# NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

## FACULTY OF ENVIRONMENTAL SCIENCE

## DEPARTMENT OF GEOSPATIAL SCIENCE

**MSC DEGREE IN APPLIED GEOGRAPHICAL INFORMATION SCIENCE AND REMOTE SENSING**

**REMOTE SENSING AND DIGITAL IMAGE PROCESSING**

**EGR 5102**

**Regular Examination Paper**

**November 2024**

This examination paper consists of 3 pages

**Time Allowed: 3 hours**

**Total Marks: 100**

**Examiner's Name: Mr Bukhosi Ngqabutho Khumalo**

**External Examiner: Dr M Shekede**

**INSTRUCTIONS**

1. Answer QUESTION ONE AND ANY THREE OTHERS
2. Each question carries 25 marks

**MARK ALLOCATION**

| QUESTION | MARKS |
|---|---|
| 1. | **25** |
| 2. | **25** |
| 3. | **25** |
| 4. | **25** |
| 5. | **25** |
| 6 | **25** |
| **TOTAL** | **100** |

**1. Reflectance properties of earth surface objects are important to the interpretation and analysis of remotely sensed images**

a). What is reflectance and what is its importance in remote sensing? **(5 marks)**

b). Differentiate between specular and diffuse reflector. **(5 marks)**

c). Explain why is it possible for measured reflectance values from water bodies to be very low in some cases and very high in others. **(5 marks)**

d). Describe the reflectance differences in the near infrared and Shortwave Infrared portions of a healthy and wilting leaf. **(10 marks)**

**2.** Image quality relies on the interaction between the electromagnetic radiation and atmospheric components at the time of image acquisition. Briefly describe the causes and different types of scattering in relation to the electromagnetic spectrum that may affect image quality.

3. "In the electromagnetic spectrum, atmospheric windows play a great role terrestrial in Remote Sensing." Give an overview of the electromagnetic spectrum in which you describe and discuss the various wavelengths used in Earth Observation and their capabilities.

4(a) With relevant application examples, describe the three major satellite orbits commonly used in remote sensing. **(9 marks)**

(b) Using two operational sensors as examples, explain in detail the four sensor platform resolutions that characterize remotely sensed imagery. **(16 marks)**

**5.** "Image rectification, restoration, and resampling are methods of geometric image correction". Please provide a detailed discussion of these methods, including the advantages and disadvantages of each resampling method.

6. Land use/ Land cover classification for Bulawayo was carried out using Sentinel 2 imagery and Support Vector machine algorithm. The results of the exercise are analysed in the classification error matrix for the 6 classes as outlined in Table 1.

**Table 1. Classification error matrix**

| | | REFFERENCE DATA | | | | | | |
|---|---|---|---|---|---|---|---|---|
| PREDICTED DATA | | Urban | Cropland | Forest | Water | Barren | Swap | Total |
| | Urban | 478 | 0 | 5 | 0 | 0 | 0 | |
| | Cropland | 10 | 43 | 0 | 20 | 0 | 0 | |
| | Forest | 0 | 0 | 313 | 40 | 0 | 0 | |
| | Water | 0 | 15 | 0 | 126 | 0 | 0 | |
| | Barren | 2 | 0 | 0 | 38 | 342 | 80 | |
| | Swamp | 0 | 1 | 38 | 24 | 60 | 360 | |
| | **Total** | | | | | | | |

**Given the table above, Fill in the totals in Table 2 and calculate the following:**

a) The Producer's accuracy for all the land cover classes. **(5 marks)**

b) The User's accuracy for all the land cover classes. **(5 marks)**

c) The overall classification accuracy for the classification exercise. **(5 marks)**

d) Kappa Coefficient. **(5 marks)**

e) Which land cover class for the classification exercise has the worst accuracy as a result of the training data set? Justify your answer. **(5 marks)**

**END OF EXAMINATION**