



**PAMIBIA UNIVERSITY**  
**OF SCIENCE AND TECHNOLOGY**  
**FACULTY OF ENGINEERING AND SPATIAL SCIENCES**

**DEPARTMENT OF ARCHITECTURE & SPATIAL SCIENCES**

<b>QUALIFICATION(S):</b> Bachelor of Geoinformation Technology; Diploma in Geomatics; Bachelor of Geomatics	
<b>QUALIFICATION CODE (S):</b> 07BGEI; 06DGEM; 06DGEO; 07BGEO	<b>LEVEL:</b> 5
<b>COURSE CODE:</b> RES511S	<b>COURSE NAME:</b> REMOTE SENSING 1
<b>SESSION:</b> JUNE 2022	<b>PAPER:</b> THEORY
<b>DURATION:</b> 3 HOURS	<b>MARKS:</b> 100

<b>FIRST OPPORTUNITY EXAMINATION QUESTION PAPER</b>	
<b>EXAMINER(S)</b>	Dr Nichola Knox
<b>MODERATOR:</b>	Ms Celeste Espach

<b>INSTRUCTIONS</b>
<ol style="list-style-type: none"><li>1. Answer ALL the questions.</li><li>2. Write clearly and neatly.</li><li>3. Number the answers clearly.</li><li>4. All calculations, unless otherwise specified, must be rounded off to the 3<sup>rd</sup> decimal.</li><li>5. Include the formulas used for each worked calculation</li></ol>

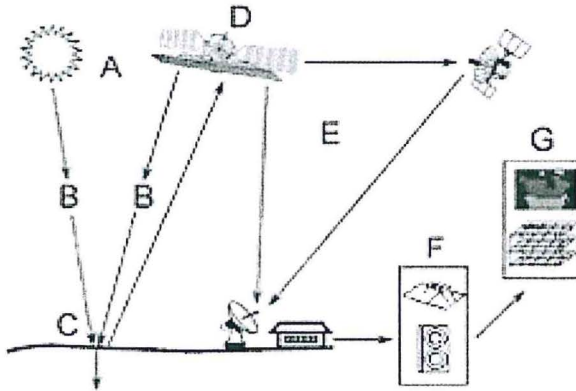
**PERMISSIBLE MATERIALS**

1. All course material and written notes (Open-book examination)
2. Calculator, and required stationery

**THIS QUESTION PAPER CONSISTS OF \_6\_ PAGES (Including this front page)**

**Question 1 – Short answer questions**

1.1 Using the image below answer the following questions based on it:



a) Provide the correct labels, in your own words, for A-G in this image with respect to the remote sensing process. (3.5)

b) For each of the labelled points provide in one or two sentences a brief explanation about how each of these points contribute to the remote sensing process (7)

1.2 Select which single answer, **in the correct order of words**, you think will complete these statements to make it true: An "Atmospheric Window" is a region of the spectrum where incoming light is \_\_\_\_\_ and is not \_\_\_\_\_ by atmospheric particles. These windows are regions, which in remote sensing, are used to study the properties of the \_\_\_\_\_ (1)

- a) Transmitted, absorbed, atmosphere
- b) Absorbed, transmitted, atmosphere
- c) Transmitted, absorbed, earth's surface
- d) Absorbed, transmitted, earth's surface

1.3 Select the correct choice which will complete this sentence to make it true: A short wavelength has \_\_\_\_\_ frequency and \_\_\_\_\_ energy (1)

- a) High, low
- b) High, high
- c) Low, high

d) Low, low

1.4 In how many ways can electromagnetic energy be modelled? And what are these ways? (1.5)

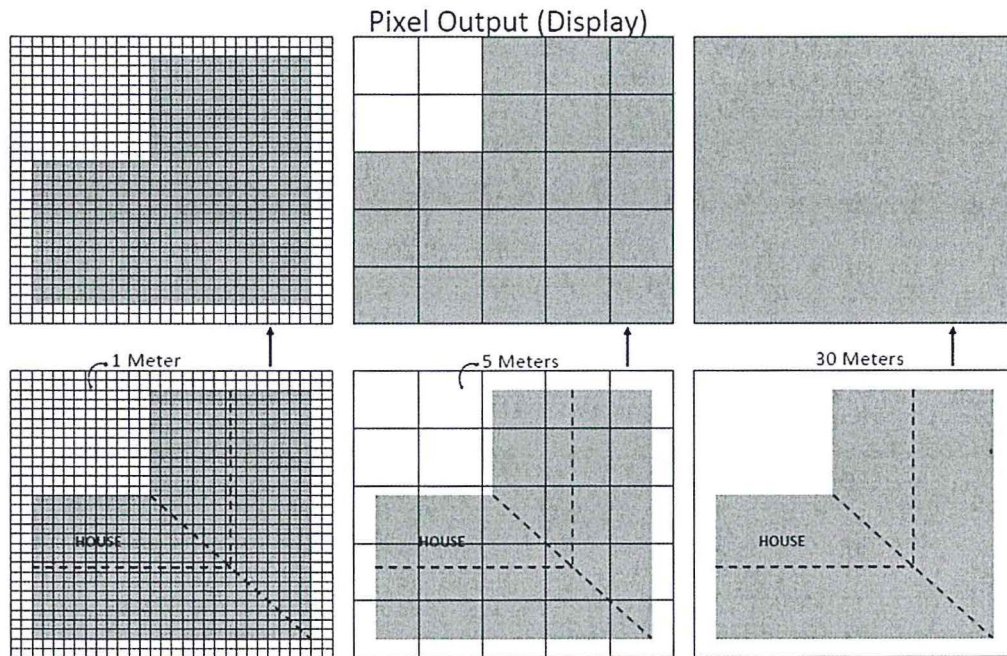
1.5 Match the correct type of image characteristics with the type of image (there is only 1 correct type of image characteristic that matches each image type): (2)

Image Type	Image characteristics
1. Raster image	A. longitude, latitude, height, .las
2. Point cloud image	B. longitude, latitude, weight, .tif
	C. longitude, latitude, DN, .las
	D. longitude, latitude, DN, .tif

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**Question 2 – Interpretation**

Use the image below to assist you in answering the following questions:



2.1 Consider the four types of resolution relevant to remote sensing sensor design. Answer the following questions using the figure to explain your answers when relevant:

- a. List the four types of resolution relevant to the field of remote sensing (4)
- b. Of these four resolutions' which do you believe this specific figure speaks too? Explain your answer (2)
- c. Each of the resolutions have specific scales (high, medium and low), which scales are represented in this figure? Explain your answer (4)
- 2.2 You work as a remote sensing specialist for the Ministry of Urban and Rural Development. They have tasked you with determining the annual rate at which the number of houses (formal and informal) are being built within the town you are living in. Formal houses are on average the size of those shown in this figure, and informal houses are on average half this size. Consider this information answer the following questions related to this task:
- a. List five important considerations (from a remote sensing perspective) you would need to consider in **selecting the appropriate images** needed to complete this task? Briefly explain your answer (10)
- b. What do you believe is the maximum size pixel you will require from an image in order for you to complete this task via an automatic classification approach? Explain how you would derive this, feel free to use a figure to support your answer (5)
- c. What is the remote sensing term used to describe when one selects the appropriate pixel size for a mapping exercise? (1)
- d. Determining this optimal pixel size is important in two stages of the mapping process. What are these two stages? Explain why you think it may be relevant to know this information prior to you starting your mapping exercise (4)
- 2.3 You have the task of monitoring (weekly) the larger (i.e over 4 ha) fresh water bodies in Namibia for their water quality. You want to be able to indicate if the water bodies have clean water, (high or low) surface sediment load or high or low quantity of surface algae. You have been given the choice of getting images from any one of these three sensors. The images have the following parameters: (14)

- I. 25 bands evenly spaced between 400 – 1000 nm, 250 m pixel size, and re-images each area daily
- II. 25 bands evenly spaced between 400 – 2500 nm, 50 m pixel size, and re-images each area every 3 days
- III. 15 bands evenly spaced between 400 - 800 nm, 100 m pixel size, and re-images each area every 7 days

Considering this background tabulate and discuss (with a figure too if it helps your explanation) the pros and cons of each of these sensors linked to the specific defined task. Use this information to indicate which of the sensors you would select to use for the task.

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### Question 3 – Calculations

- 2.1 You wish to acquire an image making use of a drone that will have a ground resolution of 4cm/pixel (IFOV). The camera to be used in the drone has a FOV of 54° and it produces images that have an image resolution (w\*h) of 1900\*1450. Calculate the required flight height (in ft) that is required to obtain this ground resolution. Would this flight be legal in Namibia? Explain your answer. Show all your calculation steps (10)
- 2.2 You have two spectrally subsetted level 1c Landsat 8 images (i.e. is already spectrally subsetted and geometrically corrected) that you wish to compare to see if there has been a change in the vegetation condition between these two images. Before you apply and compare this over the entire image you decide you want to outline and test your method by just testing on one known pixel in the two images to see if you can detect any differences. You have the following information extracted from the image and the metadata file. Use this information to answer the following questions:
- a. What are the processing steps you think need to be carried out on the images to conduct this type of analysis? Explain your answer as to why you believe these are the relevant steps that need to be conducted. (5)
  - b. If this subsetted file has 1340 columns and 1215 rows, and is a 14 bit unsigned integer, what would its file size be in kb and Mb? NOTE: the final answer in kb and (7)

Mb must be an integer. Show all your calculations

- c. What would the possible range of DN values be for a pixel in this file? Show how you determined this. (3)
- d. Using the information provided in the table, for the single pixel extracted from both images, and using the process flow you described above determine which of the two images **had healthier vegetation** for that specific pixel. Show all your calculations, and provide your interpretation of the final output. (15)

Property	Pixel 1 (From image date1)	Pixel 2 (From image date 2)
DN_B2	8024	10146
DN_B3	7629	10952
DN_B4	6847	12522
DN_B5	15228	14995
Sun Elevation	43.0531	41.0645
Reflectance_Mult_B2	2.0e-05	2.1e-05
Reflectance_Mult_B3	2.0e-05	2.1e-05
Reflectance_Mult_B4	2.0e-05	2.1e-05
Reflectance_Mult_B5	2.0e-05	2.1e-05
Reflectance_Add_B2	-0.10	-0.15
Reflectance_Add_B3	-0.10	-0.15
Reflectance_Add_B4	-0.10	-0.15
Reflectance_Add_B5	-0.10	-0.15

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