



**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**FACULTY OF ENGINEERING**

**DEPARTMENT OF CIVIL and Water Engineering**

**Engineering Survey II**

**ECW / TCW 2204**

**Examination Paper**

**March 2025**

This examination paper consists of 7 pages

**Time Allowed: 3 hours**

**Total Marks: 100**

**Special Requirements : None**

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**INSTRUCTIONS**

1. Answer any four (4) questions
2. Each question carries 25 marks
3. Use of calculators is permissible

**MARK ALLOCATION**

<b>QUESTION</b>	<b>MARKS</b>
1.	25
2.	25
3.	25
4.	25
5.	25
<b>TOTAL</b>	<b>100</b>

**Question 1**

- ( a ) List the temporary adjustments of a theodolite in chronological order . ( 14 marks)
- ( b ) What are the geometrical axis requirements of a good working theodolite ? ( 4 marks)
- ( c ) List four decisions a surveyor takes during reconnaissance which will assist him during his work . ( 4 marks)
- ( d ) List the general classes of triangulation . ( 3 marks)

**Question 2**

Fig. question 2 shows a triangulation network . Given the following observed mean horizontal angles . Adjust the observed mean horizontal angles for geometrical consistency using the method of equal shifts . ( 25 marks)

Angle	Observed value
1	19° 59' 42"
2	71° 22' 53"
3	87° 35' 05"
4	39° 42' 25"
5	61° 15' 55"
6	54° 00' 28"
7	43° 04' 38"
8	31° 08' 37"
9	79° 18' 11"
10	52° 32' 25"
11	88° 36' 40"
12	52° 42' 36"
13	64° 44' 11"
14	105° 47' 00"
15	48° 09' 33"

### Question 3

Fig. question 3 shows two straights AP and BP which are to be joined by an 80 metre radius curve MN .

Given the following information :

Coordinates ( m )

A + 5132,680                      -3274,420

B + 4931,450                      -3026,850

Bearings

A – M = 240° 00' 00''

B – N = 210° 00' 00''

Calculate the lengths of AM and BN .

**( 25 marks)**

### Question 4

- ( a ) Briefly explain the following survey terms ( 1 mark each ) : ( i ) known point  
( ii ) working from the known to the unknown , ( iii ) bearing , ( iv ) join calculation  
( v ) working from the whole to the part .
- ( b ) List the angle adjustments that are carried out in the following triangulation figures :  
( i ) braced quadrilateral **( 4 marks )** ( ii ) centre point triangle **( 3 marks)**
- ( c ) Sketch any four types of triangulation figures you learnt . **( 4 marks)**
- ( d ) List any five likely sources of error during traversing . **( 5 marks)**
- ( e ) Name two types of instruments used for measuring horizontal distances during traversing . **( 2 marks)**
- ( f ) What do you understand by face left and face right when measuring angles in traversing **( 2 marks)**

### Question 5

Three survey stations M , N and O form a right-angled triangle at station M as shown in fig. question 5 . A theodolite whose constants are  $K = 100$  ( multiplying constant ) and  $C = 0$  was used to determine the following tacheometric data :

Instrument station M , height of instrument = 1,410 m . The staff was held vertical each time.

**Question 5 continued**

Target Station	Vertical angle	Stadia readings ( m )		
		Upper	Mid	Lower
N	95° 40' 00"	1.830	1.500	1.170
O	82° 30' 00"	2.810	2.610	2.410

Calculate

- ( a ) horizontal lengths MN , MO and NO . ( 9 marks)
- ( b ) the reduced levels of N and O given that the R.L. of M = 1129.600 m . (10 marks)
- ( c ) If points M , N and O are lying in a plane , calculate the area of triangle MNO.( 6 marks )

**Question 6**

The reduced level at the intersection of a rising gradient of 2,5 per cent and a falling gradient of 2,0 per cent on a proposed road is 93,60 m . Given that the K – value for this particular road is 55 , the through chainage of the intersection point is 671,340 m and the vertical curve is to have equal tangent lengths , calculate:

- ( 1 ) the through chainages of the tangent points of the vertical curve if the minimum required length is to be used . ( 5 marks)
- ( 2 ) the reduced levels of the tangents points and the reduced levels at exact 20 m multiples of through chainage . ( 20 marks )

**List of formulae**

$$L_v = KA \quad R.L. = - ( mL_v/200 ) \quad R.L. = - ( nL_v/200 ) \quad y = L_v m/A$$

$$V'' = a - c / ( ab + cd ) \sin 1''$$

$$a = \sin 1 \times \sin 3 \times \sin 5 \quad b = \cot 1 + \cot 3 + \cot 5 \quad c = \sin 2 \times \sin 4 \times \sin 6$$

$$d = \cot 2 + \cot 4 + \cot 6$$

$$D = K s \cos^2 \theta + C \cos \theta \quad V = \frac{1}{2} ( Ks \sin 2\theta ) + C \sin \theta$$

DIAGRAMS

Fig. question 2

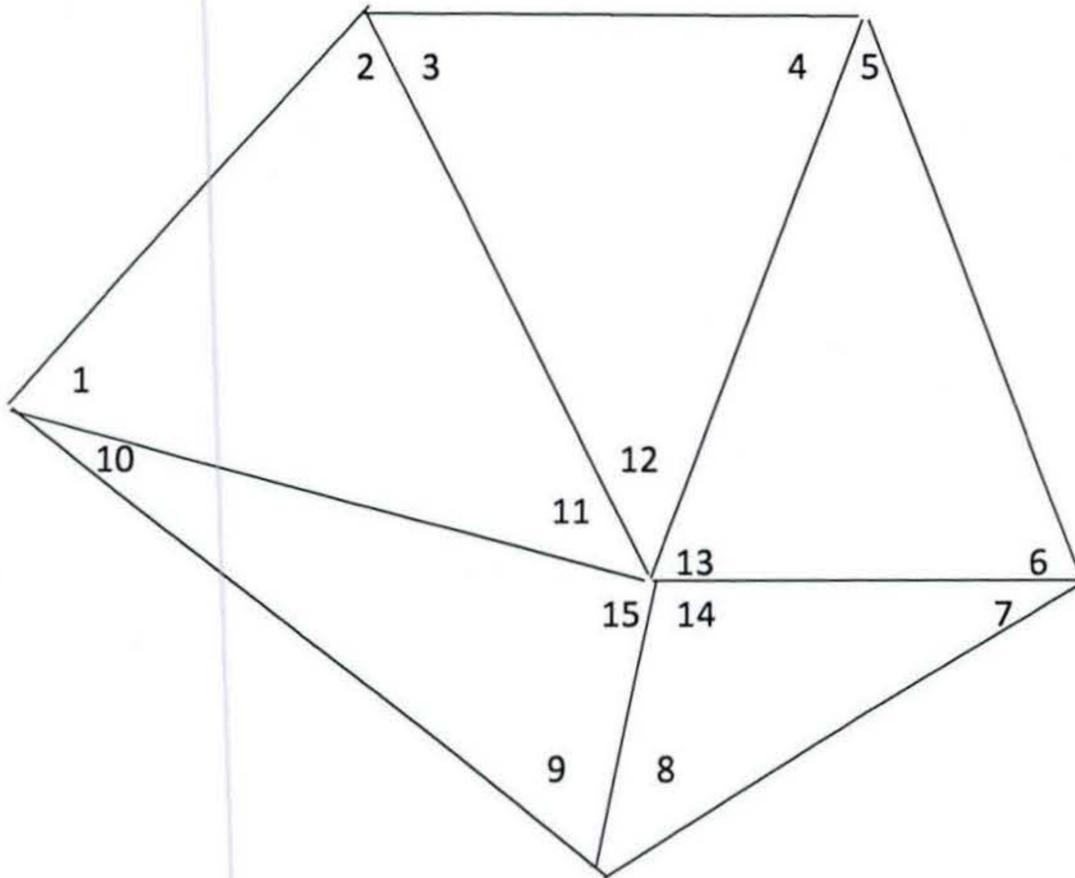


Fig. question3

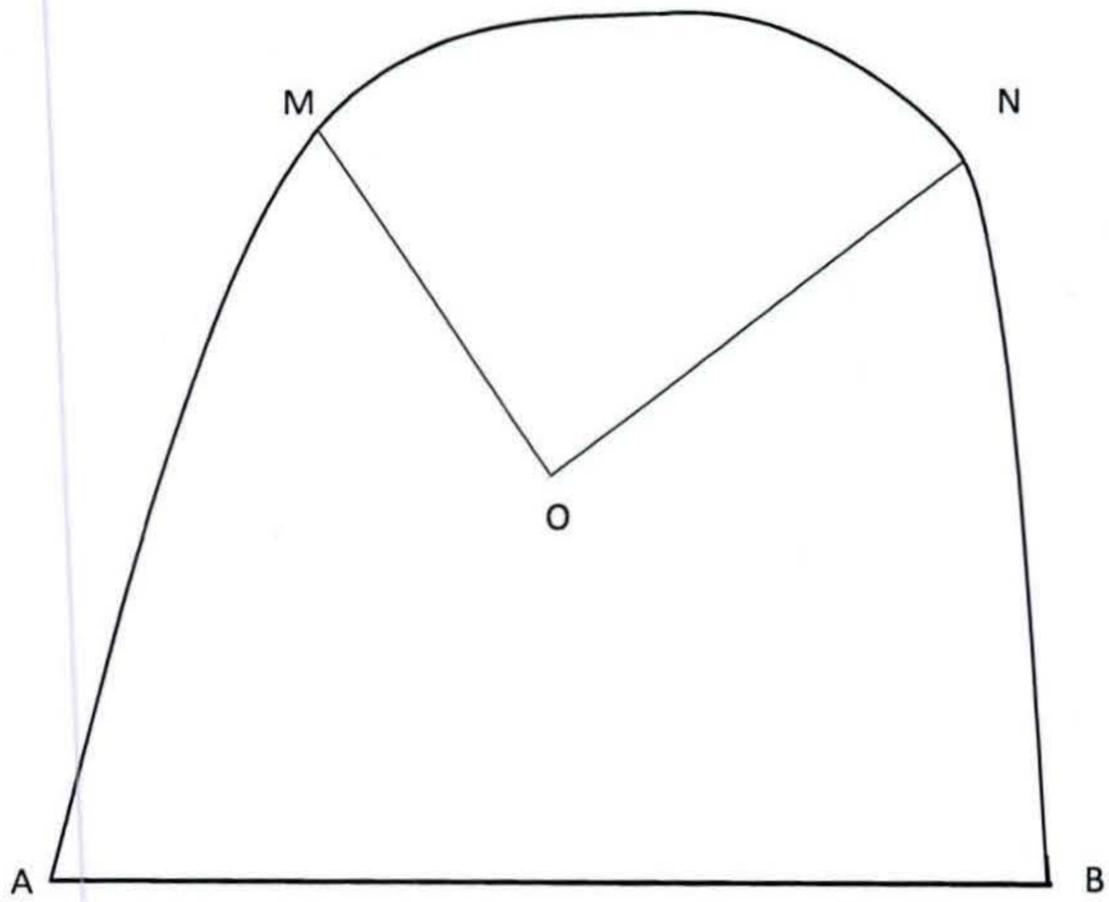


Fig. question 5

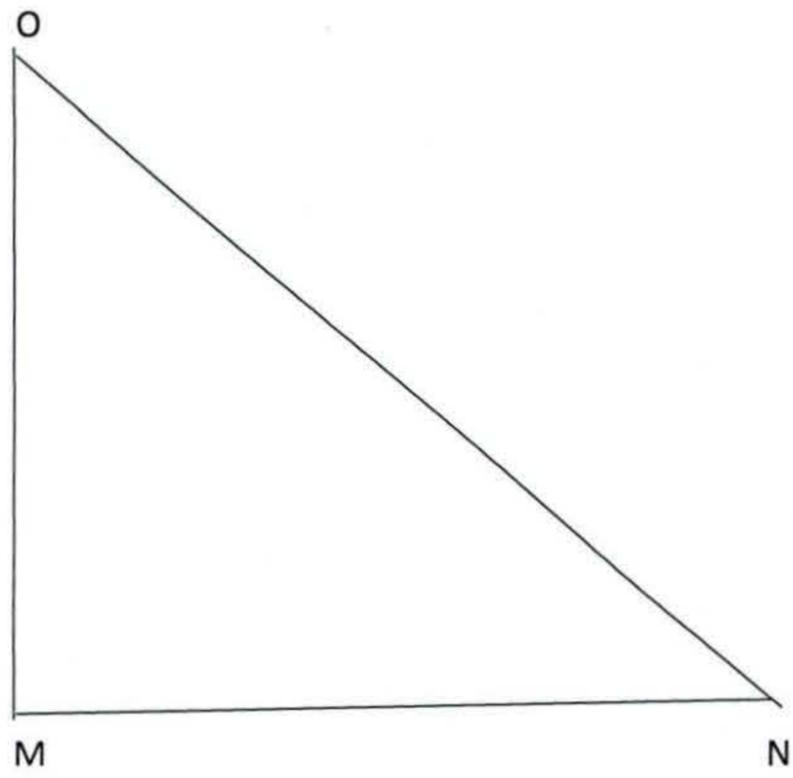


Fig. question 6

