UNIVERSITI SAINS MALAYSIA

Semester II Examination
Academic Session 2010/2011

April/May 2011

EEE 530 – COMMUNICATION CIRCUITS AND SYSTEM

Duration: 3 hours

INSTRUCTION TO CANDIDATE:

Please ensure that this examination paper contains **SEVEN** printed pages and **SIX** questions before answering.

Answer **FIVE** questions.

Distribution of marks for each question is given accordingly.

All questions must be answered in English.

1. (a) 1900~1936 MHz bandwidth is allocated to a FDD/TDMA cellular communications system. 200 KHz Half duplex data and control channels are used. Each frequency channel carries 8 time slot for TDMA operation. Each cell has one frequency channel for paging. One cluster has 10 shared broadcast frequency channels. 1st time slot of each traffic data channel is used for synchronization. Cluster size of the cellular system is 12 and 480 cells are required to cover an area. Find the maximum number of simultaneous user of the system without any congestion.

(40 marks)

(b) What are the two main reasons of short term fading? Classify the short terms fading with respect to their causes? How those fading can affect the signal?

(30 marks)

(c) Discuss how CDMA and OFDM technique can overcome frequency selective deep fading problem.

(30 marks)

2. (a) Explain the behavior of the Figure 1 curves with proper reasoning. Also give the comparative study among them.

(35 marks)

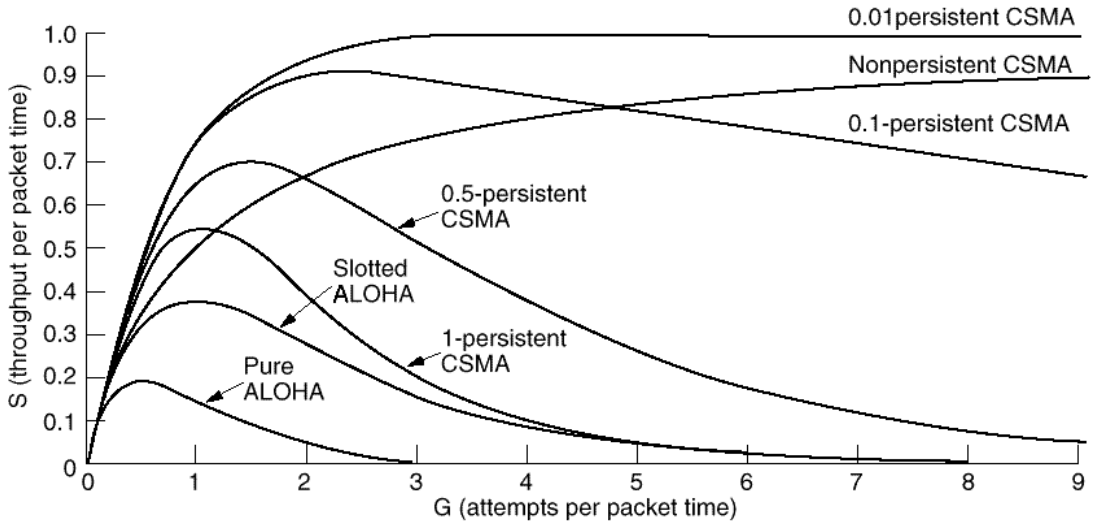

Figure 1

(b) Cluster size of a cellular system is 27. If the cell radius is 5 Km then find the distance between co-channel base stations.
If the cluster size is reduced to 19 then what would be the cell radius for the same co-channel base station separation

(35 marks)

(c) Following Figure 2 that represents data and spreading signal of CDMA system. What is the spreading factor? What is the chip rate? What is the capacity of the system?

(30 marks)

3. (a) Draw the block diagram of a general GSM network architecture and show all major components and interfaces.

(30 marks)

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(b) With a block diagram, show the call setup steps when Caller (Call Originator) and Called (Call terminator) Party belong to two different mobile networks in GSM system.

(40 marks)

(c) Classify the following channels in forward and reverse channel:

TCH/H9.6, RACH, SCH, BCCH.

(30 marks)

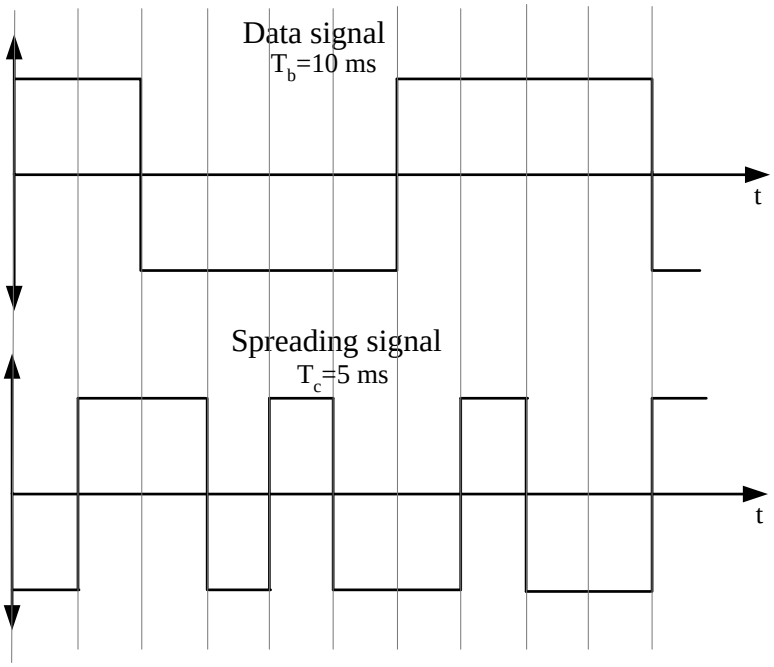

Figure 2

4. (a) Describe the requirements and trade-offs for receivers. Then, explain the similarities and differences between homodyne and superheterodyne receiver.

(20 marks)

(b) What is the frequency of the image frequency that could be received by a system that has a radio receiver tuned to receive a signal at 870 MHz. It uses an IF frequency of 87 MHz. Describe three (3) methods that could be used to minimize reception of an image signal.

(40 marks)

(c) The double-conversion receiver in Figure 4 below employs two IF filters. Specify the required local oscillator frequncies f_1 and f_2 for a receiver covering the 1-MHz to 50 MHz range. The center frequency of the first IF filter is 70 MHz, and that of the second IF filter is 16 MHz.

(40 marks)

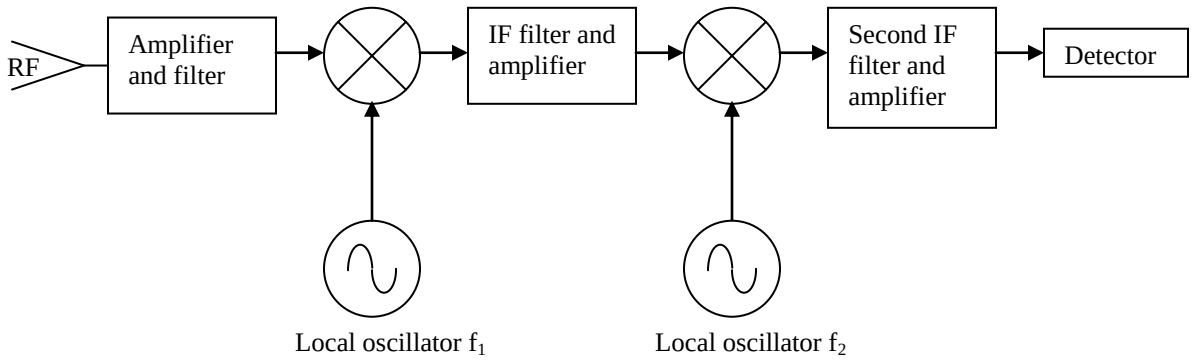

Figure 4

5. (a) Describe 2 configuration of balanced mixers using block diagrams to illustrate them

(20 marks)

(b) A double-sided signal of the form $v_{RF} = 2\left[\cos(\omega_{LO} - \omega_{IF})t + \cos(\omega_{LO} + \omega_{IF})t\right]$ is applied to a mixer with an LO voltage given by $v_{LO}(t) = \cos 2\pi f_{LO} t$. Derive the output of the mixer after low pass filtering.

(30 marks)

(c) The frequency synthesizer of Figure 5 below provides 300 output frequencies equally spaced by 10 kHz. The output frequencies extend from 144.0 to 148.0 MHz. The input frequency, f_{ref} equals 10 kHz, and the high-frequency oscillator has a frequency f_H equal to 90 MHz.

(i) Calculate the minimum and maximum values required for the ÷N counter.

(ii) What is the output frequency if N=4605?

(iii) What changes need to be made if it is desired to produce 600 frequencies equally spaced by 5 kHz?

(50 marks)

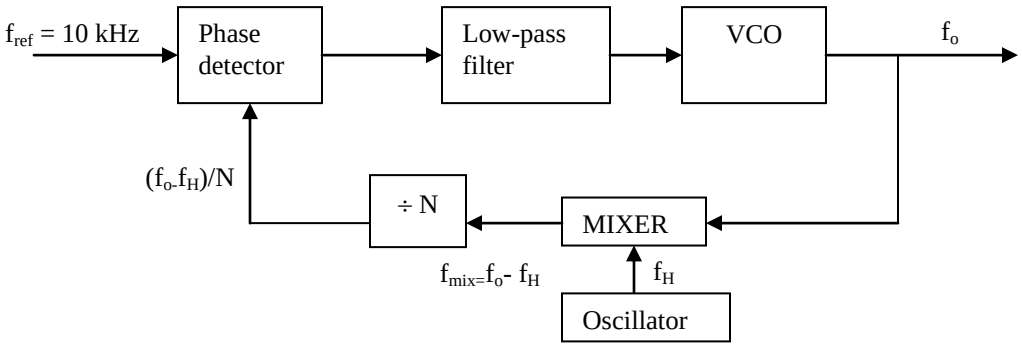

Figure 5

6. (a) An AM signal is examined on an oscilloscope. It has a maximum peak to peak of 4.5 cm and a minimum peak to peak of 2.0 cm.

(i) Sketch the pattern observed on the ‘scope’.
(ii) Determine the modulation factor and percent modulation of the signal.
(iv) Calculate the power content of each of the sidebands if the power contained by the signal at the carrier frequency is 500 W.

(40 marks)

(b) (i) What are the advantages of SSB and DSB over AM?
(ii) What is an added advantage of SSB over DSB?

(20 marks)

(c) A 93.2 MHz carrier is frequency modulated by 5 kHz sine wave. The resulting FM signal has a frequency deviation of 40 kHz.

(i) Find the carrier swing of the FM signal
(ii) Determine the highest and lowest frequencies attained by the modulated signal
(iii) What is the modulation index of the FM wave?

(30 marks)

(d) (i) What function is served by the limiter in an FM receiver
(ii) Why does the limiter not affect the information content if the signal?

(10 marks)

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