

June 16, 2010

SEG3155

Midterm

**COMMUNICATIONS and NETWORKING**

Time Allowed: 80 minutes

**NAME:** \_\_\_\_\_

Professor: A. Yongaçoğlu

**STUDENT NUMBER:** \_\_\_\_\_

- Calculators are permitted, but they should not be pre-programmed.
  - For the answers use the space provided. **DO NOT SEPARATE THE PAGES OF THIS BOOKLET APART** otherwise it will be considered a fraud attempt. If you need extra space, use page 8.
  - **Don't forget to write the units.** If you need to make any assumptions, state them clearly and make sure they are not in conflict with the problem statement.
- 

Question	Marks	Out of
1		5
2		3
3		2
4		2
5		1
6		2
7		1
8		4
Total		20

QUESTIONS 1 [5 points (1+2+2)]

A baseband analog signal occupies the spectrum from dc up to 200 kHz.

- (a) For perfect digitization, what is the required minimum sampling rate?
- (b) Suppose that the above mentioned signal is sampled at 800 ksamples/s, and then quantized by using 6 bits per sample. What is the resulting bit rate?
- (c) Suppose we transmit the digital signal described in part (b) by using a modulation technique that has a bandwidth efficiency of 0.5 b/s/Hz. How much bandwidth is required for the modulated signal?

QUESTION 2 (3 points)

The output of a digital source will be encoded and stored. The source produces 100,000 bits such that probability of a zero is 0.7 and the probability of a one is 0.3. Assume that a technique which permits encoding at the average entropy is available. After encoding approximately how many bits will be stored?

QUESTION 3 (2 points)

A channel has a bandwidth of 2 MHz. The intended capacity is 20 Mbps. Assuming white thermal noise, what should be the minimum signal-to-noise ratio (in dB) that may achieve this capacity?

QUESTION 4 (2 points)

A telephone line has 20 dB loss. The transmit (i.e. input) power is 0.5 W. The output noise level is  $100 \mu\text{W}$ . Calculate the output signal-to-noise ratio in dB.

QUESTION 5 (1 point)

How is the antenna gain related to frequency (e.g. directly or inversely proportional, linear or quadratic etc).

QUESTION 6 (2 points)

Briefly explain the difference between selective-reject and go-back N schemes. Which one is more complex, and which one utilizes the link more efficiently?

QUESTION 7 (1 point)

What is the relationship between wavelength and frequency? Choose a frequency and specify the corresponding wavelength.

QUESTION 8 (4 points)

Consider the signal  $x(t) = \cos(200t) + \cos(400t) + \sin(5000t)$ .

- (a) What is the minimum (lowest) frequency of the signal  $x(t)$  in Hz?
- (b) What is the maximum (highest) frequency of the signal  $x(t)$  in Hz?
- (c) What is the bandwidth of the signal  $x(t)$ ?
- (d) What is the bandwidth of the signal  $y(t) = 100 \sin(10,000t) + x(t)$  in Hz?

