MACHAKOS UNIVERSITY

University Examinations for 2022/2023

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: **TIME:**

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

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Derive the equations that show how the ground coordinates from a tilted photograph of a rugged terrain can be obtained. (10 marks)

b) The image coordinates of three points, A, B and C, and of the principle points P and Q on two overlapping vertical aerial photographs were as follows:

	Left Photo		*Right Photo*	
point	*x* (mm)	*y* (mm)	*x* (mm)	*y* (mm)
P	0.0	0.0	-89.2	0.0
Q	+89.4	0.0	0.0	0.0
A	+12.8	+44.6	-76.6	+44.2
B	+16.4	+6.3	-72.8	+5.9
C	+20.2	-30.7	-69.6	-31.2

Given that the ground coordinates of *A* and *C* were 60000 mE, 72000 mN and 61260 mE, 71200mN respectively, estimate those of *B*. (5 marks)

c) Two ground points A and B appear on a pair of overlapping photographs, which have been taken from a height of 3650 m above MSL. The base lines as measured on the two photographs are 89.5 and 90.5 mm respectively. The mean parallax bar reading from A and B are 29.32 mm and 30.82 mm respectively. If the elevation of A above MSL is 230.35 m, compute the elevation B. (4.5 marks)

d) An area of 220 km^2 is to be photographed at a scale of 1in 8000 from the air using a camera of focal length 150 mm, the photographs being 230 mm by 230mm. A longitudinal overlap of 60% and a lateral overlap of 25% must be provided. If the operating speed of the aircraft is 225 km/h, find:

   a. The flying height of the aircraft and the interval between exposures; (2 marks)
   b. The number of prints required if the flying strips are 16 km long. (2 marks)

e) Outline the camera constants obtained from the calibration process (1.5 marks)

f) In a pair of overlapping photographs (mean photo base length 89.84mm), the mean ground level is 70 m above the 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 150mm, find:

i) Air base *(*1 mark)

ii) The height of Y above datum, (2 marks)

iii) The difference in height between point X and Y (2 marks)

QUESTION TWO (20 MARKS)

a) 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◦ and 20◦, respectively, calculate the horizontal ground distance AB. (5 marks)

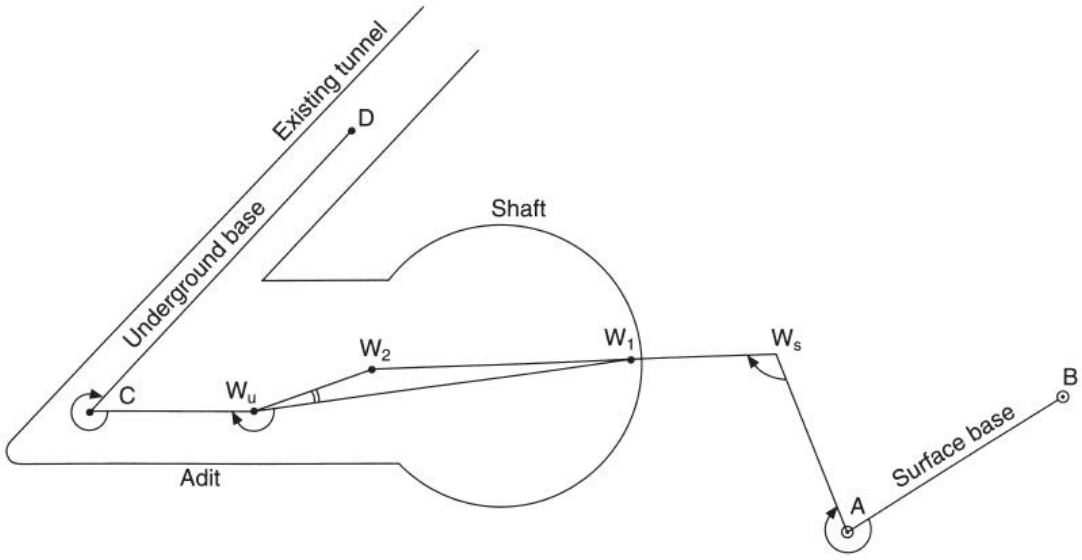
b) Describe the various steps in photogrammetric orientation (15 marks)

QUESTION THREE (20 MARKS)

a) 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)

b) From the figure below, the national grid (NG) bearing of an underground base line, *CD*, is established by co-planning 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 28' 34'', NG coordinates of *A:* E 304 625 m, N 511 612 m, the horizontal angles: *BAWs* 284 32' 12'', *AWsW*$_2$ 102 16' 18'', *W*$_2$*WuW*$_1$ 0 03' 54'', *W*$_1$*WuC* 187 51' 50'', *WuCD* 291 27' 48'' and the horizontal distances: *W*$_1$*W*$_2$ 3.625 m, *WuW*$_2$ 2.014 m. Compute the bearing of the underground base. (10 marks)



QUESTION FOUR (20 MARKS)

a) Explain how the optical method is used to connect and orient the underground control networks into the same coordinate system as the surface networks. (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 θ to the vertical. (9 marks)

c) Describe procedures for mapping water bodies. (10 marks)