



# MACHAKOS UNIVERSITY

University Examination 2018/2019

**SCHOOL OF ENGINEERING AND TECHNOLOGY**  
**DEPARTMENT OF BUILDING AND CIVIL ENGINEERING**  
**THIRD YEAR SECOND SEMESTER EXAMINATION FOR**  
**BACHELOR OF SCIENCE (CIVIL ENGINEERING)**

**ECV 311: SURVEYING IV**

**DATE: 22/5/2019**

**TIME: 2.00-4.00 PM**

**INSTRUCTIONS:** Attempt questions **ONE** and any other **TWO** questions.

**QUESTION ONE (COMPULSORY) (30 MARKS)**

- a) Define the following terminologies as used in photogrammetry (5 marks)
- i. Base lining
  - ii. X-parallax
  - iii. Stereoscopy
  - iv. Forward compensation mechanism
  - v. Parallactic angles for points
- b) Explain how the optical method is used to connect and orient the underground control networks into the same coordinate system as the surface networks. (3 marks)
- c) Two points A and B situated 10 and 40 m, respectively, above datum, are imaged on a near-vertical aerial photograph, taken from an altitude of 2000 m with a camera of focal length 152 mm. The photo coordinates of the points about the fiducial axes are measured as follows:

|   | $x$ (mm) | $y$ (mm) |
|---|----------|----------|
| a | +50.00   | +100.00  |
| b | -100.00  | +80.00   |

If the tilt and swing of the photograph are  $2^\circ$  and  $20^\circ$ , respectively, calculate the horizontal ground distance AB. (5 marks)

- d) In a pair of overlapping photographs, (mean photo base length 89.84 mm) the mean ground level is 70 m above datum. Two nearby points are observed and the following information obtained:

| Point | Height above datum (m) | Parallax bar reading (mm) |
|-------|------------------------|---------------------------|
| X     | 55                     | 7.34                      |
| Y     |                        | 9.46                      |

If the flying height was 2200 m above datum and the focal length of the camera was 150 mm find the height of Y above datum. (4 marks)

- e) Calculate the approximate number of photographs required for stereographic coverage (60% forward overlap & 25% side overlap). Consider a photographic scale of 1:30,000, ground area coverage of 30 km by 45 km & a photographic standard format size of 230 mm  $\times$  230 mm (4 marks)
- f) Outline the camera constants obtained from the calibration process (3 marks)
- g) The image coordinates of three points A, B and C and of the principle points P and Q on two overlapping photographs were determined as follows:

|   | <i>Left photo</i> |               | <i>Right photo</i> |               |
|---|-------------------|---------------|--------------------|---------------|
|   | <i>x (mm)</i>     | <i>y (mm)</i> | <i>x (mm)</i>      | <i>y (mm)</i> |
| P | 0.0               | 0.0           | -76.2              | 0.0           |
| Q | +76.0             | 0.0           | 0.0                | 0.0           |
| A | +10.6             | +60.5         | -66.0              | +59.0         |
| B | +11.2             | -6.3          | -64.5              | -6.7          |
| C | +14.5             | +34.3         | -61.5              | +33.7         |

If the ground coordinates of A and B are 79 000 mE, 92 940 mN and 78 910 mE, 92 760mN respectively, estimate those of C. (6 marks)

## QUESTION TWO (20 MARKS)

- What is the objective of photogrammetric orientation? (2 marks)
- Given that the distance between point A and B on a topographic map is 4.75 cm, at a scale of 1: 50,000, and the distance between the same points on an air photograph is 23.07 cm, calculate the photographic scale (3 marks)
- Describe the various steps in photogrammetric orientation (15 marks)

## QUESTION THREE (20 MARKS)

- Explain how the weisbach triangle method is used to connect and orient the underground control networks into the same coordinate system as the surface networks. (10 marks)
- From Figure 1 below, the national grid (NG) bearing of an underground base line,  $CD$ , is established by co-planing at the surface onto two wires,  $W_1$  and  $W_2$ , hanging in a vertical shaft, and then using a Weisbach triangle underground. The measured field data is as follows:

NG bearing  $AB$ :  $74^\circ 28' 34''$ , NG coordinates of  $A$ : E 304 625 m, N 511 612 m, the horizontal angles:  $BAW_s$   $284^\circ 32' 12''$ ,  $AW_sW_2$   $102^\circ 16' 18''$ ,  $W_2W_uW_1$   $0^\circ 03' 54''$ ,  $W_1W_uC$   $187^\circ 51' 50''$ ,  $W_uCD$   $291^\circ 27' 48''$  and the horizontal distances:  $W_1W_2$  3.625 m,  $W_uW_2$  2.014 m. Compute the bearing of the underground base. (10 marks)

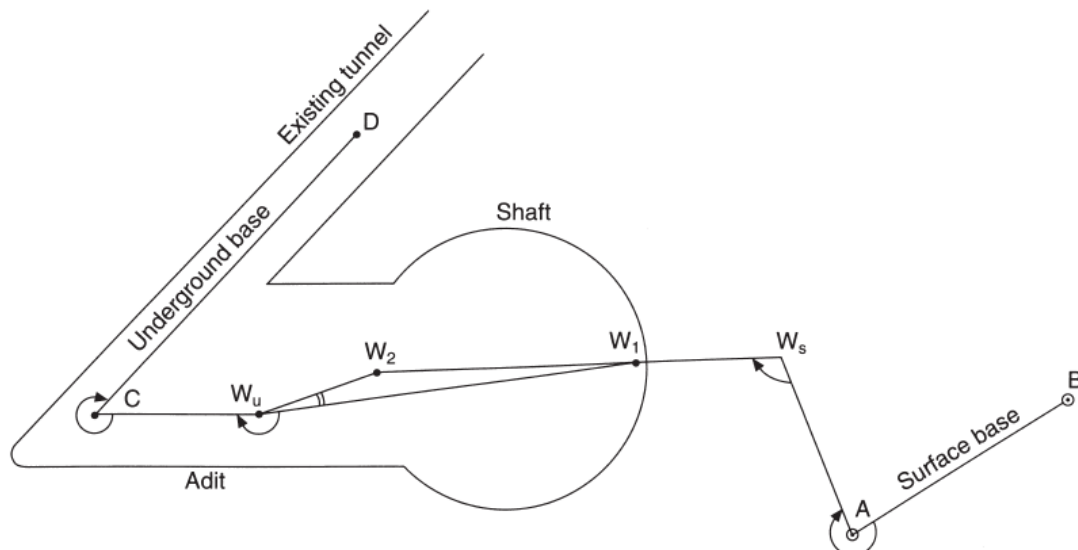


Figure 1

#### QUESTION FOUR (20 MARKS)

- a) In the Figure 2, for a certain photograph,  $H = 1200\text{m}$ ,  $f = 152$ ,  $vc$  is measured as  $88.36$  mm and  $vb$  as  $90.78$  mm:

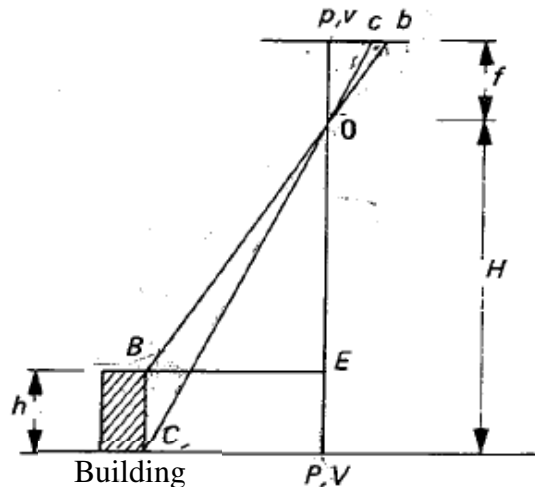


Figure 2

- i) Derive an equation for the displacement  $bc$
- ii) Estimate the height of a building (5 marks)
- b) Explain three applications of photogrammetry in Civil Engineering (15 marks)

#### QUESTION FIVE (20 MARKS)

- a) Outline the two basic tasks involved in hydrographic surveys. (1 mark)
- b) With the aid of a well labelled diagram, define the most commonly used terms in a near vertical photograph with the optical axis tilted at  $\theta$  to the vertical. (9 marks)
- c) Describe procedures for mapping water bodies. (10 marks)