WINTER– 17 EXAMINATION

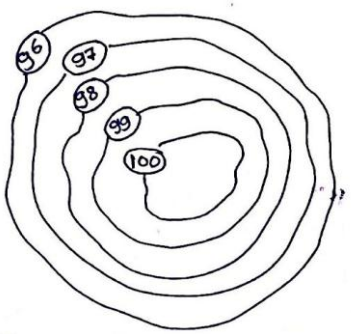
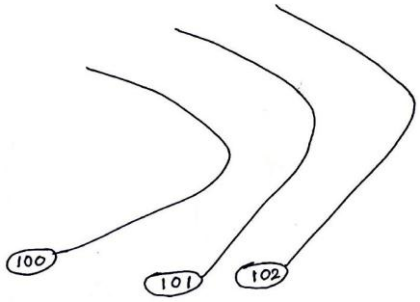
Subject Name: Advanced Surveying **Model Answer** Subject Code: 17419

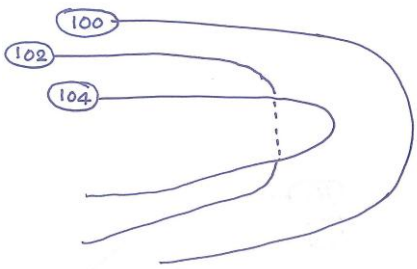
Important Instructions to examiners:

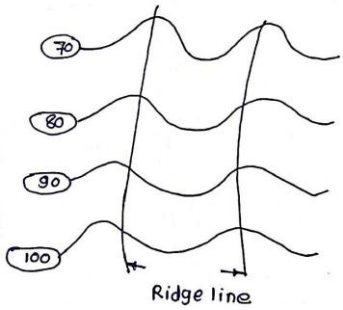
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures 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 some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

<table>
<tr><th>Q. No.</th><th>Sub Q.N.</th><th>Answer</th><th>Marking Scheme</th></tr>
<tr><td>Q.1</td><td>a)</td><td>Attempt any SIX of the following</td><td>12Marks</td></tr>
<tr><td></td><td>(i)
Ans.</td><td>Differentiate between contour interval and horizontal equivalent.
Difference between contour interval and horizontal equivalent.
<table>
<tr><th>Contour Interval</th><th>Horizontal Equivalent</th></tr>
<tr><td>1. The vertical distance between two successive contours is called “Contour Interval”.</td><td>1.The horizontal distance between any two successive contours is called “Horizontal Equivalent”.</td></tr>
<tr><td>2. The difference between R.L’s of two contours is a contour interval.</td><td>2. Horizontal distance is measured on the map and then converted with the help of scale used in map.</td></tr>
<tr><td>3. Contour interval is same throughout the survey.</td><td>3. Horizontal distance depends on steepness and slope of ground</td></tr>
</table></td><td>(Any two One Mark each)</td></tr>
<tr><td></td><td>(ii)</td><td>Define interpolation of contour and state its methods.
The process of spacing the contours proportionately between the ground points is known as “Interpolation of Contours”.
The contours may be interpolated by:
1. Estimation
2. Arithmetical calculations.
3. Graphical method.</td><td>(01 Mark)

(01 Mark)</td></tr>
</table>

	(iii) Ans.	**State importance of digital planimeter over polar planimeter.** Following are the importance of digital planimeter over polar planimeter. 1. No calculations are required for area calculations. 2. Less time required for measurement of area. 3. Gives more accurate result.	***(Any two One Mark each)***
	(iv) Ans.	**Define telescope inverted and telescope normal for transit theodolite.** **Telescope Inverted:** The position of telescope with the face right is known as "Telescope Inverted". **Telescope Normal:** The position of telescope with the face left is known as "Telescope Normal".	***(01 Mark)*** ***(01 Mark)***
	(v) Ans.	**Define the terms , swinging and transiting.** **Swinging:** It is the process of turning the telescope in horizontal plane. **Transiting:** It is the process of turning the telescope through 180° in a vertical plane about its horizontal axis.	***(01 Mark)*** ***(01 Mark)***
	(vi) Ans.	**State the principle of tacheometry.** Principle of tacheometry is stadia surveying which to enable horizontal and vertical distance to be computed from readings upon stadia rod and thus eliminate chaining operation.	***(02 Marks)***
	(vii) Ans.	**State any two special features of electronic theodolite.** Following are the special features of electronic theodolite 1. Dual side display and keyboard with push buttons / keys 2. Rechargeable Ni-Cd battery with auto power cut off. 3.Compatability with EDM. 4. Communication port	***(Any two One Mark each)***
	(viii) Ans.	**Define compound curve and reverse curve.** **Compound Curve:** A compound curve consists of two arc of different radius curving in the same direction. The centers of the two arc situated on the same side of the curve. **Reverse Curve:** A reverse curve consists of two arcs of equal or different radius curving in opposite direction with a common tangent. The two centers are on the opposite sides of a common tangent.	***(01 Mark)*** ***(01 Mark)***
Q.1	b)	**Attempt any <u>TWO</u> of the following**	**08 Marks**
	(i) Ans.	**Draw neat sketches of contour for following:** **1. Hill** **2. Gentle Slope**   **3. Overhanging cliff** **4. Ridge Line**	***(01 Mark each)***





(ii) Ans. **State any two advantages and limitations of remote sensing.**

Following are the advantages of remote sensing

- Provides data for large areas.
- Provide data for very remote and inaccessible area.
- Easy and rapid collection of data.
- Rapid production of maps for interpretation.

Following are the limitations of remote sensing

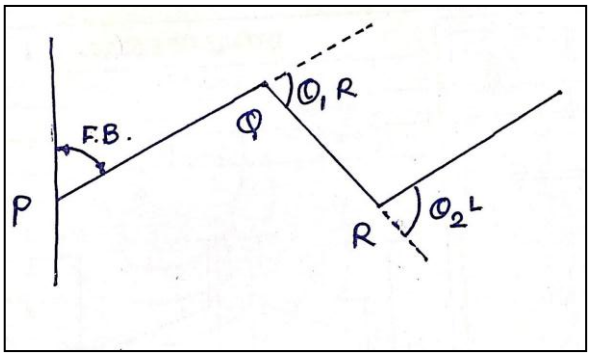
- The interpretation of imagery requires certain skill level.
- Needs cross verification with field survey data.
- Objects can be misclassified or confused.
- Expensive.

(Any two One Mark each)

(Any two One Mark each)

(iii) Ans. **State the procedure for measurement of deflection angle by transit theodolite**

Procedure:

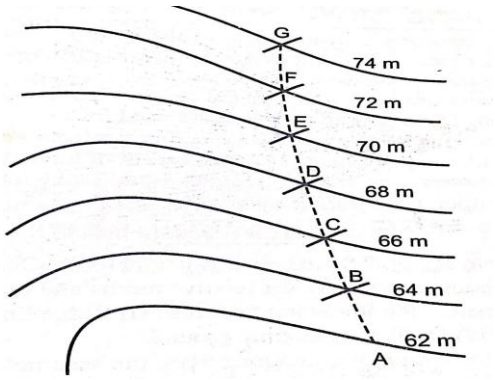


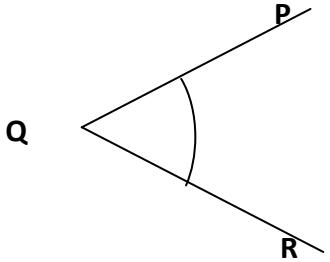
1. Set up the theodolite at Q and level it accurately.
2. With both plate clamped, the vernier A reading 360° take back sight on P (i.e bisect ranging rod at exactly)
3. Transit the telescope to direct the line of sight produced by PQ.
4. Loose the upper plate and turn to telescope clockwise to take fore sight on R (i.e. bisect ranging rod at R exactly using upper clamp and its tangent screw). The mean of two vernier readings give the approximate value of deflection angle at Q.
5. Loose the lower clamp and turn the telescope horizontally to back sight on P. The verniers will read the same reading as in above step and the telescope inverted.
6. Transit the telescope. Unclamp the plate and again bisect R read both verniers.
7. Find the mean of final vernier reading. Thus the deflection angle is doubled and hence, one half of this average value gives the accurate value of deflection angle at Q.

(01 Mark)

(03 Marks)

Q.2. **Attempt any <u>FOUR</u> of the following** **16 Marks**

	a) **Ans.**	**State methods of locating contours and explain any one.** Following are the methods of locating contours 1. Direct Method. 2. Indirect method. a) By Square / Block Contouring b) By Cross Section c) Tacheometric Contouring **By Square / Block Contouring** This method is suitable when the area is small and the ground is almost uniform. The whole area is divided into a series of squares and their corners are marked with pegs. The size of square varies from 5m to 20 m, depending upon the surface of ground. Now with the help of level, elevations of the corners of the square are determined. Theses squares are plotted and reduced levels are written at their corners and the contours lines are then interpolated. **(Students may explain any one method of locating contour)**	***(02 Marks)*** ***(02 Marks)***
Q.2	**b)** **Ans.**	**State any four applications of contour map** Following are the applications of Contour map. 1. With the help of contour lines on contour map one can know the nature of ground. 2. For determination of most economical site for dams and reservoirs, maximum flood line , submerged area. 3. For estimating volume of water to be impounded in a reservoir. 4. For location of highways, railways, canals, pipelines etc. 5. For determination of volume of cutting and embankment in given gradient. 6. For determining the indivisibility of two given points	***(01 Mark each)*****An y Four**
Q.2	**c)** **Ans:**	**Describe the procedure to locate grade contour in field** *Line joining the point along the same gradient is called contour gradient or grade contour.* All the points on a contour have the same elevation. But all the points on a contour gradient do not have the same elevation but all of them lie on the same gradient. Contour gradient can be used to locate the direction of road having a particular gradient. As shown in fig. a contour map on which the contour lines are at 2 m intervals.  Suppose it is required to trace the center line of road with a ruling gradient of 1 in 30 m from the starting point A on the 62 m contour line. Since the contour interval is 2 m and the	***(01 Mark)***

		gradient 1 in 30 m, the horizontal distance between A and the point on the next 64 m contour line is 2 × 30 = 60 m. With center A and radius equal to 60 m draw an arc cutting the 64 m contour line arc B on map. With center B and the same radius draw an arc intersecting the next contour lines obtained. A, B, C, D, E,…… are the points on required grade. Now mark the contour on ground and established a point B at a distance of 60 m from A on contour of RL 64. Similarly others points are established to obtain the grade contour on field.	***(03 Marks)***
Q.2	**d) Ans.**	**State the procedure for measuring a horizontal angle by method of repetition.** **Procedure :**  1. Set up the instrument over Q and level it accurately with the telescope in the normal position. 2. Set the vernier A to 360^{o}. Loosen the lower clamp direct the telescope to left hand ranging road at P, and bisect it exactly by using lower clamp and lower tangent. 3. The vernier reading should be the same. 4. Loose the upper clamp and truth the telescope in clockwise direction and bisect the right hand ranging road at R exactly by using the upper clamp and upper slow motion screw. 5. Read both vernier. Let the mean reading be 30^{o} 2'. 6. Leaving the vernier unchanged, unclamp the lower plate and turn the telescope in clockwise direction bisect the ranging rod at P exactly with lower clamp and lower tangent screw. The reading on vernier should be same as before. 7. Loose the upper clamp and turn the telescope in clockwise direction and bisect ranging rod at R exactly by using upper clamp and upper tangent screw. 8. The verniers will now read twice the value of angle i.e 2 × 30^{o} 2'. 9. By leaving the verniers clamped at 60^{o} 40' measure the angle third time. 10. Read both the verniers. Read the final angle. 11. The average angle with face left will be equal to the final reading divided by three. 12. Change the face and make three more repetition as described above. 13. Find the average angle with face right by dividing the final reading by three. 14. By taking average of both the face, horizontal angle PQR is obtained.	***(01 Mark)*** ***(03 Marks)***
Q.2	**e) Ans.**	**Explain the temporary adjustment of transit theodolite** Temporary adjustment of transit theodolite consists of following steps. 1. Setting up theodolite over a station 2. Levelling up 3. Focusing of eyepiece. 4. Focusing of object glass.	

1. Setting up theodolite over a station

Setting up the theodolite includes following process: ***(01 Mark)***

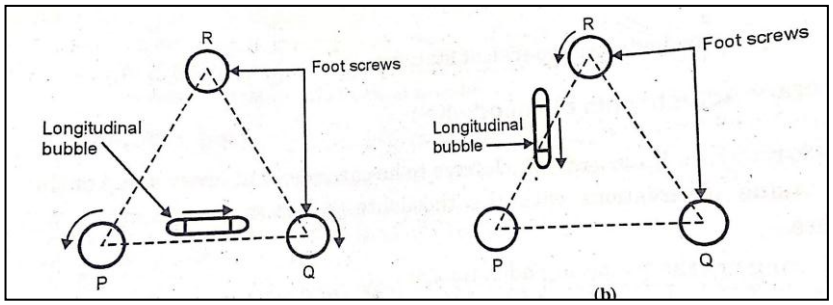
a) Centering the instrument over station point.

Centering of theodolite is carried out by suspending a plumb bob form hook exactly over a station point.

b) Levelling the instrument approximately by tripod leg.

2. Levelling up

Accurate leveling with the help of foot screw includes following steps: ***(01 Mark)***



a) Turn the theodolite about its vertical axis until the plate level is parallel to any pair of leveling screw.

b) Move the foot screw either both in outward or inward directions by same amount until the bubble comes in the center of their run.

c) Rotate the telescope by 90° and the bring it over the third foot screw and bubble is brought in center by operating third foot screw.

d) Again bring the telescope back to its original position and repeat the steps 'b' and 'c' until the bubble remains at center in both the positions.

e) Now turn the telescope in any third position through 360 °and observe the bubble, if it is remain in center , then the theodolite in accurate leveling.

3. Focusing of eyepiece. ***(01 Mark)***

Focusing of eyepiece enables to make the cross hair clear and distinct.

This is achived by holding the white paper in front of object glass and the eyepiece is rotated in clockwise or anticlockwise direction till the cross hair are clear and sharp.

4. Focusing of object glass. ***(01 Mark)***

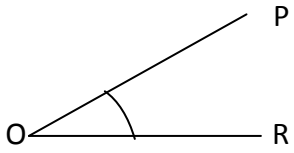
Object of focusing of object glass is to bring the image of object formed by the object glass in the plane of the cross hair.

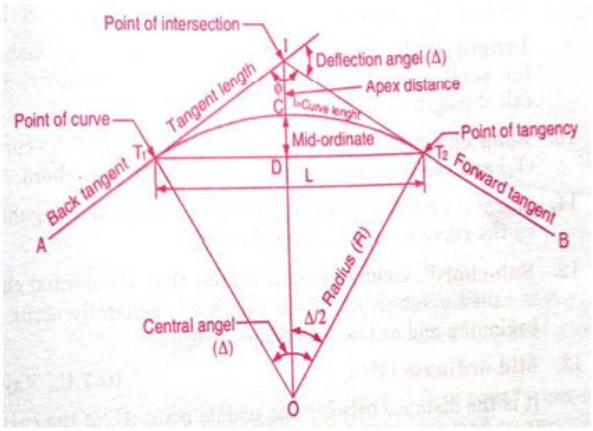
To eliminate parallax , direct the telescope towards object and turn the focusing screw until the appears clear and sharp.

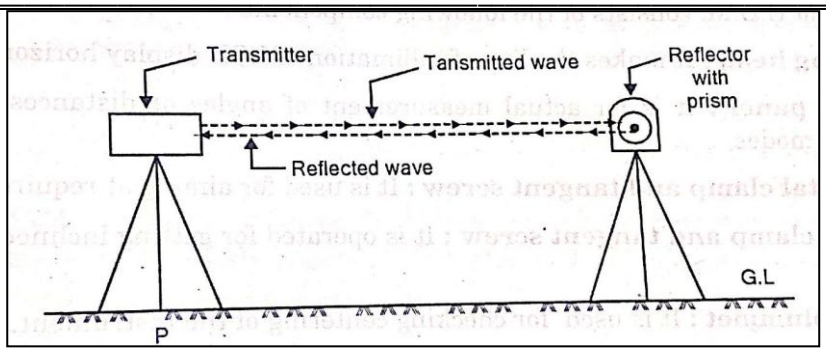
Q.2 f) Ans. **State different relationship between fundamental lines of theodolite.**

When the instrument is in perfect adjustment, the following relations should exists: ***(01 Mark each)*****Any Four**

1) The axis of the plate level must be perpendicular to the vertical axis.
2) The line of collimation must be at right angle to the vertical axis.
3) The horizontal axis must be perpendicular to the vertical axis.
4) The bubble line or the axis of the axis of the telescope level must be parallel to the

		line of collimation. 5) The vernier of vertical circle must read zero when the telescope is perfectly horizontal.	
Q.3.		**Attempt any <u>FOUR</u> of the following**	**16 Marks**
	a) Ans.	**Explain construction and use of 'one second micro optic theodolite'.** **Construction:** • Micro optical theodolite have optical system build during manufacturing. • This optical system faceplates reading of both horizontal and vertical angle precisely. The least count of this theodolite is 1" • It has a automatic compensation of vertical circle index. • It has 30 X bright and sharp telescope. • It provides clear and bright display with backlight illumination and also provides the display for both the sides. **Uses:** • This instrument is most suitable for harsh environment and extreme weather conditions (i.e. hot or cold temperatures) • For precise measurement of horizontal angle. • For precise measurement of deflection angle. • For precise measurement of vertical angle. • Alignment of transmission towers carrying electric cable can be precisely done. • For locating alignment of tunnel.	***(02Mark for any four points)*** ***(02Marks for any two uses)***
Q.3	**b) Ans.**	**Explain the procedure for measuring of vertical angle by using electronic theodolite** Suppose it is required to measure the vertical angle of an object 'P'  **Procedure:** • Set up the instrument over station 'O' and carry out all temporary adjustments. • Loosen the vertical clamping screw and direct the telescope in vertical plane and bisect 'P' exactly. • Now read the reading on displayed window.	***(01Mark)*** ***(03Marks)***
Q.3	**c) Ans.**	**Describe the procedure for setup of total station.** Following steps are followed for the set up of total station 1. Set up the tripod approximately over the station point. 2. Remove the plastic cap from tripod and make tripod nearly level by stretching tripod legs. 3. Now fix the total station on tripod and roughly leveled and centered the instrument and	***(04 Marks)***

		push each leg firmly into the ground. 4. Check the level and center it again . Adjust level by changing leg length. 5. Adjust the three screws of the tribrach to center the bubble of spirit level by using three foot screw. 6. Focusing of eyepiece. 7.Focusing of object glass. 8.Check the plate level from time to time during measurement .	
Q.3	**d) Ans.**	**State any four special feature of total station.** Following are the special feature of total station. • **High accuracy and long measuring range.** 1) High accuracy : ± (2 mm + 2 ppm) 2) Long measuring range with mini prism is 0.9 km. Long measuring range with single prism is 2 km. Long measuring range with 3 prism is 2.7 km. • **Versatile application programs.** a. On board data collection, stakeout/ survey road calculation and many more function. b. Integrated alphanumeric key realizes the quicker operation. c. Large internal memory up to 24000 points. • **Enhanced absolute encoder.** Adopted absolute encoder, which need not require zero set and it can also realize stable measurement with less reading error. • **Superior water-resistant and dust proof.** • **No worry about sudden bad weather.**	***(01 Mark each)*An y Four**
Q.3	**e)**	**Draw neat sketch of simple circular curve and show notation there on.** **Notations for curve :**  	***(02 Marks) For Fig.*** ***(02 Marks) For Notation s***
Q.3	**f) Ans:**	**Explain the principal of EDM with a neat sketch.**	



(01 Mark)

- Let the distance between P and Q be 'D' which is to be measured.
- A wave transmitted from the transmitter at station 'P' with certain phase angle. There is a reflector at the other end 'Q' reflector consist of prism. The wave strikes on reflector at Q and then gets reflected from Q.
- It is received back at the transmitter end at 'P' with different phase angle. For finding the distance, the phase difference between transmitted wave is measured and converted into distance.

(03 Marks)

4. **Attempt any <u>FOUR</u> of the following** — **16 Marks**

a) **The following readings were obtained when the area was measured by planimeter, the tracing arm so set to give 100 Sq.cm as the value of one revolution of the roller.**

IR	FR	Position of anchor point	Remark
7.225	**3.125**	**Outside the figure**	**The zero of the disc passed the fixed mark twice in clockwise direction**
1.252	**4.38**	**Inside the figure**	**The zero of the disc passed the index mark once in reverse direction.**

Ans. *(02Marks)*

<u>Find the area of zero circle</u> (Statement missing in question paper)

<u>Case I</u>

Area of the figure in the first case

= M (F.R. – I.R. + 10 N)

= 100 (3.125 – 7.225 + 10*2)

= 1590 Sq.Cm ---------- 1

(02Marks)

<u>Case II</u>

= M (F.R. – I.R. - 10 N +C)

= 100 (4.38 -1.252 -10*1 +C)

=-687.2 + 100C ---------- 2

Equating 1 and 2

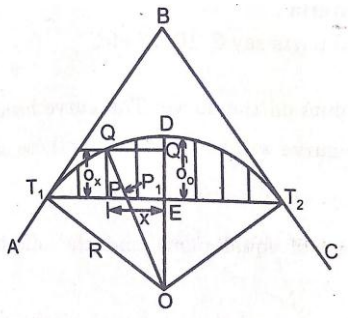
1590 =-687.2 + 100C

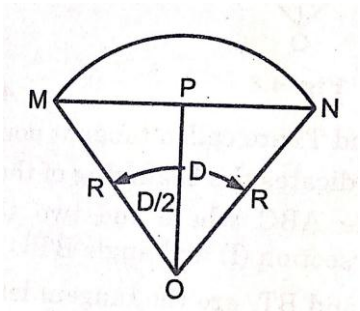
C = 22.77

Area of Zero Circle = M x C

= 100 x 22.77

= 2277 Sq.Cm

Q.4	**b) Ans.**	**State any two application of each of GIS in land information and land environmental field.** **Applications of GIS in Land information** Following are the applications of GIS in land information. • Easy creation and maintenance of data for land records. • Land planning and land use. • Managing land registry for recording titles to land holding. **Applications of GIS in Environmental field** Following are the applications of GIS in Environmental field. • Forest modeling, air/water quality modeling and monitoring. • Environmentally sensitive zone mapping. • Forest cover, soil quality and hydrology coverage.	***(02Marks for any two)*** ***(02Marks for any two)***
Q.4	**c) Ans:**	**Explain application of remote sensing in civil engineering.** Following are the applications of remote sensing in civil engineering. 1. **Revision of (existing) topo sheets:** The rapid revision and updating of existing topo (graphical) sheets can be carried out speedily with the help of aerial photography (which is also a branch of remote sensing) and satellite imagery. 2. **Alignment of (new) highways and rail-lines:** the location of most economical alternative sites for such works can very well be carried out speedily by making use of aerial photographs and satellite imagery. 3. **Location of (gravity) dam sites:** for a gravity dam, it is necessary to have very good foundations in the form of hard solid strata of rocks. Geological investigation of the existing rock in and around the propose dam site can be carried out by aerial photographs and or satellite imagery. Geological features such as folds, faults, dykes, fracture etc. can be determined by the remote sensing technique. 4. **Tunneling:** Tunnel should not be aligned along the fractured zone or faults in the rocks. Remote sensing helps in furnishing all such information and thus ensures safety of tunnel during its construction stage. **5. Silting of storage reservoirs, harbors etc.:** Silting of storage reservoirs reduces its capacity, whereas silting of harbors leads to reduction in the navigational depth and thus renders it useless. Remote sensing technique that makes use of satellite imagery (in the infrared region) gives idea about the silting of reservoir qualitatively and to some extent quantitatively.	***(01 Mark each)*****Any Four**
Q.4	**d)**	**Explain the procedure of curve setting by method of offsets from long chord** **Procedure:**  1. Divide the long chord into an even number of equal parts say 8,10,12 etc.	***(02 Marks)***

		2. Set out the offset as calculated from the formula Ox= $\sqrt{R^2 - X^2}$ – (R-O_0) and obtain the required points on the curve. The curve being symmetrical along ED, the offset for the right half of the curve will be the same as those on the left half side.	***(02 Marks)***
Q.4	**e)**	**Define tacheometer. State essential characteristics of tacheometer.** **Tacheometer** A tacheometer is essentially a transit theodolite having a stadia diaphragm. The diaphragm is equipped with two horizontal hairs called stadia hairs in addition to the regular cross hairs. **Essential Characteristics of a Tacheometer :** 1. The value of constant f/i = 100. 2. The telescope should be fitted with anallatic lens having value of (f+c) = 0 3. The telescope should be powerful, the magnification should be 20 to 30 times the diameters. The vision through the telescope should give a clear and bright image for a long distance.	***(01 Mark)*** ***(03 Marks)***
Q.4	**f)**	**What is the degree of curve? Derive the relationship between radius and degree of curve.** **Degree of curve** The degree of the curve is the angle subtended at the center by a standard chord of 30 m length.  **Relationship between radius and degree of curve.** Referring Fig Let R = the radius of the curve in m. D = the degree of cuve. MN = the chord 30 m long. P = Mid point of chord MN In OMP, OM = R, PM = ½ MN = 15 m. Then sin D/2 = PM/OM = 15/R Or R = $\frac{15(\text{Exact})}{\sin D/2}$ When D is small, sin D/2 = D/2 radians *R = $\frac{15}{(D/2)\times(\Pi/180^{o})} = \frac{15\times360}{\Pi D} = \frac{1718.89}{D}$	***(01 Mark)*** ***(03 Marks)***

R = 1719 / D

Sometimes it is taken as **R = 1720 / D**

If the length of chord is 20m

Then $R = \frac{10}{(D/2)\times(\Pi/180^{o})} = \frac{1145.45}{D}$

R = 1145.45 / D

(Students may derived for 30 m or 20 m chord length, full marks should be given for any one relationsdhip)

Q.5 a)

Calculate consecutive co-ordinates of all the survey lines of following traverse.

Line	WCB	Length in Meters
AB	121^0 30’	161.20
BC	18^0 09’	141.38
CD	218^0 31’	201.39
DA	332^0 27’	121.21

Ans

Line	Reduced Bearing	Length in Meters	Latitude l*cosθ	Departure l*sinθ
AB	S 58^0 30’ E	161.20	-84.23	+137.44
BC	N 18^0 09’ E	141.38	+134.34	+44.04
CD	S 38^0 31’ W	201.39	-157.57	-125.42
DA	N 27^0 33’ W	121.21	+107.46	-56.06

Calculations: Consecutive co-ordinates of Survey lines.

Line AB- Latitude = l*cosθ = 161.20 x cos 58^0 30’ = -84.23

Line BC- Latitude = l*cosθ = 141.38 x cos 18^0 09’ = +134.34

Line CD- Latitude = l*cosθ = 201.39 x cos 38^0 31’ = -157.57

Line DA- Latitude = l*cosθ = 121.21 x cos 27^0 33’ = +107.46

Line AB- Departure = l*sinθ = 161.20 x sin 58^0 30’ = +137.44

Line BC- Departure = l*sinθ = 141.38 x sin 18^0 09’ = +44.04

Line CD- Departure = l*sinθ = 201.39 x sin 38^0 31’ = -125.42

Line DA Departure = l*sinθ = 121.21 x sin 27^0 33’ = -56.06

01 Mark for each correct Latitude and 01 Mark for each correct Departure

Q.5 b)

Following are length and bearing of sides of traverse of PQRSP.

Line	Length in Meters	Bearing
PQ	76.80	140^0 12’
QR	195.60	35^0 24’
RS	37.20	338^0 48’
SP	--	--

Find length and bearing of line SP.

Ans

Line	Length in Meters	Bearing	Reduced Bearing	Latitude (L) l*cosθ	Departure (D) l*sinθ
PQ	76.80	140^0 12’	S39^0 48’E	-59.00	+49.16
QR	195.60	35^0 24’	N35^0 34’E	+159.11	+113.77
RS	37.20	338^0 48’	N21^0 12’W	+34.68	-13.45
SP	**187.97**	**227^0 26’**	**S47^0 57’W**	**-134.79**	**-149.48**

Since PQRSP is a closed traverse, $\Sigma L = 0$ and $\Sigma D = 0$

Line PQ- Latitude = $l*\cos\theta = 76.80 \times \cos 39^0 48' = -59.00$

Line QR- Latitude = $l*\cos\theta = 195.60 \times \cos 35^0 34' = +159.11$

Line RS- Latitude = $l*\cos\theta = 37.20 \times \cos 21^0 12' = +34.68$ — 02

Line SP- Latitude = $l*\cos\theta = l_1 \times \cos\theta_1$

$\Sigma L = 0$

$0 = -59.0 + 159.11 + 34.68 + l_1 \times \cos\theta_1$

$l_1 \times \cos\theta_1 = -134.79$ — 01

Line PQ- Departure = $l*\sin\theta = 76.80 \times \sin 39^0 48' = +49.16$

Line QR- Departure = $l*\sin\theta = 195.60 \times \sin 35^0 34' = +113.77$

Line RS- Departure = $l*\sin\theta = 37.20 \times \sin 21^0 12' = -13.45$ — 02

Line SP Departure = $l*\sin\theta = l_1 \times \sin\theta_1$

$\Sigma D = 0$

$0 = +49.16 + 113.77 - 13.45 + l_1 \times \sin\theta_1$ — 01

$l_1 \times \sin\theta_1 = -149.48$

$\tan\theta = D / L$

$= -149.48 / -134.79$

$= 1.10$

$\theta_1 = \tan^{-1}1.10 = 47^0 57'30''$

$\theta_1 = S47^0 57'W$ — 01

Length SP = $SQRT(L^2 + D^2)$

$= SQRT[(-134.79)^2 + (-149.48)^2]$

= 201.27 m. — 01

OR Length SP = 149.48 / sin 47^0 57’ = **201.27 m.**

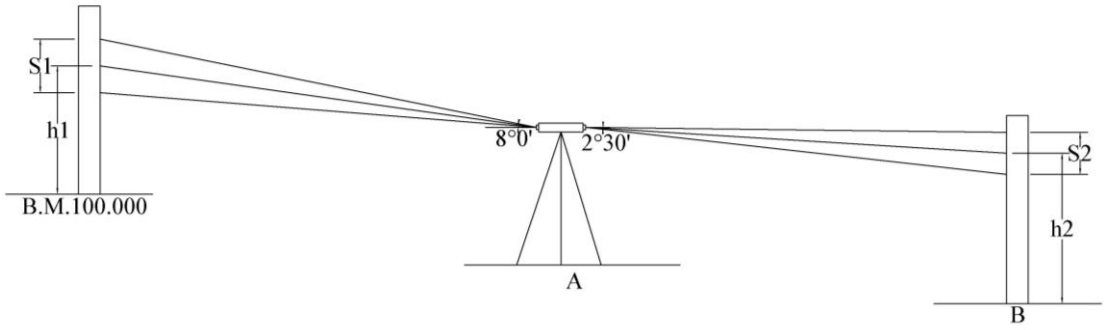
OR Length SP = 134.79 / cos47^0 57’ = **201.27 m.**

Q.5 c) A tachometer fitted with analytic lens was set up at station 'A' and the following readings were obtained on vertically held staff.

Inst. Station	Staff Station	Vertical angle	Stadia readings in meter
A	BM	$+8^0$ 00’	0.900, 1.16, 1.420
A	B	-2^0 30’	1.140, 1.235, 1.330

The constant of tachometer was 100. Find the horizontal distance AB and RL of B, if BM RL is 100.00 m.

Ans



02

Given (f / i) = 100, (f + d) = 0, B.M. = 100.000, $\theta_1 = 8^0\ 00'$

$h_1 = 1.160$, $S_1 = 1.420 - 0.900 = 0.520$

$V_1 = [(f / i) \times S_1 \times (\sin 2\theta_1/2)] + (f + d)\sin\theta$

$= 100 \times 0.520 \times (\sin 16/2) + 0$

$V_1 = 14.33 / 2 = 7.16$ m. ---------- 01

Reduced level of Instrument axis = B.M. + $h_1 - V_1$

$= 100 + 1.160 - 7.16$

$= 94.00$ m. ----------

$h_2 = 1.235$, $S_2 = 1.330 - 1.140 = 0.190$, $\theta_2 = 2^0\ 30'$ 01

$V_2 = [(f / i) \times S_2 \times (\sin 2\theta_2/2)] + (f + d)\sin\theta$

$= 100 \times 0.190 \times (\sin 5/2) + 0$

$V_1 = 1.656 / 2 = 0.828$ m. ---------- 02

Reduced level of B = Elevation of Instrument axis – $V_2 - h_2$

$= 94 + 0.828 - 1.235$

= 91.937 m. ---------- 02

Horizontal distance AB = $[(f / i) \times S_2 \times (\cos^2\theta_2)] + (f + d)\cos\theta$

$= 100 \times 0.190 \times \cos^2 2^0\ 30' + 0$

= 18.96 m ----------

Q.6 a) The formation level of a road is at a constant RL of 150.00 m. The ground level is along centre line of road are as follows:

Chainage (m)	0	40	80	120	160	200	240
Ground level	152.6	151.90	149	150.90	151.50	152.45	151.20

Calculate the volume of earthwork given that formation width is 8 m and side slope is 2: 1.

Ans

Chainage (m)	Ground level	formation level	Cutting (+)	Filling (-)	Area
0	152.6	150.00	2.60		A_1
40	151.90	150.00	1.90		A_2
80	149	150.00		1.00	A_3
120	150.90	150.00	0.90		A_4
160	151.50	150.00	1.50		A_5
200	152.45	150.00	2.45		A_6
240	151.20	150.00	1.12		A_7

Equation for Area for trapezoidal section

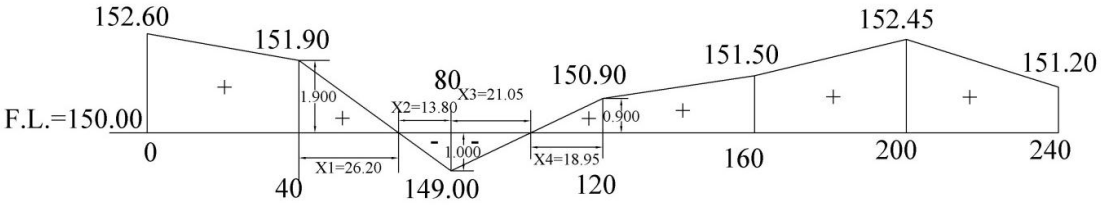
$A = (b + s*h) \times h$ b = Width of road, s = Side slope, h = Ht. of cutting/filling

$A_1 = (8 + 2 \times 2.6) \times 2.6 = 34.32\ m^2$

$A_2 = (8 + 2 \times 1.9) \times 1.9 = 22.42\ m^2$

$A_3 = (8 + 2 \times 1.0) \times 1.0 = 10.0\ m^2$

$A_4 = (8 + 2 \times 0.9) \times 0.9 = 8.82\ m^2$ 02

		$A_5 = (8 + 2 \times 1.5) \times 1.5 = 16.5\ m^2$ $A_6 = (8 + 2 \times 2.45) \times 2.45 = 31.6\ m^2$ $A_7 = (8 + 2 \times 1.12) \times 1.12 = 11.47\ m^2$  $(X_1/1.9) = [(40-X_1)/1]$ Hence $X_1 = 26.20$ m. $X_2 = 13.80$ m. $(X_3/1.0) = [(40-X_3)/0.9]$ Hence $X_3 = 21.05$ m. $X_4 = 18.95$ m. Volume calculations: a) From chainage 0 m to 40 m. Cutting = $(34.32 + 22.42) \times 40 / 2 = 1134.8\ m^3$ b) From chainage 40 m to 80 m. Cutting = $(22.42 + 0) \times 26.20 / 2 = 293.70\ m^3$ Filling = $(0 + 10) \times 10 \times 13.80 / 2 = 69.0\ m^3$ c) From chainage 80 m to 120 m. Filling = $(10 + 0) \times 21.05 / 2 = 105.25\ m^3$ Cutting = $(0 + 8.82) \times 10 \times 18.95 / 2 = 83.57\ m^3$ d) From chainage 120 m to 160 m. Cutting = $(8.82 + 16.5) \times 40 / 2 = 506.4\ m^3$ e) From chainage 160 m to 200 m. Cutting = $(16.5 + 31.6) \times 40 / 2 = 962.0\ m^3$ f) From chainage 200 m to 240 m. Cutting = $(31.6 + 11.47) \times 40 / 2 = 861.4\ m^3$ Volume of earthwork: Cutting = $1134.8 + 293.70 + 83.57 + 506.4 + 962.0 + 861.4 = 3841.87\ m^3$ Filling = $69.0 + 105.25 = 174.25\ m^3$	01 04 01
Q.6	b) Ans	State any eight practical applications of E.D.M. 1. For measurement of horizontal distance 2. For measurement of vertical distance 3. For measurement of sloping distance 4. Measurement of volume of stack. 5. Fixing alignment of railway / highway / canal. 6. Measurement of distance of remote point where chain or tape cannot be used. 7. As sensor for landing of Helicopter on helipad and parking of ship in harbor. 8. Cross verification of already measured distance by chain / tape.	01 for each correct application

Q.6 c) Tabulate the data required for setting out a circular curve by the deflection angle method, using the following information:

(i) Chainage of intersection point = 1580 m
(ii) Angle of intersection = 145°
(iii) Degree of curve = 5°
(iv) Peg interval = 30 m

Ans

i) Angle of Intersection I = 145^0
ii) Chainage at intersection point = 1580 m.
iii) Degree of curve = 5^0
iv) Peg interval = 30 m.
v) Angle of deflection $\phi = 180 - 145 = 35^0$ ---------- 0.5

Radius of curvature R = (1718.9 / Degree)
= 1718.9 / 5 = 343.78 m. ---------- 0.5

Length of Tangent = R x tan(ϕ/2) = 343.78 x tan(35/2)
= 108.40 m. ---------- 0.5

Chainage of first tangent point (point of curve0 = T_1
= 1580 – 108.40 = 1471.60 m ---------- 0.5

Length of curve = π x R x ϕ / 180
= π x 343.78 x 35 / 180 = 210 m. ---------- 0.5

Chainage of second Tangent point (point of tangency) T_2
= 1471.60 + 210
= 1681.60 m. ---------- 0.5

Length of curve is 210 m.
Peg interval is 30 m.
Total number of full chords of 30 m is 06. = 30 x 6 = 180 m. ---------- 0.5

Length of sub chord is 30 m.
Length of initial sub chord = 1480 – 1471.60 = 8.4 m.
Length of final sub chord = 21.6 m. ---------- 0.5

Calculation of deflection angles.

δ_n = 1718.9 x l_n / R = minutes

$\delta_1 = 1718.9 \times 8.4 / 343.78 = 0^0\ 42'\ 0''$ 03

$\delta_2, \delta_3, \delta_4, \delta_5, \delta_6, \delta_7 = 1718.9 \times 30 / 343.78 = 2^0\ 30'\ 0''$

$\delta_8 = 1718.9 \times 21.6 / 343.78 = 1^0\ 48'\ 0''$

$\Delta_1 = \delta_1$, $\Delta_2 = \Delta_1 + \delta_2$, $\Delta_3 = \Delta_2 + \delta_3$, $\Delta_4 = \Delta_3 + \delta_4$, -------- $\Delta_n = \Delta_{n-1} + \delta_n$,

Tabulated result:

Point on curve	Chainage	Length of chord	Deflection angle δ_n	Total deflection = Δ_n	Remark
T_1	1471.60	--	--	--	First tangent point
P_1	1480.00	8.4	$0^0\ 42'\ 0''$	$0^0\ 42'\ 0''$	
P_2	1510.00	30.0	$2^0\ 30'\ 0''$	$3^0\ 12'\ 0''$	
P_3	1540.00	30.0	$2^0\ 30'\ 0''$	$5^0\ 42'\ 0''$	
P_4	1570.00	30.0	$2^0\ 30'\ 0''$	$8^0\ 12'\ 0''$	
P_5	1600.00	30.0	$2^0\ 30'\ 0''$	$10^0\ 42'\ 0''$	
P_6	1630.00	30.0	$2^0\ 30'\ 0''$	$13^0\ 12'\ 0''$	
P_7	1660.00	30.0	$2^0\ 30'\ 0''$	$15^0\ 42'\ 0''$	
T_2	1681.60	21.6	$1^0\ 48'\ 0''$	$17^0\ 30'\ 0'' = \phi/2$	Second tangent point

01