



**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

**Faculty of Computing and Informatics**

Department of Computer Science

<b>QUALIFICATION: BACHELOR OF COMPUTER SCIENCE HONOURS</b>	
<b>QUALIFICATION CODE: 08BCHC</b>	<b>LEVEL: 8</b>
<b>COURSE: MOBILE NETWORKS AND ARCHITECTURES</b>	<b>COURSE CODE: MNA810S</b>
<b>DATE: JULY 2019</b>	<b>SESSION: 2</b>
<b>DURATION: 3 HOURS</b>	<b>MARKS: 100</b>

<b>SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION QUESTION PAPER</b>	
<b>EXAMINER(S)</b>	<b>PROF DHARM SINGH JAT</b>
<b>MODERATOR:</b>	<b>DR LINOH MAGAGULA</b>

**THIS QUESTION PAPER CONSISTS OF FOUR 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). Where does the responsibility of billing and system maintenance function in a cellular system lie?
- a) Base Station
  - b) PSTN
  - c) MSC
  - d) Mobile system
- (ii). 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
- (iii). The process of transferring a mobile station from one base station to another is
- a) MSC
  - b) Roamer
  - c) Handoff
  - d) Forward channel
- (iv). Which one is not an advantage of using frequency reuse?
- a) Increased capacity
  - b) Limited spectrum is required
  - c) Same spectrum may be allocated to other network
  - d) Number of base stations is reduced
- (v). Which of the following specifies a set of media access control (MAC) and physical layer specifications for implementing WLANs?
- a) IEEE 802.16
  - b) IEEE 802.3
  - c) IEEE 802.11
  - d) IEEE 802.15

- (vi). Why are neighbouring stations assigned different group of channels in cellular system?
- a) To minimize interference
  - b) To minimize area
  - c) To maximize throughput
  - d) To maximize capacity of each cell
- (vii). Which of the following is a universally adopted shape of cell?
- a) Square
  - b) Circle
  - c) Triangle
  - d) Hexagon
- (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). Explain how multipath propagation affects signal quality. [5]
- (ii). Explain the hand-off mechanism in mobile communications. [5]
- (iii). Explain two functions of the Physical layer in a wireless and mobile environment. [5]  
- 2 marks for each correct statement
- (iv). Explain what is the frequency reused concept in GSM. [5]

**SECTION B [60Marks]**

This section contains **FOUR** questions

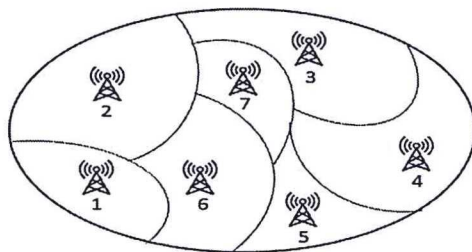
Attempt any **THREE** questions.

Q3 (a) With the help of an appropriate diagram, explain the basic steps of Mobile originated call (MOC). [10]

(b) Consider a simple high-power transmitter that can support 100 voice channels covering a given service area. Let the service area be divided into seven smaller area cells, as shown in figure below, each supported by lower power transmitters. The available spectrum of 100 voice channels is divided into 4 groups of 25 channels each. The cells (1,7) (2,4) (3,5) and 6 are assigned distinct four channel groups.

[10]

What is the total number of voice channels the new cellular networks can carry? Explain your answer.



Q4 Windhoek has a population of four million residents. Two competing trunked mobile networks (Telecom and MTC) provide cellular service in this area.

Suppose Telecom has 100 cells with 57 channels each and MTC has 23 cells with 57 channels each. The grade of service (GOS) of 2% for an Erlang B system is specified. Assuming that all two trunked systems are operated at maximum capacity.

For  $GoS = 0.02$  and  $C = 57$ , from the Erlang B chart, the total offered traffic(A) = 46.82 Erlangs.

(a). Find the number of users (Telecom and MTC) that can be supported at 2% blocking if each user averages three calls per hour at an average call duration of two minutes. Also [10]

(b). Find the percentage market penetration of Telecom and MTC. [5]

(c). Find the market penetration of the two systems (Telecom and MTC) [5]



Q5 a) With the help of an appropriate diagram discuss how Encryption is achieved in a GSM network. [8]

[Correct event in diagram = 1Mark ]

[Correct statements =1Mark ]

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*

- a) the duration of a time slot of a voice frame [3]
- b) the number of bits in a time slot of a voice frame [3]
- c) the duration of a bit [3]
- d) the duration of guard time [3]

Q6 (a) Generate orthogonal variable spreading factor (OVSF) codes from a set of orthogonal codes for UMTS communication systems which are primarily used to preserve orthogonality between different channels in a communication system. [8]

Assume the root has depth 0 and depth of tree is 4.

*[Each correct depth = 1 Marks]*

(b) Illustrate how fixed TDM patterns are used to implement multiple access and a duplex channel between a base station and mobile station in DECT cordless phone system. [6]

(c) Describe frequency division multiplexing technique in wireless communication. [6]

**GOOD LUCK!**