



MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

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: 17/8/2021

TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer questions **ONE** and any other **TWO** questions

QUESTION ONE (30 MARKS)

- a) Define the following terms as used in surveying (6 marks)
- i. Chaining
 - ii. Ranging
 - iii. Calibration
- b) Reciprocal levelling between two points Y and Z 730m apart on opposite sides of a river gave the following results:

Instrument at	Height of instrument (m)	Staff at	Staff reading (m)
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)
- c) Describe the phase difference method used in Electromagnetic distance measurement instruments (4 marks)
- d) The following levels were taken with a metric staff on a series of pegs at 100-m intervals along the line of a proposed trench.

<i>BS</i>	<i>IS</i>	<i>FS</i>	<i>Remarks</i>
2.10			TBM 28.75 m
	2.85		Peg A
1.80		3.51	Peg B
	1.58		Peg C
	2.24		Peg D
1.68		2.94	Peg E
	2.27		
	3.06		
		3.81	TBM 24.07 m

If the trench is to be excavated from peg A commencing at a formation level of 26.5 m and falling to peg E at a grade of 1 in 200, calculate the height of the sight rails in metres at A, B, C, D and E, if a 3-m boning rod is to be used. (4 marks)

- e) The height of an EDM set up at M is 1.495 m. The height of a reflector set up at P is 1.30 m. The height of the theodolite at M used to measure the vertical angle is 1.615 m. The height of the target at P on which the vertical sight is taken is 1.385 m. the slope distance after meteorological corrections is 1650.452 m. The measured vertical angle is $+3^{\circ}02'32''$. What is the horizontal distance between M and P. (3 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) Describe the ranging methods employed in surveying (6 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 299792.5km/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 taken with a level and a 4.25-m staff: 0.683, 1.109, 1.838, 3.398 [3.877 and 0.451] CP, 1.405, 1.896, 2.676 BM (102.120 AOD), 3.478 [4.039 and 1.835] CP, 0.649, 1.707, 3.722.
- i. Draw up a level book and reduce the levels by the R-and-F and height of collimation methods. (10 marks)
- ii. What error would occur in the final level if the staff had been wrongly extended and a plain gap of over 12 mm occurred at the 1.52-m section joint? (3 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)