



# MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 201 SURVEYING I

DATE:

TIME:

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

## QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define the following terms as used in surveying (6 marks)
- i. Layout survey
  - ii. Checking
  - iii. Calibration
- b) Reciprocal observations whilst levelling across a wide river gave the following readings onto staves held vertical at R and S from an instrument stationed at P and Q.

Reading of staff at R from P = 1.332 m

Reading of staff at S from P = 1.016 m

Reading of staff at R from Q = 1.614 m

Reading of staff at S from Q = 1.278 m

R and P were close to each other on one bank with S and Q similarly situated on the other bank. If the reduced level of S is 10.376 m above datum, what is the level of R? (4 marks)

- c) A base line was measured in catenary in four lengths giving 30.126, 29.973, 30.066 and 22.536 m. The differences of level were respectively 0.45, 0.60, 0.30 and 0.45 m. The temperature during observation was 10°C and the tension applied 15 kgf. The tape was standardized as 30 m, at 20°C, on the flat with a tension of 5 kg. The coefficient of expansion was 0.000 011 per °C, the weight of the tape 1 kg, the cross-sectional area 3mm<sup>2</sup>,  $E = 210 \times 103 \text{ N/mm}^2$  (210 kN/mm<sup>2</sup>), gravitational acceleration  $g = 9.806 65 \text{ m/s}^2$ .
- Calculate the length of the base. (3 marks)
  - What tension should have been applied to eliminate the sag correction? (3 marks)
- d) Reciprocal levelling between two points Y and Z 730m apart on opposite sides of a river gave the following results:

<i>Instrument at</i>	<i>Height of instrument (m)</i>	<i>Staff at</i>	<i>Staff reading (m)</i>
Y	1.463	Z	1.688
Z	1.436	Y	0.991

- Determine the difference in level between Y and Z and the amount of any collimation error in the instrument. (4 marks)
- e) Describe the phase difference method used in Electromagnetic distance measurement instruments (4 marks)
- f) A slope distance of 165.360 m (corrected for meteorological conditions) was measured from A to B, whose elevations were 447.401 and 445.389 m above datum, respectively. Find the horizontal length of line AB if the heights of the EDM instrument and reflector were 1.417 and 1.615 m above their respective stations. (3 marks)
- g) A slope distance of 204.834 m was determined by an EDM, the instrument and prism having been set up 1.645 m and 1.873m respectively above their stations. The vertical angle between the stations was later measured as 2°17' 40'', the instrument station being higher of the two. Calculate the horizontal length of the line. (3 marks)

### QUESTION TWO (20 MARKS)

- a) Describe the principle of differential leveling (5 marks)
- b) The frequencies used by an EDM are 15 MHz and 150 kHz. Taking the velocity of light as 299,793 km/s and a measure distance of 346.73 m, show the computational processes necessary to obtain this distance, clearly illustrating the phase difference technique. (8 marks)
- c) Describe the Peg Test in leveling (7 marks)

### QUESTION THREE (20 MARKS)

- a) Discuss the corrections applied to an electromagnetic distance measurement instrument (5 marks)
- b) A red laser light ( $\lambda = 632.8$  nanometers) operates at a temperature of 301.15 Kelvin, barometric pressure of 710 torr, and a vapour pressure of 30 torr. Given the Barrell and sears (1939) formula for the group index of refraction ( $n_g$ ) and the ambient refractive index  $n_a$ . Considering the speed of light in a vacuum to be  $299792.5\text{km/s}$  and a heat expansion coefficient of air 0.00367 (7 marks)
- $$(n_g - 1)10^7 = 2876.04 + \frac{3(16.288)}{\lambda^2} + \frac{5(0.136)}{\lambda^4}$$
- $$N_a = \left[ \frac{n_g - 1}{1 + \alpha t} \frac{P}{760} - \frac{5.5(10)^{-8}}{1 + \alpha t} e \right] 10^6$$
- i. What is the refractive index?
- ii. What is the velocity through air?
- iii. What is the modulated wavelength if the modulating frequency is 44MHz?
- c) Outline the procedure of measuring distance along the ground by use of a tape (8 marks)

### QUESTION FOUR (20 MARKS)

- a) Describe the various instruments used for the determination of the length of line (7 marks)
- b) The following readings were observed successively with a leveling instrument. The instrument was shifted after the fifth and eleventh readings. 0.485, 1.210, 1.635, 3.395, 3.775, 0.650, 1.400, 1.795, 2.575, 3.375, 3.895, 1.735, 0.635, 1.605m Determine the reduced level of various points and show the entries in a level book, if the reduced level of the first point is 100m, using both the rise and fall, and the height of collimation methods. (13 marks)

### QUESTION FIVE (20 MARKS)

- a) Describe the pulse method used in Electromagnetic distance measurement instruments (5 marks)
- b) Explain the different types of tapes used for distance measurement (6 marks)

- c) Although modern EDM equipment is exceptionally well constructed, the effects of age and general wear and tear may result to some errors. Describe these errors and their calibration procedures (9 marks)