The University of Zambia

School of Engineering

Department of Geomatic Engineering

2013 ACADEMIC YEAR

SECOND HALF YEAR EXAMINATIONS - JULY 2014

COURSE NAME: **PHOTOGRAMMETRY I**

COURSE CODE: **GEO 3322**

TIME: **THREE (3) HOURS**

TOTAL MARKS: **100**

INSTRUCTIONS

1. **Answer: ALL THREE** (3) QUESTIONS from SECTION A and **ANY** ONE QUESTION from SECTION B

2. This EXAMINATION is Closed Book

3. Calculators are permitted

4. Show all the work leading to the solution

SECTION A

Question 1

a)

i. Provide the definition of space resection

ii. How many and which are the unknown parameters for space resection

iii. What mathematical expression is used to determine the unknown parameters of the space resection

iv. What is required to be known to solve for the unknown parameters?

b) A project area is 16 km wide in east-west direction and 10.4 km long in north-south direction. It is to be covered with photos in scale 1:12000. The nominal end-lap and side-lap are to be 60% and 30%, respectively. A camera having a 152.4-mm-focal length lens and a 230-mm square format is to be used.

Compute:

i. Ground coverage

ii. The distance between two successive axes of the strips.

iii. Base in the strip

iv. Number of photos per strip (assuming two extra photos at each end of the strip to ensure coverage)

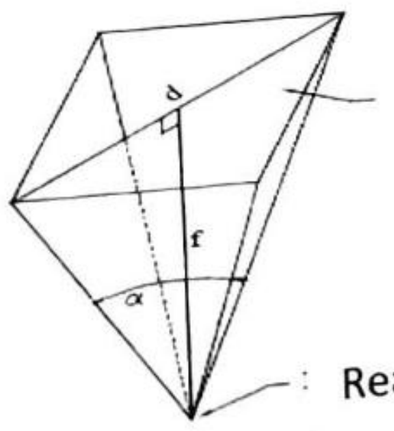
v. The intervalometer setting necessary to obtain the desired end-lap, assuming the aircraft flies at a velocity of 192km/h.

(13+10) marks

Question 2

a) Provide the definition of collinearity condition and give its mathematical expression. Explain the terms used in the mathematical expression.

b) The figure below shows the angular field of view of a camera. Calculate the angular field of view for a nominal 152-mm focal-length camera with a 23cm square format. State whether this is a wide angle, normal angle or super-wide angle type of a single-lens frame camera.



Focal Plane

α =Angular field of View

Rear Nodal point of lens

Hint: Use the formula:

$$\alpha = 2\tan^{-1}\left(\frac{d}{2f}\right)$$

(18+7) marks

Question 3

a) A pair of overlapping vertical photographs was taken from a flying height of 1,233 m above sea level with a 154.4-mm-focal-length camera. The air base was 390 m. With the photos properly oriented, parallax bar readings of 12.57 mm and 13.04 mm were obtained with the floating mark set on the principle points O_1 and O_2, respectively. On the left photo *b* was measured as 93.73 mm and on the right photo *b'* was measured as 93.30 mm. Parallax bar readings of 10.96 mm and 15.27 mm were taken on points A and B. Also, the x and y photo coordinates of points A and B measured with respect to the flight axes on the left photo were x_a= 53.41 mm, y_a= 50.84 mm, x_b=88.92mm, and y_b = -46.69 mm. Calculate the elevations of points A and B and the horizontal length of line AB.

b) Name the instrument usually employed to measure the position of a point in a photograph.

c) What are the systematic errors contained in the measured photo-coordinates that disturb the ideal linear relation between the perspective centre, the image point and the ground point?

(15+2+8) marks

SECTION B

Question 4

a) Assuming the principle point to be at the intersection of lines joining opposite corner fiducial points, calculate the coordinates of those fiducial points in the conventional xy coordinate system if their comparator coordinates XY are as in the table below.

Fiducial points	X(mm)	Y(mm)
A	87.294	210.223
B	199.826	96.996
C	313.054	209.555
D	200.512	322.768

b) Define the following photogrammetric terms, give the number of the corresponding parameter elements required for their determination and name them.

i. Basic interior orientation

ii. Relative orientation

iii. Absolute orientation

iv. Exterior orientation

(13+12) marks

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2012 Academic Year Second Semester
FINAL EXAMINATIONS

GE 212: Introduction to Geomatics

Monday 19th August 2013

TIME:Three (3) Hours

INSTRUCTIONS:

1. This examination is Closed Book
2. Calculators are permitted
3. ANSWER ALL questions
4. Show all the work leading to the solution
5. Total marks for this examination paper is 100
6. **[ ]** indicates allocated marks for the question
7. Answer: each section in a separate answer booklet:

Section A: GIS & Remote Sensing

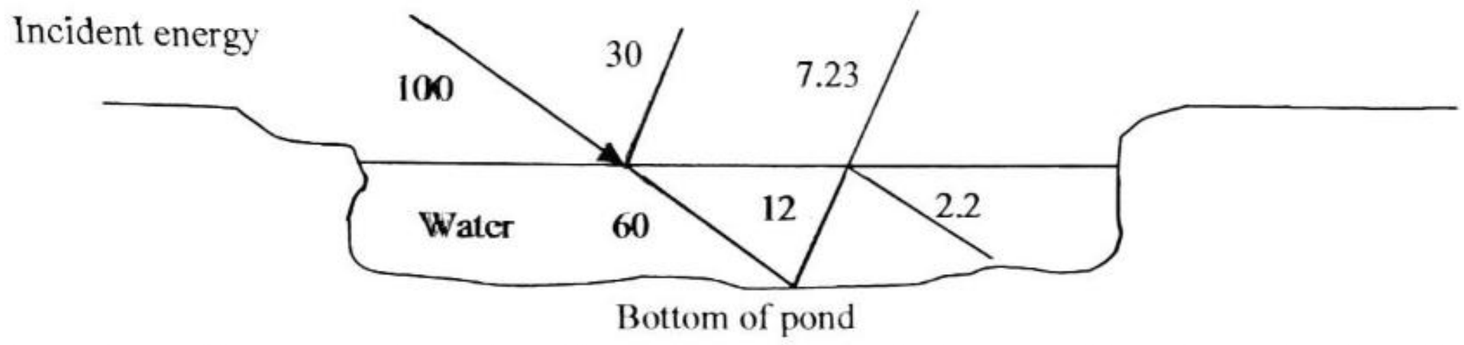
Question 1 [25 Marks]

a) Briefly but precisely explain GIS application in geomatic engineering. [4]

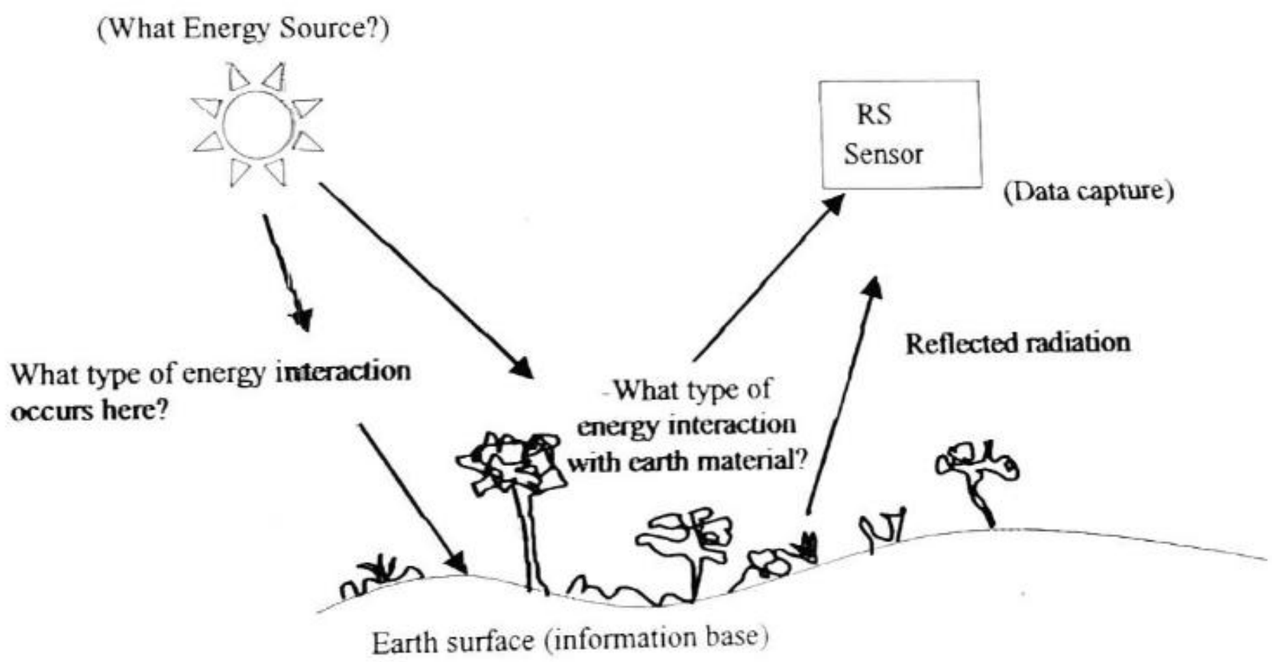
b) Briefly explain two (2) sources and/two(2) methods of spatial data capture. [4]

c) In GIS, the spatial framework can be represented in different ways. Explain with the aid of sketches the vector and raster GIS data models. [4]

d) Compute the total amount of energy reflected from the pond shown below if 30% of the energy incident on the water surface is reflected, 10% is absorbed, 60% is transmitted, and 20% of what hits the bottom of the pond is reflected. [3]



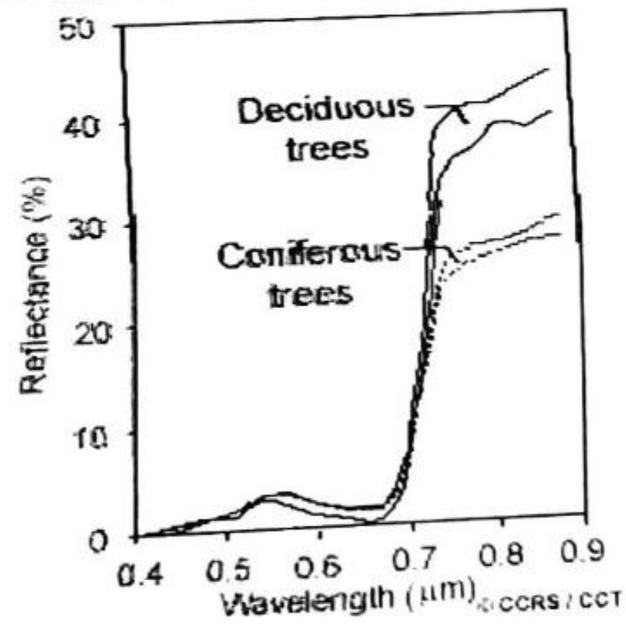
e) Below is a diagram showing the operation of the passive Remote Sensing system. Explain the types of energy interaction at each of the two stages identified on the diagram. [5].



f) The figure of reflectance curves below shows the spectral response patterns of deciduous and coniferous trees.

i. Which range of the wavelength is the visible portion and the near-infrared (NIR) of the electromagnetic spectrum? [2]

ii. State why it would be difficult to distinguish the two types of trees in the visible portion and easier in the NIR portion [3]



SECTION B: Surveying and Photogrammetry

Question 2 [25 Marks]

a) Global positioning system is nowadays the cutting edge technology of providing one's location.
   i) List four(4) advantages of GPS **[4]**
   ii) List three(3) limitations of GPS **[3]**

b) Given: A line of levels to be run from BM10 to BM11. At BM 10 the elevation is 101.325m. The level is set up at A,B,C,and D. Backsights and foresights are as follows.

Station	Backsight	Foresight
A	1.350	1.200
B	0.503	2.100
C	0.150	0.250
D	3.800	0.450

All the level setups are equally distant between back- and foresight points to reduce error to a minimum. Work out the levels to find the elevation of BM 11. **[12]**

c) With the help of sketches, describe the two types of coordinate systems used in surveying for identifying a point. **[6]**

Question 3 [25 Marks]

a) List at least four aberrations that cause different rays to converge to different points. Explain two of them in detail. **[4]**
b) State the main difference between vertical and tilted photographs. **[4]**
c) Explain the photographic terms: principle point, exposure station, endlap, sidelap, strip and block. **[12]**
d) Define 'scale of a photograph'. **[2]**
e) Mention three major applications of photogrammetry. **[3]**

SECTION C: Cartography

Question 4 [25 Marks]

Cartography should be considered a complete and independent science as well as a practical profession with specialised techniques.

a) It is a symbiosis of both theoretical and practical procedures. Clearly explain this statement. Cite an example in your answer. **[6]**

b) What is a primary topographic map and how else can it be called? Give a Zambian example **[5]**

c) The normal tasks of a cartographer are:

   i. to select required data for the map and
   ii. to process those data into a map.

List five (5) tasks a cartographer has to undertake under **(ii) "to process those data into a map"**. [10]

d) Where and when was the Zambia Survey Department first setup? **[4]**

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FINAL EXAMINATIONS

GE 332: Photogrammetry I Wednesday 28th August 2013

TIME:Three (3) Hours

INSTRUCTIONS:

1. This examination is Closed Book
2. Calculators are permitted
3. ANSWER **ALL** questions from **SECTION A** and one (1) question from **SECTION B**
4. Show all the work leading to the solution
5. Total marks for this examination paper is 100
6. **[ ]** indicates allocated marks for the question

Question 1 (20 marks)

a) Explain in details the effects of systematic errors on the image coordinates. Include sketches in your answer where necessary. **[16]**

b) During relative orientation of a photographic model, the same relative relationship between diapositives that existed at the time of photography is recreated. State the condition for relative orientation. **[2]**

c) After relative orientation, a true 3-D model is formed. State two important steps that are performed in the absolute orientation of model. **[2]**

Question 2 (20 marks)

a) Explain the meaning of the following photographic terms

i. Depth of field**[1]**
ii. Illuminance**[1]**
iii. F-stop **[1]**
iv. Isocenter**[2]**
v. Swing angle**[1]**
vi. Crab angle**[1]**
vii. Dead area**[2]**
viii. Air base**[1]**

b) In analytical photogrammetry, we often deal with matrix rotations in a plane for image points that must satisfy the orthogonality conditions. Given the following transformation:

$$\begin{pmatrix} X \\ Y \end{pmatrix} = \begin{pmatrix} 0.36 & 0.69 \\ 0.19 & 0.27 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

With the help of unit vectors

$$\mathbf{i} = \begin{pmatrix} \cos\alpha \\ \sin\alpha \end{pmatrix}, \qquad \mathbf{j} = \begin{pmatrix} -\sin\alpha \\ \cos\alpha \end{pmatrix}$$

State **three** (3) orthogonality conditions that must be satisfied for an orthogonal matrix and prove that the above transformation does not represent a rotation. **[10]**

Question 3 (20 marks)

a) Explain the following terms;
   i. Photographic properties of a film **[4]**
   ii. Metric photogrammetry **[2]**

b) Mention two important functions of filters in aerial cameras **[2]**

c) Two types of lenses are commonly used to manipulate light. These are concave (negative) and convex (positive) lenses. With the help of simple sketches, draw three different types of each these lenses showing how light is manipulated after passing through them. **[12]**

Question 4 (20 marks)

a) A shutter speed of 1/1000 is desired to obtain a sharp image at f/4.0, what f/number should be used to achieve the same result at a shutter speed of 1/500? **[6]**

b) With the help of well-labelled diagrams, describe the five (5) major lens aberrations that affect image quality. **[10]**

c) Explain the main differences between perspective and orthogonal projections. **[4]**

SECTION B

Question 5 (20 marks)

a) Assume two road intersections shown on a photograph can be located on a 1:25,000 scale topographic map. The measured distance between the intersections is 47.2 mm on the map and 94.3 mm on the photograph.
   i. What is the scale of the photograph? **[3]**
   ii. At that scale, what is the length of a fence line that measures 42.9 mm on the photograph? **[3]**

b) The length of line AB and the elevation of its endpoints, A and B, are to be determined from a stereopair containing images **a** and **b**. The camera used to take the photographs has a 154.4-mm lens. The flying height was 1200m (average for two photos) and the air base was 600m. The measured photographic coordinates of points A and B in the "flight line" coordinate

system are x(a)=54.61 mm, x(b)=98.67 mm, y(a)=50.80 mm, y(b)=-25.40 mm, x'(a)=-59.45mm, and y'(b)=-27.39 mm.

Find the length of line AB and the elevation of A and B. **[14]**

Question 6 (20 marks)

a) Explain the term depth of perception with respect to stereoviewing **[2]**

b) Given that the elevation of point C is 200m above MSL and that the parallax reading for the same point is 11.89mm and that of point A is 10.96mm, the parallax constant is 80.71mm. Calculate the parallax difference between the two points and the elevation of point A if the flying height for a pair of photos is 1000m. **[3]**

c) A mapping project is designed to use aerial photography at a scale of 1:10000 for a preliminary design of a development project covering an area of 20 x 15km. If a 15/23 camera is used with end and side overlaps of 60% and 30% respectively, calculate the following parameters if a flight plan along the longer side of the project boundary is to be prepared at a map scale of 1:20,000;

i. total number of flight lines **[3]**
ii. total number of photographs to cover the project area **[3]**
iii. spacing between boundaries and extreme flight lines close to the boundary **[3]**
iv. total number of models **[3]**
v. the required intervalometer setting that will achieve the desired end lap if the aircraft speed is 300km/h **[3]**

END OF EXAMINATION

*****GOOD LUCK *****