Time: 1 hour (for both parts)

الرقم: الفصل: الاسم بالعربية:

Part A (20 marks)

Question 1 (10 marks)

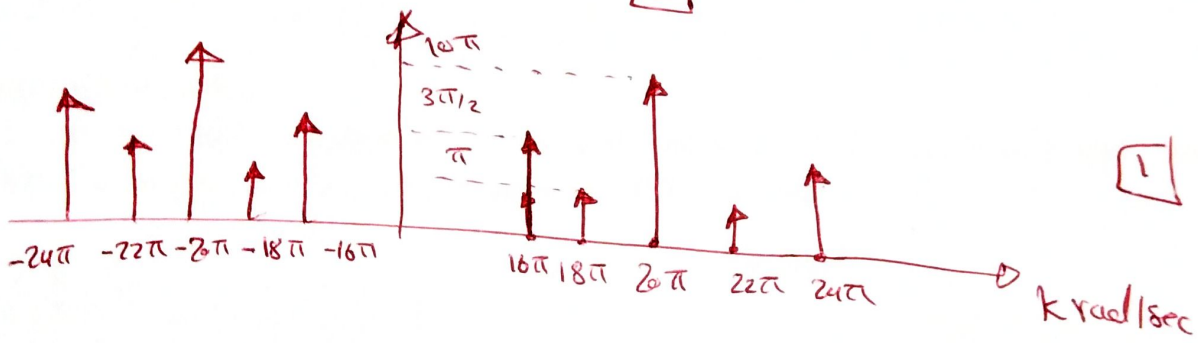
Given a baseband signal $m(t) = 2\cos 2000\pi t + 3\cos 4000\pi t$. And given a sinusoidal carrier of amplitude 10V and frequency 10,000 Hz that is modulated by $m(t)$. The modulation system is conventional AM (DSB-LC).

a) Write down the equation of the modulated signal in time domain, and sketch its spectrum.
b) Find the bandwidth of the modulated signal
c) Find the sideband power.
d) Find the power efficiency.
e) Propose a modulation system that can be used to save transmitted power. What penalty is paid if such a system is used?

[2] $(m(t)+Ac)\cos(\omega c t) = (2\cos(2000\pi t) + 3\cos(4000\pi t) + 10)\cos(20000\pi t)$

$= \cos(22000\pi t) + \cos(18000\pi t) + \frac{3}{2}\cos(24000\pi t) + \frac{3}{2}\cos(16000\pi t) + 10\cos(20000\pi t)$

[1]



[1]

(b) $BW = (24\pi - 16\pi) * 10^3 = 8\pi$ krad/sec [1]

(c) $P_{SB} = \sum (a_k)^2$ or $\frac{(\text{amp of cos in Message})^2}{4}$ or $\left(\frac{\text{amp of Cos in Modulated signal}}{2}\right)^2$ [1]

$= \left(\frac{\pi}{2\pi}\right)^2 * 4 + \left(\frac{3\pi/2}{2\pi}\right)^2 * 4 = 3.25$ watt [1]

(d) $\eta = \frac{P_{SB}}{P_{SB} + P_c} = \frac{3.25}{3.25 + \frac{10^2}{2}} = 6.1\%$ [1]

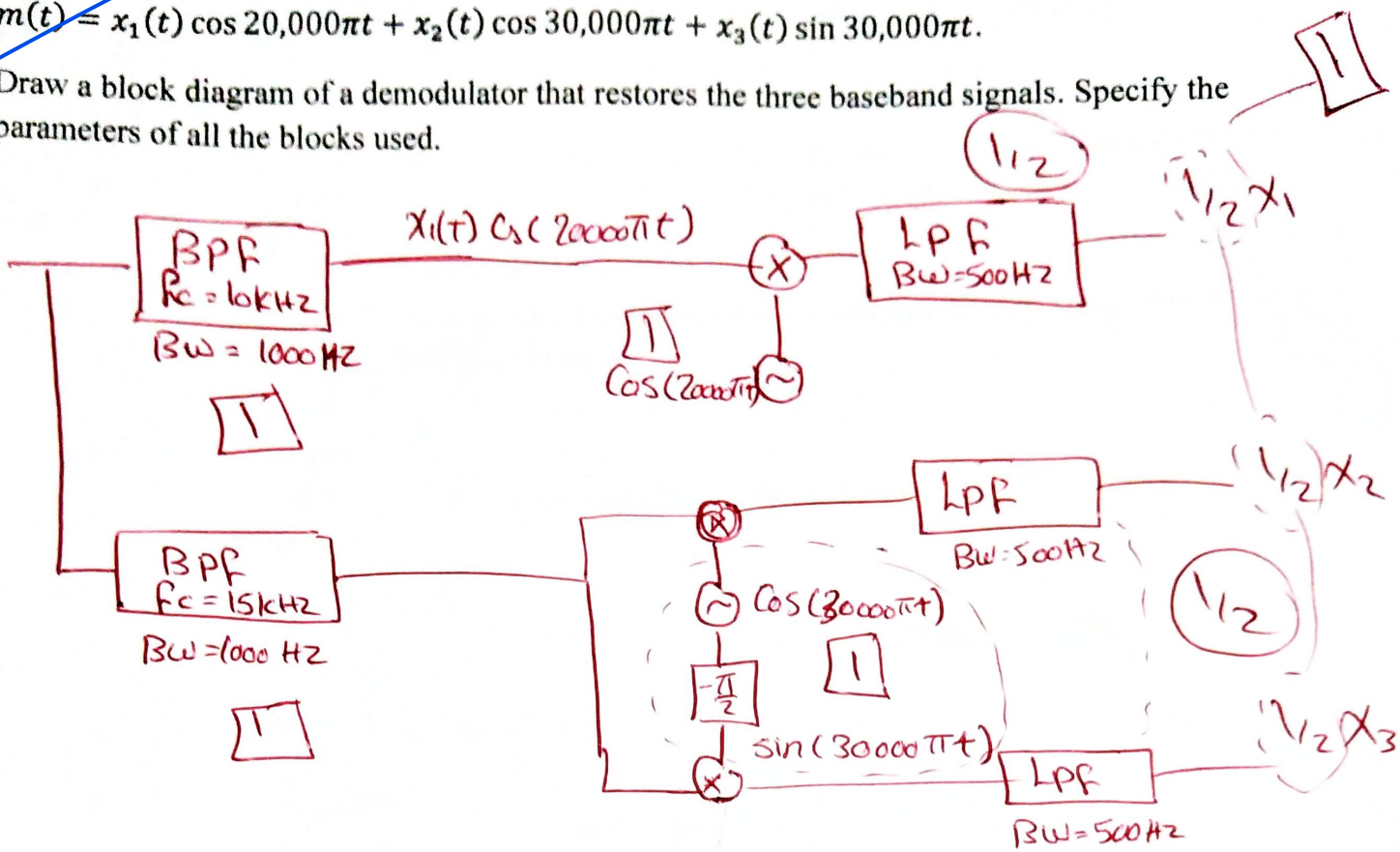
(e) DSB-SC [1]
need synchronization in demodulator or using SSB [1]
need sharp filter

Question 2 (6 marks)

Given three baseband signals $x_1(t), x_2(t)$ *and* $x_3(t)$ which have a bandwidth of 500 Hz each. The three signals are modulated resulting in a signal

$$m(t) = x_1(t)\cos 20{,}000\pi t + x_2(t)\cos 30{,}000\pi t + x_3(t)\sin 30{,}000\pi t.$$

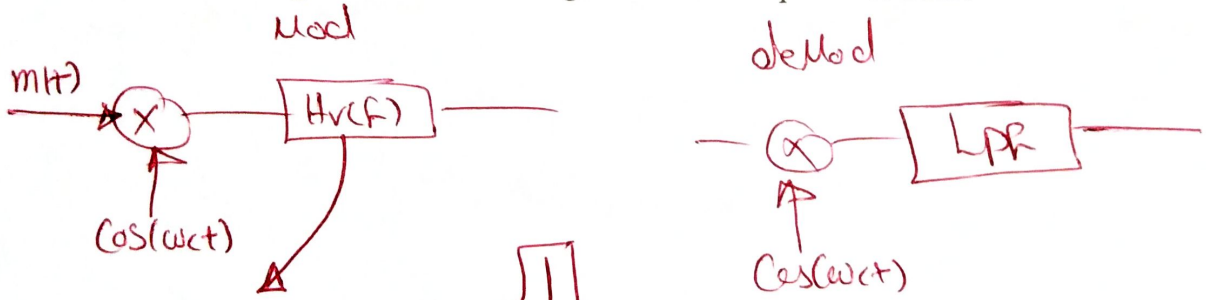
Draw a block diagram of a demodulator that restores the three baseband signals. Specify the parameters of all the blocks used.



Question 3 (4 marks)

a) Draw the block diagram of a vestigial sideband (VSB) modulator and demodulator.

b) Mention an advantage and a disadvantage of VSB compared to SSB.



• Cond of vestigial filter

$H_v(f-f_c) + H_v(f+f_c) = \text{Const}$

50 % response @ f_c

adv — Design of filter is relaxed

disadv — need higher BW & Transmit higher Power

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جامعة القاهرة

Third Year Computer
Mid-Term 2020-2021
December 2020

Communications Engineering (ELC3252A6)

الاسم بالعربية: الفصل: الرقم:

Part B (Total this part 10 Points)

B-1 Choose only one answer for each of the following questions. Mark your answer in Table-I.

(Total this Question: 5 points)

1- In designing a communication system, you have to
   a) select the information bearing waveform,
   b) bandwidth and power of waveform,
   c) a and b above,
   d) none of the above.

2- Among the communication systems operating in the VHF 30MHz-300 MHz (Very High Freq.) ITU Band 8 is:
   a) TV Ch. 14-51
   b) Mobil Telephone (CDMA, TDMA, GSM)
   c) FM radio transmission
   d) none of the above

3- Coaxial cables have many advantages over twisted pair cables such as:
   a) higher bandwidth.
   b) ease of installation.
   c) cheaper.
   d) all the above.

4- Among the advantages of optical fiber cables is (are):
   a) signals travel a longer distance.
   b) no electro-magnetic field interferences.
   c) multiple fiber strands can be included in a cable of very small diameter.
   d) all the above.

5- Among the advantages of Microwave links
   a) wide bandwidth
   b) none line of sight transmission
   c) does not subject to interference
   d) all the above

6- Among the advantages of satellite communication systems
   a) can reach a large geographical area
   b) high bandwidth
   c) small propagation delay
   d) none of the above

7- The maximum bit rate that can be transmitted over the telephone channel depends on,
   a) channel bandwidth.
   b) transmitting power.
   c) signal to noise ratio.
   d) "a" and "c" above.

8- In a noisy telephone channel if the maximum signal to noise ratio is 33 db for an antipodal signal, the maximum bit rate that can be achieved is approximately:
   a) 6,000 bps.
   b) 33,000 bps.
   c) 56,000 bps.
   d) None of the above.

9- DSL is used as last mile technology in telephone networks because
   a) DSL modems don't assume either the 4 kHz analog line or 64 kbps digital line.
   b) higher speed digital connection to subscribers is needed
   c) it is not feasible to replace UTP in the last mile
   d) all the above

10- WiFi 802.11 b/g, Bluetooth, and ZigBee are operating in the ISM sub-band in the
   a) VHF band,
   b) UHF band,
   c) SHF band,
   d) None of the above

Hint: Only answers in the table below will be considered

5

Table I : Answers to Question B-1

	1	2	3	4	5	6	7	8	9	10
a			X		X	X				
b								X		X
c	X	X								
d				X			X		X	

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B-2 Indicate whether the following statements are true or false. Mark your answer in Table II.
(Total this Question : 5 Points)

1. In any communication system, the transmitter carries out signal conditioning to transform the signal to a more appropriate form for the receiver.
2. Communication systems main resources to transfer information are; symbol waveform, power and technology.
3. The demodulator in any communication system cleans up the received signal using appropriate signal processing techniques.
4. In asynchronous communication systems, sender and receiver are not synchronized with respect to the flow of the information nor to the timing of the characters that are transmitted.
5. Digital communications can provide better quality due to being able to reconstruct exact digital patterns at the receiving end.
6. The bandwidth required to transmit a base band binary sequence of rate 8000 bps is 4 kHz.
7. A copper wire of an American Wire Gauge , AWG, 12 is used for power installations while the one with AWG of 24 is used in telephone installations.
8. A thin coaxial cable designated as 10 Base 2 means that it can carry baseband information in digital form with rate up to 10 Mbps up to 200 meter.
9. Direct transmission of data with a rate as low as 9600 pbs is not possible over a voice telephone channel.
10. The theoretical limitations on transmission rate over a telephone line are inversely proportional to the bandwidth.

Hint: Only answers in the table below will be considered

Table-II : Answers to Question B-2

5

	1	2	3	4	5	6	7	8	9	10
True	X		X		X	X	X	X	X	
False		X		X						X