NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

## FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

## DEPARTMENT OF LAND AND SPATIAL SCIENCES

| **QUALIFICATIONS:** DIPLOMA IN GEOMATICS, BACHELOR OF GEOMATICS, BACHELOR OF GEOINFORMATION TECHNOLOGY | |
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| **QUALIFICATION CODES:** 06DGEO, 07BGEO, 07BGEI | **LEVEL:** Level 6 - 06DGEO<br>Level 7 - 07BGEO, 07BGEI |
| **COURSE CODE:** RES511S | **COURSE NAME:** REMOTE SENSING 1 |
| **SESSION:** JUNE 2025 | **PAPER:** THEORY |
| **DURATION:** 3 HOURS | **MARKS:** 100 |

| **FIRST OPPORTUNITY EXAMINATION QUESTION PAPER** | |
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| **EXAMINER:** | Ms Roxanne Murangi |
| **MODERATOR:** | Ms Celeste Espach |

| **INSTRUCTIONS** |
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| 1. Write your student number and programme code (e.g.07BGEI ) on the answer sheet.<br>2. Answer ALL the questions.<br>3. Read each question carefully before attempting to answer.<br>4. Write clearly and neatly. |

| **PERMISSIBLE MATERIALS** |
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| 1. Pen<br>2. Pencil<br>3. Eraser<br>4. Ruler<br>5. Non-programming calculator |

**This question paper consists of nine (9) pages, including this cover page.**

**Question 1**

Answer the multiple-choice questions listed below. Please select the ONE most relevant to the following questions. Indicate the correct answer on the answer sheet.

1.1. Which of the following best describes electromagnetic energy? (1)

A. It consists only of electrical fields
B. It is a form of energy that travels in waves and as particles
C. It requires a medium for propagation, like sound waves
D. It does not interact with the Earth's atmosphere

1.2. Which of the following statements about electromagnetic waves is INCORRECT? (1)

A. All electromagnetic waves travel at identical speeds in a vacuum.
B. As wavelength increases, the frequency proportionally decreases.
C. Shorter wavelengths penetrate the atmosphere more effectively.
D. Thermal infrared sensors detect emitted rather than reflected energy.

1.3. What type of remote sensing system actively generates energy to illuminate a target? (1)

A. Active sensor
B. Thermal sensor
C. Passive sensor
D. Optical sensor

1.4. A researcher needs to monitor daily changes in sea surface temperature. Which satellite sensor would be most appropriate? (1)

A. Radar
B. Panchromatic
C. Thermal infrared
D. LiDAR

1.5. A radio wave has a frequency of 67 Hz. Calculate its wavelength in meters and choose the correct answer from the following options: (1)

A. $0.044 \times 10^{10}$ m
B. $1.04 \times 10^{8}$ m
C. $0.44 \times 10^{8}$ m
D. $0.044 \times 10^{8}$ m

1.6. Which factor reduces the radiometric resolution of remotely sensed imagery? (1)

A. Increased bit depth
B. Larger sensor size
C. Atmospheric scattering
D. Higher altitude

1.7. What is spectral analysis in remote sensing image interpretation? (1)

A. The process of analysing the spatial relationships between features on the Earth's surface.
B. The process of analysing the colour and intensity of light reflected from the Earth's surface.
C. The process of analysing the physical properties of the Earth's surface.
D. The process of analysing changes in features on the Earth's surface over time.

1.8. An urban planner must identify individual tree species in a city park. What spatial resolution would be most appropriate? (1)

A. 0.5 m
B. 10 m
C. 15 m
D. 30 m

1.9. A flood has occurred in a region with continuous cloud cover. Which type of sensor would provide the best data for mapping the flood extent? (1)

A. Optical (Visible & Infrared)
B. Thermal Infrared
C. Ultraviolet
D. Microwave (Radar)

1.10. Which of the following satellite sensors provides the highest spatial resolution? (1)

A. Sentinel-2 MSI
B. Landsat 8 OLI
C. WorldView-3
D. MODIS

**[10]**

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**Question 2**

2.1. A conservation agency wants to monitor deforestation in a remote rainforest with limited access. They need to track changes in vegetation over time and assess areas with illegal logging.

2.1.1. Explain how remote sensing can be used to achieve this goal. (4)

2.1.2. Which type of satellite images or remote sensing technology would be best for monitoring deforestation, and why? (4)

2.1.3. Justify why remote sensing is more effective than traditional ground surveys in this scenario. (3)

2.2. Describe how the Electromagnetic Spectrum relates to remote sensing. (3.5)

2.3. Describe how atmospheric windows affect remote sensing data acquisition and provide two (2) examples of atmospheric windows commonly used in satellite remote sensing. (5)

2.4. Figure 1 shows a schematic of the many types of electromagnetic radiation. Answer the following questions with this schematic:

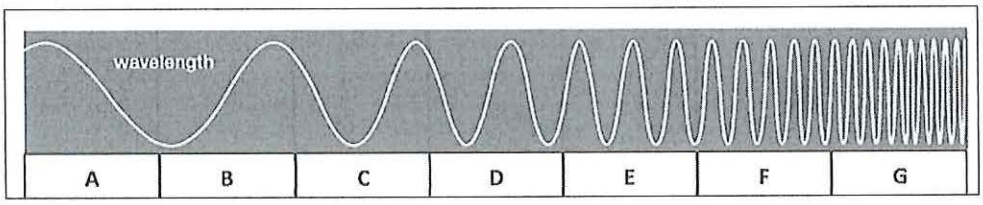


Figure 1

2.4.1. Indicate which part of the electromagnetic spectrum is represented by the letters A through G. (*Each correct answer will count for 0.5 marks).* (3.5)

2.4.2. For each of the following regions of the electromagnetic spectrum, A and C, please provide any two (2) distinct characteristics and any two (2) practical applications specifically related to each area. *(Each correct answer will count for 0.5 marks).* (4)

2.5. The Ministry of Agriculture, Fisheries, Water, and Land Reform requires cost-effective monitoring solutions to assess flood damage in the Cuvelai-Etosha Basin, track floodwater recession, and evaluate impacts on agricultural and grazing lands.

2.5.1. Compare one (1) advantage and one (1) disadvantage for each satellite, aircraft, and UAV platform for remote sensing applications. (6)

2.5.2. Which platform is most cost-effective for large-scale monitoring, and why? (3)

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**Question 3**

3.1. Environmental scientists monitor atmospheric conditions near Namibia's coastal region where the Namib Desert meets the Atlantic Ocean. They observe that the sky appears intensely red-orange during sunrise over the desert, while a whitish haze forms above fishing communities at midday when boats are most active. During the dry season, large dust storms from the desert create thick, white-grey clouds that block sunlight completely.
Analyse and describe the different types of scattering occurring in this scenario. (6)

3.2. Compare active and passive sensors in remote sensing based on their energy source, usage conditions, and applications. Present your comparison in a table format. (6)

3.3. After a wildfire in Etosha National Park, you must select appropriate satellite imagery to monitor the impact on wildlife habitat.

3.3.1. What image detail level (spatial resolution) would you need to see the burned areas in Etosha? (2)

3.3.2. Which spectral bands would help you see damaged vegetation in the park? (2)

3.3.3. How often (temporal resolution) should you take images during the rainy season to track recovery? (2)

3.3.4. Why does image sensitivity (radiometric resolution) matter when looking at bright landscapes like Etosha Pan? (2)

**[20]**

**Question 4**

4.1. You're part of a wildlife conservation team conducting aerial surveys in Etosha National Park, Namibia. Your aircraft is equipped with a specialised camera that has a 175 mm focal length. During your monitoring flight, you capture photographs from an altitude of 2450 m above ground level.

Calculate the scale of these photographs to help determine the actual size of ground features you're observing. *(Round your answer to two decimal places for metres.)* (5)

4.2. The Ministry of Environment and Tourism in Namibia has commissioned an aerial survey of Etosha National Park to monitor elephant populations and migration patterns. As a GIS specialist with the Namibia Wildlife Conservation Department, you've been asked to create detailed maps at a scale of 1:5000 to help rangers track and protect.

You have access to aerial photographs taken in 2023 by a camera with a focal length of 152 mm at a scale of 1: 18000. Before creating your maps, you need to determine the altitude at which the survey aircraft flew to capture these images, as this information will be required for your technical report and for planning future survey missions.

**Task**

Calculate the flying height of the aircraft when these photos were taken, expressing your answer in metres and feet. Show all your calculations and round your final answers to whole numbers. (5)

4.3. You are conducting an aerial survey over the Namib Desert using a MicaSense camera. You need an image with a ground resolution of 10 cm/pixel. Given that the camera has a CFOV of 50° and an image resolution (w*h) of 1920 × 1080, calculate the required flight height, expressing your answer in metres and feet. Show all your calculations and round your final answers to whole numbers. (10)

4.4. Determine the number of rows and columns of a band from Landsat 7 ETM with only the following information: its spatial resolution is 30 m, the swath width is 183 km, and the rows is 15 % less than the number of columns. Show all your calculations. (6)

4.5. What is electromagnetic radiation's wavelength (μm) with a frequency of 8000 MHz? *(Round to three (3) decimal places for metres).* (4)

4.6. Electromagnetic radiation has a wavelength of 0.055 mm. What is its frequency in MHz? (4)

**[34]**

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