# CARLETON UNIVERSITY

**Department of Systems and Computer Engineering**

## SYSC4700 Telecommunications Engineering Winter 2006

## Midterm exam

**Closed book. Use of non-programmable, non-communicating calculators is permitted.**

**Instructions:**

1. **Write answers in the spaces provided on the question sheet. If necessary, use both sides of a page. Write legibly, and state any assumptions that you make. A blank page is provided after question 4.**

**Your Name:** _____

**Student Number:** _____

| Question | Mark | Maximum possible mark |
|---|---|---|
| 1 | | 15 |
| 2 | | 10 |
| 3 | | 15 |
| 4 | | 10 |
| Total | | 50 |

## Question 1 – Pulse Code Modulation (PCM) [15 marks]

Describe the DS1 system (also known as T1), showing how it converts voice signals to digital signals and multiplexes 24 of them into a 1.544 Mb/s bit stream. In your answer, comment on the choice of sampling rate, quantizing method and bit rate; explain how the rate 1.544 Mb/s is obtained.

## Question 2 – Cellular Networks [10 marks]

- A metropolitan area is to be given cellular telephony service. Throughout this area there is approximately uniform service demand. Assume that radio spectrum is allocated to a cellular operator in two blocks of 6 MHz (one block for uplink and the other for downlink).

- Assume that one digital voice call link consumes 20 KHz of bandwidth each way (that is, 20 KHz for uplink and 20 KHz for downlink).

- To limit the co-channel interference, a cluster size of 4 is used (i.e., 4 cells per clusters).

- Due to the high number of subscribers, a total of 400 cells are deployed in this metropolitan area.

Determine the total capacity of this network (i.e., the number of simultaneous voice calls that it can handle).

## Question 3 – Short Questions [15 marks]

Briefly explain only 5 of the followings:
GSM; X.25; WiMax; TDD; Circuit switching versus packet switching; WCDMA; 3GPP

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## Question 4 – Transmission Rate and Bandwidth [10 Marks]

- A 1.544 Mb/s DS1 system in transmitted through a wireless channel.
- 8-PSK modulation is used; the carrier frequency is 1.9 GHz.

(a) [3 marks] What is the signaling pulse shape that will result in minimum bandwidth?

(b) [7 marks] Assuming this pulse shape is used, calculate the bandwidth required for this transmission. Identify the cutoff frequencies of the transmission band (i.e., if it is from $f_1$ Hz to $f_2$ Hz, find $f_1$ and $f_2$).

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