



UGANDA INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY WEEKDAY PROGRAMME END OF SEMESTER ONE EXAMINATIONS

ACADEMIC YEAR 2023/2024

DEPARTMENT: ICT

SEMESTER: TWO

PROGRAMME(S): DIPLOMA IN ELECTRICAL AND COMMUNICATIONS ENGINEERING

YEAR OF STUDY: TWO

COURSE: MOBILE COMMUNICATIONS TECHNOLOGIES

COURSE CODE : TE223

DATE: SUNDAY 30TH, JUNE 2024

TIME: 02:00 PM – 5:00 AM

DURATION: 3 HOUR

INSTRUCTIONS:

- (i) This paper consists of two (02) sections, section A and section B.**
- (ii) Attempt all questions in section A both part A and Part B. Also attempt at least three (03) questions from section B.**
- (iii) Credit will be given for use of relevant examples and illustrations.**
- (iv) Begin each number on a new page of the answer sheet.**
- (v) DO NOT write on this question paper.**

SECTION A

Part A (20 Marks)

1. The first generation cellular systems provide _____ services for communication.
a) Analog b) Digital c) Hybrid d) All the above
2. Which of the following is the world's first cellular system to specify digital modulation and network level architecture?
a) IS-94 b) AMPS c) CDMA d) GSM
3. Who sets the standards of GSM?
a) ITU b) AT & T c) ETSI d) USDC
4. Which of the following does not come under the teleservices of GSM?
a) Standard mobile telephony
b) Mobile originated traffic
c) Base originated traffic
d) Packet switched traffic
5. Which of the following comes under supplementary ISDN services?
a) Emergency calling
b) Standard mobile telephony
c) Call diversion
d) Standard mobile telephony
6. Which of the following feature makes impossible to eavesdrop on GSM radio transmission?
a) SIM b) On the air privacy c) SMS d) Packet switched traffic
- 7..... manages the switching function in GSM.
a) BSS b) NSS c) OSS d) MSC
8. To make processor or any other computer to communicate with a network _____ device is used.
a) Modem b) Repeater c) Bridge d) SIM
9. _____ is referred to as the core network part of GSM
a) Base Station Subsystem (BSS)
b) Network Switching Subsystem (NSS)
c) GPRS Core
d) Operations Support System (OSS)Network

10. _____ is known as controlling center of NSS.

- a) Base Station Subsystem
- b) Operations Support System
- c) GPRS Core Network
- d) Mobile Switching Center (MSC)

11. GMSC stands for _____.

- a) Gateway Mobile Switching Center
- b) Gateway Mobile Service Center
- c) Global Mobile Satellite Communication
- d) Global Mobile Service Center

12. The frequency in the GSM is selected by the operator. Further it is divided into

- a) Frame
- b) Packet
- c) Timeslots
- d) Bits

13. Mobility management and the call out functions for the mobile phone roaming are carried out by _____.

- a) Base Station Subsystem
- b) Network Switching Subsystem (NSS)
- c) GPRS Core Network
- d) Operations Support System

14. SIM card is protected by using _____.

- a) Personal Identification Number (PIN)
- b) Mobile Identification Number (MIN)
- c) International Mobile Subscriber Identity (IMSI)
- d) Mobile Subscription Identification Number (MSIN)

15. Cellular services utilizes _____ transmitters.

- a) High power
- b) Ultra-high power
- c) Low power
- d) Both low and high power

16. _____ is a cellular system uses FDMA and follows analog medium for communication.

- a) GSM
- b) AMPS
- c) D-AMPS
- d) None of the above

17. 1G technology uses _____ for the division of channels.

- a) TDMA
- b) FDMA
- c) CDMA
- d) SDMA

18. _____ is a time over which a call may be maintained with in a cell.

- a) Call dwell time
- b) Cell capacity time
- c) Queuing time
- d) Guard time

19. Which system allows the entire bandwidth to be available to each user at the same time.
- a) CSMA b) GSM c) CDMA d) SDMA
20. The main objective of the cell in a cellular mobile system.
- a) Hand off b) Higher bandwidth c) Simple modulation technique d) Frequency reuse

Part B (20 Marks)

- i. Why is the hexagon shape adopted as the shape of reference for modeling and planning a cellular network? Give any other shape that can be used (3 marks)
- ii. Explain why mobile communications technologies use a higher frequency for uplink and lower frequencies for down link. **(2 marks)**
- iii. Define the term *hand-off* **(2 marks)**
- iv. Outline any two (02) hand off strategies implemented in GSM network. (2 marks)
- v. Explain how it is possible for a traveler from Kenya, to use a safaricom simcard to make calls and receive SMSs while in Uganda. **(2 marks)**
- vi. Outline any two (02) security mechanisms used in 3G networks **(2 marks)**
- vii. An X influencer posted the following message on his social media platform *4G network operators steal my data bundles*. As a mobile communications student, give your opinion and support it with a reason. **(2 marks)**
- viii. Apart from *voice calls* and *short text* messages mention at least two (02) services offered by 3G network technologies. **(2 marks)**
- ix. Convert $P_r = 3 \times 10^{-5}$ watts into dB **(3 marks)**

SECTION B

Question 1 (20 Marks)

- (a) Before the introduction of cellular systems, earlier communication systems used broadcasting, outline two (02) advantages of cellular network technology. **(4 marks)**
- (b) Briefly explain the evolution of the GSM, highlighting the standard name and at least two (02) key specifications for each standard mentioned. **(08 marks)**.
- (c) Consider your analysis from 1(c) above, deduce the standard currently implemented in Uganda and give a reason to support your answer. **(02 marks)**.
- (d) Determine the number of duplex audio communication channels available per cell in a system that uses a bandwidth of 35MHz. The system uses simplex channels of bandwidth 50KHz and 5MHz of the allocated spectrum is dedicated to control channels and guard bands. The requires a $S/I = 15dB$ **(6 marks)**

Question 2 (20 Marks)

- a) Differentiate between a **VLR** and an **HLR** and give any three (03) kinds of data stored in each as applied in the GSM architecture **(8 marks)**
- b) Explain two roles played by the following entities in a GSM network, **Media gateway, EIR** and **AUC** **(06 marks)**
- c) Differentiate between an **Abis** interface and an **Um** interface as used in the GSM architecture. **(2 marks)**
- d) Nakawa is a very busy center with many pedestrians, cyclists and motorists making phone calls. Unfortunately, many pedestrians, cyclists and motorists lose their communications and their calls are dropped. As a communications technician, explain the cause of this phenomena and suggest any two (02) strategies that can be employed by mobile phone operators to remedy the situation in Nakawa center. **(4 marks)**

Question 3 (20 Marks)

- a. Explain how cluster size affects interference and network capacity in a cellular communication network **(3 marks)**
- b. Calculate the corresponding values of l and j to design a cellular network of cluster size
 - i. $N= 15$ **(3 marks)**
 - ii. $N= 19$ **(3 marks)**
 - iii. Comment on the results in a(i) and a(ii) above. **(1 marks)**
- c. If a signal-to-interference ratio of 38dB is required for satisfactory forward channel performance of a cellular system, what is the frequency reuse factor **Q** and cluster size **N** that should be used for maximum capacity if the path loss exponent is
 - i. $n = 4$ **(5 marks)**
 - ii. $n = 3$? **(5 marks)**Assume that there are two co-channel cells in the first tier, and all of them are at the same distance from the mobile. Use suitable approximations.

Question 4 (20 Marks)

A communication system has the following parameters: $P_t = 5W$, $G_{t(dB)} = 13 dB$, $G_{r(dB)} = 17 dB$, $d = 80Km$, $f = 3 GHz$ and $B = 30MHz$ Given Boltzman's $k = 1.38 \times 10^{-23} J/K$

Determine the value of the

- i. EIRP **(5 marks)**
- ii. Received power if cables and connection losses amount to 15 **(10 marks)**
- iii. Signal to noise ratio if the receiving equipment operates in a server which is kept at $T = 25^\circ C$ **(5 marks)**