



**ACCRA INSTITUTE OF TECHNOLOGY**

**The University of the Future**

**END OF TRIMESTER EXAMINATIONS**

**MAY 2022 TRIMESTER**

**DATE: SEPTEMBER 2022**

**COURSE CODE: TE 303**

**COURSE TITLE: WIRELESS & MOBILE COMMUNICATION**

**LECTURER'S NAME: EBEN NORNORMEY**

<b>COURSE OUTLINE (MAIN TOPICS)</b>		<b>QUESTION NO.</b>
MajorTopic-1	Introduction to Wireless Communication Systems	Q5B
MajorTopic-2	Introduction To Mobile Communication	Q4C
MajorTopic-3	Mobile Architecture (GSM)	Q1C Q3A Q6A
MajorTopic-4	The Cellular Concept	Q2B Q3C Q4B
MajorTopic-5	Calculations in Mobile Communication	Q2A Q5A Q6B
MajorTopic-6	Introduction to Satellite Communication	Q2C Q4A
MajorTopic-7	Satellite Design	Q1A Q3B Q6B
MajorTopic-8	Satellite Communication: Earth Channel	Q1B
MajorTopic-9	Satellite Communication: Orbital Aspects	Q6C
MajorTopic-10	Satellite Communication: Orbital Speed Equation	Q5C

## PART A

### FOUR QUESTIONS ANSWER THREE

#### Question 1

- a. The Architecture of GSM Cellular Network is grouped into four main areas; name these sectors and briefly explain the function of each sector.

Major Topic Mobile Architecture (GSM)	Blooms Designation <i>EV</i>	Score 8
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- b. With the aid of diagrams, explain briefly the operation of Communication Satellite.

Major Topic Intro. To Satellite Communication & Satellite Design	Blooms Designation <i>CR</i>	Score 6
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- c. What do you understand by call roaming in mobile telephony? Explain the condition that will occasion this feature and also explain the security feature on the mobile switch that handles this facility.

Major Topic Cellular Concept & Mobile Architecture (GSM)	Blooms Designation <i>AP</i>	Score 6
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**TOTAL SCORE: [20 Marks]**

#### Question 2

- a. Explain why the shape of a cellular cell is **HEXAGONAL**? Determine the cluster size of a cell which has the following shift parameters: **i=2 and j=1**. Draw the re-use cells of this network.

Major Topic Cellular Concept & Calculations in Mobile Communication	Blooms Designation <i>AP</i>	Score 8
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- b. What is Cellular Concept in Mobile Telephony? Explain briefly **THREE** factors of this Concept.

Major Topic Cellular Concept	Blooms Designation <i>EV</i>	Score 6
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- c. Explain **THREE** advantages and **THREE** disadvantages of Satellite Communication.

Major Topic Introduction To Satellite Communication	Blooms Designation <i>CR</i>	Score 6
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**TOTAL SCORE: [20 Marks]**

### Question 3

- a. Explain briefly the difference between apogee and perigee as applied to Highly Elliptical Orbit.

Major Topic Satellite Design	Blooms Designation <i>EV</i>	Score 6
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- b. With the aid of a sketch, briefly explain the functions of Satellite Control Center; indicate the need for this center.

Major Topic Satellite Communication: Earth Channel	Blooms Designation <i>AP</i>	Score 8
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- c. The Equipment Identity Register in GSM network contains three lists of IMEIs in its database; explain briefly the purpose of each.

Major Topic Mobile Architecture (GSM):Security Features	Blooms Designation <i>ER</i>	Score 6
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**TOTAL SCORE: [20 Marks]**

### Question 4

- a. Compare and contrast the **THREE** main Satellite Orbits (GEO, MEO and LEO) in terms of Altitude, Number of satellite to cover the world and Applications.

Major Topic Intro. To Satellite Communication	Blooms Designation <i>CR</i>	Score 6
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- b. With the help of diagrams, explain your understanding of proper and improper handoffs in cellular telephony.

Major Topic Intro. To Mobile Communication & The Cellular Concept	Blooms Designation <i>AP</i>	Score 6
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- c. The closest distance between the centers of two cells using the same frequency (in different clusters) is determined by the choice of the cluster size N and the lay-out of the cell cluster (frequency reuse distance). Study the table carefully, copy and fill the blank spaces.

	Cell Radius [R]	Cluster Size [N]	Reuse Ratio [Q]	Reuse Distance [D]
I= 2; J= 2	60 m			
I=3; J= 1	70 m			

Major Topic Calculations in Mobile Communication & Concept Cellular	Blooms Designation <i>AP</i>	Score 8
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**TOTAL SCORE: [20 Marks]**

**PART B**  
**TWO QUESTIONS ANSWER ALL**

**Question 5**

- a. AltelTigo as a Cellular Communication Service Provider has **1500** total available voice channels to handle traffic in the Volta Region. Assuming the total footprint of AltelTigo's network in the region is **3500 Km<sup>2</sup>**, prove that the system capacity and the number of channel per cell can be determined knowing that the cluster size is **7** and the coverage area of each cell is **7Km<sup>2</sup>**.

Major Topic Mobile Architecture (GSM) & Calculations in Mobile Communication	Blooms Designation <i>AP</i>	Score 8
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- b. Discuss the difference between the following Mobile Radio Transmission Systems and give **ONE** example each:
- ✓ Simplex (SX),
  - ✓ Half-duplex (HDX),
  - ✓ Full-duplex (FDX).

Major Topic Intro. to Wireless Communication Systems	Blooms Designation <i>AP</i>	Score 6
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- c. Explain briefly two critical considerations in satellite design.

Major Topic Satellite Design	Blooms Designation <i>EV</i>	Score 6
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**TOTAL SCORE: [20 Marks]**

### Question 6

- a. List **THREE** Security Features that can be found in the NSS of the GSM network and explain the function of each.

Major Topic Mobile Architecture (GSM)	Blooms Designation <i>AP</i>	Score <b>6</b>
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- b. In an effort to extend AiT TV coverage in Ghana and West Africa without the help of any television platform in the country or anywhere in the world; AIT put into the orbit a satellite. Assuming the distance between the orbit where the satellite is located and the earth at sea level is **100 kM**; prove that, the speed, the acceleration and the period of the satellite can be determined with the help of the following constants.

$$M_{\text{earth}} = 5.98 \times 10^{24} \text{ kg},$$

$$R_{\text{earth}} = 6.37 \times 10^6 \text{ m})$$

$$G = 6.673 \times 10^{-11} \text{ Nm}^2/\text{Kg}^2$$

Major Topic Satellite Design	Blooms Designation <i>AP</i>	Score <b>8</b>
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- c. Commercial satellite communication services are grouped into three general categories, explain briefly the difference between these classifications.

Major Topic Orbital Aspects	Blooms Designation <i>EV</i>	Score <b>6</b>
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**TOTAL SCORE: [20 Marks]**