UNIVERSITY OF RUHUNA

Faculty of Engineering

End - Semester 8. Examination in Engineering: December 2015

Module Number: EE8247 **Module Name: Wireless and Mobile communication**

[Three Hours]

[Answer **all questions**, each question carries **ten** marks]

Q1 a) In cryptography, what is cipher?
a) algorithm for performing encryption and decryption
b) encrypted message
c) both (a) and (b)
d) none of the mentioned

b) The cell having the same number in the adjacent cluster using the same set of RF channels are termed as
a) adjacent cell
b) Co-channel cell
c) Macro cell
d) Selective Cell

c) Multiplexing can provide
a) Efficiency
b) Privacy
c) Anti jamming
d) Both a and b

d) In TDM, the transmission rate of the multiplexed path is usually _____ the sum of the transmission rates of the signal sources.
a) Greater than
b) Lesser than
c) Equal to
d) Equal to or greater than

e) The Multiplexing technique that shifts each signal to a different carrier frequency
a) FDM
b) TDM
c) Either a or b
d) Both a and b

f) In TDM, slots are further divided into
a) Seconds
b) Frames
c) Packets
d) None of the mentioned

g) The type of Access technology that can enhance battery life is
   a) CDMA
   b) TDMA
   c) OFDMA
   d) None of the above

h) Which of these is not true for TDD (Time Division Duplex)?
   a) TDD uses different time slots for transmission and reception paths
   b) Single radio frequency can be used
   c) Duplexer is required
   d) It increases the battery life of mobile phones

i) The type of access used in GSM technology is
   a) FDMA/TDMA
   b) CDMA
   c) OFDMA
   d) None of the above

j) Remote and sparsely populated areas will be covered by
   a) Microcell
   b) Macrocell
   c) Picocell
   d) None of the above

Q2. a) I. Name the main elements of the GSM system architecture and describe their functions.

II. State the advantages of specifying not only the radio interfaces but also all internal and external interfaces of the GSM system? [1 Marks]

b) What is the purpose of using the "Timing advance" functionality in the GSM radio interface? [1 Mark]

c) How is higher data rates obtained in GPRS compared to GSM? [1 Mark]

d) i. Figure Q2 depicts a block diagram of the Convolution Encoder. Determine the generating matrix. [1 Mark]

ii. Considering the Convolution Encoder shown in Figure Q2, develop the state diagram. [1 Mark]

iii. Assume that this Convolution Encoder code is used for data communication over AWGN (Additive White Gaussian Noise). The received sequence is given by

(1.1, 0.8; 0.4, - 0.1; 0.2, 0.8; 0.9, 0.6; 0.6, 0.1; 1.2, - 0.1)

Estimate the correct encoded sequence and the input sequence "**a**" by using the Viterbi algorithm. [5 Mark]

Q3. a) What is CDMA2000? What is WCDMA? What is the main difference between them? [1 Mark]

b) With reference to UMTS, state whether the following statements are true or false and explain briefly why?

(a) RNC is equivalent to MSC in GSM with similar functionality.
(b) Node-B in UMTS is a counterpart of MS in GSM systems.
(c) Handover decision is made my Node-B. [1.5 Marks]

c) In UTRAN both the spreading code and the scrambling code are used. What is the purpose of using these two codes? [1.5 Mark]

d) The UMTS UTRA uses DSSS (Direct Sequence Spread Spectrum). What is the band width of the radio signal the DSSS spectrum? [2 Marks]

e) What is the connection between spreading factors and transmitter power in UMTS? [2 Marks]

f) What factors limit the size of a UMTS FDD cell and why? [2 Marks]

Q4 a) Explain the following concepts with regard to cellular networks. Use diagrams where necessary.

i) Cell splitting
ii) Cell sectoring
iii) Micro- zoning

[4.5 Marks]

b)

i) In cell splitting scenario, new cells have half the radius of original cells. If the larger cell transmit power at 20 dB, what is the transmit power of the smaller cells in order to fulfill the original coverage area and S/I requirements. (Assume n = 4)
ii) Explain how cell sectoring impacts S/I and trunking efficiency of a cellular system.
iii) Explain how repeaters can be used for range extension.
iv) Give two methods that are used for prioritizing handoffs. [5.5 Marks]

Q5 a) Explain "Large-scale path loss" and "small scale fading" with respect to wireless propagation. [2 Marks]

b) A transmitter antenna is located on top of a 20m tower that is on top of a 30m building. The receiver is 20 km away from the transmitter and has a receiver height of 10m. The coverage area under interest is a medium sized city with suburban environment. The base station antenna radiates at an EIRP of 1 kW at a carrier frequency of 1000 MHz. You may use Figures Q5a and Q5b and the relevant equations in the information sheet on page no 6.

i) Calculate the median path loss using Okumura's model.
ii) Calculate the median path loss using Hata's model.
iii) Find the power at the receiver in dBm for the above two models (Assume a unity gain receiving antenna). [8 Marks]

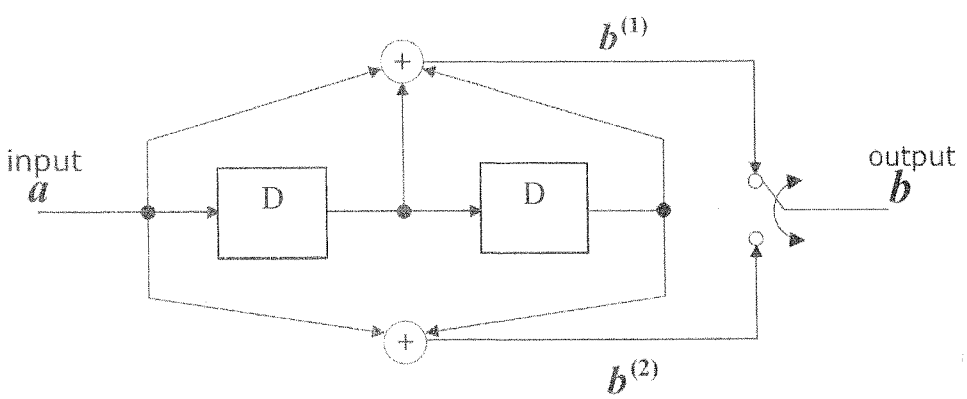

Figure Q2: Block diagram of the convolution encoder

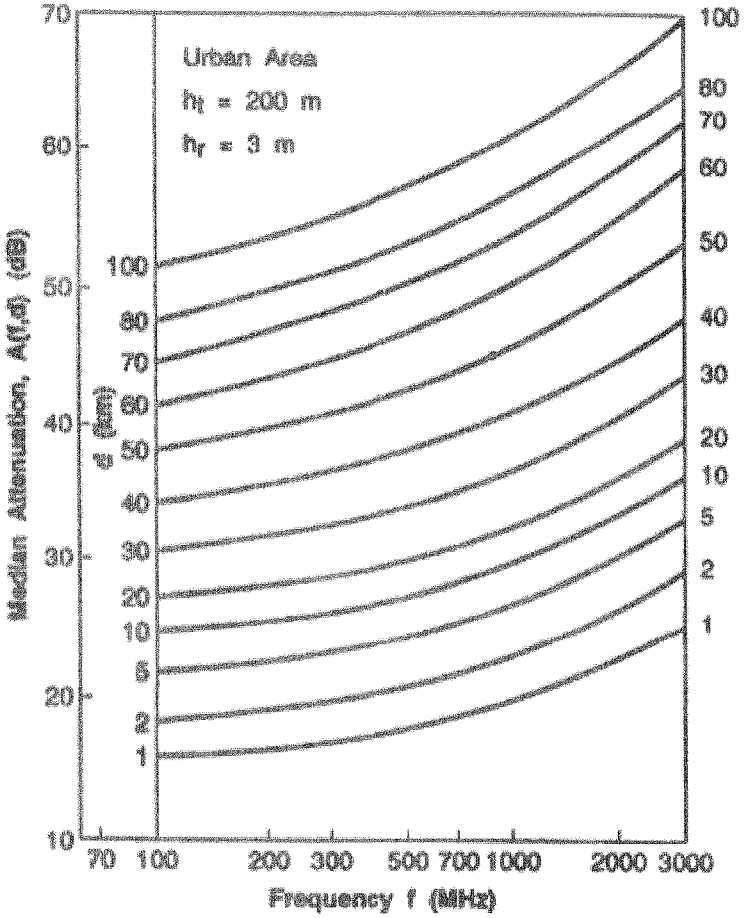

Figure Q5a: Median Attenuation relative to free space

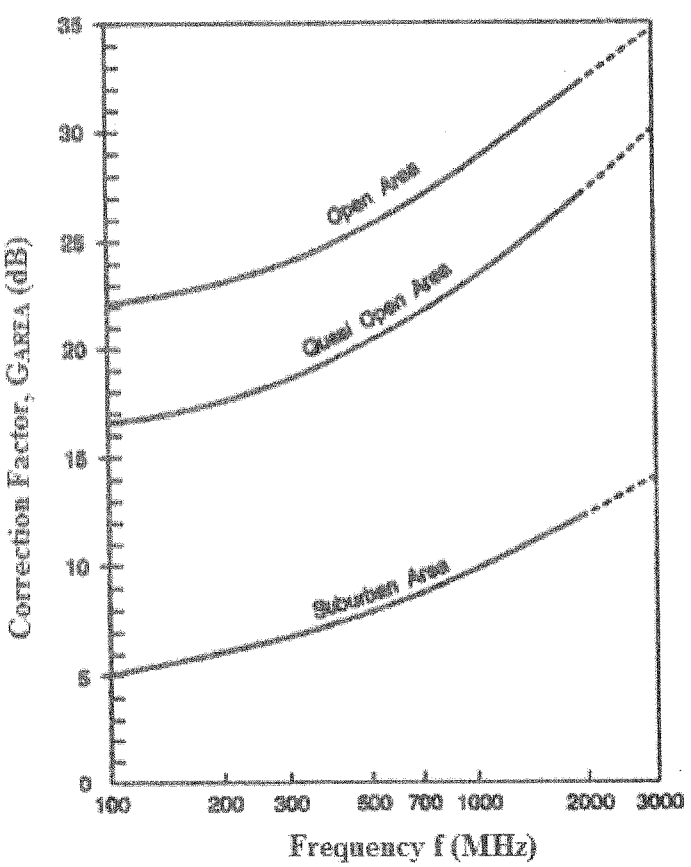

Figure Q5b: Correction factor, G_{area} for different types of terrain.

Information sheet:
All the terms have their usual meanings.

Okumura model equations

$$L_{50}(dB) = L_F + A_{mu}(f,d) - G(h_{te}) - G(h_{re}) - G_{AREA}$$

$$G(h_{te}) = 20\log\left(\frac{h_{te}}{200}\right) \quad ; \quad 1000\,m > h_{te} > 30\,m$$

$$G(h_{re}) = 10\log\left(\frac{h_{re}}{3}\right) \quad ; \quad h_{re} \leq 3\,m$$

$$G(h_{re}) = 20\log\left(\frac{h_{re}}{3}\right) \quad ; \quad 10\,m > h_{te} > 3\,m$$

Hata's model equations

$$L_{50\,(urban)}(dB) = 69.55 + 26.16\log f_c - 13.82\,log h_{te} - a(h_{re}) + (44.9 - 6.55 log h_{te}) log d$$

Mobile antenna correction factor for small to medium size city

$$a(h_{re}) = (1.1\,log f_c - 0.7)h_{re} - (1.56\,log f_c - 0.8)\ \ dB$$

Median pathloss in suburban areas.

$$L_{50}\,(dB) = L_{50\,(urban)} - 2\left[log\left(f_c/28\right)\right]^2 - 5.4$$