



MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 304: SURVEYING III

DATE: 8/3/2023

TIME: 2:00-4:00 P.M

INSTRUCTIONS

- This paper comprises of five questions. Answer **three** questions
- Question one is **compulsory** and carry 30 marks
- Answer any other **two** questions

QUESTION ONE (30 MARKS)

- a) The following offsets were taken at 15 m intervals from a survey line to an irregular boundary line 3.50, 4.30, 6.75, 5.25, 7.50, 8.80, 7.90, 6.40, 4.40, 3.25 m. Calculate the area enclosed between the survey line, the irregular boundary line, and the offsets, by: (4 marks)
- Trapezoidal rule
 - Simpson's rule
- b) What is the area of a piece of land which has a plan area of 1613 mm^2 as measured by a fixed-arm planimeter if the scale of the plan is $1/2500$? (2 marks)
- c) Define the following terms as used in surveying (4 marks)
- Residual
 - Mass haul diagram
 - Borrow
 - Limit of economical haul

- d) While observing angles at a station, the horizon was closed. The observations in Table I and their standard deviations were obtained:

Table 1

No.	Angle	S (")
a ₁	134°38'56"	±6.7
a ₂	83°17'35"	±9.9
a ₃	142°03'17"	±4.3

- What are the most probable values for these observations? (4 marks)
- e) Outline the principle behind the rate of approach stating its application in route location (2 marks)
- f) Part of a motorway scheme involves the design and setting out of a simple curve with cubic spiral transitions at each end. The transitions are to be designed such that the centrifugal ratio is 0.197, whilst the rate of change of centripetal acceleration is 0.45m/s^3 at a design speed of 100 km/h. If the chainage of the intersection to the straights is 2154.22m and the angle of deflection 50° , calculate: (8 marks)
- The length of transition to the nearest 10 m.
 - The chainage at the beginning and the end of the total composite curve.
 - The setting-out angles for the first three 10-m chords on a through chainage basis.
- g) The Volumes in cubic meters of excavation (+) and fill (–) between successive sections 100 m apart on a 1300-m length of a proposed railway are given.

Section	0	1	2	3	4	5	6	7
Volume (m ³)	–1000	–2200	–1600	–500	+200	+1300	+2100	
Section	7	8	9	10	11	12	13	
Volume (m ³)	+1800	+1100	+300	–400	–1200	–1900		

- Draw a mass haul diagram for this length.
- If earth may be borrowed at either end, which alternative would give the least haul? (6 marks)

QUESTION TWO (20 MARKS)

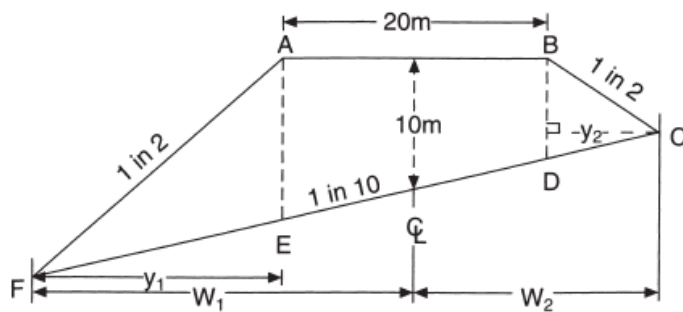
- a) With the aid of a clearly labelled diagram, derive the formula for the Apex distance in curves. (4 marks)
- b) Describe the approximations used in vertical curve computations (5 marks)
- c) Two straights, with a deflection angle of 36° , are to be joined with a circular curve of 500m radius. The forward chainage of the Intersection Point is 6051.35m. Compute the setting-out data required for chords of 20m length. (11 marks)

QUESTION THREE (20 MARKS)

A 200 meter equal tangent parabolic vertical curve is to be placed to negotiate a upward grade of 1.50% followed by a downward grade at 2.5% intersecting at a station having elevation 185.795 m above mean sea level. Calculate elevations at even 20 m stations on the vertical curve and determine the station and elevation of the highest point on the vertical curve.

QUESTION FOUR (20 MARKS)

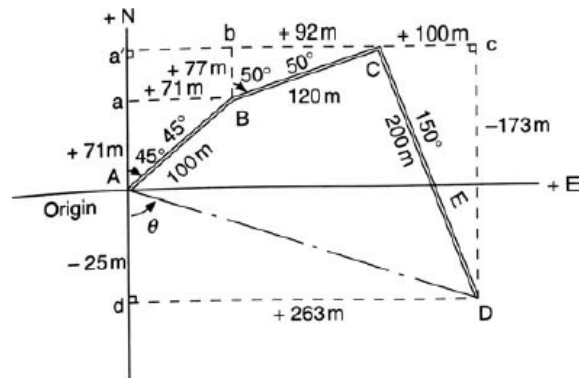
In the figure below, the line AB defines the road formation level to be attained and the line FC defines the existing ground level.



- a) Compute the area of the fill and the side widths W_1 and W_2 (6 marks)
- b) Outline two major needs of providing curves (2 marks)
- c) Describe the properties of a mass haul diagram (12 marks)

QUESTION FIVE (20 MARKS)

- a) Compute the area of the polygon ABCD by coordinates. Then carry out a check of the area by using the geometric shapes. (5 marks)



Stns	E	N
A	0.0	0.0
B	71	71
C	163	148
D	263	-25
A	0.0	0.0

- b) Derive Simpson's Rule method of area estimation (5 marks)
- c) Determine the least squares solution for the following:

$$F(x,y) = x + y - 2y^2 = -4$$

$$G(x,y) = x^2 + y^2 = 8$$

$$H(x,y) = 3x^2 - y^2 = 7.7$$

Use $x_0 = 2$, and $y_0 = 2$ for initial approximations.

(10 marks)