

UNIVERSITY OF SWAZILAND  
DEPARTMENT OF GEOGRAPHY, ENVIRONMENTAL SCIENCE AND  
PLANNING

FINAL EXAMINATION, DECEMBER 2018

MSc. E.R.M.

TITLE OF PAPER: GEOGRAPHIC INFORMATION SYSTEMS

COURSE NUMBER: GEP607

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS:

1. ANSWER TWO QUESTIONS
2. ANSWER ONE (1) QUESTION FROM BOTH SECTIONS A AND B
3. ILLUSTRATE YOUR ANSWERS WITH EXAMPLES AND USE APPROPRIATE TERMINOLOGY

ALLOCATION OF MARKS: EACH QUESTION CARRIES 50 MARKS

THIS QUESTION PAPER SHOULD NOT BE OPENED UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR

**GEP607: GEOGRAPHIC INFORMATION SYSTEMS – DECEMBER 2017**

**SECTION A**

**ANSWER ONE QUESTION**

**QUESTION 1**

You have just been hired as the Chief Planning Officer” within the Ministry of Spatial Planning and Infrastructure due to your expertise in social, economic, political, and cultural geography. The Ministry has no idea that you are also an expert in GIS. Your first assignment is to identify a location for a new airport that will be constructed in 2022 when capacity at Sikhuphe (King Mswati 111) and Matsapha Airport is expected to be overwhelmed by commercial and charter flights. You are expected to select a site for the airport that will generate maximum economic revenue with minimal environmental, cultural, and social impacts. The Ministry does not have computers, and expects you to do your job with a pencil, ruler, and a paper.

- a) Write a memo to the Principal Secretary making a strong argument on why the Ministry should use a GIS to select the optimal location for the airport. In your memo, outline the cost implications (in general terms, not in absolute Emalangeni) and limitations. Your memo should present a clear argument as to why the Ministry should invest in GIS. (20 marks)
  
- b) Congratulations, your memo was successful! The Ministry has now bought you a high-end PC with ArcGIS software, a colour plotter, and a GPS. You have also gained access to the SwaziGIS database within the Surveyor-General’s Department, which includes a geodatabase with ArcGIS shapefiles. Now you need to get down to work. You have identified the following 5 criteria as being most important to the selection of the airport location.
  - i) The terrain should be flat and free of water.
  - ii) The airport should be located within three (3) km of the main highway, MR3.

- iii) The airport can be built on farmland, but it should not be built on recreational land. Also, it cannot be located within two (2) km of a protected area.
- iv) The airport should be built at least five (5) km from areas with high population density (urban areas).
- v) To attract tourists to Swaziland, there should be at least one cultural heritage site within four (4) km of the airport.

Identify the data requirements including the required coverages (*i.e.*, shapefiles or layers) that you will use in your analysis. In a methodical manner, describe how you will go about identifying an optimal site for the airport, including any spatial analysis that you will do on your selected coverages. (20 marks)

- c) Having used GIS to select an optimal location for the airport, you now want to describe to the Principal Secretary some of the uncertainties associated with your results. What can you do to reduce the uncertainty? (10 marks)

**(50 Marks)**

## QUESTION 2

- a) Identify and describe the three fundamental “types of map features” used in desktop mapping. Identify and discuss the fourth type that is extensively used in grid-based modelling? (30 marks)
- b) Discuss the relationship between GIS and remote sensing. (10 marks)
- c) Discuss the two (2) key parts of the spectrum that are maximally reflected/scattered by green vegetation? (10 marks)

**(50 Marks)**

**SECTION B**  
**ANSWER ONE QUESTION**

**QUESTION 3**

Briefly describe how regression analysis is used to develop a prediction equation from a “map stack” of geo-referenced mapped data (continuous surfaces). Be sure your answer discusses how the data is re-organized from geographic space into data space for fitting the regression line. Also, comment on the data types required for regression.

**(50 Marks)**

**QUESTION 4**

- a) Describe the following GIS concepts or terms in no more than 3 or 4 sentences.
- i) Digitizing (3 marks)
  - ii) Spatial autocorrelation (3 marks)
  - iii) Geographic Positioning System (GPS) (3 marks)
  - iv) Relational Database (3 marks)
  - v) Georeferencing (3 marks)
  - vi) Spectral reflectance (3 marks)
  - vii) Radiometric resolution (3 marks)
  - viii) Remote sensing (3 marks)
- b) Write a short essay on how spatial data infrastructure can be valuable to sustainable development. (20 marks)
- c) Using suitable examples, describe the key characteristic of a sensor that may be used to study temperature of the soil, water, and rock on Earth's surface (average 300 °K), (6 marks)
- (50 Marks)**