NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL AND WATER ENGINEERING

Engineering Survey 1

ECW/TCW 2102

Special Supplimentary Examination Paper

August 2024

This examination paper consists of 7 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Graph paper

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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

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5.	25
TOTAL	100

QUESTION 1

(a) Name three types of tapes that you have learnt .   (3 marks)

(b) List three points on care and maintenance of tapes that should be followed . (3 marks)

(c) What do you understand by standardisation of working tapes and why is it important ?

                                                                                                       (2 marks)

(e) With the aid of diagrams show three taping techniques that can be employed in surveying

                                                                                                       (9 marks)

(d) The following details below refer to the measurements for the first 30 m bay of a baseline.

   With the tape hanging in catenary at a tension of 100 N and at a mean temperature of 14°C

   the recorded length was 299,9824 m . The difference in height between the ends was 0,460

   m and the site was 490 m above mean sea level . The tape had previously been

   standardized in catenary at a tension of 75 N and at a temperature of 16°C and the

   standardized length was 29,9970 m .

   Given the following information :

   Radius of the earth = 6367,270 km

   Mass of the tape   = 0,01963 kg m^{-1}

   Sectional area of the tape = 3,610 mm^2

   Young's modulus of elasticity = 2,2 x 10^5 N mm^2

   Coefficient of expansion or contraction of the tape material = 12 x 10^{-6} /°c

   Determine the correct length of the bay reduced to mean sea level .   (8 marks)

QUESTION 2

(a) A stockpile of 11 690 tonnes of ore is to be established on a level surface by end tipping

from a conveyor belt situated 20 metres vertically above this level surface . The stockpile

will form a regular cone with an angle of repose of 37° . Calculate the height of the conical

stockpile accepting that one cubic metre of broken ore equals 1,67 tonnes.   **(15 marks)**

(b) Fig. question 2b shows a square grid with levels at 10 m intervals . The whole area is to

be covered with waste material to form a car park formation level 86,5 m . Calculate the

volume of material to be deposited .   **(10 marks)**

QUESTION 3

(a) What are the four basic functions of electronic distance measuring instruments ?

(4 marks)

(b) List the classes of E.D.M. instruments based on the type of carrier wave . **(3 marks)**

(c) Give the name of an instrument belonging to each class in (b) above .   (3 marks)

(d) Describe the types of instrumental errors associated with E.D.M. measurements .

(15 marks)

QUESTION 4

The following levels in table Q4 were taken along the centre line of a road at the chainages shown . This section of the road is to be regraded on an even up-grade from B.M. 82 to allow a clearance of 2,700 m under bridge 1 .

Table Q4

Station	B S	I.S.	F.S.	R.L.	Horizontal distance from from B.M. 82 (m)
B.M. 82	2,383			328,452	0
Peg 1	1,730		3,151		27
Peg 2	1,134		1,360		65
Peg 3	1,980		1,511		110
Peg 4		1,321			153
Peg 5	2,387		1,256		193
Peg 6		1,925			227

Peg 7		2,561			269
Peg 8	1,052		1,865		300
Underside Bridge 1			‾2,747		314

Calculate the amount of cut or fill required to meet the conditions stated above. Use the height collimation method for reduction of levels. **(25 marks)**

QUESTION 5

The following reduced levels in table Q5 were obtained along the centre line of a proposed road between two points A and B .

Table Q5

Chainage (m)	Reduced level (m)
A 0	83,50
10	83,84
20	84,06
30	83,66
40	83,30
50	82,45
60	82,20
70	82,41
80	82,70
B 90	83,05

The road is to be constructed so that there is an even gradient between points A and B .

QUESTION 5 continued

(a) Draw a longitudinal section along the centre line at a horizontal scale of 1 : 1000 and vertical scale of 1 : 100   **(5 marks)**

(b) Determine from the section the depth of cutting or height of fill required at each station to

form a new road .   **(5 marks)**

(c) Check the answers by calculation .   **(15 marks)**

QUESTION 6

A concrete pipe is to be installed to transfer water from a catchment dam to a reservoir .

The levels in table Q6 were taken along the route on which a trench 1,400 m wide with vertical sides

Is to be excavated in which the pipe is to be laid down at a grade of – 2,5% from station A to G .

The bottom of the pipe is to be 2,000 m below station A .

Station	Horizontal distance from A (m)	B.S.	I.S.	F.S.	R.L.
A	0	2,600			100,000
B	18		1,905		
C	30		2,440		
D	56	1,900		2,190	
E	72		1,870		

F	95	1,700		3,040	
G	110			2,180	

Calculate the volume in cubic metres to be excavated   (**25 marks**)

Diagram

Fig. 2b

Fig. 2b
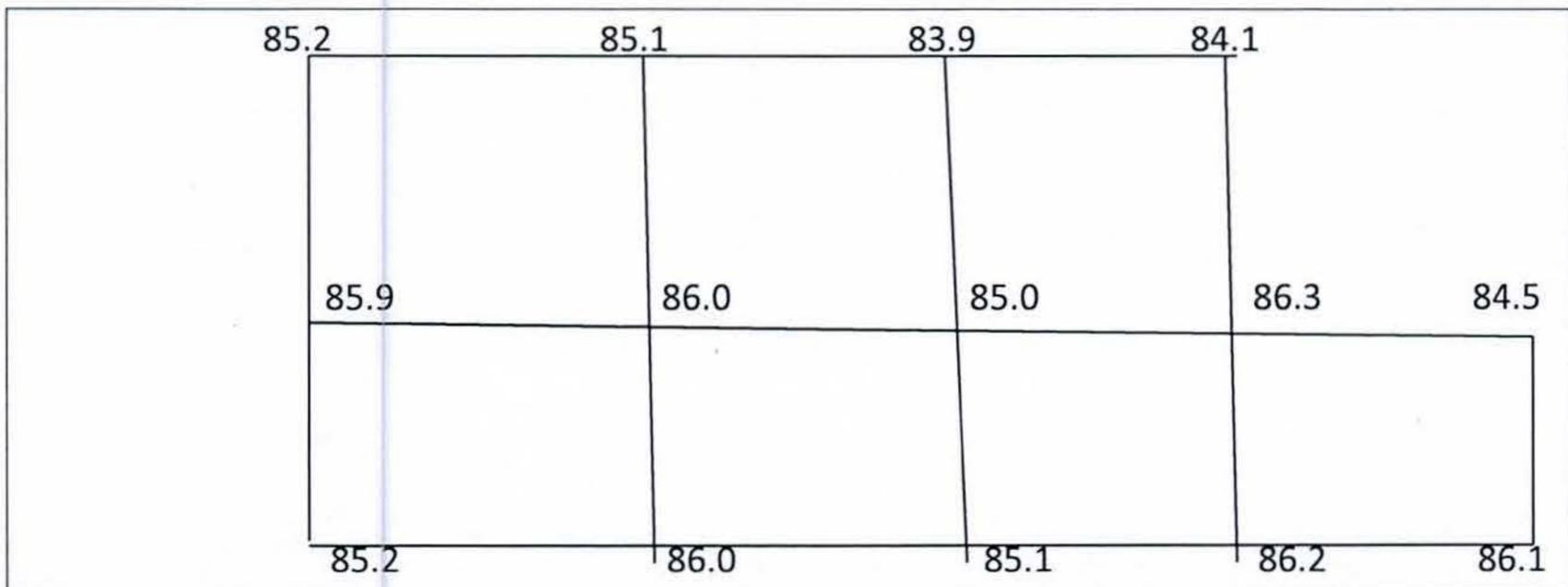
List of formulae

Total volume = A/4 ($\sum$ single depths + 2 $\sum$ double depths + 3 $\sum$ triple depths +

4 $\sum$ quadruple depths + e.t.c.)

Volume = 1/3 π r^2 h

$C_m = L_m.h/ R +h$, $C_i = \Delta h^2/ 2L_m$, $C_T = L_m (T_f - T_s)/ A x E$, $C_s = L_m (l'- l/ l)$