



PAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY
Faculty of Computing and Informatics

Department of Computer Science

QUALIFICATION: BACHELOR OF COMPUTER SCIENCE HONOURS	
QUALIFICATION CODE: 08BCHC	LEVEL: 8
COURSE: MOBILE NETWORKS AND ARCHITECTURES	COURSE CODE: MNA810S
DATE: JUNE 2024	SESSION: 1
DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	PROF DHARM SINGH JAT
MODERATOR:	DR LINOH MAGAGULA

THIS QUESTION PAPER CONSISTS OF THREE PAGES
(Excluding this front page)

INSTRUCTIONS

1. Write clearly and neatly.
2. Write all your answers in the answer booklet provided.
3. Number the answers clearly.
4. This paper consists of two sections; Section A and B.
5. Answer ALL questions in section A.
6. Answer any 3 questions in section B.
7. Begin each section on a new page.
8. Marks/scores per question are given in [].
9. Do not use or bring into the examination venue books, programmable calculators, mobile devices and other material that may provide you with unfair advantage. Should you be in possession of one right now, draw the attention of the examination officer or invigilator.
10. NUST's examination rules and regulations apply.

SECTION A [40Marks]

This section contains **TWO** questions.
Attempt **ALL** questions.

Q1 Choose the correct answer for each of the following multiple-choice questions.

[20 marks, 2 marks for each]

- (i). Five channels, each with a 100-kHz bandwidth, are to be multiplexed together. What is the minimum bandwidth of the link if there is a need for a guard band of 10 kHz between the channels to prevent interference?
- A. 550 kHz
 - B. 540 kHz
 - C. 560 kHz
 - D. 500 kHz
- (ii). What is the name of the database that stores subscriber information and the services that the subscriber is eligible to use under an MSC?
- A. MSC
 - B. AuC
 - C. EIR
 - D. HLR
- (iii). In LTE E-UTRAN Frame Structure, the number of Time -slots present in one Sub-Frame is:
- A. Five
 - B. Three
 - C. Four
 - D. Two
- (iv). 3G W-CDMA is also known as
- A. UMTS
 - B. DECT
 - C. DCS-1800
 - D. ETACS
- (v). What is the interface between NodeB and RNC in a WCDMA network?
- A. Luc
 - B. Lub
 - C. Lud
 - D. Lue
- (vi). Which of the following is a component of a 3G network architecture?
- A. User Equipment (UE)
 - B. Radio Access Network (RAN)
 - C. Core Network

- D. All the above options
- (vii). Which of the following memory device stores information such as subscriber's identification number in GSM?
 - A. Register
 - B. Flip flop
 - C. SIM
 - D. SMS
- (viii). What is a cluster in a cellular system?
 - A. Group of frequencies
 - B. Group of cells
 - C. Group of subscribers
 - D. Group of mobile systems
- (ix). Which of the following multiple access techniques allocates different time slots for the different users?
 - A. TDMA
 - B. CDMA
 - C. FDMA
 - D. FGMA
- (x). In which layer do Wireless LANs implement security measures?
 - A. System Layer
 - B. Data Link Layer
 - C. Sub Layer
 - D. Multi-Layer

- Q2 (i). Why is a Temporary Mobile Subscriber Identity (TMSI) required when we have an international mobile subscriber identity (IMSI)? [4]
- (ii). Describe frequency division multiplexing in wireless communication. [4]
- (iii). Explain how CSMA/CA solves the Hidden and exposed terminal problems. [4]
- (iv). State two functions of the eNB in E-UTRAN systems. [4]
- (v). State two functions of the Mobility Management (MM) protocol in UMTS. [4]

SECTION B [60Marks]

*This section contains **FOUR** questions*

*Attempt any **THREE** questions.*

- Q3 a) A cellular system with a total bandwidth of 15 MHz uses 10 kHz simplex channels to provide full duplex voice and control channels for 12 cell reuse patterns. 1 MHz of the total bandwidth is allocated for control channels.
- (i) Calculate the total available channels. [4]
 - (ii) Determine the number of control channels. [3]
 - (iii) Calculate the number of voice channels per cell. [3]

- b) Assume a spectrum of 480 kHz is allocated over a base frequency for communication between stations A and B.
- (i) Divide the entire bandwidth into four sub-bands. [4]
 - (ii) Why do we divide the entire bandwidth into sub-bands? [3]
 - (iii) Should we allocate a guard band? Why? [3]
- Q4 a) In LTE E-UTRAN Frame Structure
- (i). How many samples per second is full-duplex system in LTE FDD?. [2]
 - (ii). How many Sub-frames are present in a single Frame-Structure, and what is the size of each Sub-Frame in the time domain? [4]
 - (iii). How many time slots are present in a Sub-Frame? [2]
 - (iv). What is Cyclic Prefix (CP) in a Frame-Structure? [2]
 - (v). How many OFDM symbols are available in 1 time slot in Normal CP and Extended CP? [2]
- b) With the help of an appropriate diagram, explain the basic steps of Mobile originated call (MOC) to a fixed network. [8]
- Q5 a) With the help of an appropriate diagram, discuss how Encryption is achieved in a GSM network. [8]
- b) In a full-rate TDMA system used in United States Digital Cellular (USDC) IS-54 standard, the
- duration of a TDMA voice frame = 40ms
 - number of time slots in a frame = 6
 - number of bits in a voice frame = 1944
 - Number of bits in guard band = 6
- Calculate*
- i) the duration of a time slot of a voice frame [3]
 - ii) the number of bits in a time slot of a voice frame [3]
 - iii) the duration of a bit [3]
 - iv) the duration of guard time [3]
- Q6 Discuss the following subsystems of GSM Architecture:
- (i) the mobile station (MS), [5]
 - (ii) the base station sub system (BSS), [5]
 - (iii) the network and switching subsystem (NSS), and [5]
 - (iv) the operation subsystem (OSS). [5]

GOOD LUCK!