

Final Exam

Each exam is equally difficult.
Answer your own exam.

Do not start until you are told to do so.

- This page intentionally left blank. -

ELEX 4550 : Wide Area Networks
Term 201510

FINAL EXAMINATION
10:30 AM – 1:30 PM
SE6-206
May 21, 2015

This exam has nine (9) questions on three (3) pages. Answer all questions, in any order. The marks for each question are as indicated. There are a total of thirty-two (32) marks. Write your answers and all rough work in the exam book provided. Do not write anywhere else. Show your work. Underline or draw a box around your final answer. Numerical answers must include units. Books and notes are allowed. No electronic devices other than calculators are allowed. Take this exam paper with you when you leave. Show your work.

Question 1 (3 marks)

- (a) Does more current flow through a telephone local loop when it is off-hook or on-hook?
- (b) Is the *differential* voltage across the subscriber's equipment higher when it is off-hook or on-hook?
- (c) What is the purpose of the hybrid on a CO line card? What is its purpose on a telephone set?

Question 2 (3 marks)

Many customers in a CATV service area are complaining about poor picture quality. You connect a spectrum analyzer to the RF input of one set-top box and find a number of signals at frequencies between 100–300 MHz all at levels of about -60 dBm.

- (a) Do you need to adjust the downstream or upstream amplifier gains?
- (b) If you want to bring the received levels up to a nominal 0 dBmV, do you need to increase or decrease the amplifier gain? By how much?

Hint: assume 75 Ω impedance levels throughout.

Question 3 (3 marks)

A system using DMT (OFDM) uses a sampling rate of 100 MHz, 256 samples per symbol and a guard time of 0.44 μ s. Subcarriers 0–9 and 208–255 are not transmitted.

- (a) What is the symbol duration, not including the guard time?
- (b) What is the symbol rate, including the guard time?
- (c) what is the data rate if 16-QAM modulation is used on each transmitted subcarrier?

Question 4 (2 marks)

What total split ratio is supported by a PON system designed for use with 0.4 dB/km loss fibre, 0 dBm transmit power, -25 dBm receiver sensitivity, 20 km maximum line length and a 5 dB margin? Assume ideal splitters.

Question 5 (3 marks)

(a) What is the shortest possible IP+UDP packet assuming it carries an 6-byte payload? (b) How many ATM cells are required to carry this packet? (c) How many padding bytes are included in the last cell? Show your calculations.

Question 6 (3 marks)

A PPP-encapsulated frame contains the following bytes (in hex):

7E FF 03 11 7D 20 11 7D 5E 20 30 7E

What are the values of the encapsulated bytes? Assume defaults for all LCP options.

Question 7 (4 marks)

- (a) What networking utility sends ICMP echo request packets with small but growing TTL values in the IP header?
- (b) Explain (briefly) why it does this.
- (c) What two types of ICMP responses does it expect to receive?
- (d) For TTL values larger than a certain number no responses are received. Why not?

Question 8 (3 marks)

A TCP packet is received that has only the SYN bit set, a source port of 5000, destination port of 80 and sequence number of 1000 (all values in decimal). What are the values of the following fields in the response packet:

- (a) TCP flag field bits
- (b) source and destination port numbers
- (c) Acknowledgement field value

Question 9 (8 marks)

- (a) You are asked to purchase an A/D converter for a project. You are told that the signal to be digitized contains frequency components up to 500 kHz and that the A/D quantization error should be less than 1 mV for a signal that spans the range $\pm 2V$. What minimum sampling rate and resolution (number of bits) should you be looking for?
- (b) What is the bit rate of an STS-24 signal (including all overhead bits)?
- (c) If a T1 receiver uses a clock derived from an incoming T1 signal, would you expect to see frame slips? Why or why not?
- (d) A sequence of DHCP TLV-encoded option is included in the following (hex) byte stream: 12 03 20 36 3F 15 00 14 02 14 02. How many options are there? What are their types and values (in hex)?
- (e) Write *two* BIND-format DNS RR's that show that the DNS server for `bcit.ca` is at IP address 142.232.19.65. You can use whatever host name you wish (e.g. `dns.bcit.ca.`).
- (f) During a VoIP call would you expect to see more SIP or RTP packets? Why?

– This page intentionally left blank. –