EE430 Communications systems -- Summer 2004 -- Test #2 -- AM

Name_____

Student number _____

Do not put your name on any sheet other than the cover. Identify those pages only with your student number.

This test is open-book, open-notes. You may use a calculator. All problems are weighted equally.
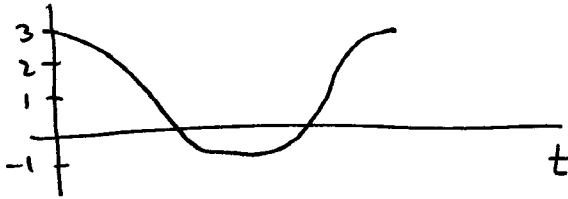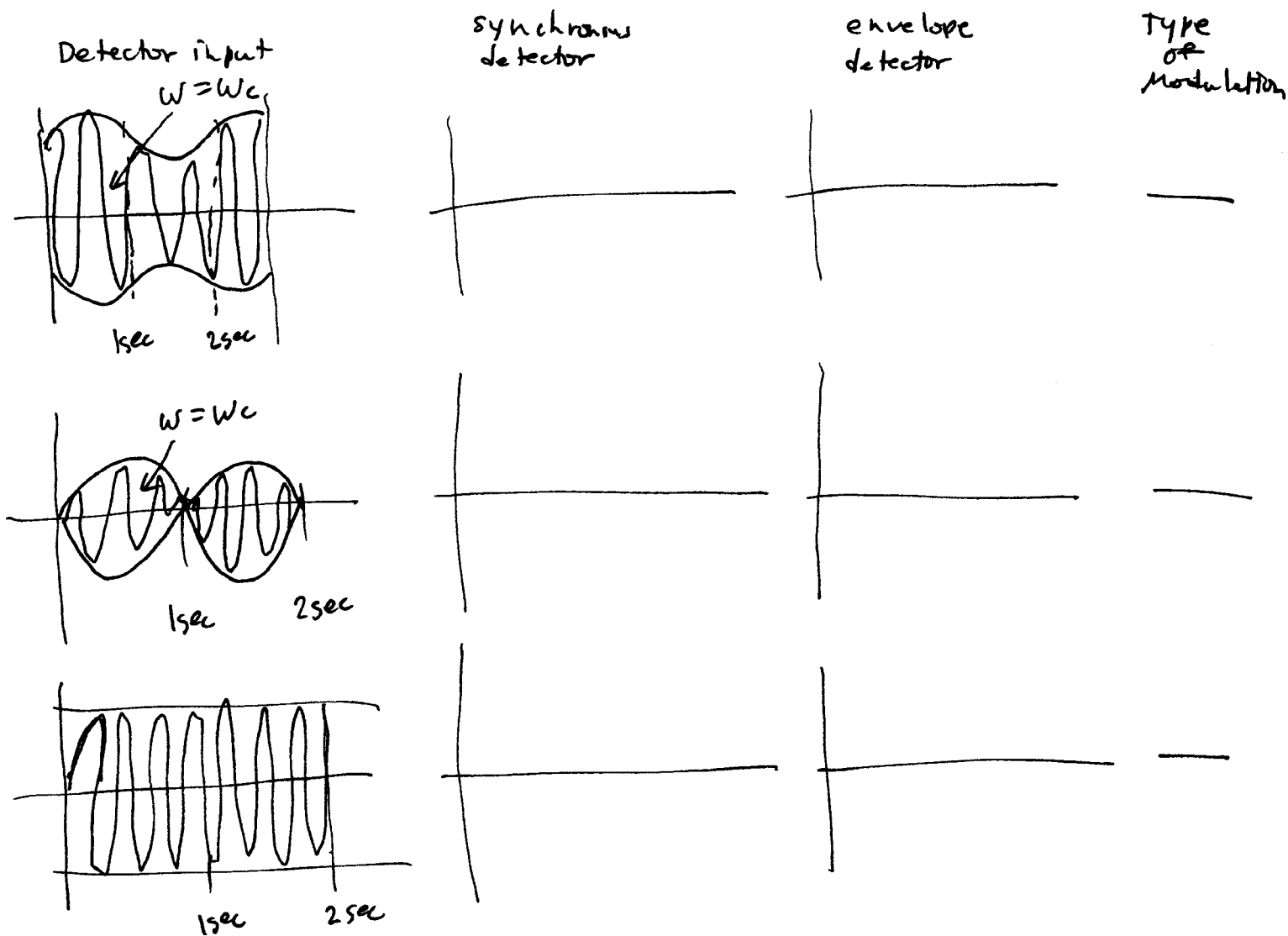
Score:

1 _____

2 _____

3 _____

4 _____

5 _____

Raw total _____

1. A periodic signal f(t) = 1 + 2 cos (100 t) is shown:

a) For amplitude modulation (AM), what must be the minimum carrier amplitude?

b) For this carrier amplitude, sketch the AM waveform if the carrier frequency is **exactly** four times that of f(t).

c) Sketch the frequency spectrum of the AM wave in part b above. Explain anything unusual about it.

d) Sketch the corresponding DSB-SC waveform for this f(t).

e) Sketch the frequency spectrum of the DSB-SC waveform in part d above. Explain the difference.

f) If the waveform of part d is passed through an envelope detector, sketch the output.

2. Sketch the outputs of the following detectors, given the inputs shown. Assume the scale factors of the detectors are unity. Sine wave modulating voltages are used. Give the type of modulation represented by the input voltages.

Detector input	Synchronous detector	envelope detector	Type of Modulation

$W = W_c$

1sec   2sec

$W = W_c$

1sec   2sec

1sec   2sec

3. Suboptimum Communications Co. Ltd., a manufacturer of single sideband communications equipment, has decided to enter the ham radio market with a transceiver for the 3.5 and 7.0 MHz bands. It must receive the frequency ranges from 3.5 to 4.0 MHz and 7.0 to 7.5 MHz. To keep cost down, the local oscillator tuning range should be the same for both bands, using the RF stage selectivity to select which band is being received. The filter method of sideband selection will be used, with an audio frequency range of 500-3500 Hz.

a) Draw a block diagram of this receiver.

b) What is the best choice of intermediate frequency?

c) What is the local oscillator tuning range?

d) What is the BFO frequency to receive ....

      1. LSB at 3.8 MHz

      2. USB at 3.8 MHz

      3. LSB at 7.3 MHz

      4. USB at 7.3 MHz

4. Answer these questions with one or two sentences.

a) In the text, on page 197, there is a description of "Multiplexing Luminance and Chrominance Signals", which indicates the the bandwidths of the color signals are limited. $m_I(t)$ is filtered to 1.6 MHz, and $m_Q(t)$ is filtered to 0.6 MHz. Why is $m_Q(t)$ filtered to a narrower bandwidth than $m_I(t)$?

b) In a system using vestigial sideband, an equalizer is often used in the receiver. What is the purpose of the equalizer?

c) Is it practical to use plate modulation to generate single sideband? Why or why not?

d) You are designing a SSB transmitter using the phase-shift method. You need a switch to select which sideband is transmitted. Without adding any electronics, show with a block diagram or describe in a sentence or two how to wire the switch. Use the simplest, cheapest switch you can.

5. You are designing a SSB transmitter using the phase-shift method. The undesired sideband must be suppressed by at least 60 dB. Assume that everything is perfect except that the gain of the audio amplifiers is not exactly as desired. How much error in the relative gain of the "I" and "Q" amplifiers can be tolerated and still meet the 60 dB sideband suppression spec?