

DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/
MANAGEMENT/COMMERCIAL PRACTICE — APRIL, 2018

SURVEYING - II

[Time : 3 hours

(Maximum marks : 100)

PART — A

(Maximum marks : 10)

Marks

I Answer *all* questions in one or two sentences. Each question carries 2 marks.

1. Define parallax.
2. What are the total co-ordinates of a point ?
3. Name the principle methods of plotting a traverse survey.
4. What is the function of an anallactic lens in a tacheometer ?
5. What is the basic principle of geodimeter measurement ?

(5 × 2 = 10)

PART — B

(Maximum marks : 30)

II Answer any *five* of the following questions. Each question carries 6 marks.

1. State on the following lines of a theodolite.
(a) Vertical axis (b) Line of collimation (c) Axis of altitude level tube.
2. What is the reiteration method of measuring a horizontal angle ? Name any four errors eliminated by reiteration method.
3. How the area of a traverse is calculated by independent co-ordinate method ?
4. The following observations were made to determine the RL of the top of a tower at a point A.

Instrument at	sight to	vertical angle	Remark
B	A	+25°30'	Staff reading on BM = 1.250
C	A	+16°20'	Staff reading on BM = 1.150

RL of BM = 152.260, BC = 30M. Find RL of A.

5. The distance of 50 m and 300 m were accurately measured out and the intercepts on the staff between the outer stadia hairs were 0.49 at the former and 3.00 at the later. Find out the tacheometric constants.
6. Obtain a relation between Radius and Degree of a curve based on 30 m length of a chord.
7. What are the basic functions involved in an EDM instrument ? (5 × 6 = 30)

PART — C

(Maximum marks : 60)

(Answer *one* full question from each unit. Each full question carries 15 marks.)

UNIT — I

- III (a) Define the following with respect to a theodolite.
- | | | |
|-------------------|------------------|---|
| (i) Swinging | (ii) Transiting | |
| (iii) Face change | (iv) Least count | 8 |
- (b) Explain the determination of bearing of a line with a theodolite. 7

OR

- IV (a) Explain the following parts of a theodolite briefly.
- | | | |
|-----------------------|-----------------------------|---|
| (i) Spindles of Axis | (ii) Upper and lower plates | |
| (iii) Vertical circle | (iv) Index frame | 8 |
- (b) What is repetition method and what are the errors eliminated by this method ? 7

UNIT — II

- V (a) The following are the lengths and bearings of the sides of a closed traverse ABCD.

<i>Line</i>	<i>Length in m</i>	<i>Bearing</i>
AB	70.80	140°20'
BC	195.50	35°40'
CD	35.40	330°40'

Compute the length and bearing of the line DA. 8

- (b) How to solve a traverse when length of one side and bearing of adjacent side is omitted ? 7

OR

- VI (a) A closed traverse was conducted round obstacle and the following observations were made. Workout the missing quantities.

Side	Length (m)	Azimuth
AB	500	98°30'
BC	620	30°20'
CD	468	298°30'
DE	—	230°0'
EA	—	150°10'

10

- (b) What are the conditions to be satisfied while a theodolite is in permanent adjustment ?

5

UNIT — III

- VII (a) Derive a relation to find the RL of a point "A" at top with its foot inaccessible and the nearest station at a lower level, the instrument used being a theodolite.

10

- (b) What are the different systems adopted in tacheometric measurements ?

5

OR

- VIII (a) A tacheometer was set up at a station A and the following readings were obtained on a staff held vertical at B.

Instrument station	staff station	Vertical angle	Hair readings	Remark
A	BM	-5°20'	1.50, 1.80, 2.450 = 750.50x	RL of BM
A	B	+8°12'	0.750, 1.500, 2.250	

Calculate the horizontal distance AB and the RL of B. The constants of the instruments are 100 and 0.15.

9

- (b) State any six advantages of tacheometric surveying.

6

UNIT — IV

- IX (a) Calculate the ordinates from a 160 m long chord at 10 m interval to set out a simple circular curve of 8°. 9

- (b) What is remote sensing ? What are its application in civil engineering field ?

6

OR

- X (a) Two straight lines AB and BC intersect at chainage 2080 m. The intersection angle being 140°. Calculate the radius and chainage of the tangent points of the circular curve connecting the two lines if $D = 8^\circ$. Take the chord length as 30 m.

7

- (b) Write in brief, the steps involved in measuring the area of a plot with a single stationed total station.

8

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Scoring Indicators

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Version: 01

B

Qn. No.	Scoring Indicators	Split score	Total score
	<u>PART-A</u>		
I 1	Parallax is a condition arising when the image formed by the objective is not in the plane of the cross hairs in the case of telescope.	2	
2	The total latitude and departure of any point with respect to a common origin are known as total co-ordinates.	2	
3)	i) The angle and distance method ii) The co-ordinate method	2	
4)	What is the function of an anallactic lens in a tachometer is to make the additive constant zero	2	
5)	Geodimeter measurement is based on propagation of modulated light waves	2	10
	<u>PART-B</u>		
II 1)	a) Vertical axis - About which the instrument rotates in a horizontal plane, on the telescope swings. It is the line passing through the centres of inner spindle, outer spindle and the centre of tribrach.	2	
	b) Line of collimation - An imaginary line passing through the intersection of cross hairs of the diaphragm and the optical centre of the objective		
	c) It is a straight line tangential to the longitudinal curve of the plate level tube at its centre	2	

Scoring Indicators

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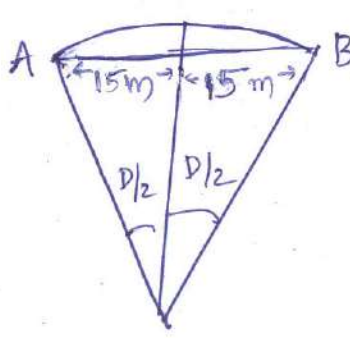
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Qn. No.	Scoring Indicators	Split score	Total score
	It is horizontal when the bubble is centred (is)	2	6
2)	<p>When several angles are to be measured at a station in a succession and finally closing it, it is the ^{the} iteration method.</p> <ol style="list-style-type: none"> 1. Graduation error 2. Error due to non adjustment of line of collimation 3. Eccentricity of vertical axis 4. Error due to improper centering and bisection <p style="text-align: center;">(2 + 1 + 1 + 1)</p>	<p>2</p> <p>1</p> <p>1</p> <p>1</p>	6
3)	<p>Determine the independent co-ordinates using the given latitude and departure. Arrange the co-ordinates in determinant form as $y_1, y_2, y_3 \dots y_n$ and $x_1, x_2, x_3 \dots x_n$. Find the sum of the products of the co-ordinates joined by $y_1 x_2, y_2 x_3, \dots, y_n x_1$ and sum of product of $x_1 y_2, x_2 y_3, \dots, x_n y_1$. The difference between these two sums gives twice the area of the traverse (6)</p>		6
4)	<p>RL of the instrument axis at B = RL of BM + Staff Reading</p> $= 152.260 + 1.250 = 153.510$ <p>RL of instrument axis at C = $152.260 + 1.150 = 153.410$</p> $S = 1.250 - 1.150 = 0.10 \text{ m}$ $\alpha_1 = 25^\circ 30', \quad \alpha_2 = 16^\circ 20'$ $\therefore D = \frac{S - b \tan \alpha_2}{\tan \alpha_2 - \tan \alpha_1} = \frac{0.10 - 30 \times \tan 16^\circ 20'}{\tan 16^\circ 20' - \tan 25^\circ 30'}$	<p>2</p> <p>1</p>	

Scoring Indicators

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Qn. No.	Scoring Indicators	Split score	Total score
	$= 47.25 \text{ m}$	2	
	$h_1 = D \tan \alpha_1 = 47.25 \times \tan 25^\circ 30' = 22.53$	1	6
	$\text{RL of A} = \text{RL of instrument axis at B} + h_1$ $= 153.510 + 22.53 = 176.04 \text{ m}$	1	
	$\text{(RL} = 2 \text{ marks, S-1, D-2, } h_1 \text{ \& RL of A} = 1 \text{ mark)}$	1	
5)	$50 = K S + C = K \times 0.49 + C \rightarrow 1 \text{ mark}$	1	
	$300 = K \times 3 + C \rightarrow 1 \text{ mark}$	1	
	$\therefore 250 = 2.51 K$	2	
	$\therefore K = 99.60 \text{ say } 100.00 \rightarrow 2 \text{ mark}$	2	
	$50 = 99.60 \times 0.49 + C$	2	6
	$C = 1.19 \rightarrow 2 \text{ mark}$	2	
	$\text{The constants are } 99.60 \text{ and } 1.19$ (1+1+2+2)		
6)	<p>Let AB be the length of the chord = 30 m</p> <p>Let D° be the angle subtended by the chord at the centre O. Then,</p>		
	$\sin D/2 = \frac{15}{R}, \quad R = \frac{15}{\sin D/2}$		
	<p>For small values of $D/2$,</p> $\sin D/2 = D/2 \text{ radians}$		
	$\text{Then, } R = \frac{15}{D/2 \times \frac{\pi}{180}}$		
		1	

Qn. No.	Scoring Indicators	Split score	Total score
	$R = \frac{360 \times 15}{\pi D} = \frac{1718.9}{D^\circ}$ $\text{OR } D^\circ = \frac{1718.9}{R}$ <p>(fig - 1, $\sin D/2 = 1$, $R = 4$)</p>	2 2	
7)	<ol style="list-style-type: none"> 1) generating Carrier wave and measuring wave of detectable frequencies. 2) The modulation and demodulation of Carrier wave. 3) Measuring the phase difference between the transmitted and received waves. 4) Displaying the result in a computerized form. <p>(1 1/2 mark each)</p>	1 1/2 1 1/2 1 1/2 1 1/2	6
	<u>PART - C</u>		
a)	<ol style="list-style-type: none"> 1) The process of turning the telescope about the vertical axis in a horizontal plane - There are right and left swings - done by 360° 2) It is the operation of turning the telescope about the horizontal axis in a vertical plane, it is done by 180° 3) If the vertical circle is on the left side of the observer the theodolite is face left condition and if on right side of the observer it is face right condition. 	2 2 2	

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Qn. No.	Scoring Indicators	Split score	Total score
	<p>face right condition.</p> <p>4) 59 main scale divisions are divided into 60 Vernier scale divisions. Hence Each Vernier Division = $\frac{59}{60}$ MSD</p> <p>LC = 1 MSD - 1 VSD = $\frac{1}{60}$ of MSD = $\frac{1}{60} \times 20$ = $\frac{1}{3}$ minute = <u>20 seconds</u> (2+2+2+2)</p> <p>5) A theodolite is provided with a compass to measure the bearing of a line.</p> <p>1) Set up the instrument at A centre it and level it accurately with face left condition. Make vernier A read zero. clamp upper plate</p> <p>2) Unclamp the lower screw. Release the magnetic needle. Then telescope until the magnetic needle is in normal position.</p> <p>3) Tighten lower clamp. Using lower clamp, bring the needle in exact magnetic meridian.</p> <p>4) Unclamp upper plate. Turn the telescope till B is bisected. Tighten upper clamp. Bisect B exactly using upper tangent screw</p> <p>5) Read both verniers. The mean is the magnetic</p>	2	8
		each step 1 mark	

Scoring Indicators

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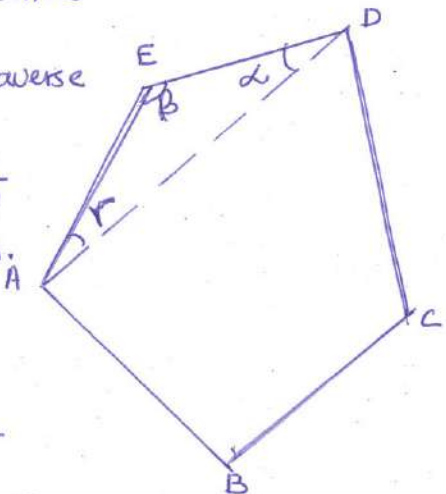
Qn. No.	Scoring Indicators	Split score	Total score
	<p>bearing of line AB.</p> <p>6) Change the face and repeat the process.</p> <p>7) The average of both values is the bearing of the line (7 marks)</p> <p><u>IV</u> a) 1) The inner and outer spindle axes coincide. The inner solid and outer is hollow. These two axes have a common axis called vertical axis of the instrument. 2) The lower plate is the main scale plate graduated from 0° to 360° in clockwise direction. The upper plate is provided with two (A & B) Verniers placed 180° apart. Each plate is provided with clamp and tangent screws. 3) The vertical circle is rigidly attached to the telescope and move with it. It carries two Vernier C & D. The vertical circle is divided into 4 quadrants, each quadrant graduated from 0° to 90°. 4) The index frame is T frame. It is centred on the horizontal axis of telescope & in front of vertical circle. The index arm can be rotated by clip screws fitted to clipping arm.</p>	<p>7</p> <p>2</p> <p>2</p> <p>2</p> <p>2</p>	<p>7</p> <p>8</p>

Scoring Indicators

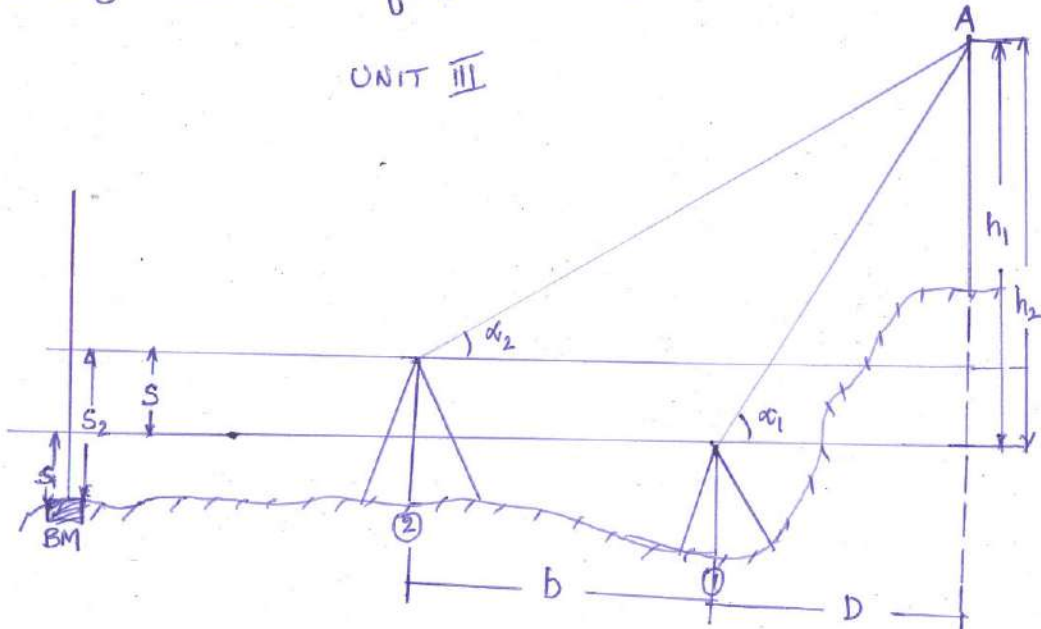
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Qn. No.	Scoring Indicators	Split score	Total score
	<p>b) Repetition method is the process of measuring an angle repeatedly a number of times and finding the mean of the angle by dividing the final reading with the number of repetitions made.</p> <p>By this method, the errors eliminated are</p> <ul style="list-style-type: none"> • errors due to eccentricity of verniers • errors due to improper adjustment of line of collimation and horizontal axis • errors due to improper graduations • errors due to improper bisection and improper centering (7 marks) 	<p>3</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>7</p>

Qn. No.	Scoring Indicators	Split score	Total score
	<p data-bbox="124 280 1185 439">b) Consider a traverse ABCDE, where length of ED and bearing of EA are missing.</p> <p data-bbox="213 465 722 528">Join DA, which becomes</p> <p data-bbox="178 551 724 631">the closing line of the traverse</p> <p data-bbox="178 642 647 775">ABCD in which details of AB, BC and CD are known.</p>  <p data-bbox="181 824 641 976">Hence the length and bearing of DA can be</p> <p data-bbox="172 981 675 1034">easily calculated from</p> $\sum \text{latitude of } AB + BC + CD + \text{latitude of } DA = 0$ $\sum \text{Departure of } AB + BC + CD + \text{Departure of } DA = 0$ $\text{length of } DA = \sqrt{(\text{lat. of } DA)^2 + (\text{Dep. of } DA)^2}$ $\theta = \tan^{-1} \left(\frac{\text{Departure of } DA}{\text{latitude of } DA} \right)$ <p data-bbox="196 1478 1121 1563">Knowing the details of DA, considering $\triangle ADE$</p> $\frac{\sin \beta}{\sin \alpha} = \frac{DA}{EA}, \text{ then } \angle V = 180^\circ - (\beta + \alpha)$ <p data-bbox="196 1664 734 1756">Similarly $DE = EA \cdot \frac{\sin V}{\sin \alpha}$</p> <p data-bbox="240 1760 1206 1843">knowing $\angle V$, the bearing of EA can be calculated.</p>	<p data-bbox="1273 936 1353 976">2</p> <p data-bbox="1279 1375 1315 1415">2</p> <p data-bbox="1289 1792 1337 1832">3</p>	<p data-bbox="1449 1944 1487 1989">7</p>

Qn. No.	Scoring Indicators	Split score	Total score
VI a)	<p style="text-align: center;">WADP</p> <p>Latitude of AB = -73.91 ($l \cos \alpha$) Latitude of BC = 535.11 Latitude of CD = 223.45 Departure of AB = 494.50 ($l \sin \alpha$). Departure of BC = 313.11 Departure of CD = -411.29 \therefore Latitude of DA = -684.55 ($\Sigma \text{lat} + \text{lat. of DA} = 0$) Departure of DA = -396.32 ($\Sigma \text{Dept} + \text{Dep of DA} = 0$). $\tan \theta = D/L = \frac{396.32}{684.55}$ $\theta = \underline{30^\circ 4'}$ Length of DA = $l \sec \theta = 791.00$, Bearing of DA = $201^\circ 4'$</p> <p>From ΔADE, $\angle ADE = \alpha = 230^\circ - 210^\circ 4' = 19^\circ 56'$ $\angle DEA = \beta = 150^\circ 10' - (230 - 180) = 100^\circ 10'$ Hence $\angle EAD = 59^\circ 54'$, Using Sine rule $DE = DA \cdot \frac{\sin \gamma}{\sin \beta} = 791 \times \frac{\sin 59^\circ 54'}{\sin 100^\circ 10'} = 695.27 \text{ m.}$ $EA = DA \times \frac{\sin \alpha}{\sin \beta} = 273.99 \text{ m.}$</p>	<p>$1\frac{1}{2}$</p> <p>$1\frac{1}{2}$</p> <p>2</p> <p>1</p> <p>3</p>	<p>10</p>

Qn. No.	Scoring Indicators	Split score	Total score
VI b)	<ol style="list-style-type: none"> 1. The plate level axis is perpendicular to the vertical axis 2. The vertical cross hairs of the diaphragm is perpendicular to the horizontal axis. 3. The line of sight is perpendicular to the horizontal axis. 4. The horizontal axis is perpendicular to the vertical axis 5. When the altitude level axis is horizontal, the vertical circle reads zero and the line of sight is horizontal. 	each point 1 mark.	5
VII a)	<p style="text-align: center;">UNIT III</p>  <p>Let the top point be A. Its foot is inaccessible. Angle of elevation to this point from nearer station is α_1 and that from farther is α_2. The instruments are apart by b and from nearer station the inaccessible distance to foot of A is D.</p> <p>From fig: $h_1 - h_2 = S_2 - S_1 = S$ $h_1 = D \tan \alpha_1$ and $h_2 = (b + D) \tan \alpha_2$ $\therefore S = D \tan \alpha_1 - (b + D) \tan \alpha_2$ $S + b \tan \alpha_2 = D (\tan \alpha_1 - \tan \alpha_2)$</p>	3	

Qn. No.	Scoring Indicators	Split score	Total score
	$D = \frac{S + b \tan \alpha_2}{\tan \alpha_1 - \tan \alpha_2}, \text{ then } h_2 = D \tan \alpha_1$ $RLq A = RLq BM + S_1 + h_2$	1 1	10
b)	<p>The different measurement systems used in tacheometry are the stadia hair system and tangential system. In stadia hair system there are two methods namely fixed hair method and movable hair method. In fixed hair method the stadia intercept 'S' is constant but staff intercept varies with distance from the instrument station. In movable hair system stadia intercept varies for a fixed known value of staff intercept. In tangential tacheometry no stadia readings are used. Staff intercepts are measured in this method.</p>	5	5
VIII a)	<p>$K = 100, C = 0.15, RLq BM = 750.50$ The staff is held vertical and line of sight is inclined. $D = K S \cos^2 \theta + C \cos \theta$ $V = K S \frac{\sin 2\theta}{2} + C \sin \theta$ In the first observation $S = 2.450 - 1.150 = 1.300$ $\theta = 5^\circ 20'$ depression. $V_1 = 100 \times 1.300 \times \frac{\sin (2 \times 5^\circ 20')}{2} + 0.15 \sin 5^\circ 20'$ $= 12.045m$</p>	1 1 1 1	

Qn. No.	Scoring Indicators	Split score	Total score
	<p>in the second observation</p> $S = 2.250 - 0.750 = 1.500, \theta = 8^{\circ}12'$ $V_2 = 100 \times 1.500 \times \frac{\sin 16^{\circ}24'}{2} + 0.15 \sin 8^{\circ}12' = 21.19 \text{ m}$ $D = K S \cos^2 \theta + C \cos \theta$ $D = 100 \times 1.500 \times \cos^2 8^{\circ}12' + 0.15 \cos 8^{\circ}12' = 147.097 \text{ m.}$ $\text{RL of instrument axis} = \text{RL of BM} + h_1 + V_1 = 750.50 + 1.800 + 12.045$ $= 764.345 \text{ m.}$ $\text{RL of B} = \text{RL of Instrument axis} + V_2 - h_2$ $= 764.345 + 21.19 - 1.500 = 784.035 \text{ m.}$	1 1 1 1 1	9
b)	<ol style="list-style-type: none"> 1. In a traverse of low accuracy, the tacheometric method is more rapid than taping. 2. Tacheometry is extremely useful for topographic surveying. 3. In conjunction with plane table, it can be used for finding horizontal distances and elevations and for plotting directly. 4. It is more useful in photographic mapping. 5. Balancing of Back sight distances and Fore sight distances are more easy in tacheometric differential levelling. 6. For indirect trigonometric levelling, tacheometric method is more rapid than any other method. 	1 each	6

Qn. No.	Scoring Indicators	Split score	Total score
18 a)	<p>Radius of the curve = $\frac{1718.9}{8} = 214.86 \text{ m}$.</p> <p>Length of the long chord = 160 m.</p> <p>Mid ordinate = $O_0 = R - \sqrt{R^2 - (L/2)^2}$</p> $O_0 = 214.86 - \sqrt{(214.86)^2 - 80^2} = 15.513 \text{ m}$ $O_x = \sqrt{R^2 - x^2} - (R - O_0)$ $O_{10} = \sqrt{(214.86)^2 - 10^2} - (214.86 - 15.513)$ $= 15.280 \text{ m}$ $O_{20} = \sqrt{(214.86)^2 - 20^2} - 199.347$ $O_{20} = 14.580 \text{ m}$ $O_{30} = \sqrt{(214.86)^2 - 30^2} - 199.347 = 13.408 \text{ m}$ $O_{40} = \sqrt{(214.86)^2 - 40^2} - 199.347 = 11.756 \text{ m}$ $O_{50} = \sqrt{(214.86)^2 - 50^2} - 199.347 = 9.614 \text{ m}$ $O_{60} = \sqrt{(214.86)^2 - 60^2} - 199.347 = 6.965 \text{ m}$ $O_{70} = \sqrt{(214.86)^2 - 70^2} - 199.347 = 3.790 \text{ m}$ $O_{80} = \sqrt{(214.86)^2 - 80^2} - 199.347 = \underline{\underline{0.064}} = \underline{\underline{0.00}}$ <p>O_{80} has to be zero.</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>9</p>

Qn. No.	Scoring Indicators	Split score	Total score
b)	<p>It is the science and art of acquiring information about a material object by making measurements at a distance from without coming into a physical contact with the help of electromagnetic energy.</p> <p>Application in Civil Engineering are → For detecting and mapping of water resources.</p> <p>2) Detection of water pollution 3) detection of geology and mineral resources, 4) for mapping of land resources 5) and monitoring environmental hazards.</p>	2	6
a)	<p>$D = \frac{360}{2\pi R} \times 30$</p> <p>$\therefore 8 = \frac{360}{2\pi R} \times 30$</p> <p>$R = \frac{360 \times 30}{2\pi \times 8} = 286.48 \text{ m.}$</p> <p>Intersection angle = 140°</p> <p>Angle of deflection = $\Delta = 180 - 140 = 40^\circ$</p> <p>Tangent length = $R \cdot \tan \frac{\Delta}{2} = 286.48 \times \tan \frac{40}{2}$ $= 104.27 \text{ m.}$</p> <p>chainage of point of intersection = 2080 m.</p> <p>\therefore chainage of $T_1 = 2080 - 104.27 = 1975.73 \text{ m}$</p> <p>Curve length = $\frac{\pi \times \Delta \times R}{180} = \frac{\pi \times 40 \times 286.48}{180} = 200.00$</p>	1 1 1 1 1 1	

Qn. No.	Scoring Indicators	Split score	Total score
$\text{chainage of } T_2 = \text{chainage of } T_1 + \text{Curve length}$ $= 1975.73 + 200 = \underline{2175.73 \text{ m}}$	1	7	
<p>b) 1. Set the total station in such a way that the boundaries of the field can be visible from the single station setup.</p> <p>2. mark the station on ground and perform temporary adjustments</p> <p>3. Select 'measure Topo' from 'Survey'</p> <p>4. The sub window is displayed. Enter the name of the first traverse station (say as A).</p> <p>5. Place the pole on A vertically, sight the prism of the pole and press 'measure'.</p> <p>6. Press 'store' to save the data in the TS</p> <p>7. Repeat the process through all other traverse points like B, C, D, ...</p> <p>8. The area of the traverse is obtained from CO GO file menu by selecting 'compute + subdivide'</p> <p>9. The area is developed as map, calculated in quantity</p>	1 mark each.	8	