UNIVERSITY OF GHANA

BACHELOR OF SCIENCE IN ENGINEERING

SECOND SEMESTER EXAMINATIONS: 2014/2015

CPEN 406: WIRELESS COMMUNICATION SYSTEMS (*3 Credits*)

INSTRUCTION: *Answer **ALL QUESTIONS** on this paper in the answer booklet provided*

TIME ALLOWED: *2 HOURS 30 MIN*

SECTION A: [5 marks per question]

1. Explain the concept of coding gain in channel coding.
2. Compare and contrast UTRAN-TDD and UTRAN-FDD systems in relation to their duplexing schemes.
3. What are the hardware and software implications of a total upgrade from an EDGE system to UMTS? Consider both the operator and the mobile subscribers.
4. List and explain two main architectural differences between UMTS and LTE systems.
5. List and explain two causes of handover in mobile communication systems.
6. Explain the main reasons why LTE uses two different multiple access schemes in uplink and downlink.
7. Explain how the *near-far effect* can be mitigated.
8. Compare GSM and IS-95 systems in terms of their pure voice capacity. Explain your answer.
9. Explain the concept of wireless fading channels. Support your answer with mathematical expressions where necessary.
10. Discuss one advantage and one disadvantage of *wave reflection* in terrestrial mobile communications.

Examiner: K. M. Koumadi, Ph.D

SECTION B:

1. A town having an area $A = 2387\ km^2$ has to be covered by the mobile operator CPENMOBILE using cells covering $3.5\ km^2$ each. The available frequency band allocated to this operator by the government is 6 Mhz, subdivided into 63 FDMA channels.
    a. A cell planning group within CPENMOBILE, after applying frequency reuse, gets 1953 available voice channels in the whole system.
        i. What is the number of clusters in their system? [5 marks]
        ii. What is the frequency reuse factor? [5 marks]
    b. Another cell planning group uses a frequency reuse factor of 11.
        i. What is the number of available channels in their system design?[5 marks]
        ii. If each cell is taken as reference cell, what is the number of interfering cells? [5 marks]
    c. Which of the above two planning schemes is more prone to inter-cell interference? Explain. [5 marks]
    d. Discuss a potential tradeoff in question 1.c. [5 marks]

2. The pathloss between a base station (BS) and a mobile station (MS) is expressed as $L(x) = 69.55 + 26.16log_{10}(f_c) - 13.82log_{10}(h_b) - ah_m + [44.9 - 6.55log_{10}(h_b)]log_{10}(x)$
where x is the distance between them. $f_c = 300MHz$, $h_b = 40m$, $h_m = 4m$, and $a = 3.5$. Note that no unit conversion is needed. Let $G_r = G_t = 1$ denote the MS antenna gain and the BS antenna gain, respectively.
    a. Express the received power at the MS as a function of the transmit power at the BS. [5 marks]
    b. Assume two BSs, i and j are located $3km$ away from each other. BS i transmits with power $P_i(t) = 10watts$ to an MS located $1km$ from BS i on the line-of-sight between the two BSs.
        i. Calculate the required power transmitted by BS j, for the MS to receive equal signal strength from both BSs. [5 marks]
        ii. It is assumed that a handover from BS i to BS j will occur if the received power from BS j exceeds the received power from BS i by 2dB. Calculate the value of $P_j(t)$ that will trigger a handover. [5 marks]
        iii. If the power from BS j is considered as interference, calculate the transmit power at BS j which will yield a signal-to-interference ratio of 3dB. [5 marks]

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