(186) 27-11-23 Scheme of Valuation 24 Nov 23

Revision : 2015 Course Code : TED(15) - 2011

Course Title : Surveying I

Qst No.	Scoring Indicator	Split up Score	Sub Total	Total
I 1.	Plane surveying is that type of surveying in which mean surface of the earth is considered as a plane & the spheroidal shape is neglected	1	2	
	Geodetic surveying is that type of surveying in which shape of the earth is taken to account. All lines lying in the surface are curved lines & the triangles are spherical triangles.	1		
I 2	True meridian through a point is the line in which a plane passing that point & the true north & south poles intersects with surface of the earth.	1		2
	Magnetic meridian through a point is the direction shown by a freely floating & balanced magnetic needle free from all other attractive forces.	1		
I 3.	Level surface is defined as a curved surface which at each point is perpendicular to direction of gravity at that point. (or)	2	2	

Any surface parallel to mean spheroidal surface of the earth is level surface.

I(4) Vertical distance between any two consecutive contours is called contour interval. 1 2

Horizontal distance between two points on two consecutive contours is known as horizontal equivalent. 1

I(5) Principal lines in a dumpy level are

i) Line of sight joining the centre of objective to the intersection of cross hair 2 2

ii) Axis of level tube

iii) Vertical axis

II 1. Fundamental Principles of surveying.

a) Location of a point by measurement from two points of reference.

The relative position of points to be surveyed should be located by measurement from atleast two points of reference, the positions of which have already been fixed. 5

Let P & Q be the reference point on ground. The distance PQ can be measured

accurately & the relative positions of P & Q can be plotted on sheet to some scale. The points P & Q will serve as reference point for fixing relative position of other points. Any other point R can be located by any of following methods

i) Distance PR & QR can be measured & point R can be plotted by swinging 2 arcs to some scale to which PQ is plotted.

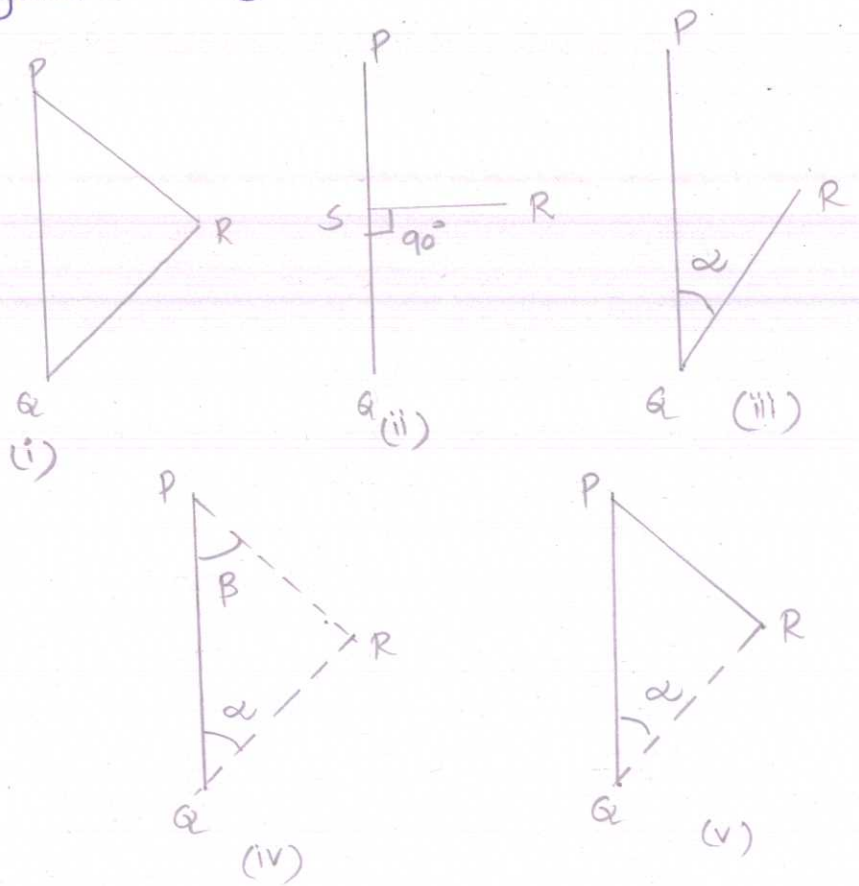
ii) A perpendicular RS can be dropped on reference line PQ & lengths PS & SR measured. The point R can be plotted using set square.

iii) The distance QR & angle PQR can be measured & point R is plotted by means of protractor or trigonometrically

iv) Angle RPQ & angle RQP are measured. Knowing distance PQ, point R is plotted by protractor or by solution of ΔPQR

v) Angle RQP & distance PR are measured & R is plotted either by protracting an

angle ψ swinging an arc from P or plotted trigonometrically.



b) Working from whole to part.

It is very essential to establish first a system of control point ψ to fix them with higher precision. Minor control points are then be established by less precise methods ψ the details can then be located by using these minor control points by running minor traverse. The idea of working this way is to prevent accumulation of errors ψ to control ψ localise minor errors.

1 6

II(2) With 20 m chain

$L' = 20 + 0.1 = 20.1\ m$

$l = l'\left(\frac{L'}{L}\right) = 1200 \times \frac{20.1}{20} = 1206\ m$ 2

= True length of line

With 25m chain 1

$l = \left(\frac{L'}{L}\right) l'$

$1206 = \left(\frac{L'}{25}\right) 1212$ 2

$L' = \frac{1206 \times 25}{1212} = 24.88\ m$

Thus 25m chain was 12 cm too short 1 6

II(3)- The angle which the magnetic lines of force makes with the surface of earth is called angle of dip or dip of the needle. 3

-(or) The inclination of the magnetic needle to the horizontal is called magnetic dip.

- Magnetic declination at a place is the horizontal angle between true meridian & magnetic meridian shown by the needle at the time of observation. If the magnetic meridian is to the right side (or eastern side) of true meridian 3

declination is said to be eastern or positive. If it is to the left side (or western side) the declination is said to be western or negative. 6

II(4) i) RB = W.C.B = $22°30'$ = N $22°30'$ E 1½

ii) RB = $180° - WCB = 180° - 170°12' = S\ 9°48'$ E 1½

iii) RB = $W.CB - 180° = 211°54' - 180° = S\ 31°54'$ W 1½

iv) RB = $360° - WCB = 360° - 327°24' = N\ 32°36'$ W 1½ 6

II(5) (i) Correction for curvature = $0.07849\ d^2$ metres

(where d is in km)

$= 0.07849 \times (1.2)^2$

$= 0.113$ m

Correction for refraction = $\frac{1}{7} C_c$

$= \frac{1}{7} \times 0.113 = 0.016$ m

(ii) Correction for curvature = $0.07849\ (2.48)^2$

$= 0.483$ m

Correction for refraction = $\frac{1}{7} C_c = 0.069$ m

II(6) (i) Height of Instrument (H.I)

It is the elevation of line of sight with respect to assumed datum. 2

(ii) Back Sight (B.S)

It is the sight taken on a rod held at a point of known elevation, to ascertain the amount by which the line of sight is above that point & thus to obtain the height of instrument.

$$HI = R_L + BS$$

2

(iii) Fore Sight (F.S)

It is the sight taken on a rod held at a point of unknown elevation, to ascertain the amount by which the point is below the line of sight & thus to obtain the elevation of station.

$$R_L = HI - FS$$

2 6

II(7) Uses of Contours

1) By inspection of a contour map information regarding character of the tract of the country is obtained whether it is flat, undulating or mountainous. etc.

2) Selection of suitable site

The most suitable site for various engineering works such as a reservoir, canal, sewer, road or railway may be selected.

3) Earth work.

The quantities of earthwork may be computed

from contour maps.

4) Area of drainage basin

Contours may be used to determine the area of drainage basin & capacity of reservoir.

5) Intervisibility between two points.

The contour map can be used to determine intervisibility between two points on surface.

6) Location of route.

A contour map is extremely useful for locating the route of a highway, railway, canal or sewer line at a given gradient & is known as tracing of contour gradient.

7) Military operations can be planned with the help of contour maps

6 for any 6 pts

6

III(a) The survey stations should be selected that a good system of lines is obtained fulfilling the following conditions.

1) Survey stations must be mutually visible

2) Survey lines must be as few as possible so that the frame work can be plotted conveniently

3) The frame work must have one or two base lines. If one base line is used it must

run along the length & through the middle of the area. If 2 baselines are used, they must intersect in the form of letter X.

4) The lines must run through level ground as possible.

5) The main line should form well conditioned triangles.

6) Each triangle or portion of skeleton must be provided with sufficient check lines.

7) All the lines from which offsets are taken should be placed closed to corresponding surface features so as to get short offsets.

8) As far as possible, the main survey lines should not pass through obstacles.

9) To avoid trespassing, main survey lines should fall within the boundaries of property to be surveyed.

7 for any 7 pts

III(b) 2

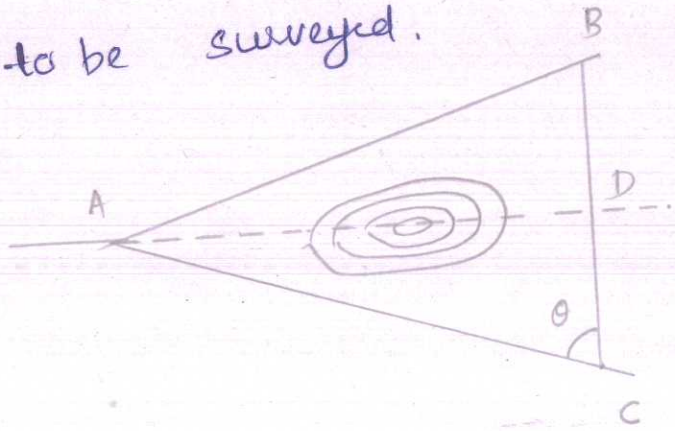


Figure.

In ΔABC, Let $\angle ACD = \theta$

$AC = 250m$, $AB = 200m$

$BC = BD + DC = 125 + 150 = 275m$

$$\cos\theta = \frac{AC^2 + CB^2 - AB^2}{2 \times AC \times CB}$$ 2+1

$$= \frac{(250)^2 + (275)^2 - (200)^2}{2 \times 250 \times 275} = \frac{9.813}{13.75} = 0.7137$$

From ΔADC 2

$$AD^2 = AC^2 + CD^2 - 2.AC.CD.\cos\theta$$

$$= 250^2 + 150^2 - 2 \times 250 \times 150 \times 0.7137$$

$$= 31474.5$$

1 8

Hence, $AD = 177.41m$

IV(a) In plane table traversing, at each sucessive station the table is set, a foresight is taken to the following station & its location is plotted by measuring the distance between 2 stations.

Procedure.

1) Set the table at A. Use plumbing fork for transferring A on to the sheet. Draw the direction of magnetic meridian with the help of trough compass.

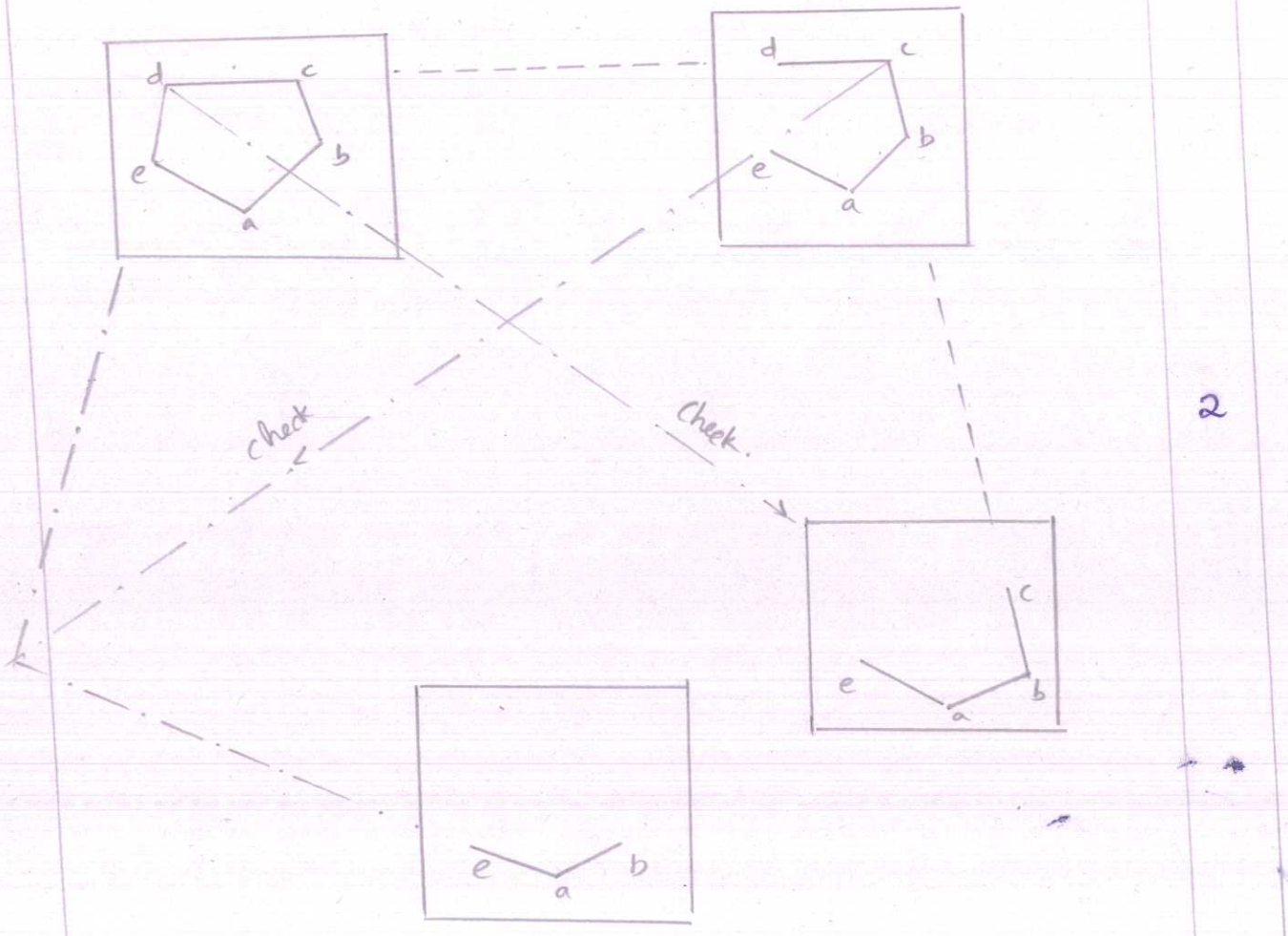
2) With the alidade pivoted about a, sight it to B

and draw the ray. Measure AB & scale off ab to some scale. Similarly, draw a ray towards E, measure AE & plot e.

3) Shift the table to B & set it. Orient the table accurately by backsighting A. Clamp the table.

4) Pivoting alidade about b, sight to C. Measure BC & plot it on the drawn ray to the same scale. Similary table can be set at other stations & traverse completed.

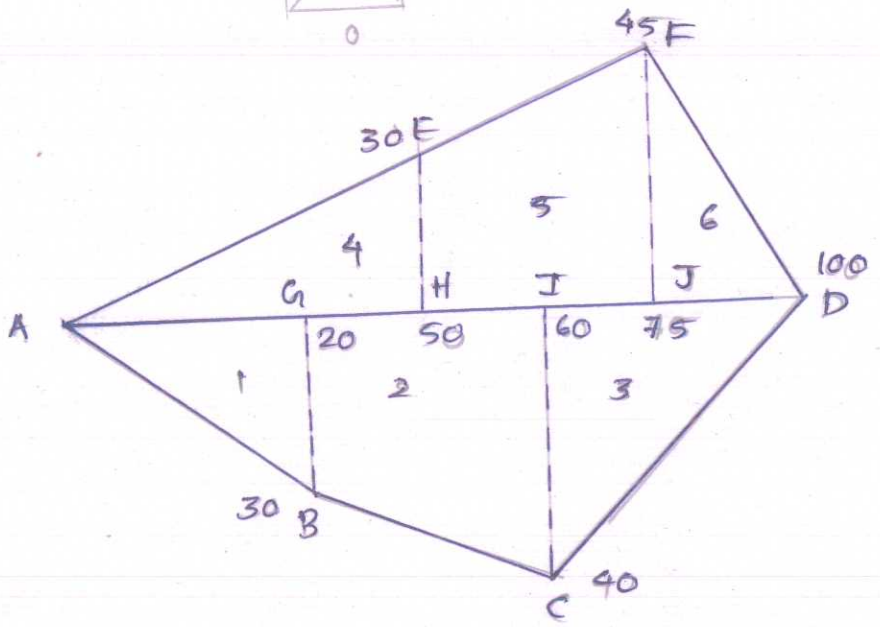
If there are n stations in a closed traverse, the table will have to be set on atleast (n-1) stations



Traversing.

7 (b) Plot the following cross staff survey of a field and calculate its area.

	100	A
F45	75	
	60	40 C
E30	50	
	20	30 B
	0	



2

1) Area of $\Delta AGB = \frac{1}{2} \times 20 \times 30 = 300\ m^2$

2) Area of trapezium $GICB = \frac{1}{2}(30+40) \times 40 = 1400\ m^2$

3) Area of $\Delta IDC = \frac{1}{2} \times 40 \times 40 = 800\ m^2$

5

4) Area of $\Delta AHE = \frac{1}{2} \times 50 \times 30 = 750\ m^2$

5) Area of trapezium $HJFE = \frac{1}{2}(30+45) \times 25$

$= 937.5\ m^2$

6) Area of $\Delta JFD = \frac{1}{2} \times 25 \times 45 = 562.5\ m^2$

Total Area $= 300 + 1400 + 800 + 750 + 937.5 + 562.5$

$= \underline{\underline{4750\ m^2}}$

1 8 12

V a) Variations in Declination.

The value of declination at a place never remains constant but changes from time to time. There are four types of variations in declination. 1

i) Diurnal variation — Diurnal variation or daily variation is the systematic departure of declination from its mean value during a period of 24 hours. 1½

ii) Annual variation — If observations of the direction of the needle are continued through out the year, there will be deviation of the needle of about 1 to 2 minutes from its mean position. 1½

iii) Secular variation — The magnetic meridian swings like a pendulum. It swings in one direction for long term of years (100 to 150 yrs) gradually comes to rest & then swings in opposite direction. 1½

iv) Irregular variation — These variations are due to what are known as magnetic storms earthquakes & other solar influences. They may occur at any time & cannot be predicted. 1½ 7

(b)

Line	Observed Bearing	Correction	Corrected Bearing	Remarks	
AB	$45°45'$	0 at A	$226°45' - 180° = 45°45'$		1
BA	$226°10'$	$-25'$ at B	$226°10' - 25' = 225°45'$		1
BC	$96°55'$	$-25'$ at B	$276°30' - 180 = 96°30'$		1
CB	$277°5'$	$-35'$ at C	$277°5' - 35' = 276°30'$		1
CD	$29°45'$	$-35'$ at C	$209°10' - 180 = 29°10'$		1
DC	$209°10'$	0 at D	$209°10'$	Stns B & C are affected by Local attraction	1
DE	$324°48'$	0 at D	$324°48'$		1
ED	$144°48'$	0 at E	$144°48'$		1 8 15

1

VI(a) BB = F.B $\pm 180°$

use + sign when F.B is less than $180°$

& - sign when it is more than $180°$

i) BB of AB = $12°24' + 180° = 192°24'$ 1½

ii) B.B of BC = $119°48' + 180° = 299°48'$ 1½

iii) BB of CD = $266°30' - 180° = 86°30'$ 1½

iv) BB of DE = $354°18' - 180° = 174°18'$ 1½ 7

VI(b) $\angle A$ = B.B of EA − FB of AB

$= 130°15' - 80°10' = 50°5'$

$\angle B$ = B.B of AB − FB of BC $= 259°0' - 120°20'$

$= 138°40'$

$\angle C$ = B.B of BC − F.B of CD

= 301°50′ − 170°50′ = 131°0′

$\angle D$ = B.B of CD − F.B of DE

= 350°50′ − 230°10′ = 120°40′ 2

$\angle E$ = B.B of DE − FB of EA

= 49°30′ − 310°20′ + 360° = 99°10′

$\angle A + \angle B + \angle C + \angle D + \angle E$ = 50°5′ + 138°40′ + 131°0′ +

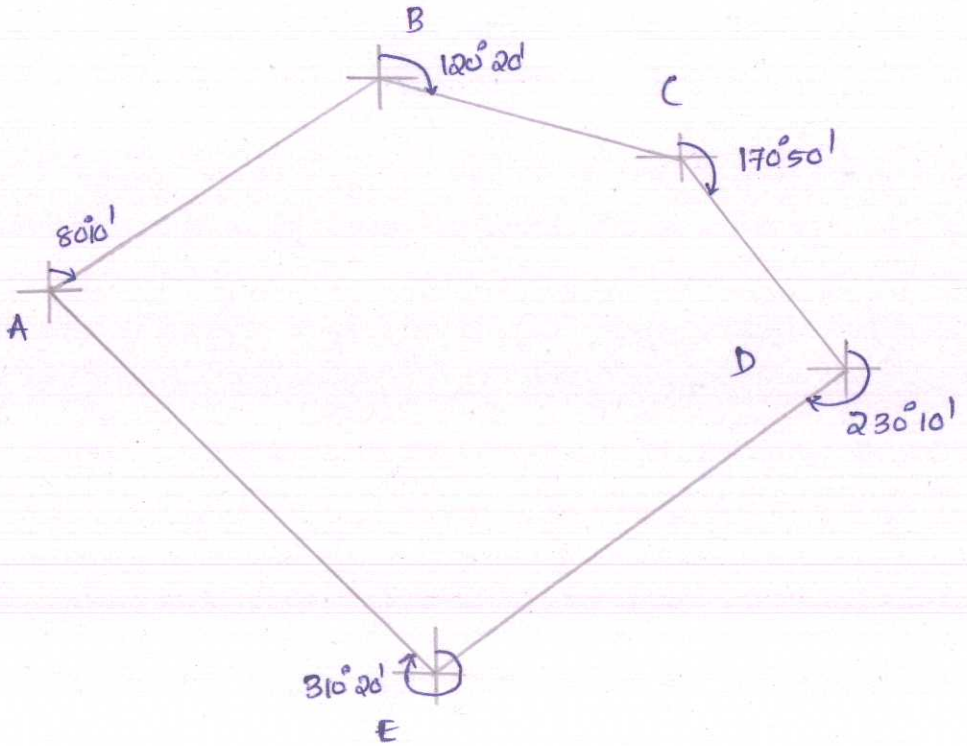
120°40′ + 99°10′ = 539°35′

Theoretical Sum = $(2n-4) \times 90 = 540°$

Error = 540 − 539°35′ = 25′ 2

Correction = +25′ to traverse

= $\frac{+25'}{5}$ = +5′ to all angles. 2



Corrected Angles $\angle A = 50°5' + 5' = 50°10'$

$\angle B = 138^\circ 40' + 5' = 138^\circ 45'$

$\angle C = 131^\circ + 5' = 131^\circ 5'$

$\angle D = 120^\circ 40' + 5' = 120^\circ 45'$

$\angle E = 99^\circ 10' + 5' = 99^\circ 15'$

2

8 15

VII(a) Temporary adjustment of a level

Temporary adjustment for a level consist of

1) Setting up the level
2) Levelling up
3) Elimination of parallax

1) Setting up the level

It includes (a) fixing the instrument on the stand & (b) levelling the instrument approximately 2 by leg adjustment, so that the instrument is at convenient height & tribrach is approximately horizontal.

2) Levelling up.

Accurate levelling is done with the help of foot screws & with reference to plate levels. The manner of levelling the instrument by plate levels depends on whether there are 3 levelling screws or four levelling screws. 3

Three Screw Head 1) Loose the clamp. Turn-

the instrument until the longitudinal axis of plate level is roughly parallel to a line joining any 2 of levelling screws.

2) Hold these levelling screws between thumb & first finger of each hand & turn them uniformly until the bubble is central.

3) Turn upper plate through 90°.

4) Turn this levelling screw until the bubble is central.

5) Return upper part through 90° & Repeat step 2 till bubble is central.

6) Repeat step 4 & then 2 till the bubble is central in both positions.

3) Elimination of Parallax.

Parallax is a condition arising when the image formed by the objective is not in the plane of cross hairs. Parallax can be eliminated in 2 steps. 2 7

i) By focussing the eye piece for distant vision of cross hairs.

For that point the telescope towards sky & move the eyepiece in or out till the cross hairs are seen sharp & distinct.

ii) By focussing the objective to bring the image of

object in the plane of cross hairs

The telescope is directed towards staff & focusing screw is turned till the image appears clear & sharp.

VII (b)

Station	BS	IS	FS	HI	R_L	Remarks	
1	1.895			32.395	30.5	BM	1
2		1.5			30.895	Highest Point	1
3		1.865			30.53		1
4.	2.99		2.57	32.815	29.825	CP1 lowest pt	1
5	2.41		2.02	33.205	30.795	CP2	1
6.	2.96		2.52	33.645	30.685	CP3	1
7.			3.115		30.53	Last Point	1
	10.255		10.225				

Check:

$\Sigma BS - \Sigma FS$ = Last R_L − First R_L

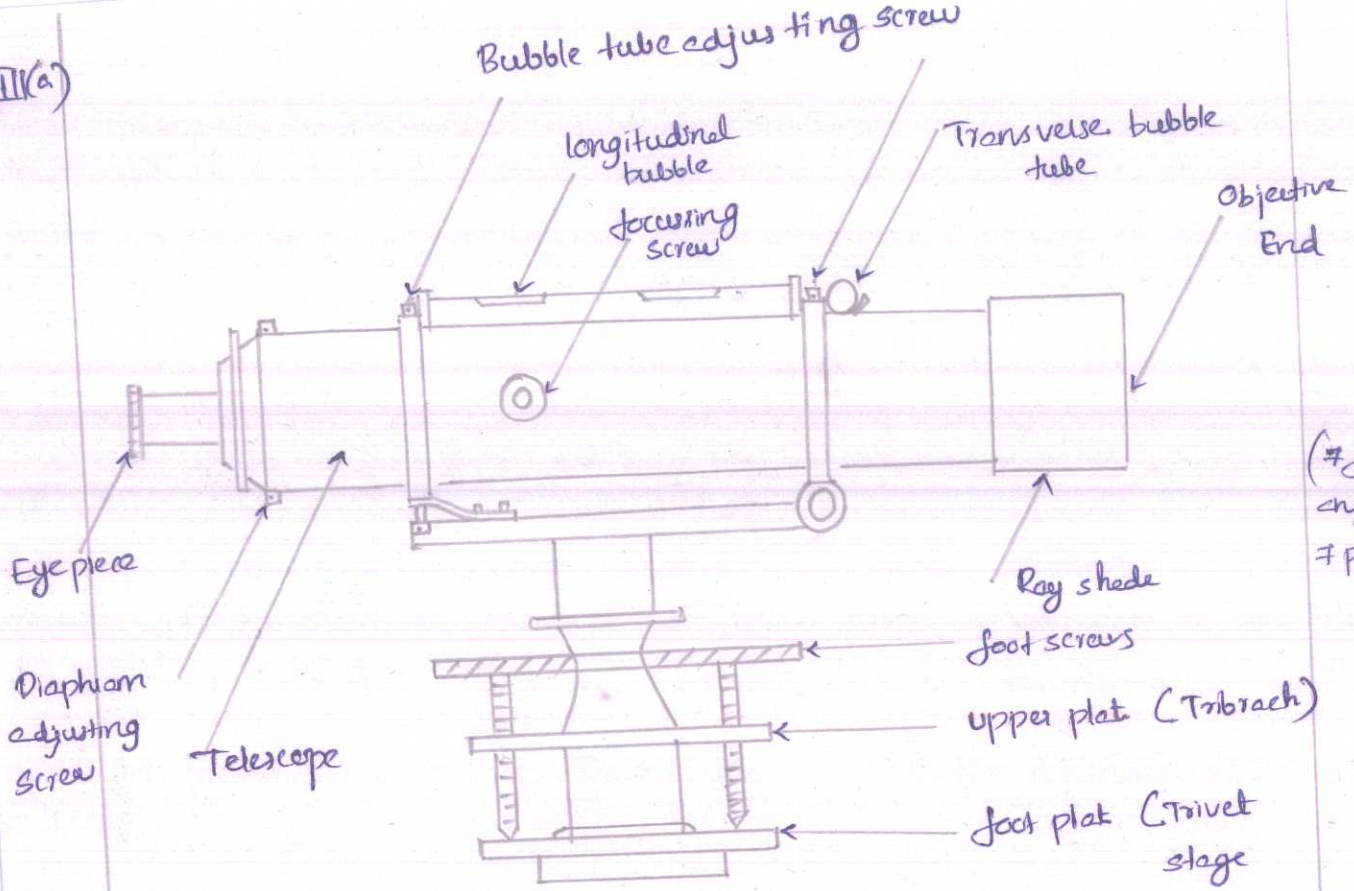
$10.255 - 10.225$ = $30.53 - 30.5$

0.03 = 0.03

Check correct.

1 8 15

VII(a)



(7 for any 7 part) 7

Dumpy level.

VIII(b)

Station	BS	IS	FS	Rise	Fall	RL	Remarks
1.	3.48					550	
2.		2.695		0.785		550.785	
3.		1.44		1.255		552.04	
4.	2.115		0.855	0.585		552.625	
5.		1.64		0.475		553.1	
6.	3.465		0.75	0.89		553.99	
7.		2.11		1.355		555.345	
8.		1.11		1.00		556.345	
9			0.655	0.455		556.8	
	9.06		2.26	6.8	③		

7

Check.

$\Sigma BS - \Sigma F = \Sigma Rise - \Sigma Fall = Last\ R_L - 1st\ R_L$

$9.06 - 2.26 = 6.8 - 0 = 556.8 - 550$ 1 8 15

$6.8 = 6.8 = 6.8$

Hence check is correct.

IX(a) i) When observations are taken from P, apparent difference in elevation between P & Q

$= 2.748 - 1.824 = 0.924\ m$ P being higher

When observations are taken from Q, apparent difference in elevation between P & Q

$= 1.606 - 0.928 = 0.678$, P being higher

∴ True difference in elevation

$= \frac{0.924 + 0.678}{2} = 0.801\ m$ 3

P is higher.

True elevation of Q = 126.386 - 0.801 = 125.585m

ii) Combined correction for curvature & refraction

$= 0.06728\,d^2 = 0.06728 \times (1.01)^2 = 0.069\ m$ 2 7

iii) When the level was at P, apparent difference in elevation = 0.924m

The difference in elevation = 0.801m 2

Error in observation = 0.924 − 0.801 = +0.123 m

This error consist of i) error due to curvature & refraction ii) collimation error

Error due to curvature & refraction = + 0.069m

Error due to collimation = 0.123 − 0.069 = +0.054m

IX(b)

Station	Distance	B.S	I.S	F.S	H.I	R_L	Remarks
1		0.965			361.465	360.5	
2.		1.63		0.945	362.15	360.52	
3.		1.105		1.15	362.105	361	
4.		0.85		1.985	360.97	360.12	
5.		0.395		1.125	360.24	359.845	
6.	0		0.24			360	Peg No. 1
7.	10		0.49			359.75	Peg No. 2
8.	20		0.74			359.5	Peg No. 3
9.	30		0.99			359.25	Peg No. 4
10	40		1.24			359	Peg No. 5
11.	50		1.49			358.75	Peg No. 6
12.	60			1.74		358.5	Peg No. 7
		4.945		6.945			

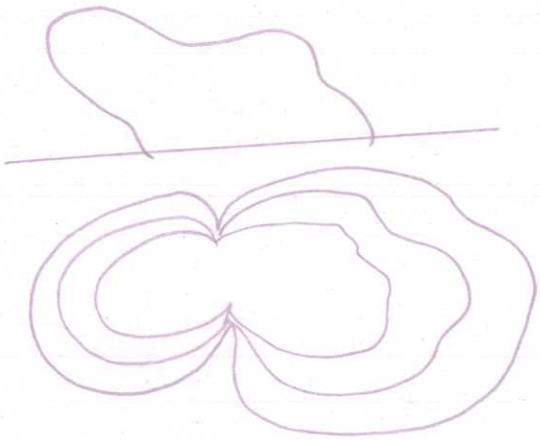
Check: $\Sigma BS - \Sigma FS$ = Last R_L − First R_L

4.945 − 6.945 = 358.5 − 360.5

−2 = −2. ; Check is correct.

2) Characteristics of Contours

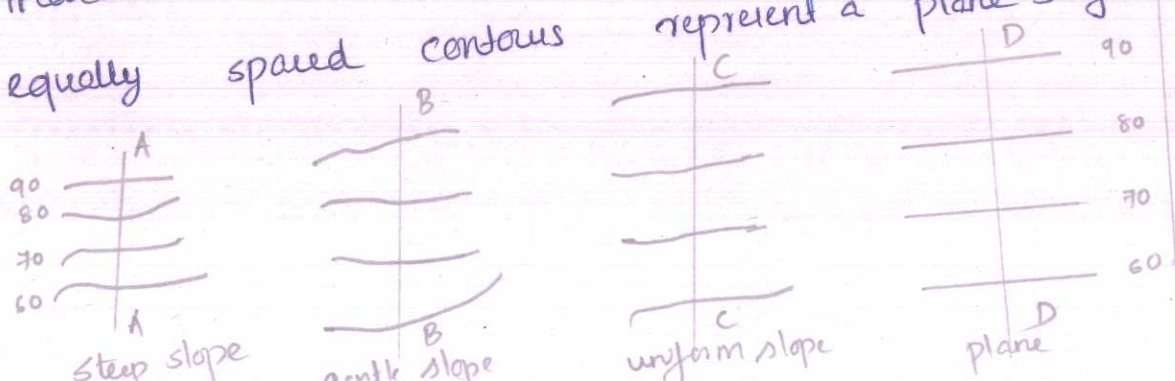
1) Two Contour lines of different elevations cannot cross each other. If they did the point of intersection would have 2 different elevations which is absurd. Contour lines of different elevations can intersect only in the case of an overhanging cliff or a cave.



overhanging cliff

2) Contour lines of different elevations can unit to form one line only in the case of a vertical cliff

3) Contour lines close together indicate steep slope. They indicate gentle slope if they are far apart. If they are equally spaced, uniform slope is indicated. A series of straight parallel & equally spaced contours represent a plane surface.



4) A contour passing through any point is perpendicular to the line of steepest slope at that point

5) A closed contour line with one or more higher ones inside it represents a hill.

A closed contour line with one or more lower ones inside it represent a depression with out an outlet.

6) Two contour lines having same elevation cannot unite & continue as one line. Similarly a single contour cannot split into 2 lines.

7) A contour line must close up on itself, through not necessarily with in the limit of the map.

7 for any 7 point.

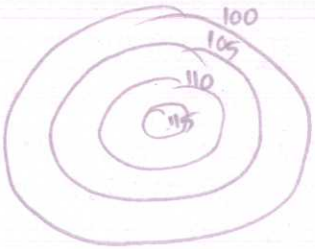
7

8) Contour lines cross a watershed or ridge line at right angles. They form curves of U shape around it with the concave side of curve towards higher ground

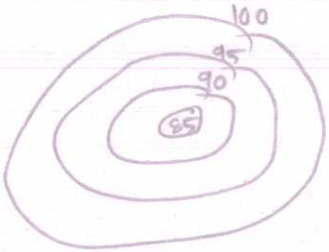
9) Contour lines cross a valley line at right angles They form sharp curves of V shape across

it with convex side of curve towards higher ground.

10) Same contour appears on either sides of ridge or valley, for the highest horizontal plane that intersects the ridge must cut it on both sides. The same is true of the lower horizontal plane that cuts a valley



Hill



depression

X(b) i) Capacity of reservoir by trapezoidal rule 2

$$V = \frac{h}{2}\left[\frac{A_1 + A_n}{2} + (A_2 + A_3 + A_4 + A_5 + A_6)\right]$$

$$= 2\left[\frac{(2745+1835)}{2} + 2725 + 1885 + 1800 + 1805 + 1795\right] \quad 1$$

$$= 24600 \ m^3 \quad 1$$

ii) Capacity of reservoir by Prismoidal rule 2

$$V = \frac{h}{3}\left[(A_1 + A_n) + 4(A_2 + A_4 + A_6) + 2(A_3 + A_5)\right]$$

$$= \frac{2}{3}\left[(2745+1835) + 4(2725+1800+1795) + 2(1885+1805)\right] = 24826.67 \ m^3 \quad 1 \quad 8$$