MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC-270001 – 2005 certified)

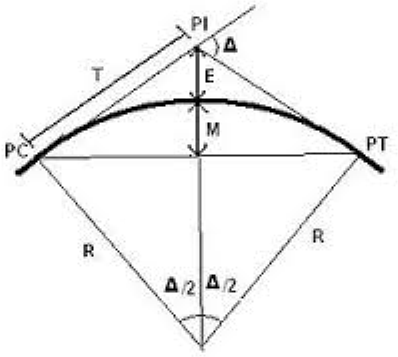
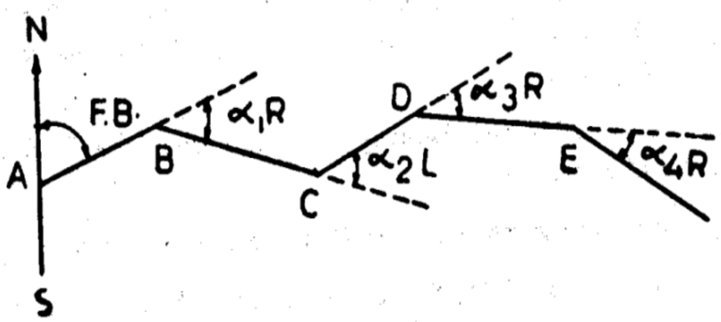
WINTER -14 EXAMINATION

Subject code: 17419 **Model Answer**

Important Instructions to examiners:

1) The answer should be examined by keywords and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language error such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skill).
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figure drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In the some cases, the assumed constants values may vary and there may be some difference in the candidates answer and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding.

Q.1 a) a) Attempt any SIX of the following:	**12**
(i) Define contour interval and horizontal equivalent..	
Contour Interval :- The vertical distance between any two consecutive contours is known as a contour interval **Horizontal Equivalent: -** The horizontal distance between any two consecutive contours is known as a Horizontal equivalent.	**1** **1**
ii) Explain the importance of digital planimeter.	
i) Can be used for any scale ii) Result will be directly displayed without calculation iii) No setting is required iv)Result be more accurate ***(Note- 1 mark each any Two)***	*****
iii) Define telescope inverted and telescope normal.	
Telescope Inverted :- It means bubble down & the face right position is called telescope inverted. **Telescope Normal :-** It means bubble down &the face left position is called as telescope normal.	**1** **1**
iv) Define the term swing of telescope.	
It can be the process of turning the telescope in horizontal plane. about vertical axis . swinging of telescope may be left sway or right sway.	**02**
(v) State any two object of Tacheometry	
i) To measure horizontal distance ii) To measure vertical distance. iii) The primary object of tacheometry is the preparation of contoured maps or plans requiring both the horizontal as well as Vertical control. Also, on surveys of higher accuracy, it provides a check on distances measured with the tape. ***(Note- 1 mark each any Two)***	*****
vi) State any two features of digital theodolite.	
i. Electronic image processing for determining heights and distances ii. With the automatic recording of data for later transfer to the computer.	*****

iii. When used in electronic mode with the rod face graduate in bar code. iv. It can work in night mode also. v. Direct display of results on digital display. **_*(Note- 1 mark each any Two)_**	
(vii) Define simple curve with sketch.	
Curve of a single arc with constant radius connecting the two tangents is defined as simple curve. 	**01** **01**
(viii) Define interpolation of contours	
The process of locating the contours proportionately between plotted points is defined as interpolation of contours	**02**
b) Attempt any TWO of the following:	**08**
(i) Define any four uses of contour map.	
i) The nature of the ground surface of a country can be understood by studying a contour map. To mark possible routes of communication between two different places. ii) A suitable site or an economical alignment can be selected for any engineering projects. iii) The capacity of a reservoir or the area of catchment can be determined approximately. iv) The indivisibility or otherwise of different points can be established. v) A suitable route for a given gradient can be marked on the map. vi) A section of the ground surface can be drawn any direction from the contour map. vii) Quantities of earthwork can be determined approximately. **_*(Note- 1 mark each any four)_**	*****
(ii) State the applications of Remote sensing with respect to natural hazard.	
Remote sensing can be applicable i) In case of flood ii) In case of earthquake iii) In case of volcano eruption and related hazards iv) In case of land slides v) In case of hurricanes vi) In case of desertification. **_*(Note- 1 mark each any four)_**	*****
(iii) State the procedure for measurement of deflection angle by transit theodolite.	
The procedure of measuring of deflection angle by theodolite is as follows: 	**01**

1) Set up the instrument at B. Level it accurately. 2) With both the plates clamped at 0° & the vernier A reding 360° take backsight on A. Read the other vernier B. 3) Transit the telescope. Unclamp the upper plate, turn the telescope & exactly bisect C. Read both verniers, the mean of the two vernier readings gives approximate value of the deflection angle at B. 4) Loosen the lower clamp.Turn the telescope horizontally & again sight back on A with the verniers still reading the approximate value of the deflection angle, and the telescope inverted. 5) Plunge the telescope. Unclamp the upper plate & again take foresight on C. Read both verniers. 6) Find the mean of the final vernier readings. Since the deflection angle is thus doubled, one-half of this average value gives the value of the deflection angle at B.	**03**
Q.2. Attempt any FOUR of the following:	**16**
a) Describe the stepwise procedure of interpolation of contours by arithmetic method with suitable example.	
By arithmetical calculation: This is very tedious but accurate method and is used for small areas where accurate results are necessary. The contours are interpolated as under: Suppose A and B are two points at a distance of 30 m and the reduced level of A and B are 25.45m and 27.54m respectively .Taking the contour interval as 1m, 26 and 27 m contours may be interpolated in between A and B. The difference of level between A and B is 2.09m.the difference of level between A and 26m, and A and 27m is 0.55mand 1.55 m respectively. Therefore the horizontal distance between A and 26 m contour =0.55/2.09 x 30m and Between A and 27 m contour =1.55/2.09 x 30m. These distances are then plotted to scale on the map.	**01** **03**
b) State direct and indirect method of contouring? Explain tacheometric method.	
Direct Method: In this method, the contours to be located are directly traced out in the field by locating and marking a number of points on each contour. These points are then surveyed and plotted on plan and the contours drawn through them. This method is most accurate but very slow and tedious as a lot of time is wasted in searching points of the same elevation for a contour. This is suitable for small area and where great accuracy is required **Indirect Method:** In this method the points located and surveyed are not necessarily on the contour lines but the spot levels are taken along the series of lines laid out over the area .The spot levels of the several representative points representing hills, depressions, ridge and valley lines and the changes in the slope all over the area to be contoured are also observed. Their positions are then plotted on the plan and the contours drawn by interpolation. This method of contouring is also known as contouring by spot levels. **By Tacheometric method:** A techeometer is a transit theodolite having a diaphragm fitted with two stadia wires, one above and other below the central wire. The horizontal distance between the instrument and staff station may be determined by multiplying the difference of the staff readings of the upper and lower stadia wires with the stadia constant of the instrument, which is usually 100.Thus the techeometer is used for both the vertical as well as horizontal measurements. This method is most suitable in hilly areas as the number of stations which can be commanded by a techeometer is far more than those by a level and thus the number of instrument settings are considerably reduced. A number of radial lines are laid out at a known angular interval and representative points are marked by pegs along these radial lines. Their elevations and distances are then calculated and plotted on the plan and the contour lines are then interpolated.	**01** **01** **02**
c) Describe method of locating a contour gradient.	
Ans.: In Establishing grade counter it is necessary to measure the distance from the starting point or the lost point fixed to the next point to be fixed the required staff reading is the calculated from i) the Distance ii) Given gradient iii) The RL of plane of collimation of the level (HI).	**02**

Example: Suppose a down gradient of 1 in 25 is to be traced on the ground. Let RL of the starting point = 750.00 m .,The distance = 30m, the height of instrument = 75.75 then **02**

R.L. of the next point = 750.00 – 30/25 = 750.00 – 1.2

= 748.80 m

H.I. = 750.75 m.

There for the staff reading required at the next point

= 750.75 – 748.80

= 1.95 m.

d) Give the desired relationships between the fundamental axis o transit theodolites.

Fundamental axis of Theodolite are as follows **01**

1) Axis of line of collimation 2) Vertical axis 3) Axis of telescope 4) Axis of bubble tube or bubble axis.
2) Relationship between fundamental axis are as follows (Any two) **03**
   i)The line of collimation should be parallel to the bubble axis
   ii)The line of collimation and axis of telescope should coincide with one another
   iii)The bubble axis should be perpendicular to the vertical axis

e) Describe the method of prolonging a straight line with transit theodolite.

There are three methods of prolonging a straight line.

First Method **01**

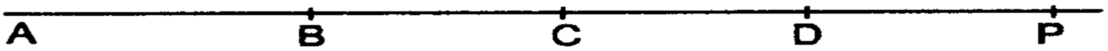


Fig. (a)

Suppose it is required to prolong a line AB upto the point P. **03**

1) Setup the theodolite over A & level it accurately. Bisect B exactly & establish a point C in line beyond B.

2) Shift the instrument to B , bisect C, and establish a point D in line beyond C.

3) Continue the process until the last point P is marked.

OR

Second Method

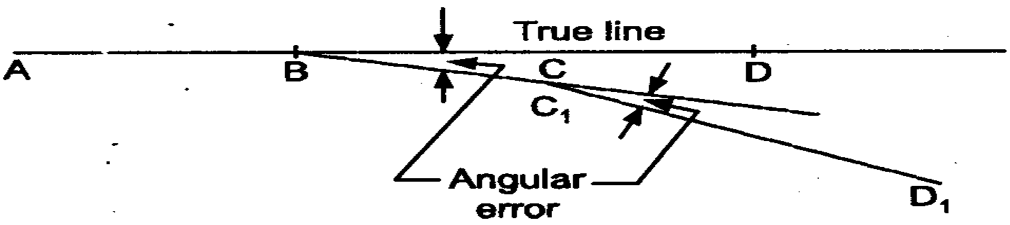


Fig. (b)

1) Setup theodolite over B and level it accurately.

2) Take a back sight on A .

3) With both motion clamp transit the telescope and set a Point C in line beyond B

4) Move the theodolite to C and back sight on B

5) Plunge the telescope and establish a point D in line beyond C.

Continue the operation until last point P is marked. This method also requires that the theodolite must be in perfect adjustment to get the true prolongation. If not instead of Point C, a point C1 will be established and angular error caused. The false line of prolongation will be established.

OR

Third Method

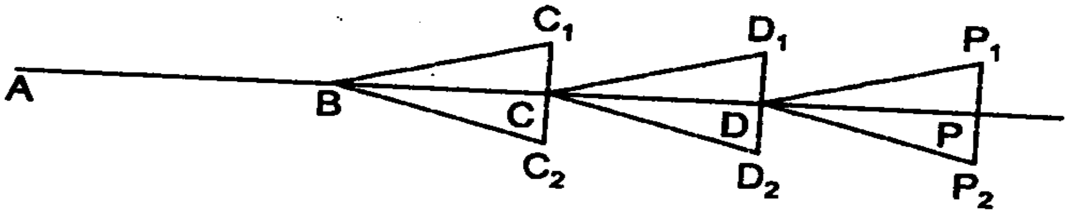


Fig. (c)

This method is known as double sighting method and is used when the line is to be prolonging with a high precision or when the instrument is in poor adjustment. Suppose it is required to prolong a line AB to some point P.

1) Setup the theodolite over B level it carefully.
2) Bisect A exactly by using the lower clamp and tangent screw.
3) Transit the telescope & it established point C on the line AB produced.
4) Lossen the lower plate , revolve the telescope about its vertical axis and take back sight on A, using lower clamp and its tangent screw. Telescope position is now inverted.
5) Transit the telescope and establish a point C2 in line AB beside the point C, as shown in figure.
6) Measure the distance C1, C2 and mark a mid point C, which will be on the true prolongation of the line AB
7) Shift the theodolite to C and repeat the process until the point P is reached.

f) What is meant by consecutive co-ordinate and independent co-ordinate?

Consecutive co ordinates

- **i)** The coordinates of any point when measured with respect to previous point are called as
- **ii)** Consecutive Co ordinates **02**
- **iii)** By using this coordinates the traverse is plotted with respect to previous point
- **iv)** Coordinates of any point may not be obtained by adding algebraically latitude and departure of the line.

Independent Co ordinates

- **i)** The coordinates of any point when measured with respect to common origin are called as Independent Co ordinates **02**
- **ii)** This method of coordinates is better than consecutive ordinates
- **iii)** By using this coordinates the traverse is plotted with respect to parallel and perpendicular to meridian.
- **iv)** Coordinates of any point may be obtained by adding algebraically latitude and departure of the line.

Q.3. Attempt any FOUR of the following: **16**

a) State the four advantages of total station.

1) Total station gives digital measurements of sloping, horizontal and vertical distances accurately and precisely. *
2) Total station gives digital measurements of vertical and horizontal angles accurately and precisely.
3) Total station consists of electronic field book to record the data and additional information.
4) Total station used for speedy completion of any type of project work.
5) Total station used for accurate setting out work by coordinate method.
6) Total station provides the provision of uploading and downloading the data to computer.
7) Total station used to prepare the map and drawings using soft wares.

(Note- 1 mark each any four)

b) Describe the temporary adjustment of micro-optic theodolite.	
Ans; **1) Setting up:** i) Take out micro optic theodolite from its box and fix it on the tripod over the required station Ii) Carryout the approximate leveling by leg adjustment and centering by judgement. 2) Accurate centering with help of optical plulmmet. 3) Levelling up : Levelling with help of foot screws and plate level 4) Focussing and sighting by using dioptric ring on the eye piece to get clear image of cross hair and focusing sleeve on telescope to get clear image of the object. 5) Open the illumination mirror and turn it towards the light to get the circle evenly illuminated. 6) Setting initial horizontal angle zero-zero by using horizontal circle drive.	**01** **01** **01** **01**
c) State four component parts of digital theodolite and state their purpose.	
Ans: 1. Control panel: to perform operations by giving commands to measure horizontal and vertical angles in left or right direction, to switch on or off the instrument. 2) LCD screen : to get the display of results 3) Horizontal clamp and slow motion screw: to control the movement of telescope in horizontal plane. 4) Vertical clamp and slow motion screw: to control the movement of telescope in vertical plane. 5) Rechargeable battery: To provide the power to operate electronic circuit of instrument. 6) Compensator: For automatic fast and steady leveling. 7) Foot screws: for leveling of instrument by usual method. ***(Note- 1 mark each any four)***	*****
d) Describe the set-up of digital level.	
Ans : Setup(constituents) and working of digital level may be as follows It is an automatic level capable of normal optical leveling with graduated leveling staff. It can take reading automatically using bar code rod .It capture and process the image of the bar code rod by using press button. It gives electronic image processing for determining height and distances along with horizontal angles. It gives automatic recording of data which can be transfer to computer. Use (Temporary adjustment) of digital level: **OR** i) Setting up :Take out digital level from its box and fix it on the tripod over the required position ii) Carry out centering ii) Leveling up: Carry out leveling of the digital level using foot screw and electronic level or bubble tube iii) Focus the image of the bar code properly, iv) Press the measure button to start the image processing. v) Press the button to record and save the reading. vi) Line leveling ,back sight and foresight, intermediate measurements in the leveling are taken ,ending a leveling line by using special keys such as start ,trigger, end , code number etc.	**02** **02** **02** **02**
e) State any four' application of digital theodolite.	
Ans 1) To measure horizontal and vertical angles. 2) It can be combined with E.D.M. to measure horizontal and vertical distances. 3) It can be connected to computer with R 232 interface. 4) To measure horizontal and vertical distances using principle of tacheometry. 5) To mark line out of complicated and large building. 6) To mark alignment of road railway canal, and electric transmition line tower. ***(Note- 1 mark each any four)***	*****

f) Draw a neat sketch of circular curve and show the following element.
(i) Tangent length
(ii) Deflection angle
(iii) Apex distance
(iv) Length of long chord.

Ans: *

Sketch of circular curve showing given element are as below:

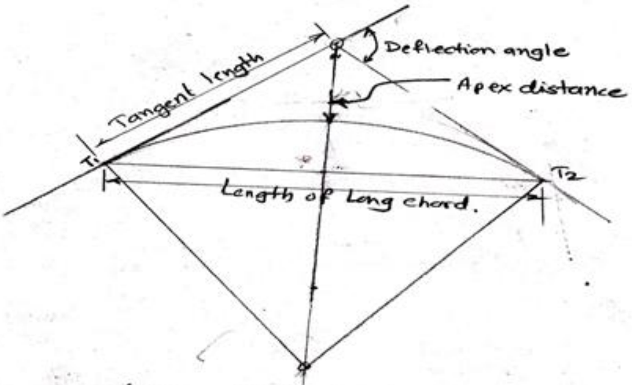


figure- simple circular curve.

(Note- 2 mark sketch, 1/2 mark each label)

Q.4.Attempt any FOUR of the following: **16**

a) State the procedure for computing the volume by prismoidal formula.

Ans:

Procedure for computing the volume by prismoidal formula are as below; **01**

1) Divide the total length of plane (L-section) in to number of strips (cross sections)

As shown in fig below

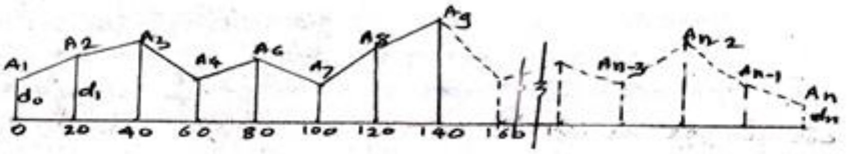


figure- L section. for Prismodial formula.

2) Calculate the areas of each section (i.e. ends , intermediate from A1 to An) **01**

3) Calculate volume of earth work in cutting and embankment by using formula **01**

4) Prismoidal formula : V = $\frac{D}{3}$ (A1 + 4(A2 + A4 +….) + 2(A3+A5+….) + An **01**

b) What is remote sensing? State the meaning of active and passive system

Ans

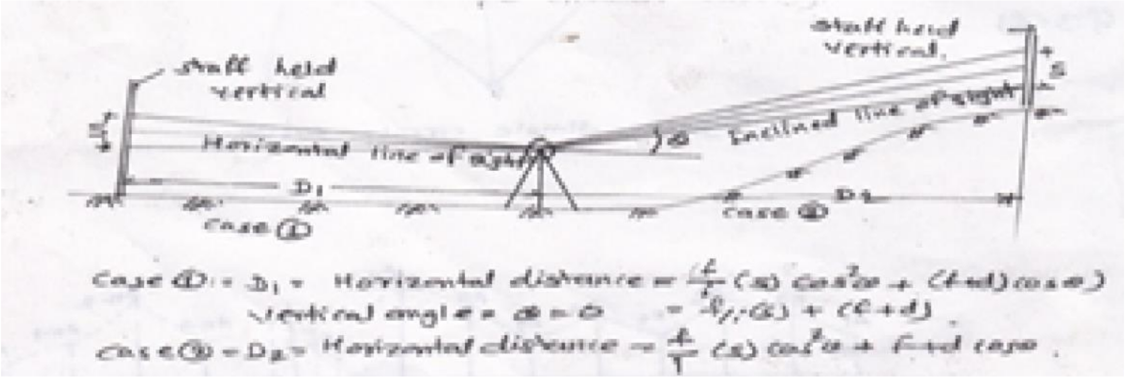
Remote sensing: The method of collecting and interpreting information about terrain and other objects from a distance without being in physical contact with the object. **02**

Active system: The system in which artificially generated energy sources are used is known as active system of remote sensing.

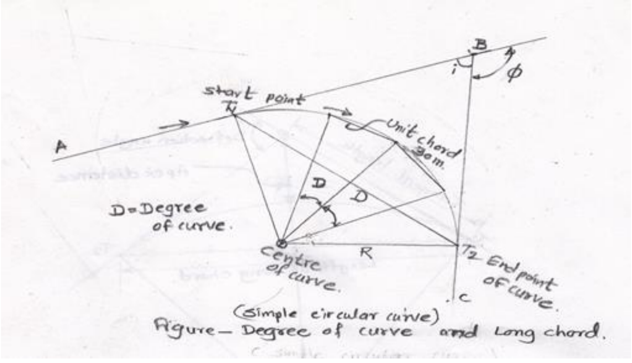
Example : Remote sensing with radar

Passive system: The system in which naturally generated energy sources usedto radiate electromagnetic energy of variable wavelength is known as passive system of remote sensing. **02**

Example: Remote sensing with sun and earth material.

c) What is GPS? State any four uses of GPS.	
GPS: Satellite navigation system used to determine ground point position and velocity (location , speed and direction)is known as global positioning system(GPS) Uses of GPS are as follows 1) It is widely used to navigation worldwide. 2) It is used for map making, land surveying, commerce, scientific uses and tracking and surveillance. 3)It is used to observe transportation system for aviation, marine or ground world wide. 4)It is used for disaster relief and emergency services knowing location and timing capabilities. 5) Accurate timing obtained by GPS is used to facilitate every day activities such as banking mobile phone, control of power grids etc. ***(Note- 1/2 mark each use any four)**	**02** *****
d) Explain in brief fixed hair method.	
Ans: Fixed hair method: In stadia method the diaphragm of the tachometer is provided with two stadia hairs (upper and lower), looking through the telescope the stadia hair readings are taken ,the difference in these readings gives the staff intercept . To determine the distance between the station and the staff , the staff intercept is multiplied by the stadia constant(i.e. 100)  Classification of stadia method : 1) The fixed hair method 2) The movable hair method 1) The fixed hair method: In this the distance between the stadia hair is fixed, when the staff is sighted through the telescope, a certain portion of the staff is intercepted by the upper and lower stadia. The value of the staff intercept varies with the distance, the distance between the station and the staff can be obtained by multiplying the staff intercept by the stadia constant.	**02** **02**
e) List any four essential characters of tacheometer.	
Ans: Essential character of tacheometer is as follows: 1) The value of the multiplying constant f/I should be 100 2) The telescope should be powerful having magnification of 20 to 30 3) The aperture of the objective should be of a 35 to 45 mm diameter for there to be bright image. 4) The telescope should be fitted with an analytic lens to make the additive constant (f+d)exactly equal to zero. 5) The eye piece should be of greater magnifying power than usual, so that it is possible to obtain clear staff reading from long distance. ***(Note- 1 mark each any four)**	*****
f) What is meaning of degree of curve and long chord?	
Ans: **Degree of curve (D):** The angle subtended by a unit chord of length 30m at center of the circle formed by the curve is known as degree of curve. It is designated as 'D'. **Long chord**: The longest chord involved in the designed curve at the intersection of two straights .i.e. Chord connecting two endpoint (start point and end point) of the curve is known as long chord. OR	**02** **02**

Degree of curve and long chord are as shown in figure below. **04**



D- Degree of Curve—
T1T2—Long Chord

Q.5. Attempt any TWO of the following: **16**

a) A traverse is run from A to G and the deflection angles are as follows:
At station B = 32°16'L, C = 18°34'R ,D = 22°12'L, B = 42°24'R, F = 52°42'R
Compute the bearing of the remaining line of the traverse given that the forward bearing of AB is $110^{0}6'$.

Ans:-The bearing of the remaining line may be calculated by the application of the rule.

Bearing of a line =Bearing of the preceding line $\underline{+}$ Deflection angle **01**

(Right Deflection angle + Left deflection angle -)

Therefore we have

Bearing of AB $=110^{0}6^{'}$

1)To determine Bearing of BC = Bearing of AB –deflection angle **01**

$=110^{0}6^{'}-32^{0}16^{'}=77^{0}50'$

2)To determine Bearing of CD = $77^{0}50^{'}+ 18^{0}34^{'}$(right) **01**

$=96^{0}25^{'}$

3)To determine Bearing of DE = $96^{0}25^{'}-22^{0}12^{'}$(left) **01**

$=74^{0}12^{'}$

4)To determine Bearing of EF = $74^{0}12^{'}+42^{0}24^{'}$ **01**

$=116^{0}63^{'}$ (right)

5)To determine Bearing of FG=$116^{0}63^{'}+ 52^{0}42^{'}$(right) **02**

$=169^{0}18^{'}$

Check : **01**

Bearing of the last line =Bearing of the first line
+∑right deflection angle
-∑left deflection angle

∑right deflection angle $=18^{0}34^{'}+42^{0}24^{'}+52^{0}42^{'}=113^{0}40^{'}$

∑left deflection angle$=32^{0}16^{'}+22^{0}12^{'}=54^{0}28^{'}$

Bearing of the last line$=169^{0}18^{'}$

Bearing of the first line$=110^{0}6^{'}$

As check

$=169^{0}18^{'}=110^{0}6^{'}+113^{0}40' - 54^{0}28^{'} =169^{0}18^{'=}169^{0}18^{'}$

b) Calculate the corrected consecutive co-ordinate for the following observations. Apply Bowditch Rule.

Line	**Length (mt)**	**Consecutive co-ordinate**			
		N	**S**	**E**	**W**
AB	**250**	**107.97**		**3.77**	
BC	**123**	**14.39**		**249.57**	
CD	**256**	**0**	**122.94**	**4.12**	
DA	**108**				**256.00**

Line	Length	Consecutive co-ordinate				Correction			
		N	S	E	W	N	S	E	W
AB	250	107.97		3.77		0.196		0.495	
BC	123	14.39		249.57		0.096		0.243	
CD	256		122.94	4.12			0.201	0.507	
DA	108	0			256.00	0.0849			0.214
Total	P=737	122.36	122.94	257.46	256.00	0.3776 +	0.201 -	1.245 -	+0.214
	Error Correction	-0.580 +0.580		+1.460 -1.460					

*

Corrected Consecutive co-Ordinate			
N	S	E	W
108.166		3.275	
14.486		249.327	
	122.736	3.613	
0.084			256.215
122.736	122.736	256.215	256.215
0.000		0.000	

*

***(Corrections 04 mark,01 marks each line, And corrected coordinate04 marks,01 marks each line)**

c) The following are the observation made by tacheometer with analatic lens the multiplying constant being 100 The staff was held vertical.

Inst. Station	HI	Start Station	Vertical angle	Hair reading	Remark RL of
P	**1.50**	**B.M**	$-6^0 12'$	**0.965, 1.515, 2.065**	**B.M. 460.500m**
P	**1.50**	**Q**	$+7^0 5$	**0.820, 1.340, 1.860**	

Find RL of Q and horizontal distance PQ.

Ans:-Multiplying constant 100

(f/i)=100

When Anallatic lence is fitted

Additive constant (f+d)=0

Find RL of Q. and horizontal distance PQ

When the staff is held vertically, the horizontal and vertical distances are given by the relation.

$D = (f/i)\ s \cos {}^2\theta + (f+d)\ \mathbf{s \cos} {}^2\theta$

$V = f/I \times s \times (\sin 2\theta/2) + (f+d) \sin \theta$

Here, = f/I =100 and (f+d) =0

In the first observation ,

$S_1 = 2.065 - 0.965 = 1.100$

*

$\theta 1 = 6^{0}121$ (depression) $2\theta 1 = 12^{0}24^{1}$

$V1 = 100 \text{ X } 1.100 \text{ x } (\text{Sin } 12^{0}24^{1}/2) + (0) \text{ Sin } 6^{0}121$ **$V_{1} = 11.81$m**.

In the second observation

S2 = 1.860 - 0.820 = 1.040

$\theta 2 = 7^{0}5^{1}$ (elevation)

$2Q_{2} = 14^{0}10^{1}$

$V_{2} = 100 \text{ x } 1.040 \text{ x } (\sin 14^{0}10^{1}/2)+(0) \sin 7^{0}5^{1}$

V2=12.72 m

$D2=100 \text{ x } 1.040 \text{ x } \cos^{2} 7^{0}5^{1} + (0) \cos 7^{0}5^{1} = 102.41$m

RL of instrument axis

= RL of BM $+ h_{1} + v_{1}$

= 460.500 +1.515+11.81

= 473.825 m.

= R.L of D = RL of inst. axis $+v_{2}-h_{2}$

= 473.825+12.7L-1.340

= 485.205m

So, **the distance PQ =102.41m**

And RL of Q =485.205m

(RL Of Q 04 marks, Horizontal distance o4 marks)

Q.6. Attempt any TWO of the following: **16**

a) A railway embankment 400 mt long is 12 rat wide at the formation level and has the side slope 2:1. The ground level at every 100 mt along the center line is as under.

Distance	**0**	**100**	**200**	**300**	**400**
RL	**204.8**	**206.2**	**207.5**	**207.2**	**208.3**

The formation level at zero chain age is 207.00mt and embankment has a rising gradient of 1 in 100. The ground is level across the center line. Calculate the volume of earth work.

Ans:-calculation of earth work L=400 m W=12m S=2:1 *

Chain-age	R.L	Formation level	Depth of Filling
0	204.8	207.2	2.400 m
100	206.2	208.2	2.000 m
200	207.5	209.2	1.700 m
300	207.2	210.2	3.000 m
400	208.3	211.2	3.000 m

Area is calculated according to the equation

A=(b+ s h)h

b=12 s=2

$A1=(12+2 \text{ X } 2.400)2.400=40.32 \text{ m}^{2}$

$A2=(12+2 \text{ X } 2)2=96 \text{ m}^{2}$

$A3=(12+2 \text{ X } 1.7)1.7=26.18 \text{ m}^{2}$

$A4=(12+2 \text{ X } 3)3=54.00 \text{ m}^{2}$

$A5=(12+2 \text{ X } 3)3=54.00 \text{ m}^{2}$

Calculation of volume by prismodial formula cutting or filling

Volume =(common dist. /3) {Area of I^{st} section + area of last section + 4 (sum of area of even section) + 2(sum of areas of odd section)}

V=100/3 {A1 + A5 + 4(A2+A4) + 2 (A3) }

V=100/3 {40.32 + 54.00 + 4 (96 + 54.00) +2(26.18) }

=100/3 { 94.32 +600 +52.36 }

$=24889.33 \text{ m}^{3}$

(Depth calculation 02 mark, Area calculation 02 mark,Prismoidal formula 02 marks, Volume of earth work 02 mark)

b) Two tangent intersect at chainage 2140 mt the deflection angle being 36° calculate all the data necessary for setting out curve with a radius 30 mt. by deflection angle.

Ans:-

Tangent length = R tan Δ /2=30 tan 18^0 =9.75 m **01**

Length of curve =R x Δ x (π/1800)=30 x 36^0 x (π/1800) =18.85 m **01**

Chain age of starting point, T1 =2140-Tangent length =2140 - 9.75 = 2130.25 **01**

Chain age of last point(T2) = Chin age of T1 + length of curve **01**

= 2130.25 + 18.85 T2 =2149.1m **01**

Assuming Length of unit chord = 5 m

Therefor no of unit chord = 3

Length of sub chord =3.85 m (Providing at end)

01

No of Chords = 3 unit chords and 1 sub chords

Rankine's deflection angle formula. $\delta 1 = 1719 \frac{C1}{R}$ **min**

SR.No.	Length of chord	Deflection angle	Total deflection angle
1	**5m**	4°46′29″	4°46′29″
2	**5m**	4°46′29″	9°32′58″
3	**5m**	4°46′29″	14°19′27″
4	**3.85 m**	3°40′35″	18°00′00″

02

c) Describe to use of digital theodolite for measurement of horizontal and vertical angle.

a) Procedure for measurement of horizontal angle.

Seting up –levelling:- **04**

i)Taking out digital theodolite for box and fix it on tripod over required station .

ii)Approximate leveling by leg adjustment and centering by judgment .

Levelling up :- Levelling the digital theodolite using foot screws by usual method i.e. plate level parallel to pair of foot screw and perpendicular position

3)focusing of diaphragm and object using eyepiece and focusing screws,

4)Switch on the digital theodolite.

5) Seleclt the left or right direction mode by press button L/R

6) Direct the telescope towards initial object ,bisect it , clamp the theodolite using horizontal clamp screw, make accurate bisection by using slow motion screw.

7) Press the button for zero reading,

8)Unclamp the clamp screw and bisect the final object, clamp it by clamping the clamp screw . accurate bisection by the slow motion screw ,

9)Press the hold button, LCD gives required horizontal angle between two point

10)The process may be repeated for required number of times to get mean reading.

b) Procedure for measurement of horizontal angle.

Seting up –levelling:- **04**

i) Taking out digital theodolite for box and fix it on tripod over required station .

ii) Approximate leveling by leg adjustment and centering by judgment .

Levelling up :- Levelling the digital theodolite using foot screws by usual method i.e. plate level parallel to pair of foot screw and perpendicular position

3)focusing of diaphragm and object using eyepiece and focusing screws,

4)Switch on the digital theodolite.

5) Direct the telescope toward A ,bisect it clamp the instrument , accurate bisection by slow motion screw.

6) Press hold button,LCD gives required vertical angle from zenith point as shown in fig,

7) Similarly bisect and take the reading at B.

8) Difference of two angle gives required vertical angle AOB