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THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING

DEPARTMENT OF GEOMATIC ENGINEERING

2011 ACADEMIC YEAR SECOND SEMESTER
FINAL EXAMINATIONS

GE 332: PHOTOGRAMMETRY I

TIME: THREE HOURS

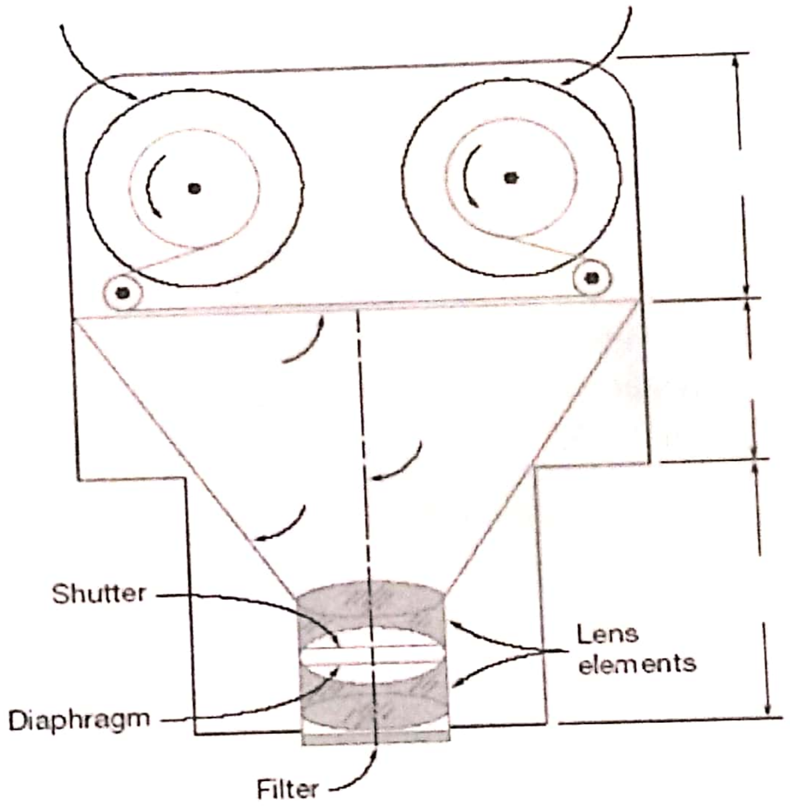
INSTRUCTIONS:

1. This examination is Closed Book
2. Calculators are permitted
3. ANSWER: ALL THREE (3) questions from Section A and ANY One question from Section B.
4. Show all the work leading to the solution
5. Total marks for this examination paper is 100

SECTION A

Question One (7+2+3+3+6+4 marks)

a) Below is a diagram of a single lens frame camera.



i) Name the parts labelled a,b,c,d,e,f and g.
ii) What is the purpose of camera calibration?
iii) What are the three elements of interior orientation?

b) What is relative orientation of a photographic stereopair?

c) Mention and explain two methods of relative orientation. Indicate all the elements or parameters that are involved during the orientations.

d) Explain what is meant by space resection and space intersection.

Question Two (16+4+5 marks)

a) Define the following terms:

- Pallarax
- Principal Point
- Nadir
- Isocenter

b) Briefly, state the main difference between a vertical photograph and a tilted photograph.

c) The distance between two points, measured on a vertical photograph, is 5.21 cm. The distance between these same two points, measured on a 1:50000 scale map, was found to be 1.43 cm. The average ground elevation between the two points is 300 m above mean sea level. Find the flying height at which the photograph was taken if the focal length used is 152.4 mm.

Question Three (15+10 marks)

a) Given the following 3x3 rotation matrices around the x-axis, y-axis and z-axis, respectively, derive the rotation matrix R(ω,ϕ,κ) which converts the measured image coordinate system(camera coordinate system) x,y,-f to the camera system x'y'z' parallel to the reference system. Assume that ω,ϕ,κ are clockwise rotation angles around x,y,z, respectively.

$$R(\omega) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\omega & \sin\omega \\ 0 & -\sin\omega & \cos\omega \end{pmatrix}, \quad R(\phi) = \begin{pmatrix} \cos\phi & 0 & -\sin\phi \\ 0 & 1 & 0 \\ \sin\phi & 0 & \cos\phi \end{pmatrix}, \quad R(\kappa) = \begin{pmatrix} \cos\kappa & \sin\kappa & 0 \\ -\sin\kappa & \cos\kappa & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Hint:

$$R(\omega,\phi,\kappa) = R(\kappa)R(\phi)R(\omega) = \begin{pmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \end{pmatrix}$$

b) Calculate the elements of the rotation matrix R, when ω= -0.0396 gon, ϕ=0.3070 gon and κ= -102.1708 gon.

SECTION B

Question Four (5+5+5+5+5 marks)

a) With the help of sketches, show how stereoscopic coverage is lost due to :

i) Tilt
ii) Unequal flying heights
iii) Terrain variations

b) Air base of a stereopair is 1400m and flying height above ground is 2400m. Camera has a 152.4 mm focal length and 23-cm format.

$s = \frac{f}{H}$

$s = \frac{152.4}{2400} =$

i) What is the percent *endlap*?
ii) Assuming spacing between adjacent lines is 2500m, what is the percent *side lap*?

Ground coverage = 0.23

Question Five (3+18+4 marks)

In an *ideal* optical system, all rays of light from a point in the object plane would converge to the same point in the image plane, forming a clear image.

a) What term is used for the *influences* which cause different rays to converge to different points?

b) Mention and briefly explain **six (6)** types of the *influences* mentioned in (a). Support your answer with sketches of the aberration types.

c) Draw ray diagrams for a typical convex lens for a real and virtual image formation.