VTU question Paper solutions

Unit 1

1 **a) Distinguish between the following (**June –July 2015**,**June - July 2014, Dec 2013)

i) Plane surveying: curvature of earth is not taken into account small areas.
Geoditic survey: curvature of earth is taken into account large areas.
ii) Precision: Consistency with repetition
Accuracy: nearness to true value
iii) Systematic error: Reason for error known and correction can be computed. + or –
Random error: reason not known error will be + as well as – ve – probability method.
iv) Instrumental error: Instrument not in adjustment
Personal error: error in observations.

2. Discuss the classification of surveying (Dec-2014)

1. Engineering survey: The objective of this type of surveying is to collect data for designing roads, railways, irrigation, water supply and sewage disposal projects. These surveys may be further subdivided into:
   a. Reconnaissance survey for determining feasibility ad estimation of the scheme.
   b. Preliminary survey for collecting more information to estimate the cost o the project selected, and
   c. Location survey to set the work on the ground.
2. Military Survey: This survey is meant for working out points of strategic importance.
3. Mine survey: This is used for exploring mineral wealth.
4. Geological survey: this survey is for finding different strata in the earth's crust.
5. Archaeological survey: this survey is for unearthing relics of antiquity.

Based on the instruments used, surveying may be classified into the following:

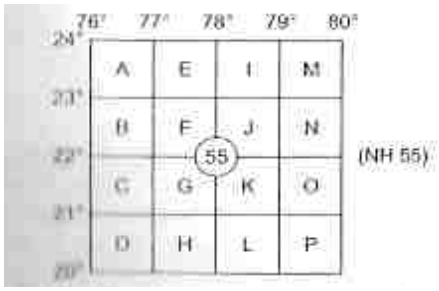
1. Chain Survey
2. Compass Survey
3. Plane Table Survey
4. Theodolite Survey
5. Tacheometric Survey
6. Modern Survey using electronic equipment like distance metres and total stations.
7. Photographic and Aerial Survey.

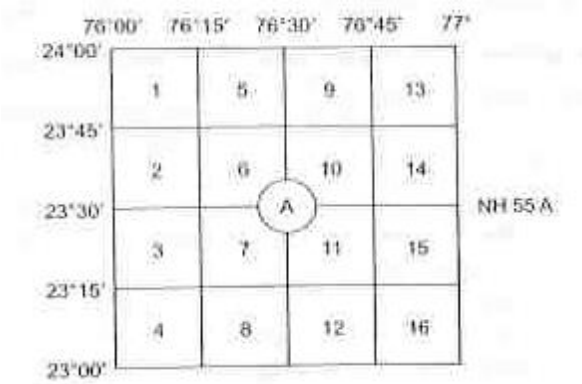
3. **Explain briefly how the maps are numbered by survey of India.(**june-july 2015 & Dec2013)

The entire area covered by India is divided into A 4^0 * 4^0 longitude and latitude and each grid is numbered as shown in Fig.1. Each grid is further divided in 4 * 4 grid of size 1^0 *1^0 longitude and latitude and they are numbered as shown in Fig 2.

The scale used for 4^0 * 4^0 grid map is 1:25000 and the scale used for 1^0 *1^0 grid maps is 1:50,000 the 1^0 *1^0 longitudinal nad lateral grids are further divided in 15' * 15' grids and are numbered.

These maps are available in 1:50,000 to 1:25000 scales. A map corresponding to 55th A of 6th grid is referred to as NH 55 A – 6, where NH refers to Northern Hemisphere.





4.Explain the principles of surveying (Dec-2014 **,J**une-july 2013 **)**

To get accurate results one should follow the two basic principles explained below:

1. **Work from whole to part**
   In surveying large areas, a system of control points is identified and they are located with high precision. Then secondary control points are located using less precise methods. With respect the secondary control point's details of the localized areas are measured and plotted. This is called working from whole t part. This principle in surveying helps in localizing the errors. If the surveying is carried out by adding localized areas, errors accumulate.
2. **Fixing positions of new control points**
   For fixing new control points with respect to already fixed points, at least two independent processes should be followed. IF A and B are two already located control points and with respect to them new control point C is to be located, apart from the minimum two measurements required, one more reading should be taken. Fixing of check lines and tie lines will also serve this purpose.

Problems (Dec-2013)

1. The distance between two points measured along a slope is 800 m. Find the distance between the points if,
   i) The difference in level between the points is 60 m.
   ii) The angle of slope between the points is 10□ (06 Marks)

L = distance measured along slope = 800 m

H = difference in level between two points= 60 m

Horizontal distance =

Q= angle up slope = 10^0

L = distance measured = 800 m along slope

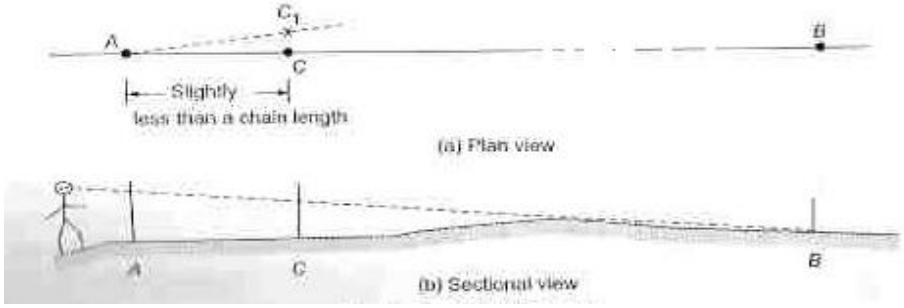
Horizontal distance = D = l cos θ

= 800 cos 10’

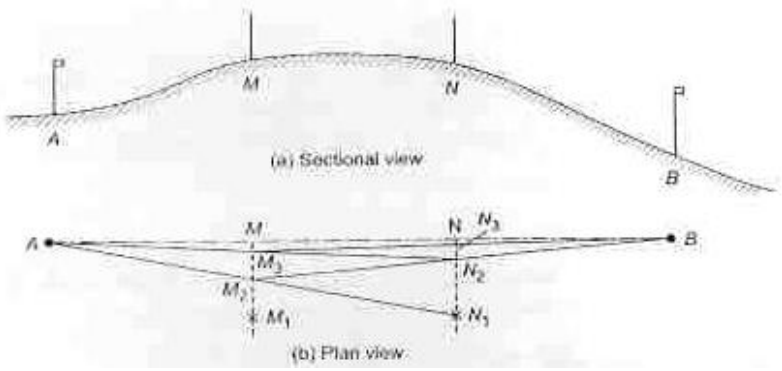
Unit2

1. Explain with a neat sketch the indirect ranging and direct ranging:(Dec-2013 **,J**une-july 2014, **J**une-july 2015 **)**

Direct ranging:
This is possible. If the first and last points on the survey line are intervisible. Fig. shows the end points A, B in a survey line which is intervisible. Now it is necessary to locate point C on line AB, which is slightly less than a chain length from A. It needs two persons. At points A and B ranging rods are erected. The assistant of survey positions himself as close to line AB as possible at a distance slightly less than a chain length and hold a ranging rod. The survey or positions himself approximately 2 m behind A and sights ranging rods at A and B. He directs the assistant to move to the left or right of line AB till he finds the ranging rods at A,B and C in a line. The surveyor should always observe at lower portion of the ranging rods. The signals used in instructing the assistant at C while ranging.



Indirect ranging: If the two end points of the line to be measured are not intervisible, the surveyor has to go for indirect ranging. This is also called reciprocal ranging. The invisibility of points may be due to unevenness of the ground or due to long distance Fig (a) shows cross – section of the ground which is a typical case of invisibility of point B of the line from point A. Fig (b) shows the plan .M and N are the two points to be fixed or AB such that both points are visible from A as well as B. It needs four people to fix points M and N one person near each point A, B, M and N.



2. Explain the basic principle of EDM devices.(June-July 2013, June-July 2015)

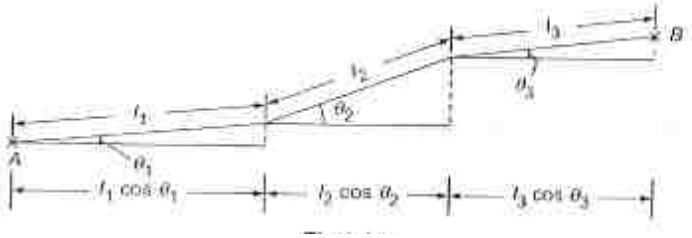
Positions are a fundamental element of geographic data. Sets of positions form features, . Positions are produced by acts of measurement, which are susceptible to human, environmental, and instrument errors. Measurement errors cannot be eliminated, but systematic errors can be estimated, and compensated for.
Land surveyors use specialized instruments to measure angles and distances, from which they calculate horizontal and vertical positions. The Global Positioning System (and to a potentially greater extent, the emerging Global Navigation Satellite System) enables both surveyors and ordinary citizens to determine positions by measuring distances to three or more Earth-orbiting satellites. As you've read in this chapter (and may known from personal experience), GPS technology now rivals electro-optical positioning devices (i.e., "total stations" that combine optical angle measurement and electronic distance measurement instruments) in both cost and performance. This raises the question, "If survey-grade GPS receivers can produce point data with sub-centimeter accuracy, why are electro-optical positioning devices still so widely used?" I

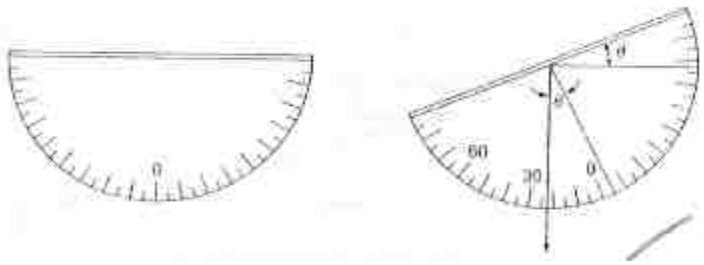
3. Explain methods of chaining on sloping ground.(June -July 2014)
In surveying horizontal distances are required. If the ground is sloping there are two methods to get horizontal distances:
1. Direct method
2. Indirect method.

Direct method: This method is known as method of stepping also, since the line is measured in smaller step length. Let AB be the length of line to be measured on a sloping ground the surveyor holds the tape firmly at A and the leader goes with a convenient length l_1 of tape say, 5 m, 10 m, 15 m, and a ranging rod in hand. After ranging, the leader holds the chain horizontally. He may be guided by the surveyor or others in the party for horizontality of the tape. After stretching the tape, with the help of a plumb bob or by dropping a pebble, the leader transfers the end of the tape to the ground and marks. The length of te tape selected is such that the drop is never more than the eyesight of the leader. The length l_1 is noted and they move to measure next step length. The two step lengths need not be the same. The procedure continues till the total length is measured. It is preferable to measure down the slope rather than up the slope, since the surveyor can hold the tape firmly, if the measurements are down the hill. In this method tape is preferred over chain since it is light and hence can be stretched horizontally, keeping sag at minimum.

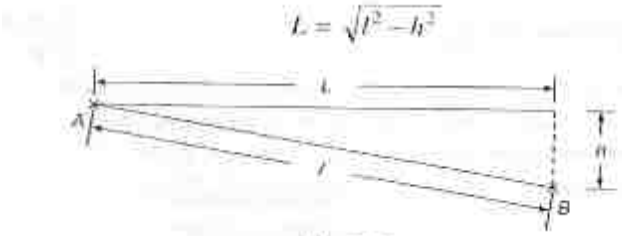
Indirect method: If the slope of the ground is gentle these methods may be employed. In these methods linear measurement is along the sloping ground and it involves angular measurement also. The following three methods are in common use:

a) First method: Total length to be divide into each segment having particular slope. **$D=\Sigma l\cos\theta$**



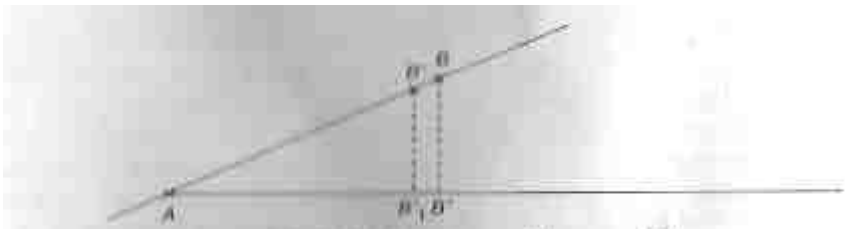


b) Second method: The difference in level 'h' is measured by knowing the sloping ground length 'l'



and the equivalent horizontal length L can be calculated

c) Third method: This method is useful when intermediate points on a line are to be used for taking offsets.



4. A 30 m chain was found to be 12 cms too long after chaining a distance of 1750 m. It was found to be 23 cms too long at the end of day's work after chaining a total distance of 3600 m. Find the true distance if the chain was correct, before the commencement of the work. (Dec-13)

b) (i) Actual length of chain (L) = 30 mt.

chain length after measuring distances of 1750 mt

meamned distance = 1750 mt

True distance = meamned $\times \frac{L'}{L}$

$$1750 \times \frac{30.60}{30.00}$$
$$= = 1753.5m$$

ii) Remaining measured distance = 3600-1750
= 1850 mt

Incorrect length of chain (L') =

True distance = measured distance $\times \frac{L'}{L}$

Total transmittance = 1753.5+1860.79 = 3614.29 m

5.The length of the line measured with 20.0m chain was 1341.0m. The same line when measured with 30.0 m chain was 20m too short was fond to be 1350.00m. Determine the error in 20.0m chain.(June-july 2015)

L =1350 x 29.80/30.00 =1341m

1341 = 1341 x L'/20 =20m

Zero error

5. **A tape 100 m long of standard length at 29□C was used to measure a line, the mean temperature during measurement being 14.4□C. The measured length was 636.94 m, the following being the slopes.(Dec-14)**

2□ 20□ for 100 m	**5□ 0□ for 60 m**
1□ 0□ for 100 m	**3□ 40□ for 100 m**
7□ 20□ for 40 m	**1□ 40□ for 100 m**
1□ 20□ for 100 m	**1□ 40□ for 36.94 m**

What was the true length of the line? Assume the coefficient of expansion of the tape was 0.00001116/1□C. The tape was used on the flat to measure the line. (08 Marks)

c) Correction for temperature or the whole length

Where L = measured length of line = 636.94m

$\propto$ =0.00001116/1^{0}c

Tm = temper during

Ct = 636.94*0.00001116(14.4-29)

Ct = 0.1037 m (negative)

Correction for slope

$$C_s = \sum l(1-\cos\theta)$$

$$= 100(1-\cos 2^0) + 60(1-\cos 5^0) + 100(1-\cos 1^0) + 100(1-\cos 3^0 40') + 40(1-\cos 7^0 20') + 100(1-\cos 1^0 40') + 100(1-\cos 1^0 20') + 3694(1-\cos 1^0 40')$$

$$C_s = -0.039 - 0.283 - 0.152 - 0.247 - 0.327 - 0.423 - 0.270 - 0.162$$

$$= -1.703\,m \text{ (negative)}$$

combined correction = −0.103 − 1.703

= −1.806 m (negative)

corrected length = measured length + C

= 3694 − 1.806

= 3692.194 m

6. A steel tape of nominal length 30 m was suspended between supports to measure the length of a line. The measured length of the line on a slope of angle $3^0 50'$ is 29.859 m. The mean temperature during the measurement was 12^0C and the pull applied was 100 N. If the standard length of tape is 30.005 m at 20^0C and a standard pull of 45.0 N, calculate the corrected horizontal length. Take weight of the tape as 0.15N/m, cross sectional area = 2.5 mm^2, co – efficient of linear expansion = $1.15*10^{-5}/^0$c and E = $2.0*10^5$N/mm^2.((June-July 2013)

Correction for standardization

Correction for temperature

$$C_t = \alpha(t_m - t_s)L = 0.0027$$

Correction for pull

$$C_p = \frac{(P - P_s)L}{AE} = 0.0022$$

Correction for sag

$$C_g = -\frac{w^2L^3}{24P^2} = -0.0074 + 0.0022$$

$$C_g = -0.0052\,m$$

For supports not being at the same level

Correction for slope

$C_{slope} = -\frac{h^2}{2L} = -\frac{0.6^2}{2 \times 29.8} = -0.06$

Total correction = - 0.06378 m
Correct horizontal distance = 29.795m

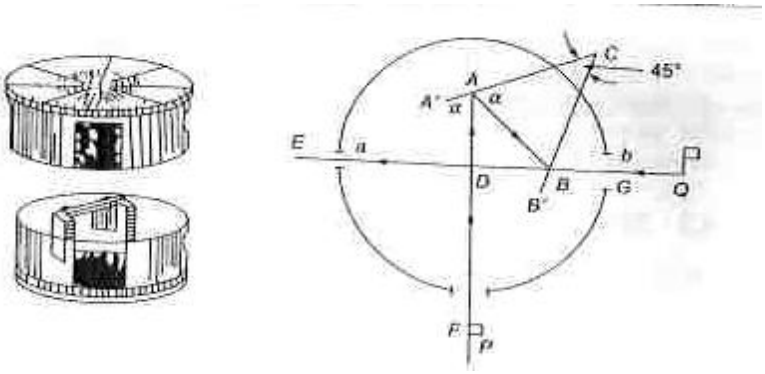
Correction for slope

$C_{slope} = -\frac{h^2}{2L} = -\frac{0.6^2}{2 \times 29.8} = -0.06$

Total correction = - 0.06378 m
Correct horizontal distance = 29.795m

Unit3

1.With a neat sketch, explain the construction and working of an optical square. . (Dec 2014, June-july 2015)



It is more accurate and convenient instrument for finding foot of the perpendicular or to set a right amgle.It is a metal box of 50mm dia. And 120 mm deep.There three openings such as pin hole, a small rectangular slot and a large rectangular slot.

3. List the point to be considered while selecting survey stations in chain surveying.(Dec 2013)
Chain survey suitable in the following cases1. Area to survey is comparatively small
2. Ground is fairly level
3. Area is open
4. Details to be filled up or simple and lets

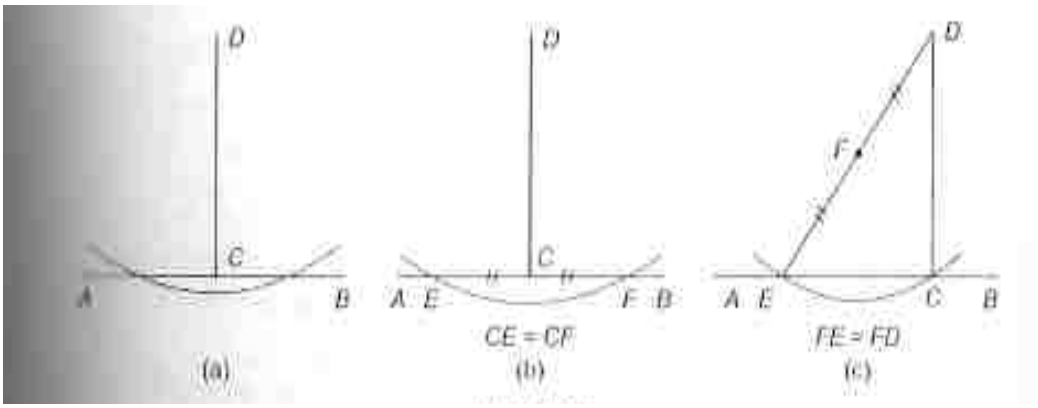
Chain survey is not suitable in the following condition
1. Area to survey to large
2. Ground is quite UN – even
3. Area is crowded
4. Details the shows are to many.

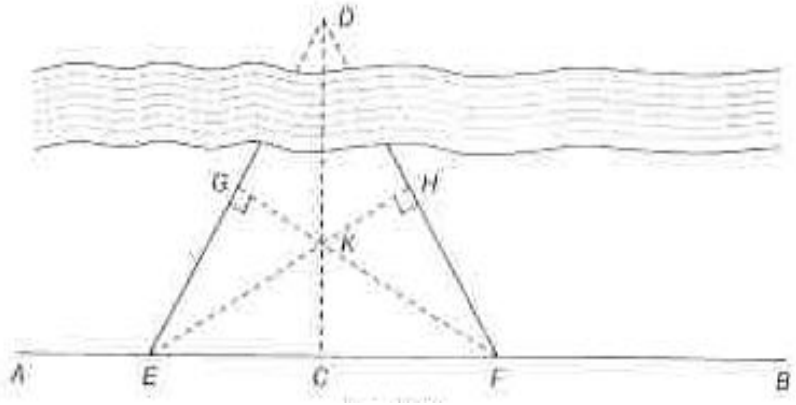
1. **Explain with neat sketches, how do you set out a perpendicular to the chain line from a**

pointout side the chain line.(

To drop a perpendicular to a chain line from outside point:

Let it be required to drop to a perpendicular to chain AB from a point D outside it.





i) **First method**: Select any point D outside the chain line AB.a perpendicular distance of DC is swung over chain line AB.

ii) **Second method:** Select any point the on the line join CD and bisect it at F. with F as centre & CF or FD as radius draw an arc to cut the chain line at 'C', CD will be perpendicular to the chain line.

4.Define baseline, checkline, tieline and detail line. (Dec2013)

Base line: It is the most important line & is the longest line. Main frame works of survey line are built on it.

Detail-line: If the important objects are far away from the main lines, the offset formed is large, which reserve into inaccuracy and time consuming in the field work. In such cases the secondary lines are run by selecting station on main lines.

Check lines: These are the lines connecting Main station to a subsidiary station on opposite site are connecting to subsidiary station. On the sides of main– lines the purpose measuring such lines is to check the accuracy within main station are located this lines are also known as group line.

5. What are the sources of error in chaining? How to avoid them? (Dec2014)

Errors in chaining may be classified as:
1. Personal errors
2. Compensating errors, and
3. Cumulative errors

Personal errors: Personal errors like wrong reading, wrong recordings, reading from wrong end or chain and miscounting of the chains are serious errors. It is not easy to detect unless they are too big. Hence, care should be taken to avoid such errors.

Compensating errors: These errors can be positive or negative. Hence, they are likely to get compensated when a large number of readings are taken. The following are the examples of such errors:
1) Incorrect marking of the end of chain
2) Fractional parts of the chain may not be correct when the chain is corrected by adding or removing a ring.
3) Graduation in the tape may not be exactly of same length throughout
4) In the method of stepping for measuring sloping ground, method of plumbing may be crude.

Cumulative errors: These are the errors which occur always in the same direction. Hence, as more number of chain lengths is required while measuring a line they go on accumulating. Hence, even if each one of such errors are small they are considerable when longer lengths are measured. Examples of such errors are:
1. Bad ranging (+ve)
2. Bad straightening
3. Non – horizontality
4. Sag in the chain
5. Erroneous length of chain
6. Temperature variation
7. Variation in pull.

First four errors are always + ve since they make measured length more than actual. Last three errors may be + ve or –ve.

6. **A tape 100 m long of standard length at 29□C was used to measure a line, the mean temperature during measurement being 14.4□C. The measured length was 636.94 m, the following being the slopes.**

2□ 20□ for 100 m	**5□ 0□ for 60 m**
1□ 0□ for 100 m	**3□ 40□ for 100 m**
7□ 20□ for 40 m	**1□ 40□ for 100 m**
1□ 20□ for 100 m	**1□ 40□ for 36.94 m**

What was the true length of the line? Assume the coefficient of expansion of the tape was 0.00001116/1□C. The tape was used on the flat to measure the line. (Dec-12)

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

$In \Delta\ ACB,\ Let\ \angle ACB = \theta$

$$COS\theta = \frac{AC^2 + BC^2 - AB^2}{2AC \times BC}$$

$In\, 4\, ACD, Let \angle ACD = \theta$

$$COS\theta = \frac{AC^2 + CD^2 - AD^2}{2AC \times CD}$$

$Equations(i)\ and\ (ii)$

$$\frac{AC^2 + BC^2 - AB^2}{2AC \times BC} = \frac{AC^2 + CD^2 - AD^2}{2AC \times CD}$$

$$\frac{(250)^2 + (275)^2 - (200)^2}{2 \times 250 \times 275} = \frac{(250)^2 + (150)^2 - AD^2}{2 \times 250 \times 150}$$

$AD = 177.4m$

7. The following are the bearings taken on a closed traverse. Compute interior angles. Find the sum 9 the interior angles nad correct for observational errors assuming the error to be equal in all the angels. From the corrected interior angles compute the bearing of the sides assuming the bearing of CD to be correct (June-July 2013)

LINE	FORE BEARING	BACK BEARING
AB	$80^0 10'$	$259^0 00'$
BC	$120^0 20'$	$301^0 50'$
CD	$170^0 50'$	$350^0 50'$
DE	$230^0 10'$	$49^0 30'$
EA	$310^0 20'$	$130^0 15'$

Total correction : 25’ correction for each : 05’

Correct angles

Corrected bearing

Line	Bearing
CD	170^0 50’
DE	230^0 05’
EA	310^0 50’
AB	80^0 40’
BC	121^0 55’

Unit4

1 Define i) Magnetic bearing and true bearing
ii) Whole circle bearing and reduced bearing
iii) Dip and Declination. (Dec2013,Dec2014, June-july2015))

True meridian and Magnetic meridian:
The points of intersection of earth's axis with the surface of earth are known as geographical north & south poles.At any point on earth's surface the line passing through the point and north & south pole of the earth is called true meridian.
The angle made by a line with true meridian is called the true bearing of the line. The north & south pole of the earth are established by astronomical observations.

Whole circle bearing and quadrantal bearing system.
In whole circle bearing (WCB) the bearing of line at any point is measured w.r.t magnetic meridian. It's value may vary from 0^0 – 360^0. 0^0 is magnetic north & the bearing increases in clockwise direction. This type of bearing system is used in prismatic compass.
In quadrantal bearing system (QB) : the bearing are read from north or from south. Towards east or west.The angle measured w.r.t magnetic meridian is designated with letter N or S in the beginning to indicate whether it's from North or from south.The letters E or W indicates whether bearing read is to the east or west respectively.
Reduced bearing (RB): This system is also known as reduced bearing system.

Magnetic dip and Magnetic declination
A balanced needle after magnetisation will dip towards north in northern hemisphere in southern hemisphere.If it is taken to the pole of earth it will take vertical position.The vertical angle between the horizontal at the point and direction shown by perfectly balanced needle is known as dip.
All important surveys are plotted with reference to true meridian since the direction of magnetic meridian at a place changes with time.The horizontal amgle made between the two meridians such as magnetic and true meridian is known as magnetic declination.

2. Explain the following: (Dec2014, June-july2013)
i) Dependent and independent coordinates.
ii) Bowditch rule and transit rule.
iii) Latitude and departure.

i) Dependent t coordinates.
The latitude& departure co-ordinates of any point with reference to the preceding point are equal to the latitude and departure of the line jioning the preciding point to the piont under consideration .Such ordinates are called as dependent ordinates.
Independent ordinates.
The total latitude & departure of any point with respect to a common origin are known as independent ordinates.
Bowditch's Method:
To balance a traverse where linear and angular measurements are required this rule is used and it is

also called as compass rule. The total error in latitude and departure is distributed in proportion to the lengths of the sides.

ii)The Bowditch's rule is: Correction to latitude (or departure) of any side =

Total error in latitude (or departure) * length of that side /perimeter of traverse

Thus if, C_L= correction of latitude of any side

C_D= correction to departure of any side

ΣL= total error in latitude

ΣD= total error in departure

Σl= length of the perimeter

l= length of any side

$C_L=\Sigma L*(l/\Sigma l)$ and $C_D=\Sigma D*(l/\Sigma l)$

Transit Method: It is employed when angular measurements are more precise than linear measurements.

The Transit rule is: Correction to latitude (or departure) of any side =

Total error in latitude (or departure) * latitude L(or departure D) of that line

Arithmetic sum of latitude L_T(or departure D_T)

$C_L=\Sigma L*(L/L_T)$ and $C_D=\Sigma D*(D/D_T)$

iii) Latitude and departure.

Latitude It is coordinate length measured parallel to an assumed meridian direction.

Departure.

Its ordinate length measured at right angles to the meridian direction.

3. Two stations P and Q on the main survey line, were taken on the opposite sides of a pond. On the right of PQ, a line PR = 210 m long was laid down and another line PS = 260m long was laid down on the left of PQ. The points R, Q and S are on the same straight line. The measured lengths of RQ and QS are 85m and 75m respectively. What is the length of PQ? (June-July 2013)

Total correction : 25’ correction for each : 05’

Correct angles

Corrected bearing

Line	Bearing
CD	170^0 50’
DE	230^0 05’
EA	310^0 50’
AB	80^0 40’
BC	121^0 55’

4. Two stations P and Q were taken on southern side of ariver flowing west to east point. P is westwards of pt Q at 75m apart. The bearings of atree R on the northern side of the bank is observed to be to38^0 and 338^0 from P and Q. Calculate the width of the river. . (June-July 2015)

Width of the river = TS/ tan22^0 x tan 38^0 = 63.29 m

5.Difference between prismatic compass & surveyor's compass. . (June-July 2015)

Prismatic compass	**Surveyor's compass**
The graduation circle is fixed to broad needle.It does not rotate with line of sight.	The graduation circle is fixed to the box and rotates with line of sight
There is a prism at viewing end.	No prism.Only slit
The graduations are in WCB system.	The graduation are in Q.B system.
The graduations are marked inverted.	The graduations are marked directly.
Magnetic needle do not act as index.	Magnetic needle acts as index.
Tripod mayor may not be provided, the instrument can be used even by holding suitably in hand	The instrument can't be used without tripod.

Unit 5

What is local attraction? How is it detected with the data of compass survey?(Dec2013)

LOCAL ATTRACTION

A magnetic meridian at a place is established by a magnetic needle which is uninfluenced by other attracting forces. However, sometimes, the magnetic needle may be attracted and prevented from indicating the true magnetic meridian when it is in proximity to certain magnetic substances. Local attraction is a term used to denote any influence, such as the above, which prevents the needle from pointing to the magnetic north in a given locality. Some of the sources of local attraction are : magnetite in the ground, wire carrying electric current, steel structures, railroad rails, underground iron pipes, keys, steel – bowed spectacles, metal buttons, axes, chains, steel tapes etc., which may be lying on the ground nearby.

Detection of local attraction.

The local attraction at a particular place can be detected by observing the fore and back bearings of each line and finding its difference. If the difference between fore and back bearing is 180^0, it may be taken that both the stations are free from local attraction, provided there are no observational and instrumental errors. If the difference is other than 180^0, the fore bearing should be measured again to find out whether the discrepancy is due to avoidable attraction from the articles on person, chains, tapes etc. it the difference still remains, the local attraction exists at one or both the stations. Strictly speaking, the term local attraction does not include avoidable attraction due to things about the person or to other sources not connected with the place where the needle is read.Elimination of local attraction. If there is local attraction at a station. All the bearings measured at that place will be incorrect and the amount of error will be equal in all the bearings. There are two methods for eliminating the effects of local attraction.

First method: In this method, the bearings of the lines are calculated on the basis of the bearing of that line which has a difference of 180^0 in its fore and back bearings. It is. However, assumed that there are no observational and other instrumental errors. The amount and direction of error due to local attraction at each of the affected station is found. If, however, there is no such line in which the two bearings differ by 180^0, the corrections should be made from the mean value of the bearing of that line in which there is least discrepancy between the back sight and fore sight readings. If the bearings are expressed in quadrantal system, the corrections must be applied in proper direction. In 1^{st} and 3^{rd} quadrants, the numerical value of bearings increase in clockwise direction while they increase in anti – clockwise direction in 2^{nd} and 4^{th} quadrants. Positive corrections are applied clockwise and negative corrections counter – clockwise.

Second method: This is more a general method and is based on the fact that though the bearings measured at a station may be incorrect due to local attraction, the included angel calculated from the bearings will be correct since the amount of error is the same for all the bearings measured at the station. The included angles between the lines are calculated at all the stations. If the traverse is a close one, the sum of the internal included angles must be right angles. If there is any discrepancy in this, observational and instrumental errors also exist. Such error is distributed equally to all the angles. Proceeding now with the line, the bearings of which differ by 180^0, the bearings of all other lines are calculated.

Problems.

1. **The following bearings were observed while traversing with a compass.**

Line	FB	BB
AB	150□ 0□	329□ 45□
BC	77□ 30□	256□ 0□
CD	41□ 30□	222□ 45□
DE	314□ 15□	134□ 45□
EA	220□ 15□	40□ 15□

At what stations do you suspect local attraction? Determine the correct bearings. Also determine the true bearings if declination is 2□ 30□ E. (Dec14)

Station A and E are free from level attraction
FB and BB of EA are correct

Also on termed FB up AB = correct

$Add = 180^0 0'$

correct BB of AB $= 330^0 0'$

also on termed BB of AB $= 329^0 45'$

$= 0^0 15'$

$Error - ve, correction + ve$

observed AB up BC $= 77^0 30'$

Add correction $= 0^0 15'$

correct AB of BC $= 77^0 45'$

Add $= 180^0 0'$

correct BB of BC $= 257^0 45'$

on serval BB of BC $= 250^0 0'$

$qiff = 1^0 45'$

$Error - ve. correction + ve$

observed AB up CD $= 41^0 30'$

Add correction $= 1^0 45'$

correct AB of CD $= 43^0 15'$

Add $= 180^0 0'$

correct BB of CD $= 223^0 15'$

but on serval BB of CD $= 222^0 45'$

$Diff = 0^0 30'$

$Error - ve. correction + ve$

observed AB up CD=$41^0 30'$

Add correction $=1^0 45'$

correct AB of CD=$43^0 15'$

Add $=180^0 0'$

correct BB of CD=$223^0 15'$

but on serval BB of CD=$222^0 45'$

$Diff = 0^0 30'$

Error –ve. correction +ve

Line	Observed		Correction	Corrected		Declination
	FB	BB		FB	BB	
AB	$150^0 0'$	$329^0 45'$	$0^0 15'$@A	$150^0 0'$	$330^0 0'$	
BC	$77^0 30'$	$256^0 0'$	$1^0 45'$@B	$77^0 45'$	$257^0 45'$	$2^0 30'$E
CD	$41^0 30'$	$222^0 45'$	$0^0 30'$@D	$43^0 15'$	$223^0 15'$	
DE	$314^0 15'$	$134^0 45'$	0^0@E	$314^0 45'$	$134^0 45'$	
EA	$220^0 15'$	$40^0 15'$	0^0@A	$220^0 15'$	$40^0 15'$	

TB=MB+D

TB=ton bearing

MB=magnetic bearing

D=declination

Declination east is positive

Tone bearing		Remarks
FB	BB	
$152^0 30'$	$332^0 30'$	Stations B,C, and D are affected by level attraction
$80^0 15'$	$260^0 15'$	
$45^0 45'$	$225^0 45'$	
$317^0 15'$	$137^0 15'$	
$220^0 15'$	$40^0 15'$	

2. **In the following traverse ABCDEA, the length and bearing of EA is omitted. Calculate the length and bearing of line EA. (June-July 2013)**

Line	Length (m)	FB
AB	**204.0**	**87□ 30□**
BC	**226.0**	**20□ 20□**
CD	**187.0**	**280□ 0□**
DE	**192.0**	**210□ 3□**

EA ? ?

Time	Latitude		Departure	
	+	-	+	-
AB	8.898		20381	
BC	211.91		78.53	
CD	32.47			184.16
DE		166.19		96.145
SUM	253.278	166.19	282.34	280.305

Latitude of EA = -

Departure of EA =-

Since the latitude and departure of EA are both negative, the time EA lies in 3rd quadrant SW Quadrant

$$RB\ OF\ EA = \tan\theta = D/L$$

$$\tan\theta = \frac{2.035}{87.09}$$

$$\theta = \tan^{-1}\left(\frac{2.035}{87.09}\right)$$

$$\theta = 1^0 20' = Sl^0 20' W$$

$$WEB\ of\ EA = 181^0 20'$$

$$Length\ of\ EA = \sqrt{L^2 + D^2}$$

$$= \sqrt{(87.09)^2 + (2.035)^2}$$

$$= 87.113m$$

Chence

$$Length\ EA = lat\ of\ EA \times \sec\theta$$

$$= 87.09 \times \frac{1}{\cos 1^0 20'} = 87.11m$$

$$Length\ EA = Dep\ of\ EA \times \cos\theta$$

$$= 2.035 \times \frac{1}{\sin 1^0 20'} = 87.11m$$

3. Following are the bearings observed in a compass traverse. Identify the stations affected by local attraction and determine corrected bearings.(Dec-14)

LINE	FORE BEARING	BACK BEARING
AB	$45^0 45'$	$226^0 10'$
BC	$96^0 55'$	$277^0 05'$
CD	$29^0 45'$	$209^0 10'$
DE	$324^0 48'$	$144^0 48'$

a) Stations D and E are not affected by local attraction. Other stations are suspected to be appeared ad by local attraction but further investigation required (Dec-12)

Line	bearing	Error	correction	Corrected bearing
AB	45^0 45'	0	0	45^0 45'
BA	226^0 10'	+25'	-25'	225^0 45'
BC	96^0 55'	+25'	-25'	96^0 30'
CB	277^0 05'	+35'	-35'	276^0 30'
CD	29^0 45'	+35'	-35'	29^0 10'
DC	209^0 10'	0	0	209^0 10'
DE	324^0 48'	0	0	324^0 48'
ED	144^0 48'	0	0	144^0 48'

4 **An abstract form a traverse sheet for a closed traverse is given below. Balance the traverse using i) Bowditch's method; ii) Transit method.**(June-July 2011)

LINE	LENGTH (m)	LATITUDE (m)	DEPARTURE (m)
AB	200	-173.20	+100.00
BC	130	0.00	+130.00
CD	100	+86.60	+50.00
DE	250	+250.00	+0.00
EA	320	-154.90	-250.00

B)

Departure requires no correction total correction for latitude = -8.5

Corrected latitudes: bowditch's method:

-174.90, -1.105, 85.75, 247.88, -157.62

Corrected latitudes: transit method:

-175.41, 0, 85.492, 246.80, -156.88

5. Reciprocal leveling was done to determine the difference in elevation between two stations C and D. the following observations were made. Find the difference in elevation and the error due to line of collimation. Neglect other errors. :(June-july2015)

Positi	Staff reading	
	C	D
Near	3.250	2.730
Near D at a higher elevation than c	2.505	1.950

$$h = \frac{c_1 - d_1 + c_2 - d_2}{2}$$

$$= 0.5375m$$

$$e = \frac{c_1 - d_1 - c_2 - d_2}{2}$$

$$= -0.0175m$$

h=0.535m
e=_0.0175m

Unit6

1. Explain the following :i) Types of adjustments of dumpy level. ii) Differential leveling and profile lavelling. (Dec2013, June-july2014)

Adjustment of a level
1. Setting up
2. Leveling up
3. Focusing

Setting up: It is to set the tripod stand to a convenient height by bringing bubble to the centre of run through the movement of tripod legs radially.

Levelling up: To make the vertical axis truly vertical the levelling is made with the help of foot screws.

1. Loosen the clamp and turn the instrument until bubble axis is parallel to line joining any two screws.
2. Turn the two screws inward or outward equally till bubble is centered.
3. Turn the telescope through 90 degrees so that it lies over the third screw.

Focusing: For quantitative measurements it is essential that the image should always be formed in the fixed plane in the telescope where the cross – hairs are situated

Differential leveling and profile levelling.

profile levelling.

This type of leveling is known as – longitudinal section.

The reduced levels of various points at regular intervals are found along a line or a set of lines. Then the engineers draw the sectional view of the ground to get the profile. This type of leveling is commonly employed in deciding railways, highways, canal, sewage line routes.

After getting reduced level of various points along the line, profile of the ground is plotted on a drawing sheet. Normally vertical scale is much larger than the horizontal scale to clearly view the profile. Then when the engineers decide the formation level of the proposed project

The decision is mainly based on balancing, cutting & filling so that the transport of earth is minimum.

However the proposed gradient of formation level should not be more than as permitted. After deciding the formation level & the gradient the difference between two consecutive points is known. If RL of first point is known RL of other points are calculated.
Differential levelling: When the distance between two points is very large it may not be possible to tak ethe readings from single setting of instruments. Each shifting facilitated by taking CP.

2. What is meant by sensitiveness of bubble tube? Describe how you would determine in the field the sensitiveness of a level tube attached to a dumpy level. (Dec13, june-july14)

Sensitiveness of a bubble tube: When the difference in elevation between any two points is determined from a single set up by back sighting on one point and fore sighting on the other. The error is due to non parallelism. When the bubble is not in the centre of run and sensitivity is lost, due to the error of curvature and refraction which is eleminated if lengths of 2 sides are made equal.

Error due to Curvature: The horizontal line of sight does not remain straight but it slightly bends towards having concavity towards earth surface due to refraction.
$C_C = d^2/2R$
Error due to Refraction: As the line of sight is curved downwards towards the earth surface reading gets decreased. To make the objects appear higher than they really are, this correction is applied to staff readings, **$C_R = 0.01121d^2$** where d is in Km.

3. Define the following terms: :(June-july2015)

i) Benchmark ii) Back sight iii) Foresight iv) Reduced level

i)Bench mark;A permanent reference object to which the mesurements are considered.
ii) 3. Back sight: It is sight taken on a level staff held at a point of known elevation with an intension of determining plane of collimation or sight.
The sight is also known as +ve sight (add)
iii)**.** Fore sight (F.S)**: T**his is the last reading – taken from instrument just before shifting the instrument.This is also – ve sight.

iv) Reduced level**:** Reduced level of a point is the level of the point with respect to assumed datum.

Problems.

1. **(Dec-13)**

Back sight	**Inter sight**	**Fore sight**	**Rise**	**Fall**	**R.L**	**Remarks**
0.675					**100.000**	**BM**
0.750		**1.230**		**0.555**	**99.445**	
	2.565			**1.815**	**97.630**	
1.935		**2.225**	**0.340**		**97.970**	
	1.835		**0.100**		**98.070**	
3.115		**3.220**		**0.385**	**96.685**	
		2.875	**0.24**		**96.925**	**Last point**
IBS = 6.475		$\sum FS = 9.55$	$\sum Rise = 0.68$			

Antiemetic check

Unit7:

1. INTERPOLATION OF CONTOURS (Dec14, june-july13)

After finding RL of many points on the ground and plotted the position of those points. Points on contour lines are identified assuming uniform slope between any two neighbouring points is uniform. In other words, the points on contour lines are interpolated linearly between the two neighbouring points. For example, in Fig 100^{th} contour lies between points D_3 and E_2 assuming ground slopes uniformly form 100.3 it 99.8 between these two points contour point is located for this purpose any one of the following three methods may be used.

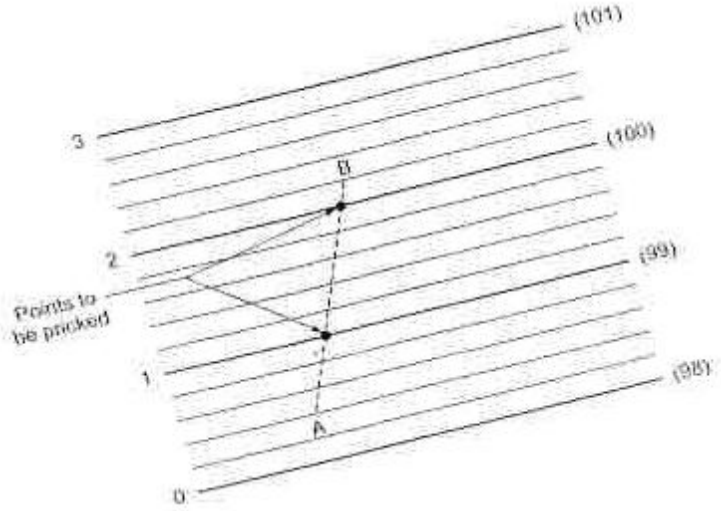
i) Estimation
ii) Arithmetic calculation
iii) Mechanical or Graphical method.

Estimation: By eye judgment or estimation the point on contour is located between the two points. For example, between D_3 and E_3 where elevations are 100.3 and 99.8 m, the contour point is estimated at a distance . From E_3. Similarly the point on D_L E_2 where RLs are 100.1 and 99.5 the point should be at a distance This method is rough and is used for small – scale works. However, it is very fast.

Arithmetic calculation: In this method, instead of estimating the position of points on contour, arithmetic calculations are made for locating the points on contour.

Mechanical or Graphical method: Any one of the following two methods are used for linearly interpolating contour points using tracing sheet.

Method 1: On a tracing sheet several parallel lines are drawn at regular interval. Every fifth or tenth line is made dark for easy counting. If RL of A is 98. 4 m and that of B is 100.2 m assume bottom most dark line represents 98 m RL and every parallel line is at 0.2 m intervals. Then hold a point on second parallel line on A. Rotate tracing sheet so that 100.2th parallel line passes through point B. then intersection of dark lines on AB represents the points on 99 m and 100 m contours similarly. Contour points along any line connecting two – level points can be obtained and contour lines interpolated and pricked. This method maintains the accuracy of arithmetic calculations, at the same time is fast also.



Method 2 : In this method a line PQ is drawn on a tracing sheet from the mid – point of PQ say R a perpendicular line RO is drawn. 'O' is selected at any convenient distance. PQ is divided into a number of equal parts, say 20 parts. Then the radial lines from 'O' to these equally spaced points are drawn.A number of guide lines 1-1, 2-2, etc. are drawn parallel to PQ. To interpolate between two points A and B on drawing sheet, tracing sheet is held with its guide lines parallel to AB. OQ is assigned a contour lien point just below that of RL of A. Of dark lines are at every 5 ray interval, and contours are required at every 1 m interval, the interval between two consecutive rays is 0.2 m. Appropriate ray is made to appear on A and tracing sheet is rotated till the ray corresponding to B coincides with B. Then the contour points on AB correspond to the dark lines intersection with AB. These points are produced and the contour points on line AB are obtained. Thus, in this case also exact interpolation is made mechanically.

2. How do you trace a contour gradient of 1 in 50 on a map having contour interval 2.0 m. (Dec13, june-july14)

i) Contour gradient on a map: The contour lines are at 20 m interval and the map is to a scale of 1:500. Since slope is assumed uniform between two contour lines, the length of gradient line between two contour lines should be equivalent to 50 m on the ground, it should be 50/500 m on paper, 40 mm from starting point a draw an arc of radius 40 mm to interest next contour line at b. from b this procedure is repeated to get point c line joining a,b,c… is the desired gradient line.
ii) Contour gradient on ground: For setting contour gradient on ground level a clinometers may be used.If a clinometers is used, it is set at the required slope. A person stands near point A, suspends the sloping clinometers at a convenient height to view. The looks through clinometers, and directs a person holding ranging pole, which is tied with a target at the same height as the height of instrument from the ground point A. Tape is used to maintain the required distance from A. after getting next point B, the clinometers is shifted to point B and the staff man moves to next probable point. The procedure is continued till the last point is established. The method is fast but any small angular error gets magnified.

3. a. **Explain rise and fall method of entering the levelling data, with an example.**
b. What is fly back levelling? Why is it performed? (june-july14)

Fly levelling: It is to carry out levelling with respect to temporary bench mark in convenient direction taking number of CP**s:**

In this method difference in staff reading at a point with previous reading is found.If the present reading is less than the previous reading it indicates – rise.If it is more it is fall in the level of presenting point.If the reduced level of 1st point is known using rise & fall values of consecutive readings, the reduced level of all pointcan be calculated one after the other.
Note: 1. Previous reading - Present reading is +ve then it's – Rise
2. Previous reading – present reading is - -ve then it's – fall

Problems:
1. Following consecutive readings were taken with a dumpy level on a continuously sloping ground. 1.550, 1.955, 2.310, 2.655, 3.170, 0.530, 1.850, 2.755, 0.300, 1.730 and 2.150. Enter the readings in a level field book and calculate the RL of points using rise and fall method. RL of bench mark = +380.000. Apply usual arithmetic checks.(June-july-14)

a)

BS	IS	FS	RISE	FALL	RL	REMARKS
1.550					380.000	BM
	1.955			0.405	379.595	
	2.310			0.355	379.240	
	2.655			0.345	378.895	
0.530		3.170		0.515	378.380	TP
	1.850			1.320	377.060	
0.300		2.755		0.905	376.155	TP
	1.730			1.430	374.725	
		2.150		0.420	374.305	

2. The following set of readings were obtained in a leveling job: 2.500, 1.000, 1.500, 1.800, 2.300, 2.900, 1.300, 3.200, 2.800, 2.000, 1.500. the instrument was shifted after 4th and 7th readings. The first readings was taken on a bench mark of RL = +250.000. Find the RL of points using HI method. Apply usual arithmetic checks.(June-july-13)

BS	IS	FS	HI	RL	REMARKS
2.500			252.500	250.000	BM
	1.000			251.500	
	1.500			251.000	
2.300		1.800	253.000	250.700	TP
	2.900			250.100	
3.200		1.300	254.900	251.700	TP
	2.800			252.100	
	2.000			252.900	
		1.500		253.400	

UNIT 8:

1. List the methods of plane tabling. Explain the radiation method.

(Dec-13,June-July15.,Dec14,)

In this method of surveying a table top, similar to a drawing board is fitted to a tripod and is provided with a drawing sheet – the observations are made to the objects, distances scaled down and objects re plotted in the field itself. Since both the observations and plotting are done in the field simultaneously. **i) Radiation:** To fill up details of objects near station 'O', plan table is set on station 'O' the plotted position 'O' approximately over the ground station. Then using alidade pivoted at 'O' the rays are drawn in the direction OA, OB, OC with soft pencil. Then the distances OA, OB< OC…. Are measured and scaled down to get the plotted positions a,b,c… of field positions A,B,… thus, the objects are plotted by first drawing radial lines.

This method is suitable for small area and is convenient if the distances are small. This method has wider scope if the telescopic alidade is used, where distances are measured tacheometrically.

ii) Intersection: In this method rays are drawn to an object form plotted positions of two stations and the intersection is the plotted position of the objet. Thus, it needs linear measurements between the two station points and there is no need to measure distances up to objects. O_1 and O_2 are the plotted positions of stations. After setting the plane table at station O_1, the rays OA, OB etc. are drawn. Then plane table is shifted to O_2 and set on it by back sighting. Then intersection of lines O_2A, O_2B, etc. with O_1A and O_1B, locate the plotted positions a, b, etc. of the objects.

This method is commonly employed for locating:

i) Details

ii) the distant and inaccessible points

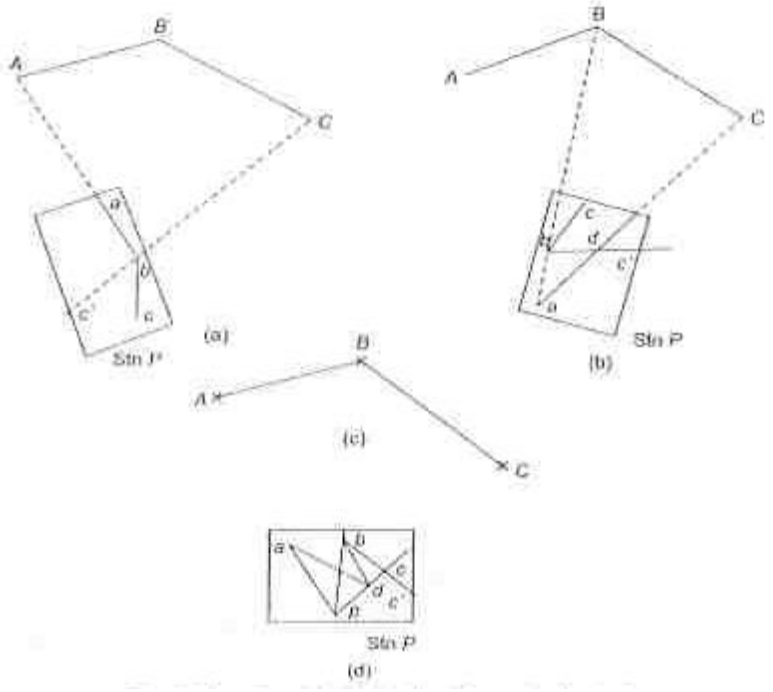
iii) the objects on the other side of river

iv) the stations which may be used subsequently.voids missing any measurement required for plotting.

2. What is orientation? Explain the orientation of plane table by back sighting.
(,June-July13.,Dec14,.)

Levelling: Sprit level is used to check the level of the table. The level should be ensured in two positions of spirit level which are at right angles to each other. The legs of tripod are moved radially or along the circumference to adjust the level of the table.
Orientation: Orientation is the process of setting plane table at a station such that all the line plotted is parallel to corresponding lines on the ground. This is very important process in plane tabling. Accuracy of plan table survey mainly depends upon how accurately at each station perfect orientation is achieved. It can be achieved by any one of the following methods:
i) Using Trough compass
ii) by Back sighting
iii) by Solving two point or three point problems.
Orientation using trough compass: When the survey work begins form the first station, the table is oriented in appropriate direction and the north direction is marked near right – hand top corner using trough compass. This orientation is to be maintained at all subsequent stations. To get the same orientation, through compass is placed along the north directon marked, and the table is rotated till compass needle is along zero – zero readings. Then it is clamped. Thus, the required orientation of the table is obtained.
This method of orientation is considered rough, since the local attraction to compass can affect proper orientation. This method is used as preliminary orientation and finer orientation is obtained by other methods.
Orientation by back sighting: It is a commonly employed method. Before shifting the table, from station A to station B, line ab is drawn from plotted position of station towards next station B. Distance AB is measured and plotted position b of station B is located. Then plane table is shifted to station B, and centred such that point 'b' is exactly over station B. now keeping the alidade along ba station A is sighted and clamped. This gives the required orientation. Checks may be applied by sighting already plotted objects from point b.

3. What is three point problem in plane table survey? Explain Bessel's graphical solution for the same.
(Dec-13,June-July14)



Bessel's solution: In this method

1. Keep fiducial edge along bad n sight object at A. clamp the table. Pivoting alidade at b sight C and draw line bc'
2. Keep fiducial edge of alidade along ab. Unclamp0 the table and sight B. clamp the table. Pivoting alidade at a sight station C and draw lien to intersect
3. Keep the fuducial edge of alidade along dc and bisect C. clamp the table this gives the correct orientation of the table.
4. Let resector Aa intersect cd at 'P' this is the plotted position of station P. this may be checked with resector Bb.

Method of perpendiculars

This is another graphical method. The steps involved in solving three point problem are:

1. Draw ae perpendicular to ab. Keep alidade along ea and turn the table till A is sighted. Clamp the table and draw the ray Bb to intersect the ray Aae at e.
2. Similarly, draw cf perpendicular to bc. Clamp the table when fcC are in a line. Draw Bb to intersect Ccf at f.
3. Join df. Drop bp perpendicular to ef P is the plotted position of instrument station P.
4. Orient the table such that pbB are in a line. Clamp the table. This is the required orientation. Check the orientation by drawing resectors Aa and Cc.

4. What is resection? State 3 – point problem (,June-July15.,Dec14,.)

Resection: The principle of this method is just opposite to that of the method of intersection. The rays drawn from the unplotted position of a station to the points of known location are called resectors. This method is used to locate the plotted position of survey station by drawing resectors from plotted position of the objects. If a, b and c are the plotted positions A,B and C to locate instrument station P on the paper, after orienting the table resectors may be plotted. IF the orientation at P is correct all resectors will pass through a single point. That point is the plotted position P of station P. the problem, therefore, reduces to that of obtaining the correct orientation of C. Resection can be done after orientation of table by any one of the following methods:

i) By compass
ii) By back sighting
iii) By solving two point problems
iv) By solving three point problem.