Menoufia University
Faculty of Electronic Engineering
Dept. Electronics and Electrical Commun. Eng.
Course: Communication Engineering (ECE 222)
Second Year
Total Exam Time: 3 Hours (10:00 AM-1:00 PM)
Part 2 Time: 1.5 Hours

2nd Term Exam
Academic Year: 2018 / 2019
Date: 13 / 6 / 2019
No. of Exam Pages: 2
No. of Exam Questions: 2
Total Exam Marks: 70 Marks
Part 2 Marks: 40 Marks

Part 2

Answer all the following questions:

Question 1: [20 Marks]

a) Explain how the problem of aliasing arises in communication systems, and how anti-aliasing filters can be used to prevent this problem. Discuss whether such a filter should come before or after the sampling process. [4 Marks]

b) Explain the difference between analog messages and digital messages. Discuss why digital technology is replacing analog technology in modern communication. [4 Marks]

c) Using mathematical expressions, discuss whether a coherent demodulator could be used to recover the message signal from an AM (DSB with carrier) signal given by $[A + m(t)] \cos \omega_c t$. [4 Marks]

d) You are asked to design a DSB-SC modulator to generate a modulated signal $km(t) \cos 3\omega_c t$, where $m(t)$ is a signal band-limited to B Hz. Fig. Q1.(a) shows a DSB-SC modulator available in the stock. The carrier generator available generates $\cos^3 \omega_c t$. Explain whether you would be able to generate the desired signal using only this equipment. You may use any kind of filter you like. [8 Marks]

   a. What kind of filter is required in Fig. Q1.(a)?
   b. Refer to Fig. Q1.(b) and determine the signal spectra at point x and y.
   c. Would this scheme work if the carrier generator output were $\cos^2 \omega_c t$? Explain.

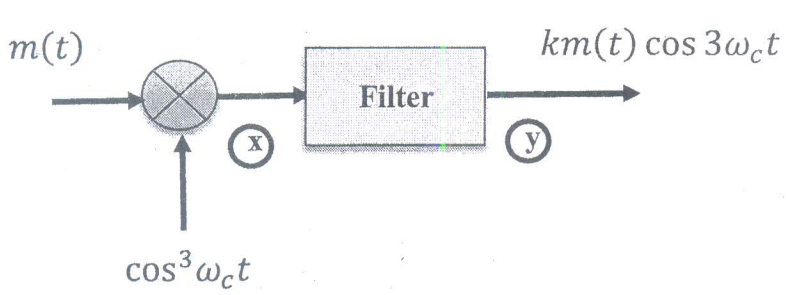

Fig. Q1.(a)

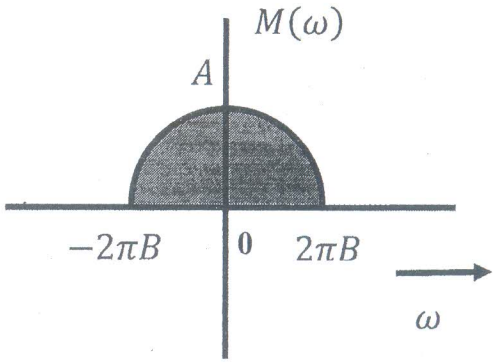

Fig. Q1.(b)

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Question 2: [20 Marks]

a) Draw the block diagram of the Quadrature Amplitude Modulation (QAM) transmitter and receiver. Explain how this scheme can solve the problem of twice the baseband signal bandwidth required for DSB-SC transmission. [4 Marks]

b) Referring to the QAM scheme in the above question, prove that any slight error in the phase or frequency of the carrier used at demodulator will lead to interference between the two channels as well as distortion. [4 Marks]

c) The FM output signal of an angle modulator is given as: [6 Marks]

$$\varphi(t) = 20\cos(1.9 \times 10^8 \pi t + 2\pi \sin 1000\pi t)$$

a. Determine the modulation index and the carrier frequency.

b. Is this signal narrow-band FM or wide-band FM? Determine the effective frequency bandwidth of the signal.

c. If the same signal $\varphi(t)$ were instead the PM output of an angle modulator, what would the original message signal be?

d) Design (only the block diagram) an Armstrong indirect FM modulator to generate an FM carrier with a carrier frequency 98.1 MHz and $\Delta f = 75$ KHz. A narrow-band FM generator is available at a carrier frequency of 80 KHz and $\Delta f = 20$ Hz. The stock room also has an oscillator with an adjustable frequency in the range of 4 to 5 MHz. There is a bandpass filter with any center frequency and plenty of frequency doublers ($\times$ 2), triplers ($\times$ 3), and quintuplers ($\times$ 5). [6 Marks]

WITH MY BEST WISHES

DR. AHMED MOHAMED BENAYA