



The University of Zambia

School of Engineering

**Department of Geomatic Engineering**

2019/2020 Academic Year

**Deferred Examinations- January 2021**

**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. Where necessary, 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 One (16+9) marks

(a) Define the following photographic terms:

- Aperture = opening of lens
- F-number
- Illuminance
- Depth of field
- Principle point
- Ground nodal point\*
- Air base \*
- X-parallax \*

(10)

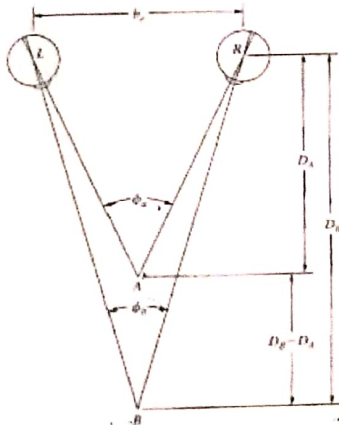
(b) What are the relationships between?

- F-number and shutter speed
- Film speed and emulsion grain size
- Resolution and emulsion grain size

(9)

### Question Two (8+4+4+9) marks

(a) Choose between (a) or (b) to complete the statement below correctly:



(8)

Stereoscopic depth perception is a function of the (a) parallactic (b) orthogonal angles. Parallactic angle is the angle of intersection of optical axes that converge on a certain point. The (a) smaller (b) greater the parallax angle and vice versa. The depth between object A and B ( $D_B - D_A$ ) is perceived as the (a) sum (b) difference in their parallax angles ( $\phi_a - \phi_b$ )

(b) x-parallax is the change in position of an object from one photo to the next caused by aircraft's

(u) motion (True or False)

(c) illuminance is a degree of brightness received per unit area of the image plane (a) after (b) during exposure

(d) The image distance for a photograph of an object, which is located 4.5 meters from the camera, is 76.5mm. What image distance is required for perfect focus if the object is in infinity?

(5)

### Question Three (4+10+2+9)

Remote sensing is a method of obtaining information from distant objects without direct contact.

The table below shows some key characteristics of remote sensing. Align the characteristics on the left with the correct definition on the right side of the table.

Spectral Differentiation	a) Refers to the use of many images of the same region acquired over time
Radiometric Differentiation	b) Every sensor is limited in respect to the size of the smallest area that can be separately recorded as an entity on an image
Spatial Differentiation	c) Refers to the detection of differences in the brightness of objects and the features
Temporal Dimension	d) Refers to observed spectral differences in the energy reflected or emitted from features of interest

(5)

(c)

(a)

Illustrate briefly, the major divisions of the electromagnetic spectrum.

In Remote sensing, what is meant by the term "atmospheric windows"?

All radiation used for remote sensing pass through the earth's atmosphere. Scattering is the re-direction of electromagnetic energy by particles suspended in the atmosphere. Briefly, explain three types of scattering involved.

## SECTION B

### Question Four ( 3+22) marks

Laser scanning in geomatics is used for topographic mapping and close range 3D object recording.

- i. Name three(3) basic sensor hardware for laser mapping
- ii. An airplane carrying an Airborne Laser scanning (ALS) system emits a laser pulse with a pointing angle of  $\alpha=5.000^\circ$  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  $x=100.00\text{m}$ ,  $Y=100.00\text{m}$ ,  $Z=1000.00\text{m}$ , and the orientation as  $\omega=f=k=0$ .

What is the location of the object on the ground?

Formulas:

Formula 1.

$$D=c.t/2$$

Formula 2.

$$\begin{pmatrix} X_A \\ Y_A \\ Z_A \end{pmatrix} = \begin{pmatrix} X_S \\ Y_S \\ Z_S \end{pmatrix} + M \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos(\alpha) & \sin(\alpha) \\ 0 & -\sin(\alpha) & \cos(\alpha) \end{pmatrix} \begin{pmatrix} 0 \\ 0 \\ -D \end{pmatrix}$$

$X_A, Y_A, Z_A$  : point coordinates

$X_S, Y_S, Z_S$  : scanner position coordinates

M: the Rotation matrix from the scanner to the ground system

$\alpha$  : is the pointing angle

### Question Five (6+3+2+4+10) marks

a)

- i. Describe the main parts of frame aerial camera
- ii. List three functions of the filter in the lens cone assembly of an aerial camera
- iii. Mention two types of laboratory procedures for calibration of the camera
- iv. List at least four(4) interior orientation parameters that are determined during the calibration process of an aerial camera

b) Discuss the characteristic curve H and D, or D-log- E curve.

-----End of Exams-----