

ELEX 7860 : Wireless System Design  
2021 Winter Term

Midterm Exam 1  
12:30 – 14:20  
Thursday, February 4, 2021

This exam has six (6) questions on eight (8) pages. The marks for each question are as indicated. There are a total of fifteen (15) marks.

Download this exam and write your answers in the space provided. You may print the exam and write the answers by hand, mark up this document using a tablet, or edit the file with a word processor.

Books and notes are allowed but you may not communicate with anyone else during the exam. Please sign the following declaration to confirm your understanding of this:

This work is solely my own effort and I understand the consequences of plagiarism and other offences described in BCIT Policy 5104.

Signed: \_\_\_\_\_

Answer all questions. *Show your work.* Draw a box around your final answer. Numerical answers must include units.

When you are done, export your document to a **PDF** file. Submit the PDF file to the Midterm Exam 1 Assignment folder on the course web site before the submission deadline, 11:20 AM . If you submit multiple times only the most recent submission will be marked.

**Only PDF files will be marked.**

Name: \_\_\_\_\_

BCIT ID: \_\_\_\_\_

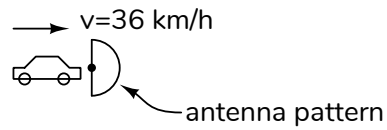
Question	Mark	Max.
1		3
2		2
3		3
4		2
5		3
6		2
Total		15

## Question 1

3 marks

An antenna mounted on a vehicle receives only from directions within  $\pm 90$  degrees of the direction of travel. If we make the same assumptions as Clarke's model for the distribution of scatterers, sketch the shape of the power spectrum (power spectral density versus frequency) that you would expect to see for an unmodulated carrier.

Label the frequency axis if the carrier frequency is 900 MHz and the vehicle speed is 36 km/h.



**Question 2****2 marks**

What is the ratio of the level crossing rate ( $N_R$ ) to the maximum Doppler rate ( $f_m$ ) when the threshold level is equal to the mean signal level ( $\rho = 1$ )?

**Question 3****3 marks**

The loss due to propagation through walls in a building can be modelled as having a log-normal distribution. If the standard deviation of this loss is 10 dB, what fraction of locations will have a loss of more than 20 dB above the mean due to the log-normal fading?

**Question 4****2 marks**

- (a) A cellular telephone system suffers from Rayleigh fading. The mean SNR is 20 dB, and the minimum SNR to detect the base station signal is 10 dB. What is the probability of not detecting the base station signal if diversity is not used?
- (b) What is the probability of not detecting the base station signal when using three-branch space diversity with switched-diversity combining, assuming independent fading on each branch?

**Question 5****3 marks**

A garage door opener transmits a 10 mW signal at a frequency of 450 MHz. How much power is received at a distance of 10 m assuming the transmit and receive antenna gains are each  $-6$  dB?

**Question 6****2 marks**

You would like to implement a space diversity system but can only receive on one antenna at a time.  
What type(s) of diversity combining can you use?

