

**MSC Examination by course unit**

**Wednesday, 20 May 2015 10:00 am**

**ECS702P/U/D Mobile and WLAN Technologies Duration: 2 hours 30 minutes**

**YOU ARE NOT PERMITTED TO READ THE CONTENTS OF THIS QUESTION PAPER UNTIL  
INSTRUCTED TO DO SO BY AN INVIGILATOR**

**Answer TWO questions of PART A AND answer TWO questions of PART B.**

If you answer more questions than specified, only the first answers (up to the specified number) will be marked. Cross out any answers that you do not wish to be marked

Calculators are permitted in this examination. Please state on your answer book the name and type of machine used.

Complete all rough workings in the answer book and cross through any work that is not to be assessed.

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**EXAM PAPERS MUST NOT BE REMOVED FROM THE EXAM ROOM**

**Examiners:**

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**PART A**

**Question 1**

a) Explain the Rayleigh and Rician fading, respectively. Describe their impacts on the wireless channel, with the help of a sketch of BER vs  $E_b/N_0$  curves.

**[6 marks]**

b) With the help of diagrams, explain how the Frequency Hopping Spread Spectrum (FHSS) works and what processing gain is.

**[6 marks]**

c) Explain three ALOHA Access techniques in wireless data networks. What are their main disadvantages?

**[6 marks]**

d) What are hidden terminals? Explain in detail how this problem is solved in the IEEE802.11 standard?

**[7 marks]**

**Question 2**

a) Describe the Physical layer specification in the IEEE802. 11a, 11b and 11g standards, respectively.

**[6 marks]**

b) Describe in detail the handoff process in IEEE802.11.

**[7 marks]**

c) Describe the improvements on security being made in IEEE802.11i.

**[6 marks]**

d) Describe the main improvements being made in IEEE802.11n standards.

**[6 marks]**

**Question 3**

a) Explain the network topology and access methods in Bluetooth.

**[6 marks]**

b) Describe the main features of the Bluetooth Low Energy standard.

**[7 marks]**

c) Describe the security improvement made in Bluetooth 2.1

**[6 marks]**

d) Describe the main features of Zigbee

**[6 marks]**

**PART B****Question 4**

a) Complete the blanks for each of the following (**write your answers in the answer book and NOT on this page**):

- i) In traffic engineering, assume a cell receives on average 630 calls per hour, the mean holding time is 120 seconds, and the grade of service is 2%. Therefore, the offered traffic in the cell is \_\_\_\_\_ (1) and the dimensionless unit is \_\_\_\_\_ (2). If the number of channels needed for this offered traffic is 28 channels, the corresponding trunking efficiency is \_\_\_\_\_ (3).
- ii) In a FDMA/TDMA system, there are two types of frequency interference. The first type is the *cochannel interference* and the second type is the \_\_\_\_\_ (1) *channel interference*. Depending of the value of the *cochannel reuse ratio* the network will have different number of cells per cluster. For example, if the *cochannel reuse ratio* is 6, the number of cells per cluster will be \_\_\_\_\_ (2). In order to avoid the second type of frequency interference, the assigned frequencies for the channels of a cell have maximum possible \_\_\_\_\_ (3) and sectorization can also help.

**[9 marks]**

b) Considering the importance of power control in cellular networks, answer the following questions.

- i) Explain Open Loop Power Control.
- ii) Why is Power Control so important in CDMA systems?

**[8 marks]**

c) Explain the multiple access technique used in GSM systems and cite the name of the random access method used in GSM .

**[4 marks]**

d) Considering basic cellular operation for mobile initialisation, i.e. when the mobile station is turned on by the user, briefly describe the general steps that occur from the moment the mobile station is turned on, up to the stage where the mobile station enters the *idle* state when there is cellular service available. (Tip: base your answer on the first generation steps which are the simplest to explain)

**[4 marks]**

**Question 5**

a) Answer the following questions about Short Messaging Services (SMS):

- i) Which network component is responsible for controlling the Short Messaging Services?
- ii) Cite the two SMS types of services?
- iii) Cite 2 different logical channels that can be used to transmit SMS messages?

**[5 marks]**

b) Supply the appropriate words to fill the blanks (1 to 10) in the following sentences (**write your answer in the answer book and NOT on this page**):

Security in GSM is implemented to prevent fraud via \_\_\_\_\_ (1) of the subscriber, not revealing the subscriber number over the air, and by \_\_\_\_\_ (2) the conversations to avoid eavesdropping. The SIM card has a microprocessor chip that can perform the computations required for security purposes. A \_\_\_\_\_ (3) key Ki is stored on the SIM card, and it is unique to the card. This key is used in two proprietary algorithms: A3 for \_\_\_\_\_ (4) and A8 for \_\_\_\_\_ (5). Ki is used in a \_\_\_\_\_ (6) response protocol using the A3 algorithm between the BSS/MSC and the MS. Ki is used to generate a privacy key \_\_\_\_ (7) that is used to \_\_\_\_\_ (8) messages (voice or data) using the A8 algorithm. Finally, the control channel signals are also \_\_\_\_\_ (9) to avoid eavesdropping by using a third algorithm called \_\_\_\_ (10).

**[5 marks]**

c) Supply the appropriate words to complete the blanks (1 to 12) in the following sentences about the GSM system (**write your answers in the answer book and NOT on this page**).

GSM uses \_\_\_\_\_ (1) as a multiple access technique. The GSM spectrum provides \_\_\_\_\_ (2) different frequency carriers, and a guard band is left between the first and the last carrier. Each frequency carrier in GSM occupies a frequency band of \_\_\_\_\_ (3) accommodating \_\_\_\_\_ (4) logical channels in it. Each logical channel is defined by the repetitive occurrence of \_\_\_\_\_ (5) each one with an approximate duration of 0.577ms. In a GSM full rate traffic channel, the payload data is encrypted in blocks of \_\_\_\_\_ (6) bits. The capacity in kbps of a full rate traffic channel is \_\_\_\_\_ (7), this value takes into consideration that in \_\_\_\_\_ (8) frames occurring in a \_\_\_\_\_ (9) ms multi-frame, \_\_\_\_\_ (10) slots are used for other purposes which are: \_\_\_\_\_ (11) and the \_\_\_\_\_ (12) logical channel.

**[6 marks]**

d) Explain why the concept of conventional frequency reuse and planning found in FDMA and TDMA systems is not used for a CDMA system.

**[5 marks]**

e) Describe how the capacity of a single CDMA cell can be calculated.

**[4 marks]**

## Question 6

a) Explain the **outer loop power control** used in UMTS.

[4 marks]

b) Figure 1 gives an overview of several types of handover in a combined UMTS/GSM network. Indicate what handover UE1 is performing and describe this type of handover.

[4 marks]

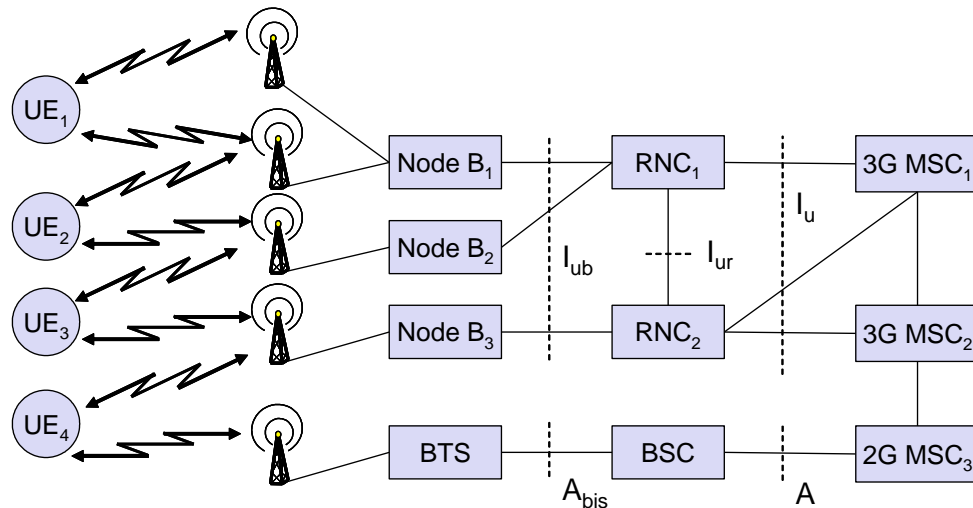


Figure 1: Handovers in UMTS

c) Explain the main concept of HSUPA and give an illustration of the general functionality of HSUPA.

[7 marks]

d) Answer the following questions about HSDPA:

- What does HSDPA stand for?
- Cite one of the means used by HSDPA to increase downlink data throughput.
- What radio entity was mainly modified to cope with and control HSDPA channels?
- Two important features of UMTS channels are disabled in HSDPA channels. Cite one of them.

[4 marks]

e) Sketch the GPRS network architecture and describe in more detail the GPRS supporting nodes.

[6 marks]



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End of Paper

Turn Over