MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous)

(ISO/IEC-270001 – 2005 certified)

SUMMER -13 EXAMINATION

Subject code:12082 **Model Answer** Page No: 1/24 Nos

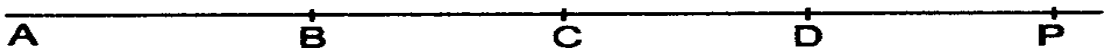
Important Instructions to examiners:

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

Q1)a)i)State the principle of plane table survey	2
Principle of plane table surveying: The principle of plane table surveying is that the rays drawn from different points should pass through a single point i.e. a position of station point. And the position of the table at any station should be the same as that at previous station, i.e. the table should be accurately oriented at all subsequent stations.	2
OR The principle of plane tabling is parallelism , meaning that the rays drawn from station to objects on the paper are parallel to the lines from the stations to the object to the ground.	2
OR All the lines drawn on the drawing are parallel to the corresponding lines on the ground if the plane	2

table is properly oriented position.	
Q1)a)ii)Define telescope inverted and swinging the telescope.	2
Telescope inverted The Telescope is said to be inverted when the vertical circle is to the right of the observer and the bubble down, **Swinging the telescope** The process of turning the telescope in horizontal plane about vertical axis is known as swinging the telescope.	1 1
Q1)a)iii)What is tachometer ?	2
Tachoemeter A tachoemeter 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. The additional hairs are equidistant from the central one and also known as stadia lines, webs, wires etc.	2
Q1)a)iv)Define 'degree of curve.'	2
Degree of the curve: The degree of the curve is the angle subtended at the center by a standard chord of 30m or 20m length.	2
Q1)a)v)State the two uses of G.P.S.	2
Uses of G.P.S.: 1. Navigation. 2. Surveying.3. Mapping. 4. Remote sensing. 5. Geographical information system. 6. Military and space.7. Agriculture. **(Note- Any four 1/2 marks each)*	*
Q1) a) vi)State any two uses of theodolite.	2
Uses of theodolite: 1. To measure horizontal angle. 2. To measure vertical angle. 3. To measure direct angle. 4. To measure Deflection angle. 5. To prolong a straight line. 6. To fix intermediate points. 7. To measure the bearing of the line. 8. To determine horizontal distance. 9. To determine vertical distance. **(Note- Any two 1 mark each)*	*
Q1)a) vii)State any two advantages of telescopic alidade.	2
Advantages of telescopic alidade:	*

1. It can be used when it is required to take inclined sights. 2. Horizontal distance can be computed by stadia readings. 3. Elevation of the point can also be computed by tachometric formula. 4. Straight rays are drawn more precisely. **(Note- Any two 1 mark each)*	
Q1)a)viii)State the four advantages of total station over transit theodolite.	2
viii) Advantages of Total station over Transit Theodolite: 1) Tri-axis compensation. 2) Easy to read. 3) Higher distance resolution. 4) No necessary of maintaining field book 5) Automatic atmospheric correction. 6) Output of field data and its interpretation is possible easily. **(Note- Any four1/2 mark each)*	*
Q1)B)i)Describe temporary adjustment of plane table	4
Temporary adjustment of Plane Table: Each step 1 mark While using the Plane Table the following operations are needed **1)Fixing :-** Fixing the table on the tripod **2)Setting up :-** Setting can be divided into two parts The table should be set up at a convenient height for working say about 1.0 m. The legs of tripod should be spread well apart and firmly fixed into the ground. **a)Centering:-** The table should so place over the station on the ground that the point plotted on the sheet corresponds the station occupied and it should be exactly over the station on the ground. The operation is known as centering of the table. It Is one by using the plumbing fork or U-frame. **b)Levelling :-** The table is leveled by placing the level on the board in two positions at right angles. **3)Orientation : -** The system of keeping the at each of the successive stations, parallel to the position which it occupied at the first station is called orientation.	1 1 1 1
Q1)b)ii)What are the checks applied in case of closed traverse ?	4
Checks Applied in case of Closed Traverse 1) Check on Angular Measurement :- a) Traverse by included angles	2 *

i) The sum of measured included angles should be equal to (2n-4) right angles ii) The sum of measured exterior angles should be equal to (2 n+4)right angles Where n is the No of sides of traverse b) Traverse by Deflection angles**: -** The algebraic sum of the deflection angles should be equal to 360^0 considering the right hand deflection angle as positive and left hand deflection angle as –ve. c) Traverse by direct observation of bearings**: -** The fore bearing of the last line should be equal to its back bearing + 180^0 measured at the initial station. **(Any two methods)* Checks on linear measurement**: -** i) Distances should measure Twice with same accuracy on different days and in opposite direction ii) Sum of northing should equal to sum of southing and sum of easting should equal to sum westing	2
Q1)b)iii)Give procedure for prolonging a straight line by theodolite .	4
Procedure for prolonging a straight line:- There are three methods of prolonging a straight line.  **Fig. (a)** Suppose it is required to prolong a line AB up to the point P. 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**	*

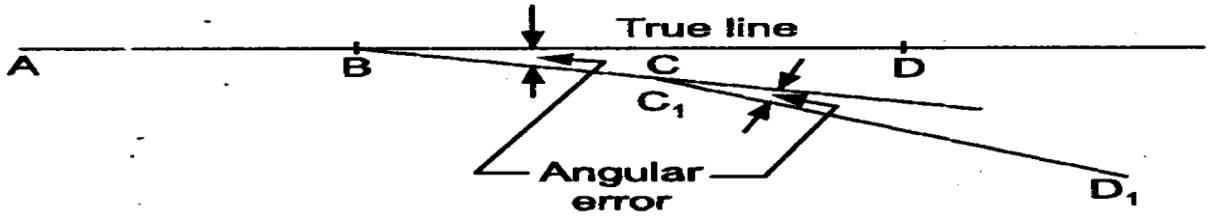


Fig. (b)

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 backsight 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 C_1 will be established and angular error caused. The false line of prolongation will be established.

OR

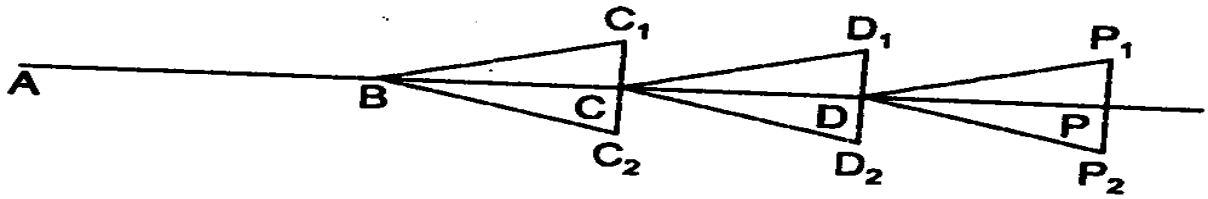


Fig. (c)

This method is known as double sighting method and is used when the line is to be prolong 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.

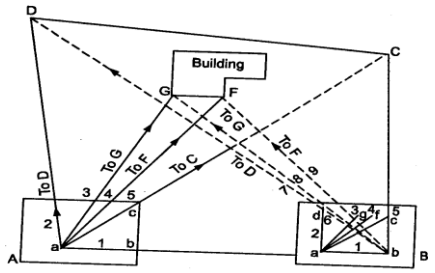
1) Setup the theodolite over B levels it carefully.

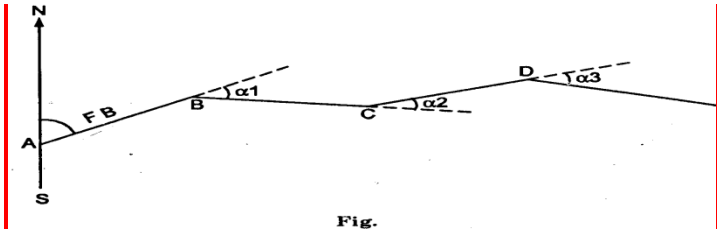
2) Bisect A exactly by using the lower clamp and tangent screw.

3) Transit the telescope & it established point C on the line AB produced.

4) Loosen 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 C_2 in line AB beside the point C, as shown in figure.

6) Measure the distance C_1, 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. * (*Note- Sketch 2 mark and explanation 2)*	
Q2)a)Explain the method of intersection of plane table survey with neat sketch .	4
This method is largely used for i) Mapping details ii) For Locating the distinct and inaccessible points, broken boundaries, bank of rivers, edges of woods and for plotting the positions of points to be used subsequently as the instrument station  Fig. Procedure:- 1) Layout a base line AB and Measure it. 2) Plot the distance ab on the using convenient scale. 3) Set out the instrument at A with over 'a' over station A 4) Orient the table by replacing alidade along ab and turn the table, until the ranging rod at b is bisected clamp the table. 5) With the alidade touching point 'a' draw rays 1,2,3,4 and 5 of indefinite length as shown in fig. 6) The table is then moved to station B, oriented it be back sighting on A that is keeping the alidade along 'ba' until ranging rod A is bisected. Through 'b' draw rays towards 7) The point previously sighted line 6,7,8,and 9 drawn to determine the points on intersection d, g, and c *(Note- Sketch 2 mark and explanation 2 mark)*	*
Q2)b)Enlist the situations where plane table survey is used .	4
1) For small scale mapping 2) Where field work and plotting both activities require to carry out simultaneously 3) Where compass survey is not possible due to presence of magnetic materials in field	*

4) Where no great skill is required to prepare a satisfactory map. **(Any such four situation, 1 mark each)*	
Q2)c)Describe the procedure for measurement of deflection angle by theodolite .	4
A deflection angle is the angle which a survey line makes with the prolongation of the preceding line. In the above fig. α_1, α_2, α_3, are deflection angles. Survey line BC makes an angle with the prolongation of preceding survey line AB, similarly α_2, α_3 etc. are deflection angles. Deflection angle=180^0- included angle. i.e. $\alpha_1 = 180^0$x Angle ABC or $\alpha_2 = 180^0$x Angle BCD and so on.  Fig. The deflection angle may vary from 0^0 to 180^0 but never greater than 180^0 Deflection angle measured clockwise from the prolonged survey line is known as right, deflection angle and that measure anticlockwise from the prolonged survey line is known as left deflection angle. Thus, in figure the deflection angle at B is α_1 R and that at C is α_2 L. To Measure the deflection angle the following procedure are followed 1) Set up the theodolite at B and level it accurately. 2) With both plates clamped, the vernier A reading 360^0, Take back sight on A. 3) Plunge the telescope to direct the line of sight AB produced. 4) Loosen the upper [plate and turn the telescope clockwise to take foresight on C. Read both vernier the mean of two vernier readings gives the approximate value of deflection angle at B (α_1) 5) Loosen the lower clamp turn the telescope horizontally to back sight on A. the vernier will read same reading as in step in 4 6) Plunge the telescope. unclamp the plate and again bisect C read both vernier. 7) Find the mean of final vernier readings. Thus the deflection angle is double and hence , ½ of this average value gives the accurate value of deflection angle at B. **(Note-1 mark fig,3 marks for procedure)*	*

Q2)d)State the sources of errors in theodolite .	4
1) Instrumental Error i) Error due to in imperfect adjustment of plate level ii) Error due to line of collimination not being perpendicular to the horizontal axis. iii) Error due to horizontal axis not being perpendicular to vertical axis. iv) Error due to non-parallelism of the axis of telescope level and the line of collimination. v) Error due to eccentricity of inner and outer axis. Vi) Error due to eccentricity of vernier vii) Errors of graduations *(Note-Any four of above)* **2) Personal Errors** i) Errors in manipulation ii) Errors in sighting and readings **3) Natural Errors** i) Settlement of tripod ii) Unequal refraction iii) Unequal expansion of parts of the telescope. iv)Wind producing vibrations. *(Note-Any two of the above)*	2 1 1
Q2)e)Can theodolite be used as dumpy level ? If yes explain how it is possible. Which fundamental relation must fulfill the same?	4
Yes, a theodolite can be used as a dumpy level for determining the elevations of various points in the field. The process is as follows 1) Set up the theodolite anywhere and center the plate bubble. 2) Make the reading on vertical circle 0-0 3) Clamp the telescope. With the help of the vertical tangent screw make the reading on vertical exactly 0-0 4) Check that the altitude bubble is central. 5) Keep the staff on the point whose elevation is to be found. Direct the telescope towards the staff by loosening the lower clamping screw.	1 2

6) The reading on the staff corresponding to the cross wire is recorded.

The fundamental relation: - The axis of bubble tube must be perpendicular to vertical axis. 1

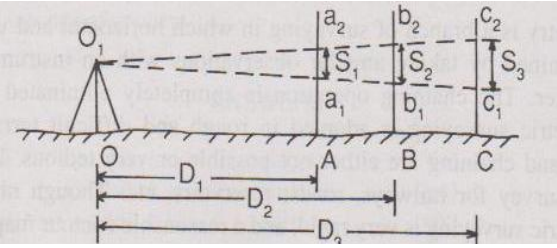
Q2)f)Distinguish between consecutive co-ordinates and independent co-ordinates 4

Sr. No.	Consecutive co ordinates	Independent Co ordinates
1	The coordinates of any point when measured with respect to previous point are called as Consecutive Co ordinates	The coordinates of any point when measured with respect to common origin are called as Independent Co ordinates
2	This method of coordinates is having error.	This method of coordinates is better than consecutive ordinates
3	By using this coordinates the traverse is plotted with respect to previous point	By using this coordinates the traverse is plotted with respect to parallel and perpendicular to meridian.
4	Coordinates of any point may not be obtained by adding algebraically latitude and departure of the line.	Coordinates of any point may be obtained by adding algebraically latitude and departure of the line.

**(Note-Any four such difference 1 mark each)* *

Q3)a)Explain the principle of stadia method . 4

The principal of stadia method i.e. .tachometer is based on the property of isosceles triangles, where the ratio of distance of the base from the apex and the length of the base is always constant. OR The stadia method is based on the principle that the ratio of the perpendicular to the base is constant in similar isosceles triangle 2



2

Q3)b)List any for essential characteristics of tachometer. 4

Following are the essential characteristics of a tachometer 1.The value of the constant f/I should be 100 2. The telescope should be fitted with an analytical lens. 3. The telescope should be powerful, the magnification being 20 to 30 diameters. 4 The aperture of the objective should be 35 to 45mm in diameter in order to have a sufficiently bright image. 5. The magnifying power of the eyepiece should be greater to render staff graduations clearer at a long distance. **(Note-any four ,1 mark each)*	*
Q3)c)State the data required for curve setting.	4
Following data is required for setting out a curve 1.Chainage of point of intersection 2 Angle of intersection/ Deflection angle 3. Tangent lengths. 4. Chain age of first tangent point 5. Length of curve 6. Chain age of last tangent point *(Any four)* **By offsets from long chord** 7. Length of long chord 8. Mid-point of long chord 9. Mid ordinate height i. e. versed sine of the curve. 10 Ordinates height at equal peg interval OR **By Rankin's method** 7. Length of first initial sub chord 8. Length of unit chord/ full chords & number of chords 9. Length of last sub chord. 10. Deflection angles for first initial sub chord, full or unit chord & last sub chord	2 2
Q3)d)Describe the method of setting out simple curve by using the method of offset from long chord with sketch.	4

Field procedure to set out a curve by using the method of offset from long chord.

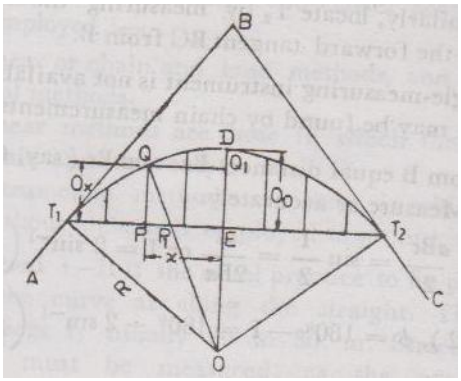


Fig from K & K

1 Fix the directions of tangents & produce them so as to meet at the point of intersection B

2 Set up theodolite at the point of intersection B & measure the angle of intersection & find deflection angle

3 Calculate tangent lengths by formula Rtan0/2

4 Locate T1 by measuring the tangent lengths backward along the rear tangent AB from the point of intersection B.

5 Similarly locate T2 by measuring the same distance forward along the forward tangent BC from B.

6 To set out curve , divide the long chord into an even number of equal parts

7 Set out the offsets as calculated by formula $O_x = (R^2-x^2)^{(1/2)-} (R-O_0)$

8 Since the curve is symmetrical along ED, offset for right half will be same.

**(Note-Fig 1 and procedure 3 marks)*

Q3)e)The following are the interior angles of closed traverse . 4

<A= $87^0 50'20''$

<B=$114^0 55'50''$

<C=$94^0 38'50''$

<D=$129^0 40'40''$

<E=$112^0 54'20''$

If the observed bearing of AB = $221^0 18'40''$

Calculate bearings of the remaining sides.

Sol: Fore bearing of AB =$221^0 18'40''$

Add angle B =$114^0 55'50''$

$=336^0 14'30'' > 180^0$ Deduct $=180^0$ Fore bearing of BC $=156^0 14'30''$ Add angle C $=94^0 38'50''$ $=250^0 53'20'' > 180^0$ Deduct $=180^0$ Fore bearing of CD $=70^0 53'20''$ Add angle D= $129^0 40'40''$ $=2000^0 34;0'' > 180^0$ Deduct $=180^0$ Fore bearing of DE $=20^0 34'0''$ Add angel É$=112^0 54'30''$ Fore bearing of EA $=133^0 28'20''$ Check Add angle A$=87^0 50'20''$ Fore bearing of AB $=221^0 18'40''$	1 1 1 1
Q3)f)The following deflection angles were measured in running a traverse from A to G AT station B 23^0 47' R C 18^0 19' L D 37^0 20' R E 15^0 35' R F 10^0 12' L The truth bearing of AB is $62^0 18'$.Calculate the truth bearing of remaining sides.	4
Sol: Fore bearing of AB$=62^0 18'$ Add Angle $\delta_B = 23^0\ 47'$ Fore bearing of BC$=86^0 5'0''$ Deduct angle $\delta C = 18^0\ 19'$ Fore bearing of CD$=67^0 46'0''$ Add Angle $\delta D = 37^0 20'$ Fore bearing of DE$=105^0 6'0''$ Add Angle $\delta E = 15^0 35''$ Fore bearing of EF$=120^0 41'$	*

Deduct Angle $\underline{\delta F=10^0 12'}$

Fore bearing of $FG=110^0 29'$

**(Note-Any four correct bearing 1 mark each)*

Q4)a)Find the corrected consecutive co-ordinates applying Bowditch's rule for traverse PQRSSTP from following data, given below — 8

Line	Length(meter)	Consecutive co-ordinates	
		Latitude	Departure
PQ	70	+21.5	-65.450
QR	80	-80.755	-5.250
RS	43	-41.0	+13.550
ST	38	-14.250	+35.150
TP	115	+114.150	+22.315

Sol: Bowditch's rule-Correction to latitude or departure of any side

= total error in latitude or departure x $(\frac{\text{length of that side}}{peremeter\ of\ traverse})$

Total error in latitude =+21.5-80.755-41.0-14.250+114.150 = - 0.355

Total error in departure= -65.450-5.250+13.550+35.150+22.315 = + 0.315

Perimeter of traverse=length of PQ + length of QR + length of RS + length of ST + length of TP

=70+80+43+38+115 =346 — 1

Correction in latitude of PQ= total error in latitude of PQ x $(\frac{\text{length of PQ}}{peremeter\ of\ traverse})$

=- 0.355 x 70/346 =+0.0718

QR=-0.355 x 80/346 = -0.0821

RS=-0.355 x 43/346 = -0.0441

ST=-0.355 x 38/346 = -0.0390

TP=-0.355 x 115/346 = +0.118 — 2

Correction in departure of PQ= total error in departure of PQ x $(\frac{\text{length of PQ}}{peremeter\ of\ traverse})$

=- 0.315 x 70/346= -0.0647

QR=-0.315 x 80/346 = -0.0740

RS=-0.315 x 43/346 = +0.03998

ST=-0.315 x 38/346 = +0.0351

TP=-0.315 x 115/346 = +0.1064 — 2

Since total error in latitude is negative therefore **add** northing (i.e.+ ve) correction and **subtract** southing (i.e.- ve) correction of respective line to find corrected latitude.

Since total error in departure is positive therefore **subtract** easting (i.e.+ ve) correction and **add** wasting (i.e.- ve) correction of respective line to find corrected departure..

Therefore corrected consecutive co-ordinates of are

Corrected latitude=

For PQ=+21.5+0.0718=+21.5718

For QR = -80.755-0.0821=-80.6729

For RS = -41.0-0.0441 = - 40.9559

For ST = -14.250-0.0390=-14.2110

For TP =+114.150+0.118=+114.2680

Corrected departures=

For PQ = -65.450-0.0647= -65.5147

For QR = -5.250-0.0821= -5.3240

For RS = +13.550-0.0441 = +13.5102

For ST = +35.150-0.0390= +35.1149

For TP =+22.315+0.118= +22.2086 — 3

Line	Consecutive co-ordinates		Corrections		Corrected e co-ordinates	
	Latitude	Departure	Latitude	Departure	Latitude	Departure
PQ	+21.5	-65.450	+0.0718	-0.0647	+21.5718	-65.5147
QR	-80.755	-5.250	-0.0821	-0.0740	-80.6729	-5.3240
RS	-41.0	+13.550	-0.0441	+0.0398	-40.9559	+13.5102
ST	-14.250	+35.150	-0.0390	+0.0351	-14.2110	+35.1149
TP	+114.150	+22.315	+0.1180	+0.1064	+114.2680	+22.2086

Q4)b)Calculate the ordinates at every 12m interval to set out a simple circular curve having long chord of 120m and radios 200m.Illustrate your answer with neat sketch. — 8

Sol: Ordinate at the middle of the long chord=versed sine — *

$= O_0 = R - \sqrt{R2 - (\frac{l}{2})2}$

Now R=200m,L=120m

$= O_{0\,=\,200} - \sqrt{200^2 - 60^2}$ =9.212m

The various ordinates may be calculated,

By Exact Formula $O_x = \sqrt{R^2 - x^2} - \sqrt{R^2 - (\frac{l}{2})^2}$

The distance x being measured from the midpoint of the long chord.

$O_{12} = \sqrt{200^2 - 12^2} - \sqrt{200^2 - (60)^2}$ =8.852m

$O_{24} = \sqrt{200^2 - 24^2} - \sqrt{200^2 - (60)^2}$ =7.767m

$O_{36} = \sqrt{200^2 - 36^2} - \sqrt{200^2 - (60)^2}$ =5.945m

$O_{48} = \sqrt{200^2 - 48^2} - \sqrt{200^2 - (60)^2}$ =3.3668m

$O_{60} = \sqrt{200^2 - 60^2} - \sqrt{200^2 - (60)^2}$ =0m

The ordinates for the other half of the curve are the same as above.

OR

By approximate formula $O_x = \frac{x(L-x)}{2R}$

Where x is the distance of the point measured from either end of the long chord.

The ordinates are;

$O_{12} = \frac{12(120-12)}{2\ x\ 200}$ = 3.24m

$O_{24} = \frac{24(120-24)}{2\ x\ 200}$ =5.76m

$O_{36} = \frac{36(120-36)}{2\ x\ 200}$ =7.56

$O_{48} = \frac{48(120-48)}{2\ x\ 200}$ =8.64

$O_{60} = \frac{60(120-60)}{2\ x\ 200}$ =9

O_{72}=8.64,O_{84}=7.56,O_{96}=5.76,O_{108}=3.24 O_{120}=0

**(Note- correct value of* $O_{0\,2}$ *marks,* O_x *formula 1mark,each offset value 1mark)*

Q4)c)A tachometer was set up at a station A and the following readings were obtained on vertically held staff — 8

Station	Staff	Vertical angle	Hair reading(m)
A	Bm	$+6^0 30'$	0.900,1.160,1.420
A	B	$-2^0 20'$	1.140,1.235,1.330

The constants of the instruments were 100 and 0.1 find the horizontal distance. AB and RL of B if RL Bm is 300.00 m

The horizontal distance to the staff station , and vertical distance of the axial reading above or the below the instrument axis may be obtained by — *

$D = \frac{f}{i} \times S x cos^2\ \theta + (f + d)\ cos\ \theta$

And $v = D \tan \theta$

$\frac{f}{i} = 100$ and $f+d=0.1$

First observation:-

$S_1 = 1.42 - 0.900 = 0.52$, $\theta_1 = +6^0 30'$

Therefore $D = 100 \times 0.52 \times \cos 6^0 30' \times \cos 6^0 30' + 0.1 \times \cos 6^0 30' = 51.433$m

$V_1 = 51.433 \times \tan 6^0 30' = 5.860$m

Second observation:-

$S_2 = 1.33 - 1.14 = 0.19$, $\theta_2 = -2^0 20'$

Therefore horizontal distance AB is $D = 100 \times 0.19 \times \cos 2^0 20' \times \cos 2^0 20' + 0.1 \times \cos 2^0 20' = 19.068$m

$V_2 = 19.068 \times \tan 2^0 20' = 0.7766$m

Now RL of instrumental axis = RL of bench mark + backsight $- v_1$

$= 300 + 1.160 - 5.860 = 295.3$m

Therefore RL of B= RL of instrumental axis $- v_2$ – forsight

$= 295.3 - 0.7766 - 1.235 = 293.2884$m

Ans 1) Therefore horizontal distance AB = 19.068

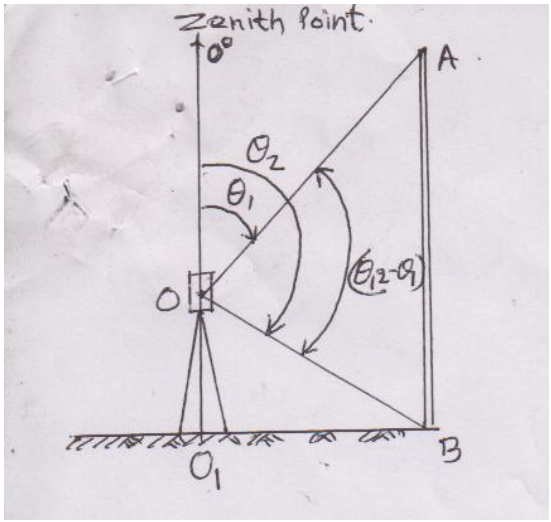
2) RL of B = 293.2884 m

**(Note-2 marks for 2 formula and 3 marks for corrected distance,3 marks for correct RL)*

Q . 5. a)Explain the procedure for measuring vertical angle by using electronic theodolite. — 4

In electronic theodolites, absolute angle measurement is provided by a dynamic system with opto-electronic scanning. The electronic theodolites are provided with control panels with — *

key boards and liquid crystal displays. The key board contains multi-function keys. Fig.



Procedure : Let us to measure vertical angle AOB

1) Set up the electronic Theodolite at station O1 and carryout all temporary adjustment i.e. centering , leveling , focusing etc.
2) Switch on the instrument and activate angle measurement mode.
3) Bisect object A and Read the vertical angle with respect to zenith point say θ1,record it by pressing Rec. key .
4) Bisect object B and read the vertical angle with respect to zenith point say θ2 record it by pressing Rec. key

Required vertical angle AOB = θ2-θ1, record it by pressing Rec. key

**(Note-Sketch 1 mark, procedure 3 marks)*

Q . 5.b) What are the features of total station	4
1) Angle Measurement: An electronic theodolite of a total station is used to measure the angles and record it 2) Distance Measurement: Total station generally measures a slope distance, and the microprocessor uses the vertical angle recorded by the theodolite along the line of sight to calculate the horizontal distance. 3) Control Panel:Total station is activated through its control panel. It consists of key board with multifunction keys and multiple line liquid crystal display. Some of the total station has	*

two control panels one on each face of it for easier use. The keyboard enables the user to select and implement different measurement modes, changes in instrument parameters and allow special software functions. The data can be processed much more quickly by downloading it into appropriate softwares. 4) Power supply: Rechargeable nickel-cadmium batteries are used for power supply. The uses time 2 to 10 hours. Some instrument are provided with auto power save features 5) Accessories: i) Track light or lumi- guide: It is visible light which enable a pole mounted prism to be set directly on the line of sight. The device flashes three colour light for line of sight i.e. prism to left –green, right-red, correct –white. ii) Geotropic Unicom: It is communication system which allows speech to be transmitted from the instrument to prism with help of small micro-phone on control panel and receiver small loudspeaker mounted on the prism pole. iii)Reflector and Retro reflector : Special form of Corner cube prism mounted on pole used as a target 5) Onboard software's; In addition to controlling the angles and distance functions of total station, the microprocessor is also programmed to perform calculations of reduced levels, coordinates measurements, Traverse measurements, Resection, remote elevation measurement, Setting out functions, electronic data recording and internal memories about 1000 points. **(Note-Any four points one mark each)*	
Q5)c) Give the application of remote sensing with respect of the natural hazards and that of archeology	4
Natural Hazards: Earth quake , landslides, volcanic eruptions and floods are the natural hazards that causes losses both material as well as human. Remote sensing can by no mean prevent any of these hazards, but it can definitely minimize the damage in the following ways *(Any two)* i) By analyzing the geological formation of the area, there by identifying the risk-prone areas ii) By providing specific warning of certain natural hazards e.g. volcanic eruption in Hawai have been successfully predicted on the basis of the ground movements revealed by remote sensing techniques iii) Assess the damage caused and thereby help in the rescue and aid operations	2

Archaeology; Archaeological pattern of prehistoric land use may be recognized in remote sensing images. Many roads and towns of the old rea are now covered by agricultural field. But due to change in moisture content and other characteristics of the underlying old objects and the upper new layers, remote sensors are able to recognize the buried archaeologically important sites.	2
Q5)d) Compare Aerial Photograph with map.	4

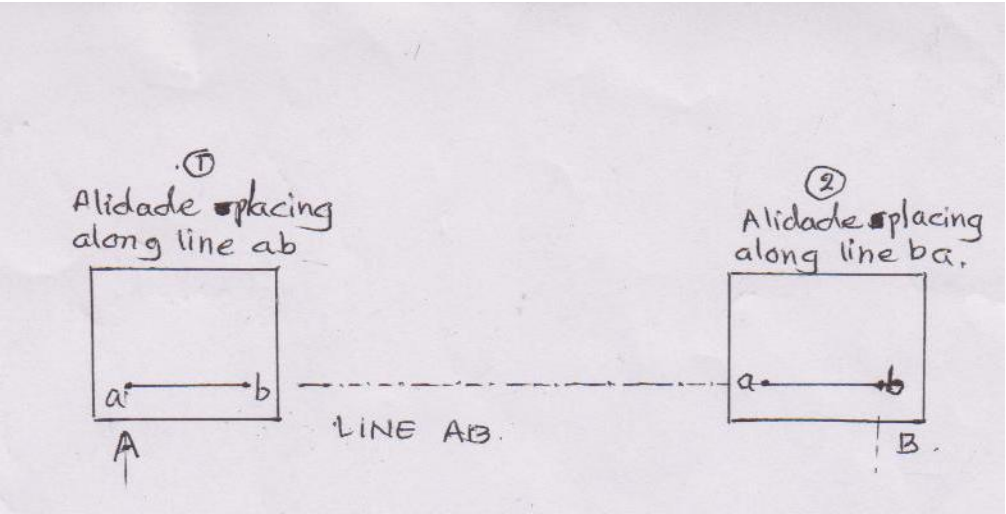
Aerial Photograph	Map	
1. Aerial photograph is a central projection i.e.perspective projection	1.Map is an orthgonalprojection	1
2. On aerial photograph scale varies from point to point	2.On map scale is constant	1
3. In an aerial photograph much more details are there	3.The amount of details on map are selective	1
4. The clarity of details is less on aerial photograph	4.The clarity of details is more in map.	1

Q5)e)The stadia hair reading at distance 150m from the instrument having additive constant 40cm are 1.230,1.580,1.980 respectively. Calculate the value of multiplying constant of the instrument.	4
Horizontal distance = $\frac{f}{i}$ s $\cos^2\theta$ + (f+c) cos θ Θ = 0^o (Assuming line of sight horizontal) Additive Constant = o.40 m(Given) Staff intercept (s) = 1.98-1.23 = 0.75 150= $\frac{f}{i}$ (0.75) (1) + 0.40(1) Multiplying Constant = $\frac{f}{i}$ = 199.46 … (ANS) **(Note- Horizontal distance formula one mark , calculation one mark and answer two marks)*	*
Q5)f) Explain any one method of orientation of plane table.	4
Orientation by Trough compass: The trough compass is placed on the top right corner of	*

the plane table in such a way that the magnetic needle points exactly towards the N-S direction. Draw this line along the edge of the compass. Shift and set up the plane table on the next station .Place the trough compass along the N-S line . Rotate the table till the magnetic needle coincides with N-S line drawn previously. This is a crude method of orientation and can not be employed at station where local attraction is suspecte

OR

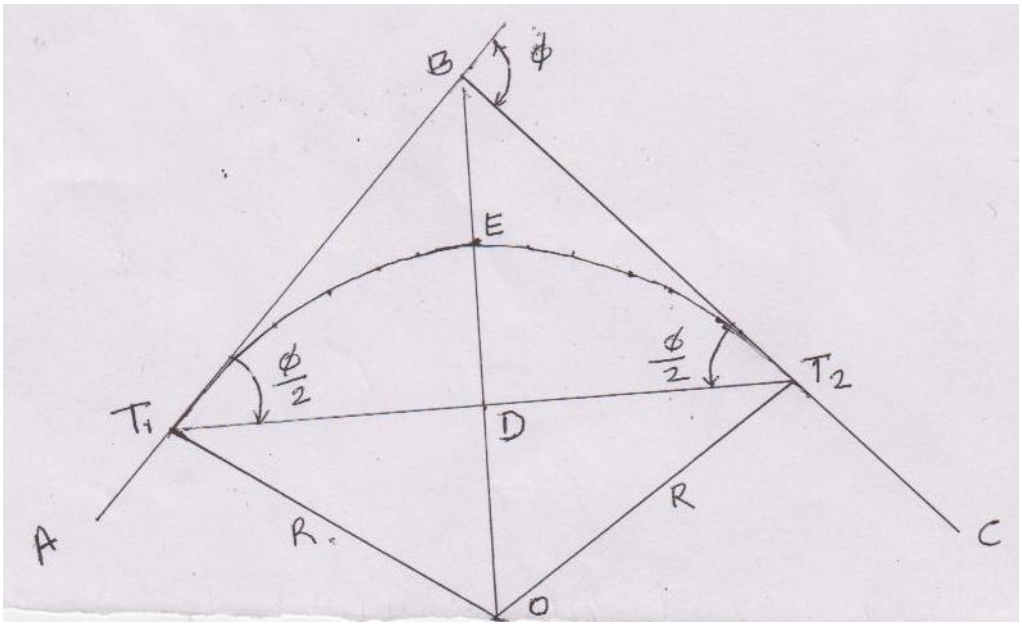
Orientation by back sighting: This is most accurate method of orientation .The plane table is set on new station and the alidade is placed against the line joining new station with the preceding station. The table is rotated until the line of sight bisect the previous station . Fig.



To achieve this , let the plane table be shifted from station A to B (fig) and let the line ab has been plotted with the plane table at A . Set up the plane table on B , Place the alidade along the plotted line ba and rotate the table until the line of sight bisect the station A. clamp the board .The line ba truly represents the line BA on the ground.

**(Note-Any one - description with or without sketch 4 marks)*

Q. 6 a) State the classification of Electronic Distance Meter	4
1.Depending upon the type of carrier wave employed , EDM instruments can be classified as i) Microwave EDM ii)Visible light EDM iii)Infrared EDM	2

2) Depending upon the range , EDM instrument can be classified as i) Short range (less than 3 km) ii)Medium range(less than 25 km) iii) Long range (less than 100 km)	2
Q6) b) Enlist the parts of Aerial Surveying	4
Parts or general procedure of an aerial surveying are as follows i)Ground control ii)Flight planning and photography iii)Photo -interpretation and stereoscopy iv) Construction of map and cartography	 1 1 1 1
Q6)c) What is simple curve ? Describe with neat sketch the notations used in simple circular curve.	4
A curve connecting two intersecting straights having a constant radius all through is known as simple circular curve. OR A curve consist of a single arc with constant radius connecting the two tangents known as simple circular curve. Notations used in simple circular curve are as follows and shown in figure  1.AB and BC are known as the tangent to the curve 2) B is known as the point of intersection or vertex 3) The angle Ø is known as the angle of deflection 4) The angle I is called the angle of intersection	*

5)Point T1 and T2 are known as tangent points

6)Distances BT1 and BT2 are known as tangent lengths

7When the curve deflect to the right , it is called right hand curve, when it is deflect to the left ,it is said to be left hand curve

8)AB is called rear tangent and BC the forward tangent

9)The straight line T1DT2 is known as long chord.

10)The curved line T1ET2 is said to be the length of the curve.

11) The mid point E of the curve T1ET2 is known as the apex or summit of the curve .

12)The distance BE is known as the apex distance or external distance.

13) the distance DE is called the versed sine of the curve

14) R is the radius of the curve.

15) ∠ T1OT2 is equal to the angle Ø

16) The point T1 is known as the beginning of the curve or the point of curve

17)The end of the curve (T2)is known as the point of tangency.

**(Note- sketch 2 marks, any four notation ½ mark each)*

Q6)d) The following are the lengths and bearing of the sides of closed traverse ABCDA — 4

Line	Length(m)	Bearing
AB	76.80	140o 12’
BC	195.60	36o 24’
CD	37.20	338o 48’
DA	?	?

Compute the length and bearing of line DA

From the given length and bearings of the lines AB,BC,CD.and DA the corresponding latitudes and departures are calculated and result are tabulated as under — *

Let the unknown latitude and departure of line DA be lcosθ1 and lsinθ1 respectively

Line	Length(m)	W.C.B.	R.B.	Latitude	Departure
AB	76.80	140^o 12’	$S39^0$ 48’E	- 59.00	+ 49.16
BC	195.60	36^o 24’	$N36^o$ 24’E	+ 157.44	+115.72
CD	37.20	338^o 48’	$N21^0$ 12’W	+ 34.68	- 13.45
DA	?	?	?		

	∑133.12	∑151.43

As Condition for closed traverse ∑L =0 and ∑ = 0

There fore ∑ L + lcosθ1=0 and ∑ D + lsinθ1=0

Latitude of line DA = -133.12m and Departure of line DA = -151.43

Since the latitude is –ve and departure is –ve line DA lies in third quadrant.

Tanθ= $\frac{151.43}{133.12}$ = 1.137 θ = 48.68 ^{0} = 48^{0}40’54.29’’

ANS W.C.B.of line DA = 48^{0}40’54.29’’+ 180 ^{0} = 228^0 40’ 54.2’’

ANS Length of line DA = 201.62m and

**(Note-Length 1 mark W.C.B.1 mark, calculations 2 marks)*

Q6)e)Find the length and bearing of a line PQ the co-ordinates of two points P and Q are given as — 4

	Co-ordinates
P	970.50 , 850.40
Q	1200.40,602.20

solution: Let l be the length of the line PQ and θ be the reduced bearing of the line PQ. *

The difference between North coordinates of P and Q

=Latitude of PQ= 1200.40-970.50 = 229.90Type equation here.

The difference between east coordinates of p and Q

= Departure of PQ = 602.20-850.40= - 248.20

tan θ =$\frac{departure}{latitude}$ = $\frac{248.2}{229.9}$ = 1.079 θ = 47.19 ^{0} = 47^0 11’ 31.24’’

Since the latitude is +ve and departure is –ve the line lies in fourth quadrant (N-W)

Reduced bearing of line PQ = N 47^0 11’ 31.24’’ W

Whole circle bearing of line PQ = 360^0-47^0 11’ 31.24’’ =312^0 48’28.7’’

Length of line PQ =$\sqrt{(L)^2 + (D)^2}$ = $\sqrt{229.9^2 + 248.2^2}$ = 338.31m ANS

**(Note-Length 1 mark, bearing 1 mark, calculations 2 marks)*

Q6)f)Explain construction of one Second Micro Optic Theodolite. — 4

These are also known as optical or glass arc theodolite. In this the graduated brass or silver circles are replaced by graduated glass circles. The graduations are photographically etched on a glass disc. A system of prisms and lenses is used by means of which an image of graduations, near the point at which they are being read, is reflected into the microscope. The eye piece of the microscope lies near the eye *

piece of the telescope. The observer can thus simultaneously see the object as well as the reading without changing his position from the end of the telescope to the side of the instrument.

Special precautions in design and construction are that the center of graduations and the axis of rotations are in coincidence. A much finer image of graduations, accomplished by a much brighter field of view ,is obtained by this arrangement.

Large size theodolite are so designed that the optical micrometer or the reading device gives directly a reading which is the mean of the reading on the opposite ends of a diameter, thus eliminating any error which might otherwise arise from non-coincidence of the center of graduations and the axes of rotation of the instrument. In smaller instrument this arrangement is possible and reading is from one end of diameter only.

When a theodolite is fitted with a glass circle, ray of light generally pass through the glass of the circle, and are then reflected by prisms or mirrors to the micrometer. Hence, means must be provided for reflecting ordinary sunlight into the interior and then through the circle and micrometers. Sometimes, electric illuminates provided by dry batteries is usually fitted to supplement natural illumination.

A device called automatic vertical index, similar to the compensator in an automatic level is built into the standard containing the vertical circle. Many optical theodolites do not have a lower plate clamp and tangent screw. These have the facility for altering the position of the horizontal circle within the instrument and this can be achieved using a horizontal circle setting screw or by use of a repetition clamp.

The horizontal and vertical circles are both graduated to 1''. The microscope scale facilitates the reading of graduations.

The optical theodolites are equipped with optical plummet for accurate centering. It consists of a small eyepiece built into the tribrach. Or the alidade of the theodolite. A prism placed at 45o, deviate the ray from the ground station just below the instruments vertical axis by 90o so as to view it through the eyepiece.

**(Note-1 mark for each component information)*