UNAM
UNIVERSITY OF NAMIBIA

FACULTY	**AGRICULTURE, ENGINEERING AND NATURAL SCIENCES**		
DEPARTMENT	**ENVIRONMENTAL SCIENCE**		
SUBJECT	**REMOTE SENSING I**		
SUBJECT CODE	**GRS3611**		
DATE	**June/July 2022**		
DURATION	**3 HOURS**	**MARKS**	**100**

SUPPLEMENTARY/SPECIAL EXAMINATION

Examiner: **M Hipondoka, PhD**
External Moderator: **Prof Timothy Dube, University of the Western Cape**

INSTRUCTIONS

1. Work in an orderly manner and present your work as neatly as possible.
2. While most of the marks will be awarded for content, candidates must bear in mind the importance of presentation, i.e. insight and critical thinking.
3. Number your questions correctly and clearly.
4. This paper consists of four (4) pages (excluding this front page).
5. Answer all questions in Section A and answer one (1) question in Section B.
6. Usage of a calculator is allowed.

Section A

1. In **your own words** and in the context of Remote Sensing, **define** the following terms: **/10/**

a) Image georeferencing (2)
b) Panchromatic band (2)
c) Bandwidth (2)
d) Digital number (2)
e) Atmospheric window (2)

2. **Using practical examples, demonstrate your understanding (not definitions)** of the difference between the following terms: **/12/**

a) Radiance and Irradiance (4)
b) Low and high frequency (4)
c) Nadir and Principal point (4)

3. Using either Equation 1 or Equation 2 below, **prove** that hails emit energy (show all of your work). **/5/**

$$M = \sigma T^4 \quad \text{..... Equation 1}$$

$$\lambda_m = \frac{A}{T} \quad \text{..... Equation 2}$$

Note: In equation 1, the Stefan-Boltzmann constant (σ) is 5.6697 x 10-8 W m-2; while in equation 2, A = 2898 μm K

4. **/6/**

a) In **which** region of the electromagnetic spectrum most electromagnetic radiation from the Sun is emitted? (2)
b) **Briefly explain** whether the region mentioned in 4a) is available for remote sensing. (4)

5. You find a colleague having a global positioning system (GPS) and a hard copy of an original aerial photograph. They would like to locate themselves on the aerial photograph with the aid of a GPS, but they have a hard time. **Educate** them and **suggest** what needs to be done to resolve their struggle. (5)

6. Assume that you need to classify a satellite image into three classes a) water b) bare soil and c) vegetation at a sub-continental scale. To save space on the hard-drive, you opted to use the matching radiometric resolution. **/6/**

a) **What** is the smallest bit that can be used for such a data set? (2)
b) **Justify** your answer in 6a. (4)

7. Assume that your colleague, Hoveka, who missed one of our classes that dealt with color composite approached you for assistance. He related that he was trying to present an impressive color composite from an image with 8 bands. With immense frustration, he claimed that it is a nightmare to come up with a satisfactory color composite because of the relatively large number of bands. **/8/**

   a) **How many** color composites (non-repeating) can be obtained from such a data set? (4)

   b) Using Table 1, **advise** him on how a reasonable color composite can be obtained under the circumstances. (4)

Table 1: Correlation matrix of a Landsat 5 image

Layer	1	2	3	4	5	6	7	8
1	1.000	0.999	0.992	0.975	0.966	0.939	0.939	0.982
2	0.999	1.000	0.996	0.982	0.972	0.949	0.948	0.987
3	0.992	0.996	1.000	0.994	0.986	0.968	0.967	0.993
4	0.975	0.982	0.994	1.000	0.991	0.984	0.983	0.990
5	0.966	0.972	0.986	0.991	1.000	0.984	0.975	0.982
6	0.939	0.949	0.968	0.984	0.984	1.000	0.995	0.969
7	0.939	0.948	0.967	0.983	0.975	0.995	1.000	0.968
8	0.982	0.987	0.993	0.990	0.982	0.969	0.968	1.000

8. Using the minimum number of features(s) in Table 2, **prove** that for a sensor located in space the resultant signal would make darker objects to appear brighter than they ought to be, while lighter objects would be impacted much less. **/5/**

Table 2: Hypothetical reflectance of selected features

Ground cover	**Reflectance value from ground feature**	**Reflectance value from atmosphere**
Tree canopy	25	4
Water	2	4
Bare soil	100	4
Green grass	43	4

9. Study Figure 1 and answer the following questions: **/8/**

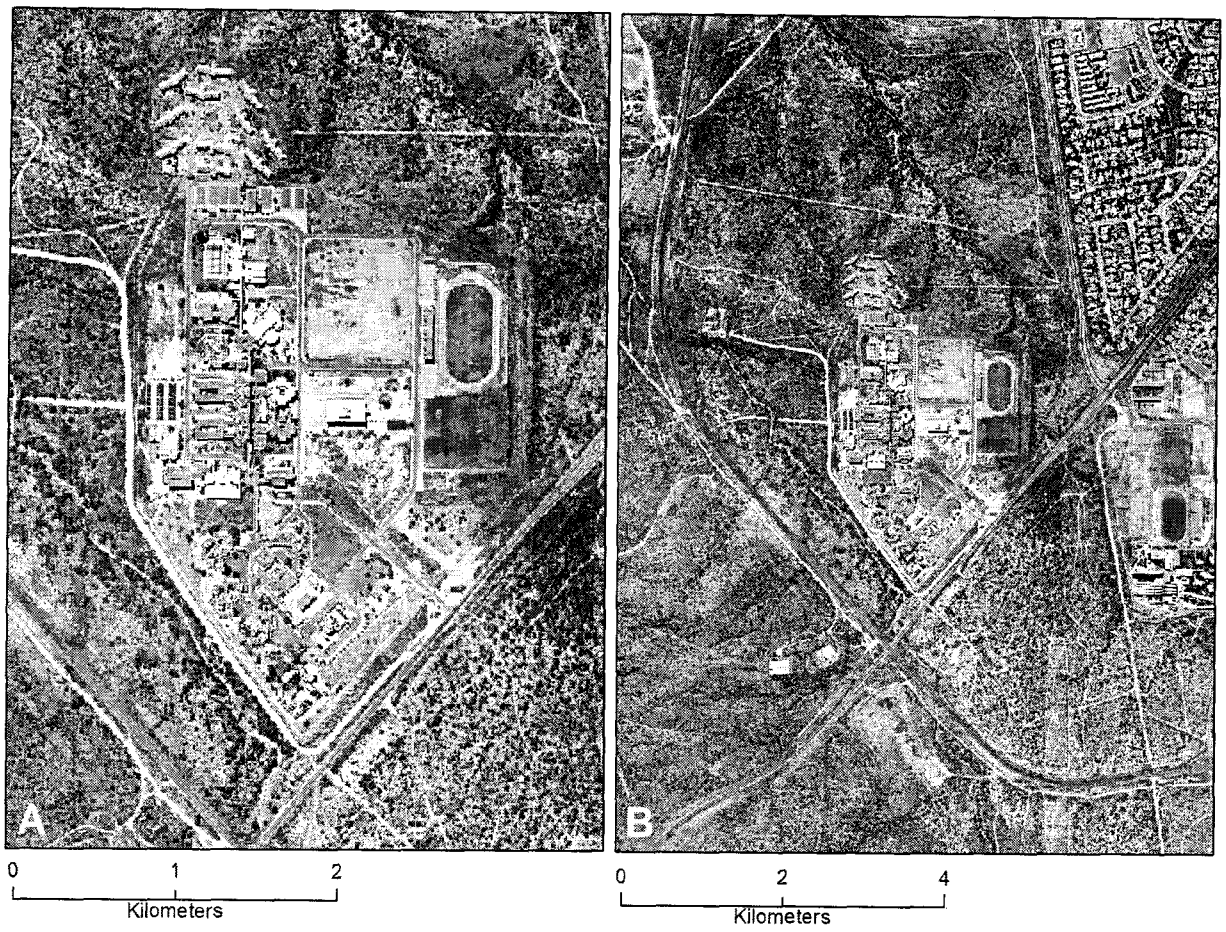

Figure 1: Images covering UNAM Main Campus taken at two different scales

a) **Which** of the two images is a large scale? (2)
b) **Which** of the two images has a large field of view? (2)
c) **Motivate** your answer in 9b. (4)

10. **/15/**

a. Using Table 3, **construct** the spectral signature for features A, B and C. (8)
b. On the basis of the spectral signature derived in 10a) **what** is the likely ground cover represented by each signature? (3)
c. **Motivate** your answer for features A and C. (4)

Table 3: Reflected values for selected features captured in the Sentinel 2 image covering part of Windhoek. Image acquisition date, April 27, 2022.

FEATURE	Band Number (and Spectral Region)								
	2 (Blue)	3 (Green)	4 (Red)	5 (Red Edge)	6 (Red Edge)	7 (Red Edge)	8 (NIR)	11 (SWIR)	12 (SWIR)
A	1902	2736	3320	3627	3852	3930	3892	4863	4469
B	1	36	1	58	1	1	1	35	80
C	256	931	407	1413	4342	5274	5096	2526	1297

Section B

Answer only one question in this section. **/20/**

11. After learning that you have taken both GIS and Remote Sensing classes at a university level, a farmer purchased a hard copy of an aerial photograph covering her medium size (5000 ha) farm and approached you for assistance. In particular, she would like to introduce smallholding irrigation schemes at her farm, located around Windhoek. To assess how much land is available and suitable for the project, she asked you to provide her with computer-based visuals showing areas on her farm that are 1) within 600 m from drainage lines, 2) having low or medium relief, and 3) currently covered by high vegetation density. **Describe** salient GIS and Remote Sensing steps that you would take to produce such information. (20)

OR

12. Four types of resolutions are recognized in Remote Sensing. **Discuss** the significance of each of these resolutions in Remote Sensing. (20)

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