INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS – APRIL-MAY 2025

PROGRAMME: BACHELOR IN CIVIL ENGINEERING

YEAR/SEM: YR. II/SEMESTER II

COURSE CODE: BCE 2104

COURSE NAME: ENGINEERING SURVEYING II

DATE: 15th/04/2024 **TIME: 2:00PM – 5:00PM**

INSTRUCTIONS TO CANDIDATES:

- **THIS EXAMINATION PAPER CONSISTS OF NINE QUESTIONS.**
- **ATTEMPT ANY FIVE (5) QUESTIONS FOR FULL MARKS**
- **DO NOT OPEN THIS EXAMINATION UNTIL YOU ARE TOLD TO DO SO**
- **ALL ROUGH WORK SHOULD BE IN YOUR ANSWER BOOKLET**
- **THE TIME ALLOWED FOR THIS EXAMINATION IS STRICTLY THREE HOURS**
- **ON THE FIRST PAGE OF YOUR ANSWER BOOKLET**
    - **WRITE YOUR REGISTRATION NUMBER PROPERLY**
    - **WRITE THE COURSE NAME AND COURSE CODE**
    - **WRITE EXAMINATION VENUE**
    - **DO NOT WRITE, DROW OR SCRATCH ANYTHING ELSE ON THE FIRST PAGE**
    - **WRITING UNNECESSARY INFORMATION LIKE PHONE NUMBERS IN THE FIRST PAGE SHALL ANNUL YOUR EXAM**
    - **ANSWER BOOKLETS THAT DO NOT CARRY THE REQUIRED INFORMATION, OR THAT HAVE UNNECCESSAY WRITING IN THE FIRST PAGE SHALL NOT BE MARKED**

QUESTION ONE [20 MARKS]

a. Explain the 9 procedures of locating intersection point and tangent points in the field. **(9 marks)**

b. A straight section of a proposed road having a formation width of 10.00 m is to be constructed as a cutting having side slopes of 1 in 2. A cross-section is to be taken at chainage 1225 m, where the depth of dig to the proposed formation level is to be 4.82 m. At this cross-section, the transverse slope at right angles to the proposed center line falls from left to right but changes at the proposed center line from a fall of 1 in 11 to a fall of 1 in 17. Calculate the area of cut required at this cross-section. **(11 marks)**

QUESTION TWO [20 MARKS]

c. Two straights, which meet at an intersection angle of 135°00'00", are to be connected by a circular curve of radius 60 m. The curve is to be set out by offsets from its long chord. Calculate the data required:

(i) to set out the midpoint of the curve. **(10 marks)**

(ii) (ii) to set out pegs on the center line of the curve by offsets taken at exact 5 m intervals along its long chord. (**10 marks)**

QUESTION THREE [20 MARKS]

a. A circular curve of radius 900 m is to be constructed between two straights of a proposed highway. The deflection angle between the straights is 14°28'06" and the curve is to be set out by the tangential angles' method using a theodolite and a tape. The through chainage of the intersection point is 1345.82 m and pegs are required on the center line at exact 20 m multiples of through chainage.

(i) Calculate the tangent lengths **(4 mark)**

(ii) Calculate the length of the circular curve **(4 mark)**

(iii) Calculate the through chainages of the two tangent points **(4 marks)**

(iv) Tabulate the data required to set out the curve. **(8 marks)**

QUESTION FOUR [20 MARKS]

A circular curve of radius 750 m is to connect two straights, which deflect through an angle of 14°36'12". The through chainage of the intersection point is 2319.87 m. The center line of the curve is to be set out by the tangential angles' method using a total station and a pole-mounted reflector. Pegs are required on the center line at exact 25 m multiples of through chainage.

(i) Calculate the through chainage of the two tangent points **(2 marks)**

(ii) Draw up a table listing the data required to set out the curve from the entry tangent point **(13marks)**

(iii) Briefly describe how the center line is set out. **(5marks)**

QUESTION FIVE [20 MARKS]

Along a proposed road, the volumes of earthwork between successive cross-sections 50m apart are given in the table below.

Chainage (m)	5000	5050	5100	5150	5200	5250	5300	5350	5400	5450	5500	5550	5600
Volume (m^3)	-	- 2100	- 2400	- 1500	+1800	+2200	+2100	+1700	+1300	+300	-600	- 2300	- 2500

a. Plot a mass-haul diagram for chainage 5000 to 5600, assuming that the earth works were balanced at chainage 5000. The positive volumes denote cut and the negative volumes denote fill. **(6marks)**

b. Draw the balancing lines for the following cases:

I. Balance of earthworks at chainage 5000 and borrow at chainage 5600. **(3marks)**

II. Equal borrow at chainage 5000 and 5600 **(3 marks)**

c. Determine the costs of earthworks in the above cases using the rates as under.

i. Excavate, cart and fill within a free haul distance of 200m 5000Ugx/m^3 **(2marks)**

ii. Excavate, cart and fill for overhaul 7000Ugx/m^3 **(2marks)**

iii. Borrow and fill at chainage 5000 9000Ugx/m^3 **(2marks)**

iv. Borrow and fill at chainage 5600 12000Ugx/m^3 **(2marks)**

QUESTION FOUR [20 MARKS]

a) State and prove Simpson's Rule for areas. **(5 marks)**

b) Measurements made from a survey line to an irregular boundary were as follows:

Chainage (m)	0	10	20	30	40	50	60	70	80
Offset (m)	5.5	6.4	7.3	7.9	8.2	6.7	4.9	3.0	0

Calculate the area between the survey line and the boundary. **(09 marks)**

c) Define the following as applied in curve ranging **(6 marks)**

i. Horizontal and vertical curves

ii. Reverse and compound curves

iii. Transition curves and simple circular curves

QUESTION SEVEN [20 MARKS]

a. Direct measurement of volumes is rarely made in surveying, since it is difficult to actually apply a unit of measure to the material involved. However indirect measurements are obtained. Precisely describe at least three 3 principles systems / methods used in determining volume of earth material **(9 marks)**

b. Compute the volume of water impounded by the proposed dam illustrated in Figure 2. Map scale is 500 ft/in. and the proposed spillway elevation 940 ft. **(11 marks)**

Table 5.1

Contour line	910	920	930	940
Area enclosed(in^2)	1.683	5.208	11.256	19.210

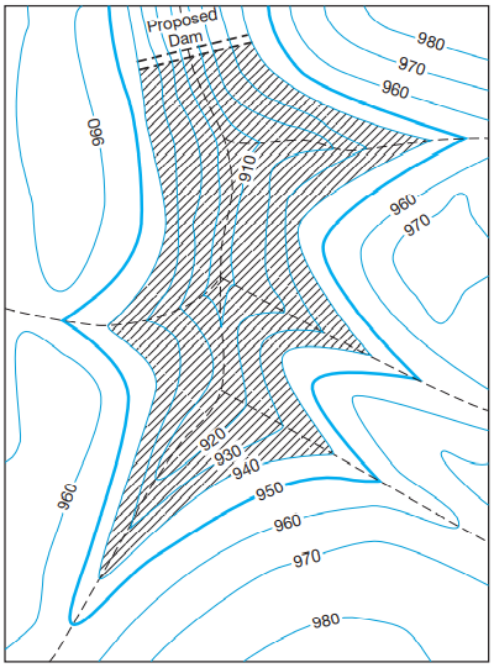


Figure 2: Determining the volume of water impounded in a reservoir by the contour-area method.

QUESTION EIGHT [20 MARKS]

a. Define the following terms. **(@ 1mark)**

i. Haul
ii. Free haul
iii. Overhaul
iv. Average haul distance
v. Waste
vi. Borrow
vii. Haul distance
viii. Free haul distance
ix. Mass haul distance

b. Describe the four uses of mass haul diagram. **(8 marks)**

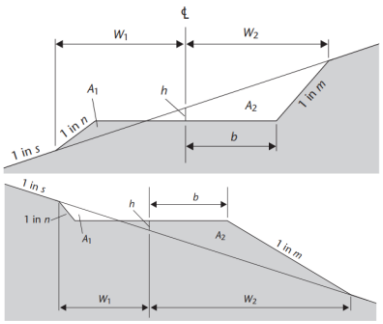
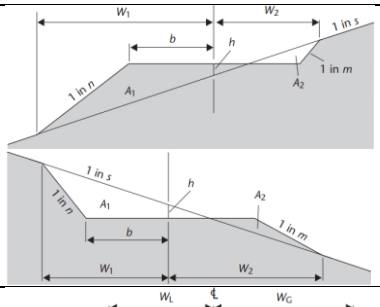
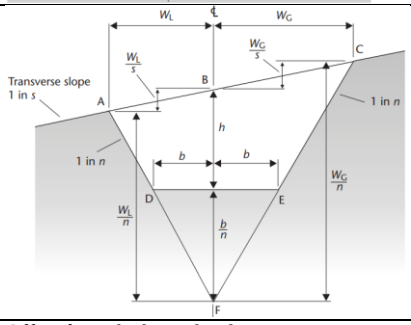
c. Describe the properties of mass haul diagram. **(3 marks)**

QUESTION NINE [20 MARKS]

The junctions of the square grid shown below were levelled to determine the volume of excavation necessary in the construction of a basement floor. The reduced levels of the grid points are as shown. The horizontal distance between the grid points is 20 m and the required formation level of the basement floor foundations is to be 178.00 m. Calculate the volume of the excavation within the grid area. (10 marks)

x	x	x	x	x
185.67	186.22	187.34	187.45	188.00
x	x	x	x	x
186.33	187.03	187.22	187.56	187.90
x	x	x		
186.64	186.98	187.44		
x	x	x	x	x
187.08	187.35	187.89	187.34	187.43
x	x	x	x	x
187.24	187.46	188.02	187.93	187.26

TABLE OF FORMULAE

1.	End area method	total volume = $\left(\frac{d}{2}\right)$[first area + last area + twice all other areas]
2.	Prismoid formula	$V = \left(\frac{d}{3}\right)(A_1 + A_N + 4\Sigma \text{ even areas} + 2\Sigma \text{ remaining odd areas})$
3.		$W_1 = \frac{s(b-nh)}{(s-n)}$ $W_2 = \frac{s(b+mh)}{(s-m)}$ $A_1 = \frac{(b-sh)^2}{2(s-n)}$ $A_2 = \frac{(b+sh)^2}{2(s-m)}$ h = depth of cut or fill on the center line from the existing to the proposed levels; W1 and W2 = side widths; A1 and A2 = areas of cut or fill; 1 in n and 1 in m = side slopes; 1 in s = transverse slope.
4.		$W_1 = \frac{s(b+nh)}{(s-n)}$ $W_2 = \frac{s(b-mh)}{(s-m)}$ $A_1 = \frac{(b+sh)^2}{2(s-n)}$ $A_2 = \frac{(b-sh)^2}{2(s-m)}$
5.		$W_G = \frac{s(b+nh)}{(s-n)}$ $W_L = \frac{s(b+nh)}{(s+n)}$ *plan width* = $(W_G + W_L)$ $A = \frac{1}{2}\left[h + \left(\frac{b}{n}\right)\right](W_G + W_L) - \left(\frac{b^2}{n}\right)$
6.	Offset from the long chord	$X = \sqrt{R^2 - Y^2} - \sqrt{R^2 - \left(\frac{W}{2}\right)^2}$
7.	Offset from tangent lengths	$X = R - \sqrt{R^2 - Y^2}$
8.	For total station and pole mounted reflector	long chord of the curve of arc TK = $2R\sin(\alpha_1)$ long chord of the curve of arc TL = $2R\sin(\alpha_1 + \alpha_2)$ long chord of the curve of arc TM = $2R\sin(\alpha_1 + \alpha_2 + \alpha_3)$
9.	Converting radians to degrees	$\alpha = \left(\frac{90}{\pi}\right)\left(\frac{\text{chord length}}{R}\right)$ degrees
10.	Tangent length	$R\tan(\theta/2)$
11.	Through chainage of T	through chainage of I – IT
12.	Through chainage of U	through chainage of T + L_C
13.	Length of circular curve with radius R and deflection angle θ	$L_C = R\theta$ metres where R is in metres and θ is in radians. For a $D°$ degree curve: $L_C = 100\left(\frac{\theta}{D}\right)$ metres