

UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 5 Examination in Engineering: June 2014

Module Number: CE5233

Module Name: Advanced Surveying

[Two Hours]

[Answer all questions. Each question carries FIVE marks]

All Standard Notations denote their regular meanings

- Q1. a) In a pair of overlapping aerial photographs (mean photo base length 89.84 mm) the mean ground level is 70 m above datum. Two nearby points are observed and the information is given in Table Q1. If the flying height was 2,200 m above datum and the focal length of the camera was 150 mm find the height of Y above datum. (Assume a direct reading stereometer.)

[2.0 Marks]

- b) Images of points A and B appear on two overlapping vertical aerial photographs. The flying height above datum was 1,050 m and the air base was 500 m. The camera had a 150 mm focal length. Measured photographic coordinates (in mm) on the left-hand image are $X_a = 2.10$, $X_b = 3.50$, $Y_a = 2.00$, and $Y_b = -1.05$; and on the right-hand image $X_{1a} = -2.25$, $X_{1b} = -1.17$.

Determine the horizontal length of line AB and elevations of points A and B.

[2.0 Marks]

- c) Explain the terms 'metrical photogrammetry' and 'interpretative photogrammetry'

[1.0 Marks]

- Q2. a) Prove that the angle α measured on tilted aerial photograph, between any line through the principle point (pa) and the line of greatest tilt (pv) is related to corresponding horizontal angle β measured on the ground by

$$\tan \beta = \tan \alpha \cos \theta$$

Here, θ is the angle of tilt of the photograph.

Hint: if we extend photo it will meet the datum plane at an angle θ at the perspective axis. Line pv will meet the corresponding line PV at the perspective axis at point B. There is another point D on the perspective axis so that PA and pa will meet there. You may use Figure Q2.

[2.5 Marks]

- b) Two ground control points A, and B were photographed on tilt using an aerial camera with 300 mm focal length. Table Q2 shows the photo coordinates of the plumb point v, and the images a, b and c of ground points A, B and C. Determine the ground angle APB.

[2.5 Marks]

- Q3 a) A phototheodolite having a focal length of 200 mm was used at two stations A and B having co-ordinates (0 mN, 0 mE) and (0mN, 152.0 mE) In both cases station C, a tower 49.5 m high to the north, is on the vertical centre line of the photograph. In that from A, it measures 27.10 mm and its base is 6.50 mm above centre, while in that from B, it measures 24.00 mm and its base is 1.50 mm above the centre.
- Determine the co-ordinates of C
 - Level of the tower base relative to A
 - Level of B relative to A

[4.0 Marks]

- b) On a vertical aerial photo, a line (4530 ft long) is imaged. Its photographic length is 3.50 inches. On this same photo, a rectangular parcel of land measures 2.1-inches by 0.92-inches. Calculate the approximate ground dimensions of the parcel in units of feet and its acreage.

[1.0 Marks]

- Q4 a) Define the following terms used in positional astronomy

- Co-latitude
- Prime Meridian
- Local Meridian

[1.5 Marks]

- b) An aircraft flies from Lima, Peru (12.0433° S, 77.0283° W) to Katunayake, Sri Lanka (7.1667° N, 79.8667° E) along the shortest path. If the average speed of the aircraft is 800 km/hr, how long does it take to reach Katunayake? Assume that the radius of Earth is 6380 km.

If an aircraft needs to fly from Katunayake to Lima, what heading should the pilot follow?

[3.5 Marks]

Table Q1 Information from direct reading stereometer

Point	Height above datum	Parallax bar reading
X	56 m	8.32 mm
Y	-	10.43 mm

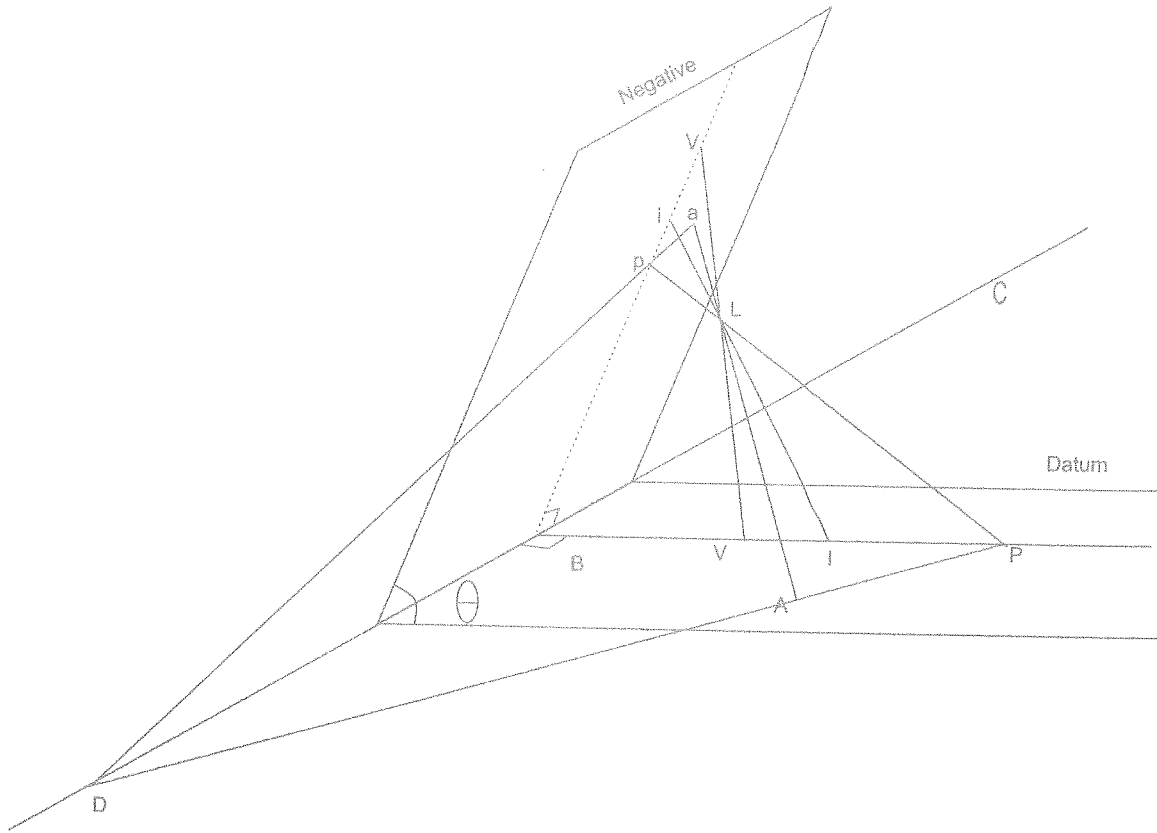


Figure Q2 Schematic diagram showing lines on the photo and corresponding lines on the ground meeting on a single line

Table Q2 Photo Coordinates

Point	x (mm)	y (mm)
v	-10.81	-11.42
a	-80.0	57.2
b	96.1	20.4

Equations and Conversion of Units

1. $\cos(a) = \cos(b) \times \cos(c) + \sin(b) \times \sin(c) \times \cos(A)$
2. $\sin(a) / \sin(A) = \sin(b) / \sin(B) = \sin(c) / \sin(C)$
3. 43,560 square feet=1 acre
4. 1 feet=12 inches
5. 5280 feet=1 mile