The University of Zambia

School of Engineering

Department of Geomatic Engineering

2018/2019 Academic Year

Second-Half Year Final Examinations

GEE 3622: Principles of Data Acquisition and Processing

Time: Three (3) Hours
Instructions

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1. This Examination is **Closed Book**
2. Calculators are permitted
3. Time allowed is **Three (3) Hours**
4. **Answer: ALL QUESTIONS FROM SECTION (A) AND ONE FROM SECTION (B)**
5. Show all the work leading to the solution
6. Total marks for this Examination paper is 100

Please! Do Not Turn This Page Until Instructed By The Invigilator

SECTION A

Question 1 (25 marks)

a) A vertical aerial photograph was taken with a 152.4-mm-focal-length camera from a flying height of 1385 m above datum. Images *a* and *b* of two ground points A and B appear on the photograph, and their measured photo coordinates are x_a = -52.35 mm, y_a = 48.27 mm, x_b = 40.64 mm and y_b = 43.88 mm. Determine the horizontal length of line AB if elevations of points A and B are 204 and 148 m above datum, respectively.

b) A distance ab on a vertical photograph is 65.0 mm, and the corresponding ground distance AB is 1150 m. If the camera focal length is 152.4 mm, what is the flying height above the terrain upon which line AB is located?

Assume that the values given for focal length, photo distance and ground length contain random errors of ± 0.005 mm, ±0.50 mm, and ±0.30 m respectively. What is the expected error in the computed flying height?

Question 2 (25 marks)

a) Discuss and give examples of the terms:

i) Active Remote and
ii) Passive Remote sensor systems

b) Mention three (3) most common bands of the electromagnetic spectrum used for remote sensing.

c) When electromagnetic radiation strikes matter, it interacts with it in possibly four main ways; Name the four (4) processes involved?

d) Three main types of scattering important to remote sensing are: Explain their effects.
- Rayleigh scattering
- Mia scattering
- Nonselective scattering

Question 3 (25 marks)

a) Spatial and non-spatial data are the two types of data to be entered in a GIS. Give a brief description of Spatial and non-spatial data?

b) Briefly describe what the terms digitizing and scanning mean in GIS data entry?

c) What are the two main types of data formats used in GIS?

d) Give three (3) advantages and disadvantages of Vector Data?

e) What does the term "Georeferencing" mean?

SECTION B

Question 4 (25 marks)

a) Explain the main principle behind laser mapping systems. What is the basic sensor hardware for laser mapping systems?

b) An airplane carrying an airborne laser scanning (ALS) system emits a laser pulse with a pointing angle of α=5.000° that takes 0.0051110 millisecond to reach an object on the ground and return to the sensor. At the same time, an onboard GPS-INS system measures the position of the laser coordinates as X=100.00m, Y=100.00m, Z=1000.00m, and the orientation as $\omega=\phi=\kappa=0$. What is the location of the object on the ground?

c) The rotation matrix R (ω,ϕ,κ) rotates the coordinate system of a tilted photograph to the coordinate system parallel to the reference ground system.

Determine the rotation angles (ω,ϕ,κ) if R has the following form:

$$R = \begin{pmatrix} 0.999910 & 0.013319 & 0.001635 \\ -0.013351 & 0.999671 & 0.021907 \\ -0.001343 & -0.021927 & 0.999759 \end{pmatrix}$$

(Formulas: sin φ= r13, tan κ= -r12/r11, tan ω=-r23/r33)

Question 5 (25 marks)

A project area is 16 km long in the east-west direction and 10.5 km wide in the north-south direction. It is to be covered with vertical aerial photography having scale of 1:12,000. A camera having a 152.4-mm-focal-length lens and a 230-mm square format is to be used. The nominal end lap and side lap are to be 60 and 30 percent, respectively. Beginning and ending flight lines are to be positioned along the boundaries of the study area. The only base map available for the area is at a scale of 1: 24,000. This map indicates that the average terrain elevation is 300 m above datum.

Compute the following data for the flight crew:

i. Flying height above mean sea level

ii. Ground coverage per image

iii. Distance between two successive axes of the strips.

iv. Number of flight lines required

v. Total number of photos needed

vi. Spacing of flight lines on the map

End of Examination