Satellite Image Processing – Test 1

Full Marks: 34

Question 1:

Spectral enhancement is the process of creating new spectral data from available bands. New data are created on a pixel-by-pixel basis by applying an operation (e.g., subtraction, division) to corresponding pixels in existing bands.

(a) Sate down and explain the three (3) most widely used spectral enhancement techniques.

Spectral Ratios and Indices - Performs band ratios that are commonly used in vegetation and mineral studies, water, built-up, soil;

Principal Components Analysis (PCA) - Compresses redundant data values into fewer bands which are often more interpretable than the source data (we will not perform a PCA in this tutorial);

Tasseled Cap – Transforms and rotates the data structure axes to optimize data viewing for vegetation studies.

(marks: 6)

(b) When using the Landsat TM Imagery to perform ration indices, match the following to its correct definition.

4 / 3 Ratio - (NIR/Red) –	To pull out water bodies
2 / 5 Ration – (Green/MIR) –	Enhances the presence of vegetation
3 / 7 Ratio - (Red/MIR) –	To detect clay rich rocks.
5 / 7 Ratio – (MIR / MIR) –	To see differences in water turbidity.

(marks: 4)

Total marks: 10

Question 2:

Differentiate with diagram how you understand Spatial and Spectral resolution. Provide examples to assist your discussions?

Spatial Resolution: This refers to the level of detail or clarity of the image, typically measured in meters per pixel. Higher spatial resolution means smaller pixel sizes and thus more detailed images.

Spectral Resolution: This refers to the range and number of bands/layers a particular imagery can have or it is the number of bands in the electromagnetic spectrum that the sensor can detect.. A sensor with higher spectral resolution can distinguish between more subtle differences in the reflectance properties of different materials.

Marks: 4

Question 3:

Explain with example the technique of resolution merge in satellite image.

The resolution of a specific sensor can refer to radiometric, spatial, spectral, or temporal resolution.
Landsat TM sensors have seven bands with a spatial resolution of 28.5m.
SPOT panchromatic has one broad band with very good spatial resolution—10m.
Combining these two images to yield a seven band dataset with 10m resolution provides the best characteristics of both sensors.

Marks: 4

Question 4:

State down three (3) most common reason for satellite image/aerial image to become low contrast or to contain error during capturing.

1. The individual objects and background that make up the terrain may have nearly uniform electromagnetic response.

2. Due to atmospheric scattering of electromagnetic energy.

3. The remote sensing system may lack sufficient sensitivity to detect and record the contrast of the terrain.

4. Lack of precise response record by the sensor.

5. And also incorrect recording technique can result in low contrast imagery although the scene has a high contrast ratio.

Marks: 4

Question 5:

In linear contrast enhancement, the small range of brightness values (DN values) of the input scene is stretched to occupy the entire range of 0 to 255 in the output scene. State down the algorithm/equation that are used to perform linear contrast enhancement.

To perform the linear contrast enhancement, the following algorithm is used-

$$DN' = \frac{(DN - MIN)}{(MAX - MIN)} \times 255$$

where, DN' = Digital value assigned to pixel in output image
DN = Original digital number of pixel in input image
MIN = Minimum value of input image
MAX = Maximum value of input image

Marks: 4

Question 6:

For multi-spectral satellite images, each cell has more than one value, data are stored in either of the following formats:

1. Band Interleaved by Pixel (BIP)
2. Band Interleaved by Line (BIL)
3. Band Sequential (BSQ)

Using the sample data as illustrated, fully show, how data is stored using **BIL**

Column

Band 1

Row	1	2	3
1	6	3	8
2	5	4	9
3	7	2	8

Band 2

Row	1	2	3
1	6	9	8
2	4	5	7
3	3	1	8

Band 3

Row	1	2	3
1	9	8	7
2	5	6	4
3	7	2	6

1^{st} row band1, 1^{st} row band2, 1^{st} row band3; 2^{nd} row band1, 2^{nd} row band2, 2^{nd} row band3; 3^{rd} row band1, 3^{rd} row band2, 3^{rd} row band3

Ex: 6 3 8, 6 9 8, 9 8 7; 5 4 9, 4 5 7, 5 6 4; 7 2 8, 3 1 8, 7 2 6.

Marks: 3

Question 7:

Discuss with equation/formula how you calculate NDVI and NDBI using Landsat 7 ETM+. Clearly discuss how output from the calculation are understood and presented.

NDVI=(IR – R)/(IR + R) – Calculated output NDVI raster values ranges from -1 to +1. The healthier vegetation or the more the presence of good vegetation the higher the value towards +1, the less the vegetation or no good quality available vegetation the value appears to be below 0.5 towards -1.

Marks: 5

$$NDBI = \frac{NIR - SWIR}{NIR + SWIR}$$

Calculated output Natural Diferential built-up index raster values ranges from -1 to +1. The good available or the presence of built-up areas the higher the value towards +1, the less the builtu-up zones the value appears to be below 0.5 towards -1.