July 19, 2010 SEG3155 **Final Exam**

COMMUNICATIONS and NETWORKING

Time Allowed: 180 minutes **NAME:** _____

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• 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 the last 2 pages of the booklet and indicate this on the booklet.
• 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		5
3		4
4		5
5		3
6		5
7		3
8		5
9		3
10		5.5
11		4.5
12		2
Total		50

QUESTION 1 [5 points]

What do the following acronyms represent in communications? Just the name, no explanation! For example, FDM: Frequency Division Multiplexing. Attention no partial marks in this question.

(i) MIMO:

(ii) WCDMA:

(iii) EIRP:

(iv) PDU:

(v) ATM:

(vi) TCP:

(vii) PCM:

(viii) HDB3:

(ix) NRZ:

(x) ADSL:

QUESTIONS 2 [5 points (3+2)]

(a) In a cellular network a given bandwidth of 200 kHz is shared by 6 users based on TDMA. The cluster size is 11. The total area is covered by 462 cells. The operator is assigned a total of 15.4 MHz in each direction. What is the maximum number of users that can simultaneously use the system?

(b) Suppose a new, improved system will replace the old system described above. In the new system 200 kHz is shared by 8 users, and the cluster size is reduced to 7. All other parameters remain the same. What is the maximum number of simultaneous users in this case?

QUESTION 3 [4 points (2+2]

(a) Briefly describe what power control is and why it is important in cellular networks?

(b) Is power control more important in CDMA or TDMA networks? Briefly jusitify your answer.

QUESTION 4 [5 points (2.5+2.5]

A TDM system multiplexes the data of four users over a single link. Two users operate at 5 kbps each (call them U1 and U2) and the other two users operate at 10 kbps each (U3 and U4) . Following every 48 bits of data from these 4 sources, 2 overhead bits are added to make a frame.

(a) Draw the frame structure (i.e. show the number of bits from U1, U2, U3 and U4 per frame).

(b) What is the overall data rate of the multiplexed system?

QUESTION 5 [3 points (1.5+1.5]

In ATM there are 2 types of headers. One for UNI and another one for NNI. They are both 5 bytes, but their make up is slightly different.

(a) What do UNI and NNI refer to?

(b) What is the main difference between the headers of UNI and NNI? (No need to specify how many bits are each part of the header. Just mention the functional difference).

QUESTION 6 [5 points]

In mobile radio channels errors occur in burts. Hence error control coding is essential for reliable communication. Let us say we have 6 bits to transmit. These are 1 1 0 0 1 0. After coding the data block becomes:
1 1 1, 1 1 1, 0 0 0, 0, 0, 0, 1, 1, 1, 0, 0, 0.
Instead of sending the data block in this form, it is interleaved to yield:
1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0.
This interleaved block is transmitted. The received block contains 4 consecutive bits in error, and is:
1, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 0.
Show what happens after de-interleaving. Then show what happens after decoding. How many output bits in the decoded 6 bit message are in error?

QUESTION 7 [3 points (1.5+1.5]

In CDMA, whenever it is practical, orthogonal spreading codes are used. Suppose the code user A employs is 1 1 -1 -1 1 1 -1 -1.

(a) Assign a code to user B such that Code A and Code B are orthogonal.

(b) Assign a code to user C such that all 3 codes are mutually orthogonal.

QUESTION 8 [5 points]

Consider using the stop and wait protocol for sending packets from A to B (we will focus only in the transmission from A to B. The link from B to A is separate). Assuming acknowledgements from B to A require negligible processing time and with negligible acknowledgement length.) Let the propagation delay be 10 ms and the data rate be 10 kbps. If the link (from A to B) utilization efficiency is to be at least 75%, what should be the minimum packet length

QUESTION 9 [3 points]

A wireless communications system requires a spectral efficiency of 5 b/s/Hz. What modulation technique and what constellation size would you recommend? Note: there is not a single correct answer. You should briefly argue out your choice assuming practical values.

QUESTION 10 [5.5 points (3.5+2]

(a) The signal transmitted from a satellite is 1W. The signal bandwidth is 1 MHz, and the receiver noise temperature is 1200^o Kelvin. A signal to noise ratio of 20 dB is required, what is the maximum amout of attenuation (in dB) the signal can undergo and still satisfy the SNR requirement? Boltzman's constant $k = 1.38 \times 10^{-23}$ J/K.

(b) For the SNR and bandwidth given above, what is the maximum capacity of the system?

QUESTION 11 [4.5 points (1.5+1.5+1.5]

Data consisting of 0 1 1 0 1 0 is modulated by binary (a) ASK, (b) FSK, (c) PSK. Sketch carefully and neatly the corresponding waveforms.

QUESTION 12 [2 points]

What is the difference between a simple hub and a Layer 2 switch?