency f_c is 100 MHz and frequency deviation $\Delta f = 75$ kHz the message signal to be broadcast is given by:

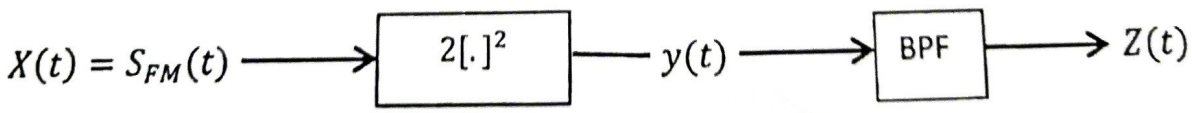
$$m(t) = 1000\sin^2(15000\pi t)$$

The following information is given: $f_0 = 100kHz$, $k_1 = 150$, $k_2 = 50$

Determine the following quantities:

a. NBFM frequency deviation Δf_0
b. Carrier frequencies f_1 *and* f_2 *and the corresponding frequency deviations* Δf_1 *and* Δf_2
c. The oscillator frequency f_{LO}
d. The center frequency and bandwidth of the band pass filter.

Q-7)- $S_{FM}(t) = 5\cos(2\pi \times 10^6\, t + \sin(50000\pi t))$ is input to a square-law nonlinearity (with the characteristic: $y(t) = 2X^2(t)$, where $X(t)$ is the input, $y(t)$ is the output and filtered by an ideal bandpas fillter. The bandpass filter has a center frequency 0f 2.025 MHz and bandwidth of 25kHz. Determine the output $Z(t)$, and sketch its magnitude spectrum.[6 points]



تمنياتي للجميع بالتوفيق

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