



# UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 6 Examination in Engineering: Nove./Dec. 2016

Module Number: EE6207

Module Name: Wireless and Mobile Communication

[Three Hours]

[Answer all questions, each question carries 10 marks]

Q1. For each question below, there may be one or several correct answers. You get 1 point, if you mark a correct answer. You also get 1 point, if you leave the wrong answer unmarked. Otherwise you get 0 points. There are 9 questions and 30 answers in this question. You will not get any points, if you mark all 30 answers as correct or leave all 30 answers unmarked. Mark an answer as correct by filling in the check-box with an 'x' or leave it blank  to select a wrong answer. Attach the answered sheets (page numbers 1 and 2) to your answer booklet.

[10 Marks]

a) Which of the technique(s) listed below could be used for network planning of a cellular Network ?

- Erlang B Formula
- Traffic Pattern Analysis and Prediction
- Network Performance Evaluation
- Shannon Channel Capacity

b) Which of the statement(s) below is/are correct with respect to mobile/wireless networks and corresponding MAC mechanism(s) used.

- GSM - CDMA (Code Division Multiple Access)
- UMTS - both CDMA (Code Division Multiple Access) and TDD (Time Division Duplex)
- IEEE 802.11 WLAN - CSMA/CD (Carrier Sensing Multiple Access/ Collision Detection)

c) Which of the delay component(s) listed below should be included in the end-to-end delay calculation of a mobile service?

- Propagation delay
- Queuing delay
- Transmission delay
- Processing delay

- d) Are the following units used correctly for the given parameter in digital wireless systems?
- Channel capacity – Hz (Hertz)
  - Bandwidth – bps (bits per second)
  - Link data rate – bps
- e) Which of the statement(s) below is/are correct with respect to the 802.11 standard amendment?
- 802.11g and 802.11a work on different frequency bands
  - 802.11i is the QoS standard and it is designed for multi-hop ad hoc networks
  - 802.11e uses MIMO (Multiple-Input and Multiple-Output) technology for achieving high capacity
- f) Which of the following listed below is/are the correctly stated the bandwidth occupancy per channel for a given mobile system/wireless network?
- GSM - 200 KHz
  - IEEE 802.11b - 22 MHz
  - UMTS - 3.84 MHz
- g) When GSM is upgraded to GPRS by introducing SGSN (Serving GPRS Support Node) and GGSN (Gateway GPRS Support Node) nodes, which entity/entities in the radio access network listed below is/are affected?
- HLR (Home Location Register)
  - BS (Base Station)
  - MT (Mobile Terminal)
- h) Which one of the following entities in GPRS is the gateway to the Internet?
- SGSN
  - GGSN
  - GMSC
- i) Which statement(s) listed below is/are correct regarding GSM
- Paging channel is used only in downlink.
  - Random Access channel is used only in uplink.
  - Access grant channel is used only in downlink.
  - Dedicated signal channel is used in both uplink and downlink.

- Q2 a) i) What is handover threshold? Explain the handover process of a cellular mobile network when a user moves from one cell to another cell. [2 Marks]
- ii) Explain the importance of choosing an appropriate value for the handover threshold in making handover decisions. [1 Mark]
- b) Briefly explain the two practical handover considerations, Umbrella Cell method and Cell Dragging, in cellular mobile systems. [3 Marks]
- c) "Cell splitting, Sectoring and Microzone concepts are used to increase the coverage and the capacity in modern cellular mobile systems." Explain analytically how it has been achieved for one of the aforesaid techniques. [4 Marks]
- Q3 a) Briefly explain the different channel assignment methods used in modern cellular mobile networks. [2 Marks]
- b) You are asked to design a GSM cellular network for a city population of 10,000. Once the frequency reusing is implemented among 7-cell clusters, each user in a cell will make an average of 5 calls per day. It is expected that one user will make a call for 4 minutes, on average during a busy hour. The Grade of Service (GoS) required in the network is 2%.
- i) If the GSM network uses only FDMA (Frequency Division Multiple Access) method, determine the number of base stations required for the network. Assume that each cell has a single Base Station and each user requires a channel bandwidth of 200 kHz in a total spectrum of 14 MHz. [4 Marks]
- ii) Suppose that the GSM network is expanded by employing both FDMA and TDMA (Time Division Multiple Access) methods. If one TDMA frame is divided into 2 time slots, determine the number of base stations required for the new network. [2.5 Marks]
- iii) Compare the results obtained in part i) and part ii). [1.5 Marks]

**Hint:** State all the assumptions and use the provided entries of Erlang-B in table Q3 to calculate the offered traffic load of the GSM network.

- Q4 a) Is it possible to transmit a digital signal, e.g., coded as a square wave as used inside a computer, using radio transmission without any loss? Why? [2 Marks]
- b) What are the main benefits of a spread spectrum system? How can spreading be achieved?. What is the reason for using the word 'spread' in such systems? [2 Marks]
- c) Why is frequency planning not needed in a CDMA cell/sector? [1 Mark]
- d) Why do the transmitter and the receiver need to be precisely synchronised in TDMA systems? [2 Marks]
- e) What limits the number of simultaneous users in a TDMA or FDMA system compared with a CDMA system? What happens to the transmission quality of connections if the load gets higher in a cell, i.e, how does an additional user affects the other users in the cell in each system? [3 Marks]
- Q5 a) What is the main difference between handover and roaming? [1 Mark]
- b) What are the five types of bursts used in the GSM frame hierarchy? Explain the functions of the above mentioned bursts. [1 Mark]
- d) Compared with other bursts, "access burst" consist of a 68.25 bit large guard period. Briefly explain the reasons for it. [1 Mark]
- e) i) Figure Q5 depicts a block diagram of a Convolution encoder. Determine the generating matrix. [1 Mark]
- ii) Considering the convolution encoder shown in Figure Q5, develop the state diagram. [2 Marks]
- iii) Assume that this 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. [4 Marks]

Table Q3: Entries of the Erlang-B table

$\frac{P_B}{N}$	1.0%	1.2%	1.5%	2%	3%	5%	7%	10%	15%	20%	30%	40%	50%
8	3.13	3.25	3.40	3.63	3.99	4.54	5.00	5.60	6.50	7.37	9.21	11.4	14.3
10	4.46	4.61	4.81	5.08	5.53	6.22	6.78	7.51	8.62	9.68	12.0	14.7	18.3
20	12.0	12.3	12.7	13.2	14.0	15.2	16.3	17.6	19.6	21.6	25.9	31.2	38.2
70	56.1	56.8	57.8	59.1	61.3	64.7	67.5	71.3	77.3	83.3	96.9	114.3	138.1
80	65.4	66.2	67.2	68.7	71.1	74.8	78.0	82.2	88.9	95.7	111.2	130.9	158.0
140	122.0	123.2	124.8	127.0	130.6	136.4	141.3	148.1	159.1	170.5	196.8	230.9	278.0
160	141.2	142.5	144.2	146.6	150.6	157.0	162.5	170.2	182.5	195.5	225.4	264.2	318.0

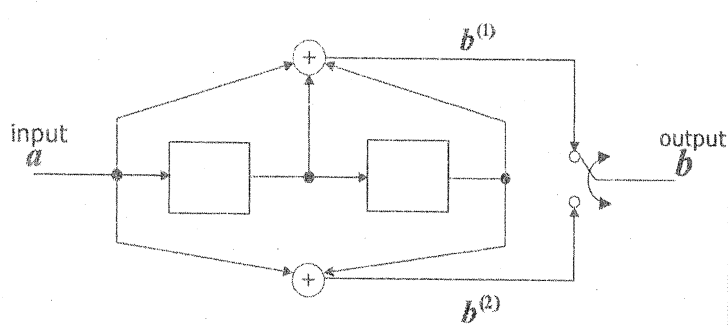


Figure Q5: Block diagram of the convolution encoder