Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–II • EXAMINATION – WINTER 2013

Subject Code: X20601 **Date: 20-12-2013**

Subject Name: Advance Surveying

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** What is tacheometry? Write its uses. **07**

(b) Describe the method of determining the constants of a tacheometer from field measurements. **07**

Q.2 **(a)** Explain the various sources of errors in tacheometry. **07**

(b) A tacheometer having constants 100 and 0.15 is set at X. The RL of Bench Mark is 350 meter. Followings are the readings obtained on a staff vertically held. Determine the distance between XY and RL of Y. **07**

Instrument station	staff point	Vertical angle	Staff Readings in meter.		
			Bottom	Center	Top
X	B.M.	-6^0	1.300	2.000	2.690
	Y	$+8^0$	0.900	1.700	2.500

OR

(b) Explain the various types of curve with neat sketch. **07**

Q.3 **(a)** Explain the elements of circular curve with neat sketch. **07**

(b) Describe briefly the location of sounding stations by means of (a) Cross rope soundings and (b) Intersecting ranges. **07**

OR

Q.3 **(a)** Explain the principle and objectives of photogrammetry. **07**

(b) Define: - Flight line, Azimuth, Swing, Tilted photographs, Exposure station, Principal line, Relief displacement. **07**

Q.4 **(a)** What are the advantages of EDM instruments? **07**

(b) Discuss electromagnetic spectrum with neat sketch. **07**

OR

Q.4 **(a)** Explain the following terms: **07**

(i) Departure (ii) Shortest Distance

(iii) Zenith (iv) Spherical triangle

Q.4 **(b)** Enlist the methods of determining Azimuth. Explain any one method. **07**

Q.5 **(a)** Explain components of Remote Sensing. **07**

(b) What is GPS? How it is useful in ground truth verification? **07**

OR

Q.5 **(a)** Define Geographical Information System. Explain the objectives of GIS. **07**

(b) Explain types of data in GIS software. **07**

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20-12-2013.

Q.1 (a) What is tacheometry & write its uses.

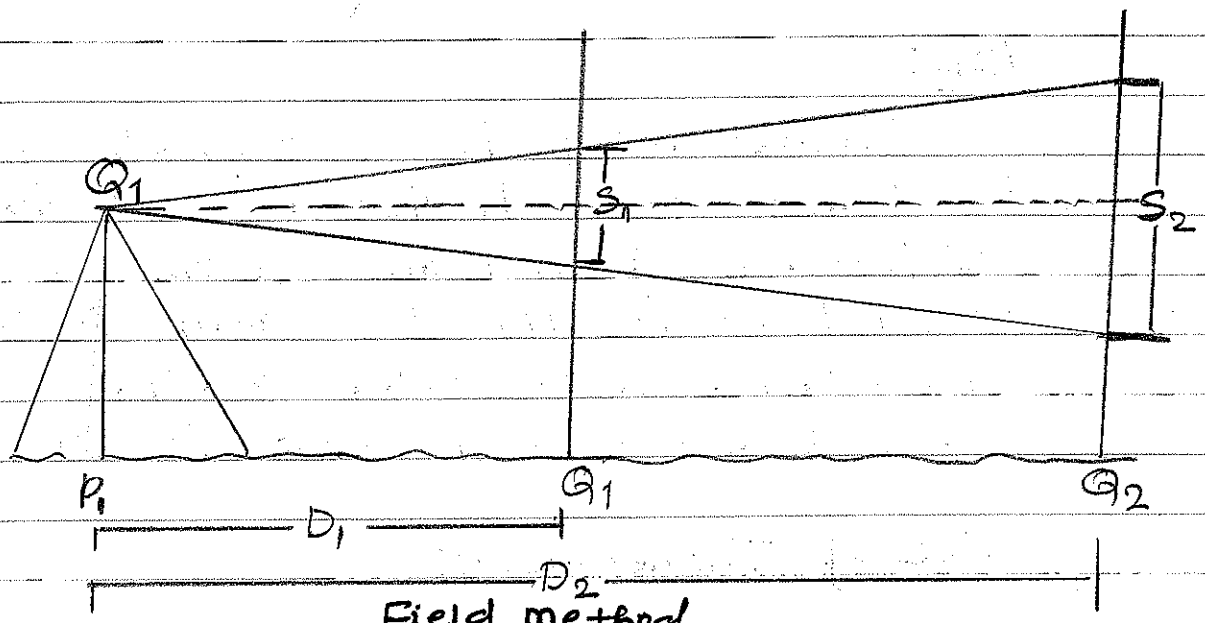
Ans:

Tacheometry is a branch of surveying in which the horizontal distance and the difference of heights (elevations) are determined indirectly by taking instrument observations (i.e. stadia reading and vertical angle when line of sight is inclined).

Use of Tacheometry:

(1) preparation of topographic maps in which both elevations and horizontal distance are required.
(2) Survey work in difficult terrains where direct methods would be inconvenient.
(3) Fillings in details in a traverse.
(4) Reconnaissance surveys for highways, railway reservoirs canals etc.
(5) checking of the distance measured with a tape or for checking of the elevations determined with a level.
(6) Hydrographic survey.
(7) Establishing secondary control points.

(b) Described the method of determining the constants of a tacheometer from field measurements.



Field method

(1) A fairly level ground is selected. The tacheometer is set up P_1 and pegs are fixed at Q_1 and Q_2 known distance apart.

(2) The staff intercepts (stadia hair readings) are noted at each the pegs. Let these intercepts be S_1 and S_2.

(3) The horizontal distances of the pegs from P_1 are accurately measured. Let these distance be D_1 and D_2

(4) By substituting the values of D_1 and D_2, S_1 & S_2 in the general Equation $D = A \cdot S + B$

We get two equations as follows.

$$D_1 = A \cdot S_1 + B \quad \text{and} \quad D_2 = A \cdot S_2 + B$$

(5) By solving the above two equations, values of A and B are determined.

Q.2 (a) Explain the various sources of errors in tacheometry.

Ans.

The following are the different sources of errors in tacheometry.

(1) Instrumental errors.
(2) personal errors.
(3) Errors due to Natural causes.

(1) Instrumental errors:

(a) Errors due to imperfects adjustments of the tacheometer. The adjustments of tacheometer may not be perfects, the errors will occurs. The permanent adjustments of the tacheometer should be checked and corrective actions may be taken if necessary.

(b) Errors due to staff (or Stadia rod). The graduation of the staff of stadia rod may not be uniform, the error will occur. the stadia rod should be standardised. Either the imperfect staff or rod should be replaced, or necessary corrections should be applied.

(c) Errors due to instrument constants. If the multiplying constant (A) and the additive constant (B) of the instrument may not be correct, the errors will occur. The constants should be verified by careful field observations before commencement of the work.

Personal errors:

These are errors of manipulation and sighting

(a) Errors due to inaccurate centring and levelling. To eliminate these errors.

(b) Errors due to non-verticality of the staff.

(c) Errors due to incorrect estimation of the staff intercept.

(d). Errors due to incorrect reading of vertical angle.

Errors due to natural causes:

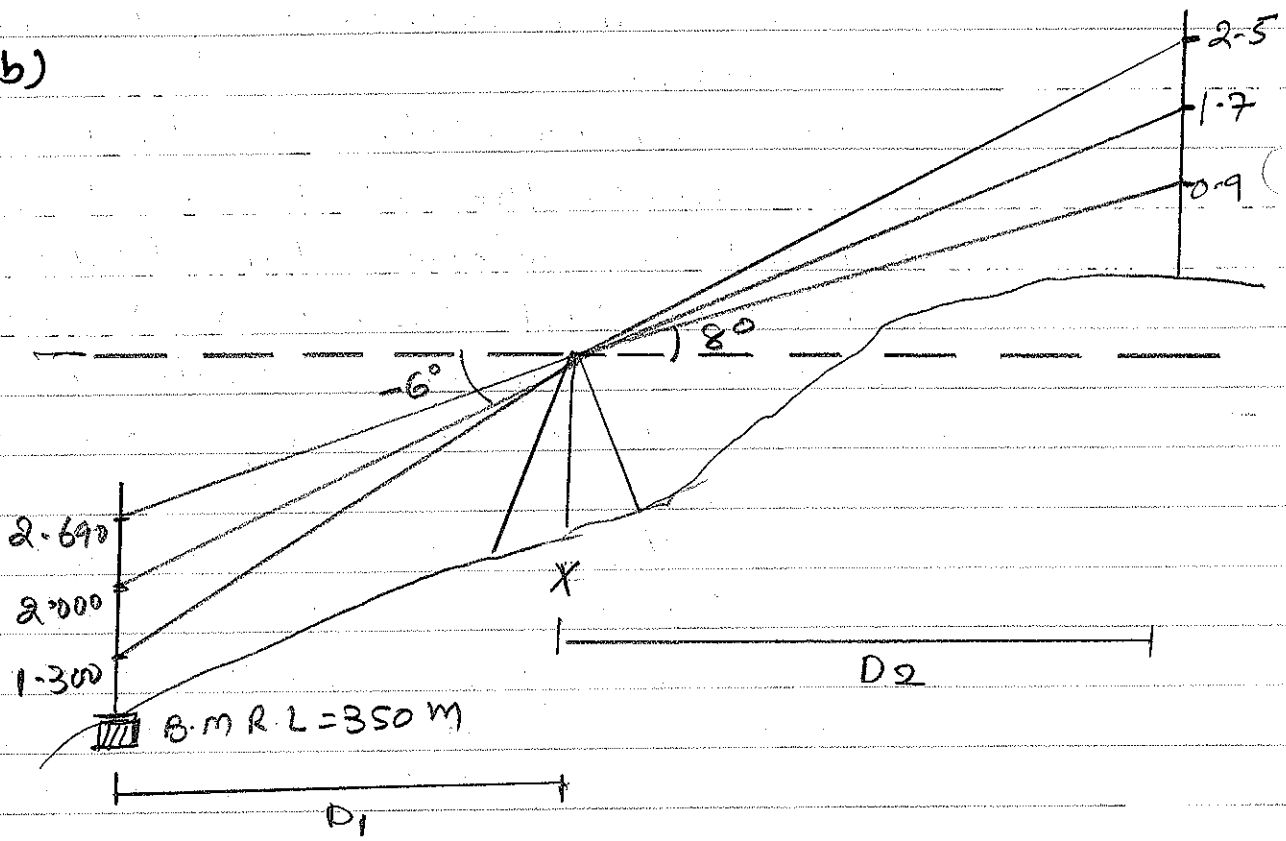
(a) Refraction

(b) Sun

(c) Wind

(d) poor visibility.

Q.2 (b)



When line of sight is inclined and the staff is held vertically, the horizontal and vertical distance are given by the equations.

$$D = A \cdot S \cdot \cos^2\theta + B\cos\theta$$

$$V = A \cdot S \sin\frac{2\theta}{2} + B\sin\theta$$

$A = 100$ & $B = 0.15$

In the first observation

$$S_1 = 2.690 - 1.300 = 1.390\,m$$

$$\theta_1 = -6^\circ \text{ (depression)}$$

$$V_1 = A \cdot S_1 \frac{\sin 2\theta}{2} + B\sin\theta_1$$

$$= 100 \times 1.390 \times \frac{\sin(2\times 6^\circ)}{2} + 0.15 \times \sin 6^\circ$$

$$= 14.55\,m$$

In the second observation

$$S_2 = 2.500 - 0.900 = 1.6\,m$$

$$\theta_2 = 8^\circ \text{ (Elevation)}$$

$$V_2 = A \cdot S_2 \times \frac{\sin 2\theta}{2} + B\sin\theta_2$$

$$= 100 \times 1.6 \times \left(\frac{\sin 8^\circ \times 2}{2}\right) + 0.15 \times \sin 8^\circ$$

$$= 22.29\,m$$

$D_2 = A \cdot S_2 \cos^2\theta + B \cos\theta_2$

$= (100 \times 1.6 \times \cos^2 8) + (0.15 \times \cos 8^\circ)$

$= 156.90 + 0.149$

$= 157.05\,m$

R.L. of instrument axis

$= R.L \text{ of } BM + h_1 + h_2$

$= 350 + 2.000 + 14.55$

$= 366.55\,m$

$R.L. \text{ of } B = R.L \text{ of Inst. axis} + V_2 - h_2$

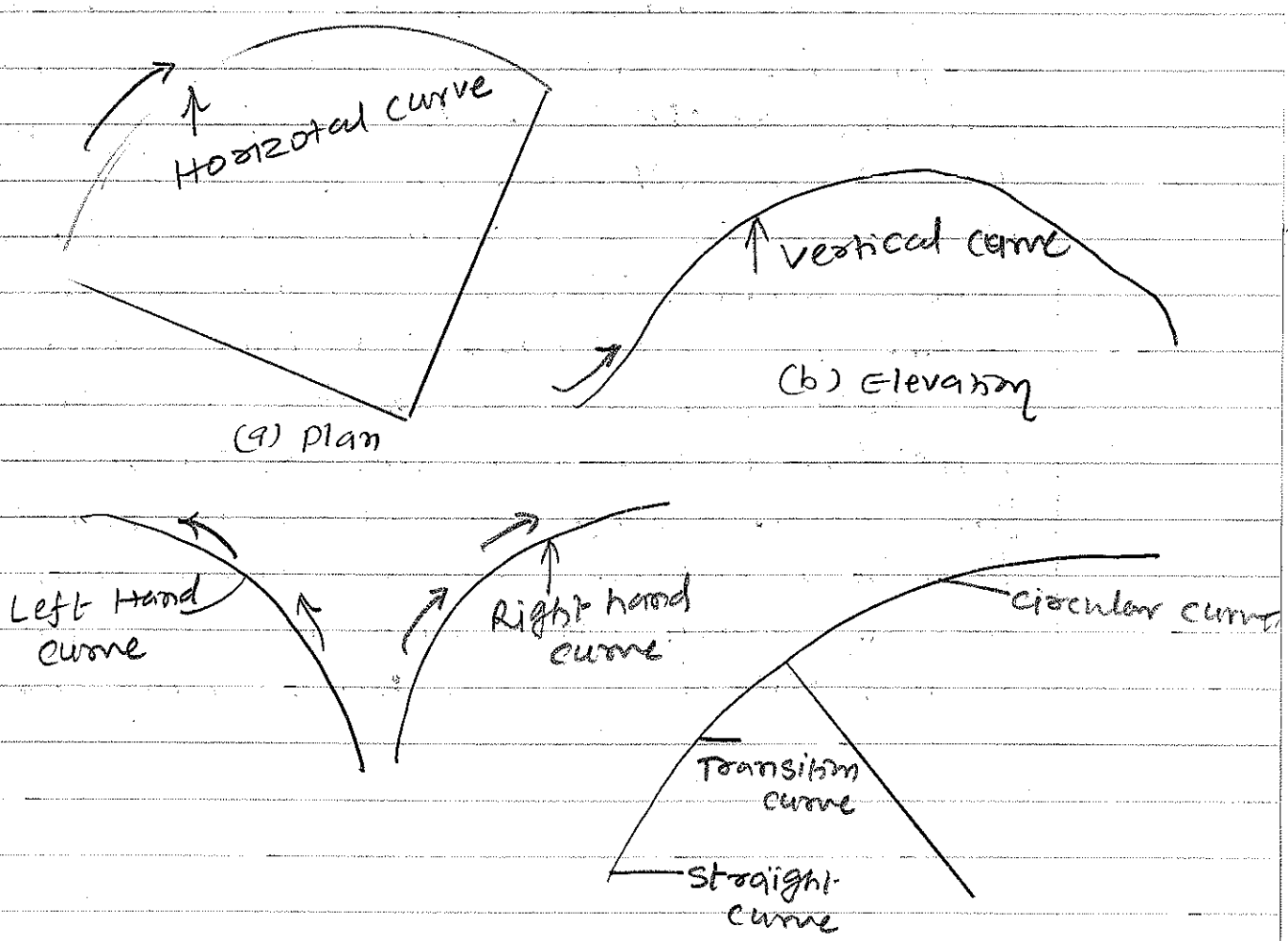
$= 366.55 + 22.29 - 1.700$

$= 387.14\,m$

So, Distance $XY = 157.05\,m$ and

RL of $Y = 387.14\,m$

Q.2(b) Explain the various types of curves with net sketch.



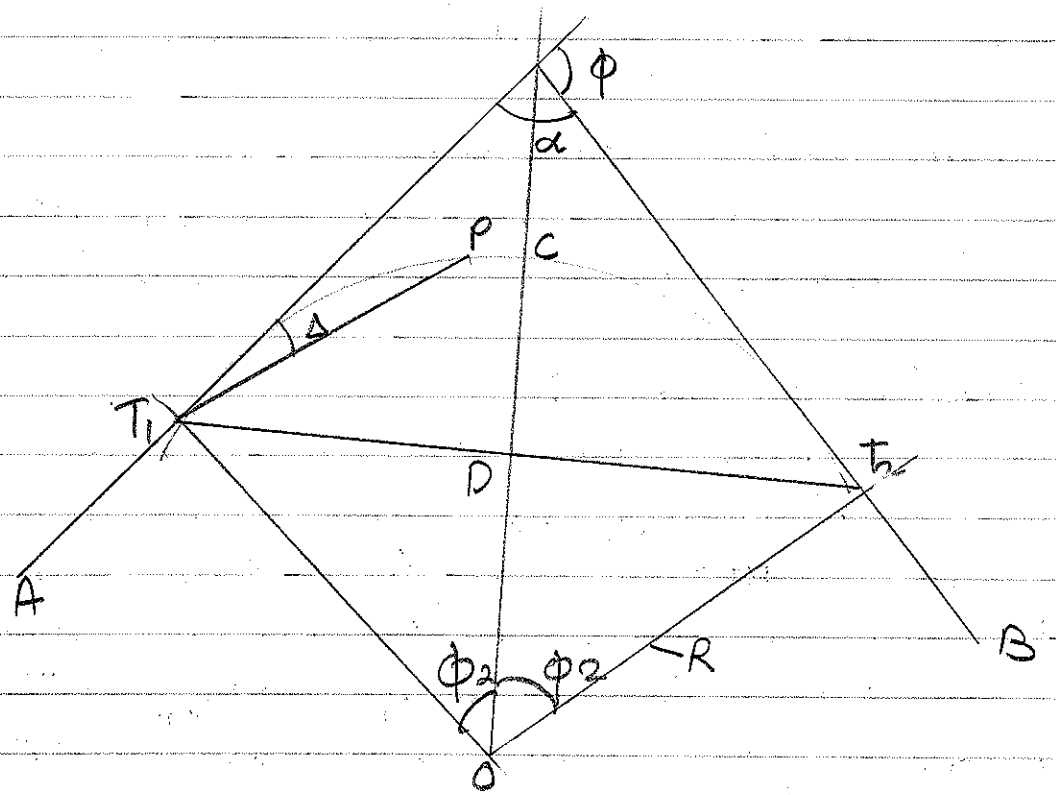
classi

Curves can be basically classified into two types - horizontal curve (curves in plan) and vertical curves (curves in a vertical section) of these two types, horizontal curves are more common and they often lie along a gradient. Vertical curves are used in hilly

terrian to move from one ~~elements~~ elevation to another smoothly (show fig). both these types of curves.

Curves can be classified based on their profile into circular curves, parabolic curves spirals, ~~spiro~~ etc. A curves of finite radius has to be attached to a straight line which is a curve of infinite radius. These is a sharp change in a radius at the meeting point. To smoothen out this sharp change of radius, a curve of varying radius is introduced between the straight part and the curve. Such a curve is known as a transition curve. Curve can be right-hand curves, when they turn towards the right or left-hand curves, when they turn ~~to~~ left-

Q.3(a) Explain the elements of circular curve with net sketch.



Back tangent:

The straight line AT_1 before the curve AT_1 is a tangent to the curve at T_1

Point of curve:

The point T_1 where the alignment changes from a straight line to a curve

Centre of curvature:

The point O which is the centre of the arc of radius R

Radius of curvature:

The radius R of the curve.

Point of intersection of vertex:

The point I where the two tangents to the curve intersect when produced.

Intersection angle (α)

The angle between the two tangents at I, T_1IT_2 is the intersection angle.

Deflection Angle:

The angle (ϕ) between the line AT_1 produced and the other tangent line IIT_2 is the deflection angle. If this angle is measured from the back tangent in the clockwise direction the curve is a right-hand curve. If it is measured in the anticlockwise direction from the back tangent, the curve is a left-hand curve. The deflection angle is also the angle between the radii OT_1 and OT_2 from the properties of circles.

Deflection angle to a point:

The deflection angle to any point like P on the curve is the angle by which the chord to that point T_1P, deflects from the back tangent. The angle IT_1P is the deflection angle at P.

Tangent lengths:

The length IT_1 or IT_2 are known as tangent length or tangent distances.

Long Chord:

The Straight length between T_1 and T_2 or the length $T_1 D T_2$.

Length of Curve:

The length $T_1 C T_2$ along the Curve It is the arc length and is designated by l.

Apex or summit:

The point C This is the midpoint of the arc length and lies on the bisector of the angle ϕ at the centre.

Apex distance or external distance:

The disance IC from the point of inter-section of the tangents to the apex C

Versed Sine:

The distance CD - distance from the ~~midpoint~~ midpoint of the Chord to the apex C.

Forward tangent:

The Straight line T_2B tangent to the Curve and at the end of the Curve.

Point of tangency:

The point T_2 which is at the end of the Curve and is the begining of the tangent.

Q.3 (a) Explain the principle and objectives of photogrammetry.

Ans:

Principle:

(1) Terestorial photogrammetry:

Photo theodolite is used to take the photographs from higher altitude points of earth. Plans are developed from photographs taken for same area from different ground points. Using principles of plane table survey, maps are prepared using photographs.

(1) Aerial photogrammetry:

Where photographs are taken with the help of aerial camera mounted on aircraft. Each photograph is perspective view. But orthographic view is developed using stereoscopic principle when two photo graph of same area either taken by two pairs of aerial camera at same point of time or two successive photographs taken from single camera photographs are viewed in stereoscope or computer software gives 3D view of the ground area and can be used to produce orthographic plan or map of the area by applying principle of plane tabling.

Objective of photogrammetry.

(1) military ~~Intelli~~ Intiligence: for Strategic planning of security of country and during war to map military camps of enemy

(2) Soil classification: To prepare maps showing types of soil over particular area may be used for agriculture or Forest development.

(3) Land use classification:
Aerial survey is very convenient to classify areas based on use of area, i.e. industrial residential commercial, agricultural etc.

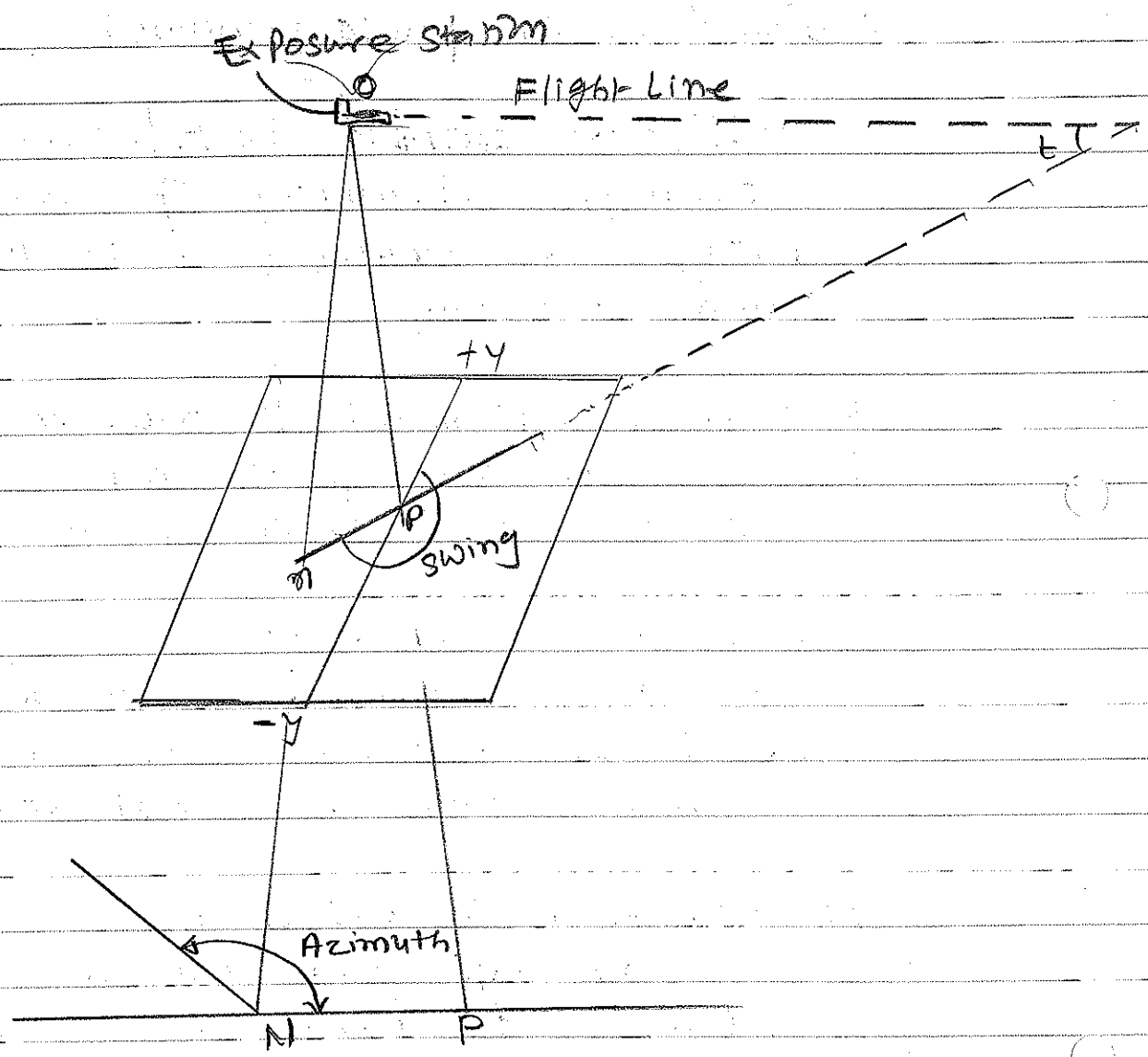
(4). Geological Investigation:
photomaps and mosaics can be used to identify ~~for~~ interpret rocks, fault, dip etc.

(5) Law and order:
Aerial survey can be used for planning security for large public gatherings like republic days parade or kumbh mela.

(6) Satellite Image Interpretation:

For ground truth verification of training areas of satellite images and interpretation of images photogrammetry is very useful and convenient.

Q.3(b).



(1) Flight Line:

Line traced by exposure station in atmosphere i.e. track of aircraft.

(2) Azimuth:

clockwise horizontal angle measured about ground Nadir point from true north to the principal plane of photograph.

(3). Swing:

Angle measured in plane of photograph from +y axis clockwise to photo nadir point.

Tilted Photographs:

Camera axis are tilted and does not coincide with direction of gravity (plumb line) and angle of tilt t is less than 3°. Such photographs are also known as low oblique photographs.

Exposure station:

The point in the atmosphere occupied by centre of camera lense at instance of photography (exposure)

Principal line:

Line of intersection of principal plane with photograph plane i.e line np

Relief displacement:

Every point on photo is displaced from true orthographic position. This displacement is termed as relief displacement

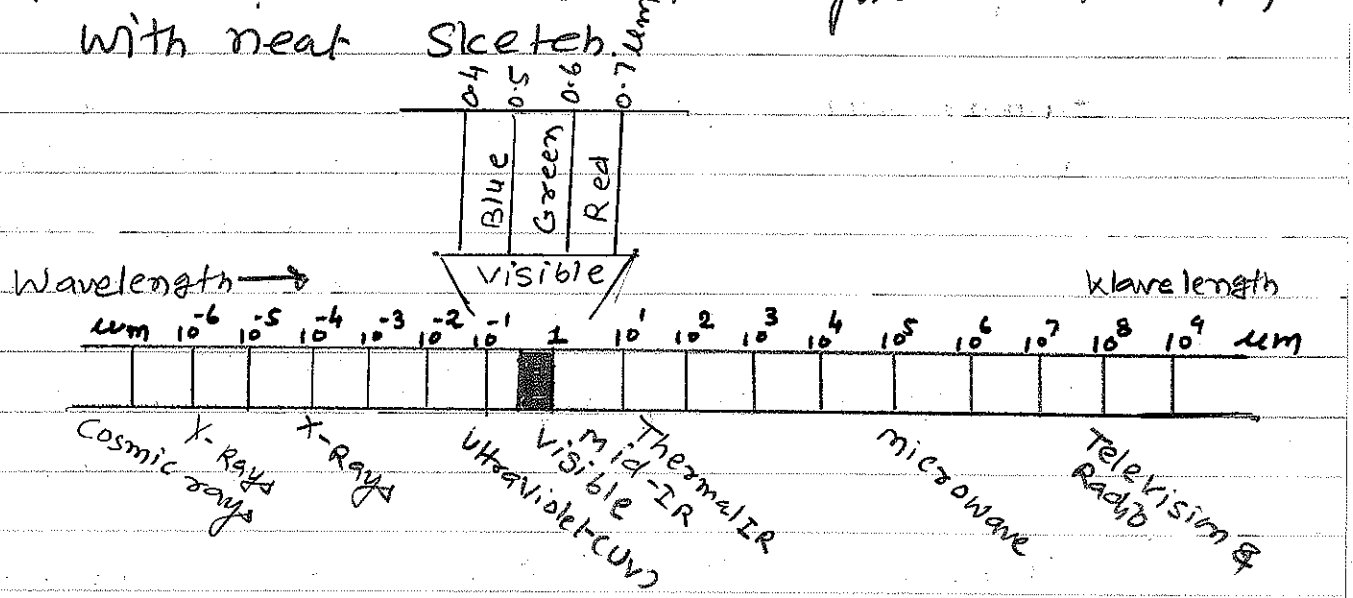
$$d = \frac{rh}{H}$$

$$d = \frac{r_0 h}{H-h}.$$

Q.4

(a) What are the advantages of EDM instruments.

Q. 4 (b) Discuss electromagnetic spectrum with neat sketch.



Electromagnetic Spectrum.

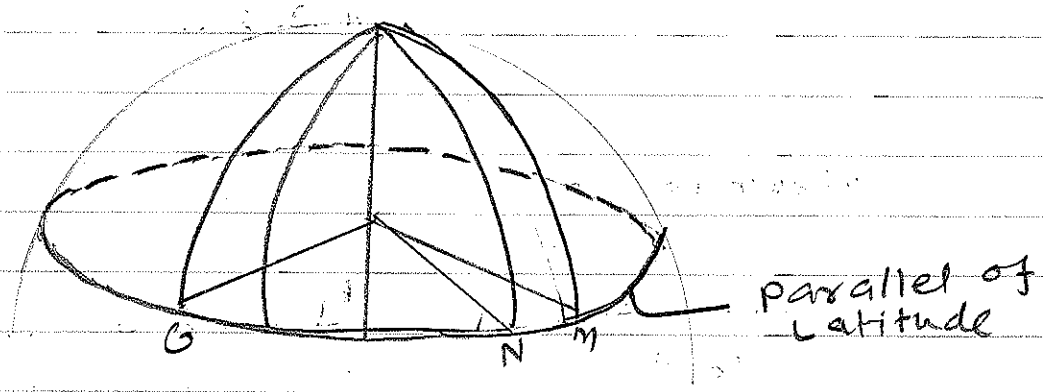
The light which our eyes are able to see is comprised of seven colours which is only a very small portion of EM spectrum coming from the Sun to earth's surface. The total of energy coming from the Sun comprises energy wave length varying from 10^{-6} μm to 10^{9} μm. EM spectrum is whole bunch of all wave length energy continuously coming from the Sun to earth.

Different ranges of wave length are classified based on their similar characteristics.

Components	Wave band	Description
Gamma and X-rays	< 0.3 μm	Energy waves upto wave length 0.3 μm are completely blocked by ozone layer of upper atmosphere.
Ultraviolet	0.3 to 0.4	Can be photographs both are possible.
Visible	0.4 to 0.7 μm	Image and photographs both are possible.
Infrared	0.7 to 1.0 μm	Interaction with object varies according to wave length.
mid-IR	0.7 to 0.9 μm	Can be filmed known as photographic IR
Reflected IR	0.9 to 3.0 μm	Reflected energy contains information about thermal properties of materials.
Thermal IR	3 to 5 μm	Optical mechanical scanners and specials vidicon system used.
Radar	0.1 to 30 cm	Active remote sensing using this band.
Radio	> 30 cm	Radio and Television broadcasting using this wave band

Q.4 (a)

(I) Departure: & (II) Shortest Distance.



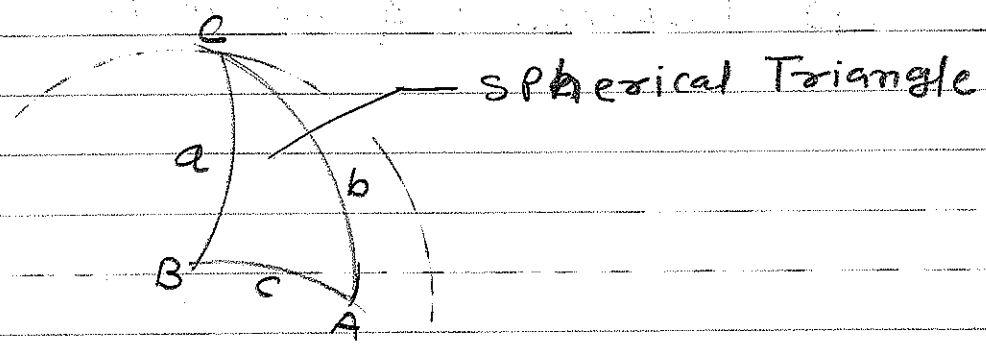
Small circular parallel to equator is known as parallel of latitude (Fig) All the points on this parellel of latitude will have same latitude. The angular distance between two point on parellel of latitude is know as departure.

Departure = arc MN = Difference of longitude
$\times \cos$ (latitude)
$= (L_M - L_N) \times \cos\theta$

Departure i.e distance between any two points along parallel of latitude is not shortest distance. Shortest distance between any two points is along the arc of great circle passing from both points.

Shortest angular distance between two points A and B can be calculated using spherical Trigonometry.

Spherical Triangle



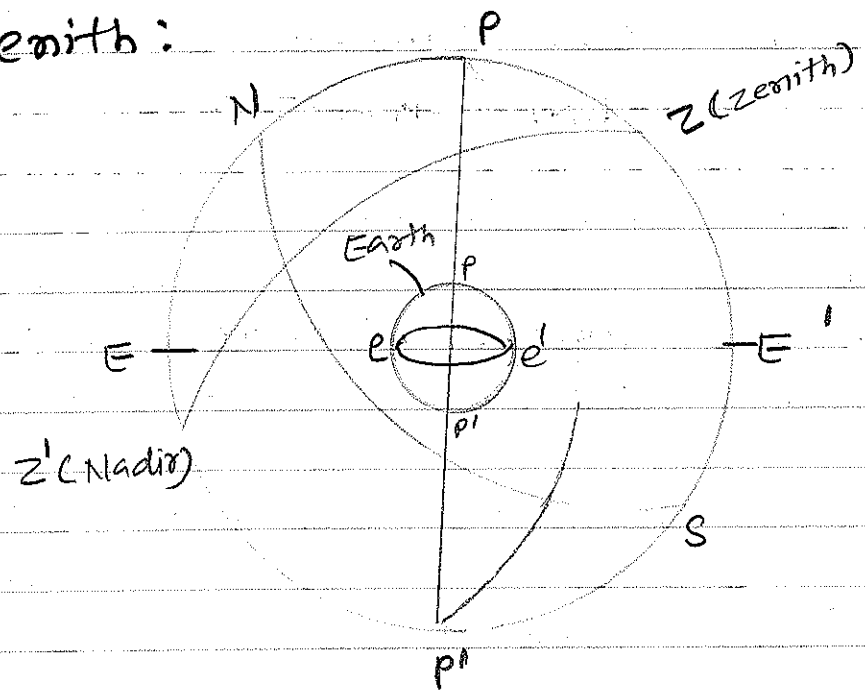
A B and C are spherical angle and a, b and c are sides opposite to them for spherical Triangle.

Cosine formula : $\cos a = \cos b \cos c + \sin b \sin c \cos A$

$\cos A = -\cos B \cos C + \sin B \sin C \cos a$

Sine formula : $\dfrac{\sin a}{\sin A} = \dfrac{\sin b}{\sin B} = \dfrac{\sin c}{\sin C}$

Zenith :



The vertical axis of instrument (theodolite or total station) at survey station of earth are vertically projected upward to intersect with celestial sphere at a point known as zenith.

Q.4(b)

Enlist the methods of determining Azimuth. Explain any one method.

method of determining Azimuth are as follows.

(i) method of determination of True meridian

(a) Observation on polaris or polar star at culmination.

(b) observation on polaris or pole star at elongation. (western or eastern).

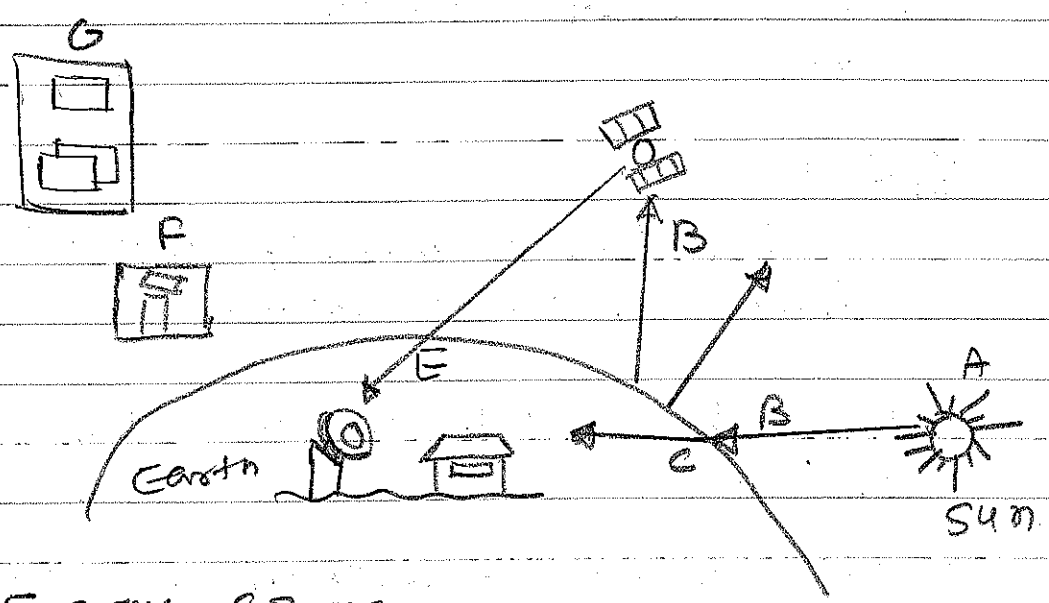
(ii) Determination of Azimuth of the Survey line

- observation on the sun
- Observation on circumpolar star on prime vertical
- By observation on circumpolar star at elongation (East or West)
- Observation on a circumpolar star on equal altitudes.
- measuring horizontal angles of the sun on equal altitudes.

Q.5

(a) Explain components of Remote sensing.

* Components of Remote sensing are follows



(A) Energy Source
(B) Interaction of Energy with Atmosphere
(C) Interaction of Energy with target
(D) Recording of Energy by sensor
(E) Transmission, Reception and processing
(F) Interpretation and Analysis.
(G) Application.

(A) Energy Source.

The first requirements of remote sensing is to have an energy source that illuminates or radiates electromagnetic energy to the target of interest.

(B) Interaction of Energy with Atmosphere:

As the EM energy travels from its source to the target, it will come in contact with and interact with the atmosphere on its way to earth's surface. Also after reflecting

from the earth's surface, it again passes through the atmosphere on its way to sensor.

(C) Interaction of Energy with Target

once the energy makes its way to the target through the atmosphere it interacts with the target depending on the properties of both the target and the radiation. The interaction of EM energy with earth's surface features generates reflected and/or emitted singnals.

(D) Recording of Energy by sensor:

After the energy has been reflected by or emitted from the target, we require a sensor to collect and record the EMR. Sensor are mounted on satellite

(E) Transmission, Reception and processing:

The energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station on the ground where the data are processed into an image. The data product are mainly classified into two categories.

(i) Pictorial or Photographic product
(ii) Digital product.

(F) Interpretation and Analysis:

The processed immage is interpreted visually and/or digitally or electronically to extract information about the target of interest. The data analysis process involves examining the data using various viewing instruments to analyses pictorial data, which is called the visual image interpretation technique.

(G) Application.

Finally we apply the information about the target of interest to prepare maps. The set of data becomes various forms of maps for different users with the understanding of their field and interpretation. Hopefully, the people can use information to make improved engin-eering and management decisions.

Q.5 (b)

What is GPS? How it is useful in ground truth verification

Ans

The Global Positioning systems (GPS) is a worldwide radio navigation system formed from a constellation of 24 satellites and their ground stations.

The GPS enables the user to locate his/her position in three dimensions (longitude, latitude and altitude or x, y and z) as well as with respect to time.

Use and Application:

(a) Navigation
(b) Surveying.

(a) Navigation:

Marine and air navigation are perhaps the two most obvious applications of GPS. Both military and civilians wish to know their spatial locations are precisely as possible. The regional applications of GPS include exploration, transportation management, structural monitoring and various types of automation. As a local application GPS can be aid in berthing and docking of large vessels. For approches to airport and harbours, Differential Global Positioning system has been developed.

Surveying:

GPS provides a means to locate position it is evident that it can be used for survey works as surveying is the process of locating points on the surface of the earth since GPS receivers need to receive signals from satellites, it is clear that the ground equipment should be placed such that it is possible to receive signals from satellites. A GPS receiver can determine positions when it receives signals from atleast four satellites in the range.

GPS can be used in base line measurement for geodetic surveying staking out and all other forms of surveys.

GPS techniques permit the collection of data on specified profile cross section and boundary locations, contours may be readily plotted from the collected data. Local use of GPS includes local property and site survey to perform topographic survey, to use GPS kinematic surveying to determine the co-ordinates of the photo centre during aerial mapping flights.

GPS is very useful for layout works one base receiver supported by many rover receivers permits the instantaneous layout of boundaries, pipelines roads and building locations.

Q.5 (a) Define Geographical Information System. Explain the objective of GIS.

Ans:

Define: GIS is tool for storing, processing and retrieving displying data for Geospatially referenced earth surface

Objective of the GIS.

(1) To collect analyse and manipulate spatial data
(2) To produce maps and other products in standardized formats for different uses.
(3) To supply information in useful formats for logical decision making for planners
(4) To support research activities using spatial as well as non spatial data.

Q.5 (b). Explain types of data in GIS Software.

Ans

There are basically two types of data :

(1) Spatial Data
(1) Attribute Data.

Spatial Data: also known as location data. This data is in form of co-ordinates Latitude, Longitude, Elevation and Time of data recording.

Attribute Data:

This is in form of other information of feature like name, size, age, characteristics: Qualitatives: i.e type condition etc. and Quantitative: area, capacity length diameter population, number, spread etc.

Sources of Data.

(1) Topographic maps of different scales
(2) Satellite images and photographs.
(3) Administrative boundaries
(4) Census Data
(5) Statistical data of viz. - Landuse
- Land cover
- ownership
- People.
(6) Data on utilities viz. - Gas
- Water
- Electricity lines
- Drainage network
(7) Data on - rocks, water, soil
- atmosphere,
- Biological activity
- natural hazards and disasters.

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–II • EXAMINATION – SUMMER 2013

Subject Code: X20601 **Date: 06-06-2013**

Subject Name: ADVANCE SURVEYING

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Describe the method of determining the constants of Tacheometer from field measurements. **07**

(b) Tacheometer was setup on the line joining stations A and B. Following reading were obtained on a staff held vertically at a point A and B. **07**

Instrument station	Staff station	Vertical angle	Staff reading	Remarks
P	A	+ 8° 24'	2.225, 2.605, 2.985	R L of A is 150 m
	B	- 1° 06'	1.640, 1.920, 2.200	

Calculate the horizontal distance between point A and B and R L of B when the constant of instruments are 100 and 0.00.

Q.2 **(a)** What are the different types of curves ? Draw neat sketch of each. **07**

(b) Two tangents intersect at a chainage of 1000 m, the angle of deflection being 30°. Calculate all the necessary data for setting out a circular curve of radius 200 m by a peg interval of 20 m. **07**

OR

(b) Two tangents intersect at a chainage of 1320.5 m. The deflection angle being 24°. Calculate the following quantities for setting out a curve of radius 275 m. **07**

(i) Tangent length
(ii) Length of long chord
(iii) Length of the Curve
(iv) Chainage of point of tangency
(v) Apex distance
(vi) Versed sine of curve

Q.3 **(a)** Define Hydrographic survey and write it's uses. **5**

(b) Enlist the equipments used for hydrographic survey. **5**

(c) Write advantages of echo sounding. **4**

OR

Q.3 **(a)** Define **07**

(i) Overlap
(ii) Side lap
(iii) Principal point
(iv) Isocenter
(v) Tilt

(b) Two points A and B on the ground appear in vertical photo as a and b taken from an aerial camera, having focal length of 16 cm and flying height (H) of 5000 m. The photo co ordinates of a and b are as follow. **07**

Photograph co ordinates

	x	y
a	- 2.0 cm	+ 2.65 cm
b	+ 2.18 cm	+ 1.30 cm

The height of points A and B is 160 m and 180 m respectively. Calculate the ground distance of point A and B.

Q.4 **(a)** Enlist the different types of EDM instruments and explain briefly the salient features of " Total station". **07**

(b) What are the properties of electromagnetic waves ? Draw complete electromagnetic spectrum showing all wave length. **07**

OR

Q.4 **(a)** Define **07**

(i) Zenith
(ii) Nadir
(iii) Vertical circle
(iv) Prime vertical
(v) Observer's meridian
(vi) Circumpolar star
(vii) Celestial circle

Q.4 **(b)** Calculate the sun's hour angle (H) and azimuth (A) at sunrise for a place in latitude 26° when it's declination is 18° N. **07**

Q.5 **(a)** Define Remote sensing and explain principle of remote sensing with sketch. **07**

(b) Classify the sensors and explain briefly each of them. **07**

OR

Q.5 **(a)** Define GIS and write the key components of GIS with it's functions. **07**

(b) Explain types of data in GIS and also write sources of data. **07**

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(1)

Q.1 (b).

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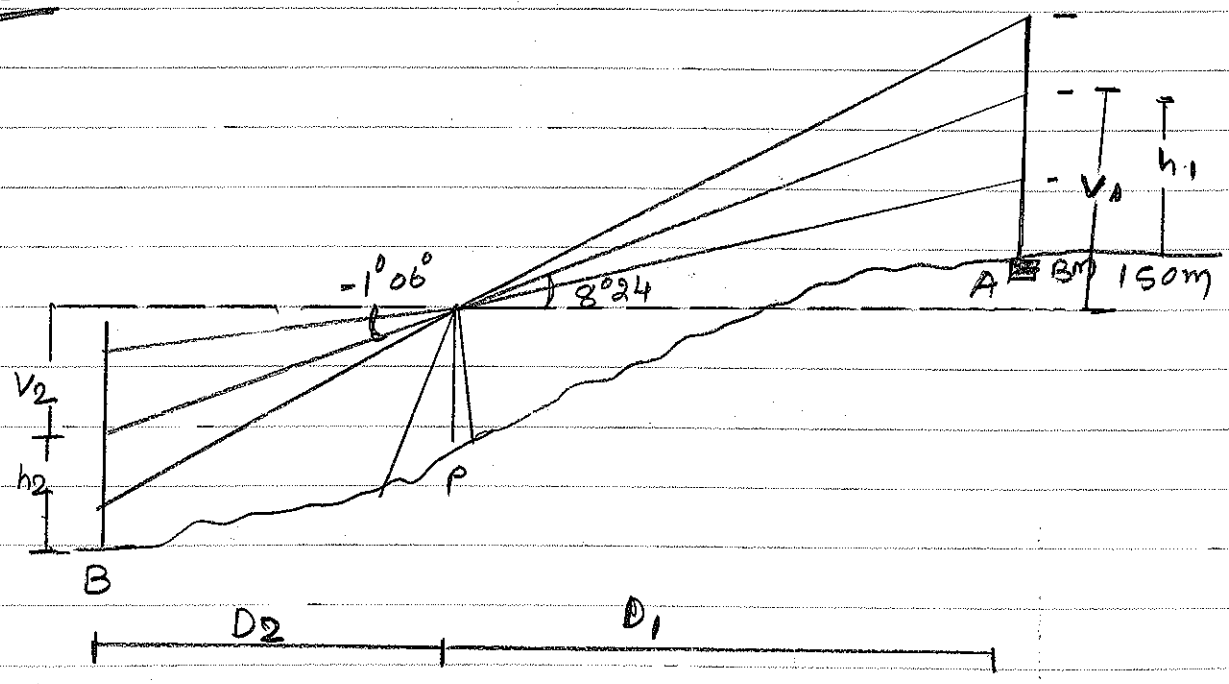


Data First observation PA

$S_1 = 2.985 - 2.225$

$= 0.76\,m$

$\theta_1 = 8°24'$

$A = 100$

$B = 0.00$

$V_1 = A \times S_1 \times \frac{\sin 2(\theta_1)}{2} + B \sin \theta_1$

$= \frac{100 \times 0.76 \times \sin 2(8°24')}{2}$

$= 11.10\,m$

$D_1 = A \times S_1 \cos^2 \theta_1 + B \cos \theta_1$

$= 100 \times 0.76 \times \cos^2 8°24' + 0$

$= 74.38\,m$

Second observation PB

$S_2 = 2.200 - 1.640$

$= 0.56\,m$

$\theta_2 = -1^\circ 06'$

$V_2 = A \times S_2 \times \frac{\sin 2\theta}{2}$

$= \frac{100 \times 0.56 \times \sin 2(1^\circ 06')}{2}$

$= 1.075\,m$

$D_2 = A \times S_2 \times \cos^2 \theta_2$

$= 100 \times 0.56 (\cos^2 1^\circ 06')$

$= 55.97\,m$

R.L of B

$-$ RL of H.I at P $= R.L\ of\ h_1 - V_1$

$= 150 + 2.065 - 11.70$

$= 141.505$

R.L of B $= H.I - V_2 - h_2$

$= 141.505 - 1.075 - 1.92$

$= 138.57\,m$

Q.2 (b) OR.

Given Data.

Chainage of P.I = 1320.5 m
Deflection angle $\Delta = 24^\circ$
Radius of curve = 275 m.

(1) Tangent length

$$T = R \tan \frac{\Delta}{2}$$

$$= 275 \times \tan \frac{24}{2}$$

$$= 58.45 m$$

(2) Length of long chord.

$$L = 2R \sin \Delta/2$$

$$= 2 \times 275 \times \sin 24/2$$

$$= 114.350 m$$

(3) Length of the curve

$$l = \frac{R \times \Delta \times \pi}{180}$$

$$= \frac{275 \times 24 \times \pi}{180}$$

$$= 115.19 m$$

(iv) Chainage of point of tangency.

= Chainage of point of intersection − tangent length

= 1320.50 − 58.45m

= 1262.05

Chainage of the point of tangency

= Chainage of point of curve + length of curve

= 1262.05 + 115.19

= 1377.24m

(v) Apex Distance

$= R\left(\sec\frac{\Delta}{2} - 1\right)$

$= 275\left(\sec\frac{24}{2} - 1\right)$

$= 275\left(\frac{1}{\cos 12} - 1\right)$

= 6.14m

(vi) Versed sine of curve

$= R\left(1 - \cos\frac{\Delta}{2}\right)$

$= 275(1 - \cos 12)$

= 6 m.

Q.3 (a) Define Hydrographic Survey and write it' uses.

Ans:

Define:

Hydrographic survey is that branch of surveying which deals with the measurement of bodies of water. It is the art of delineating the submarine levels, contours and features of seas, gulfs, rivers and lakes,

Uses:

(1) making nautical charts for navigations and determination of rocks sand bars lights and buoys.

(2) making subaqueous investigation to secure information needed for the construction development and improvement of port facilities

(3) measurement of areas subject to scour or silting and to ascertain the quantities of dredged material.

(4) controlling and Planning of Engineering projects like bridges, tunnels, dams, reservoirs docks and harbours.

(5) Establishing mean sea level and observation of tides.

(6) Determination of shore lines; and

(7) measurement of discharge of rivers.

Q.3 (b) Enlist the equipment used for hydrographic Survey.

Ans:

(i) sounding boat
(ii) Sounding Rods or poles.
(iii) Lead lines.
(iv) Sounding machine
(v) Fathometer.

Q.3 (c). Write Advantages of echo sounding.

Ans:

(1) It is more accurate as it gives the vertical depth correctly
(2) It can be used even in strong currents and when the weather is not suitable for the lead-line method.
(3). It is more sensitive than the lead line method.
(4) It gives a continuous record of the bed.
(5) The sounding and plotting is done quickly
(6) Rocks underlying the softer bed material can also be located.

Q.2 (b)

Given Data

$\Delta = 30^\circ$

Peg interval = 20m

R = 200m

(A) Tangent Length (T) = $R \tan\frac{\Delta}{2}$

$= 200 \times \tan 30/2$

$= 53.59m$

(B) Length of Curve (l) = $\frac{\pi R \Delta}{180}$

$= \frac{\pi \times 200 \times 30}{180}$

$= 140.72m$

(C) Chainage of P.C = Chainage of P.I − T

$= 1000 - 53.59$

$= 946.41m$

(d) Chainage of P.T. = Chainage of P.C + l

$= 946.41 + 104.72$

$= 1051.13m$

(e) The chainage of each peg will be multiple of 20m

Length of Sub chord $c = 950 - 946.41$

$= 3.59m$

Length of last Sub Chord = $c' = 1051.13 - 1050$

$= 1.13m$

No of Full chords (20m) $= \frac{1050-950}{20}$

$= 5$ (each 20m)

$C = 20m$ (each intermediate chord length)

tangential length $\delta = 1718.9 \times \frac{C}{R}$ minute

$= 1718.9 \times \frac{3.59}{200}$

$= 30.85$ min $= 30^\circ 51' 15.32''$

δ_2 to δ_6 $= 1718.9 \times \frac{20}{200} = 171.89$ min

$= 171^\circ 53' 24''$

$\delta_7 = 1718.9 \times \frac{1.13}{200} = 9.711$ min $= 9^\circ 42' 42.43''$

Peg No	Chainage (m)	Chord length (m)	Deflection Angle	
1	950	3.59	$\Delta_1 = \delta_1 =$	$0^\circ 30' 57''$
2	970	20.00		$2^\circ 42' 44''$
3	990	20.00		$4^\circ 54' 37''$
4	1010	20.00		$7^\circ 6' 30''$
5	1030	20.00		$9^\circ 18' 23''$
6	1050	20.00		$11^\circ 30' 16''$
7	1051.13	1.13		$11^\circ 39' 58''$

Q.3
(b).

$f = 16\,cm = 160\,mm$

$H = 5000$

$h_A = 160$

$h_B = 180$

$x_a = -2.0\,cm = 20\,mm$

$x_b = +2.18\,cm = 21.8\,mm$

$y_a = +2.65\,cm = 26.5\,mm$

$y_b = +1.30\,cm = 13.0\,mm$

$$X_A = \frac{H - h_A}{f} \times x_A$$

$$= \frac{5000 - 160}{220} \times (-20) = -440\,m$$

$$X_B = \frac{H - h_A}{f} \times y_B$$

$$= \frac{5000 - 160}{220} \times 26.50 = 583\,m$$

$$X_B = \frac{H - h_B}{f} \times x_b$$

$$= \frac{5000 - 180}{220} \times 21.8$$

$$= 447.62\,m$$

$$Y_B = \frac{5000 - 180}{220} \times 13$$

$$= 284.82\,m$$

$\therefore$ Length of ground line AB

$$AB = \sqrt{(X_A - X_B)^2 + (Y_A - Y_B)^2}$$

$$= \sqrt{(2440 - 447.62)^2 + (583 - 284.82)^2}$$

$$= 936.36\,m.$$

OR

Q.3 (a)

Define

(I) overlaps:

Overlaps of photographs means same ground area in adjacent photographs is common i.e. same area is viewed by several photographs, that is known as overlap.

(II) Side lap:

Overlap between photographs of adjacent flight line is known as side lap or lateral overlap.

(iii) principal point:

The point of intersection of optical axis is called principal point.

(iv) Isocenter:

point on photo where bisection of tilt falls on photo.

(v) Tilt: ~~[illegible] line on plane of photograph~~ & Camera axis are tilted and does not coincide with direction of gravity (plumb line) and angle of tilt t is less than 3°.

Q. 4 (a) List the different type of EDM instruments and explain briefly the Sailent features of "Total station"

Ans:

Type of EDM are as follows.

(1) microwave Instruments - Tellurometer
(2) Infrared Instruments - wild distometer
(3) Visible light Instruments - Geodimeter.

Sailent feature of Total station:

A total station is also known as electronic Tacheometer.

Various parts of total station and the function of each part is given below.

(1) Electronic Theodolite.
(2) EDM instrument.
(3) microprocessor and memory unit.

(1) Electronic Theodolite:
- The main function of the Electronic theodolite is to measure vertical angles and horizontal angle.

(2) A Standard transit is basically a telescope with cross hairs for sighting a target.

(3) measuring angles are displayed on the screen in the form of form.

(4) The accuracy in the measurement of angle is about 2 to 6 seconds.

(2) EDM Instrument:
- The EDM instrument is an important part of total station EDM = Electronic Distance measuring.
- The main function of EDM is to measure distance.
- Its range of measuring distance ~~measuring~~ measurement is about 5 mm to 10 mm per kilometer.

or

(3) microprocessor and memory unit:
- most of the total stations include data recorders or memory units.
- The raw data (angles and distance) and the coordinates of points sighted are recorded along with some additional information in the memory unit.
- The Data so collected is analysed by microprocessor and angle and distance are displayed digitally.

Q.4 (b) Refer Paper. 20.12.13 Ans. 4(b)

Q.4(a) OR

Define:

(1) Zenith:

The point on the celestial sphere vertically above the observer's station is called the zenith (Z).

(2) Nadir:

The point on the celestial sphere vertically below the observer's station is called the Nadir (Z')

(3) Vertical circle:

The great circle of the celestial sphere passing through the zenith and nadir points are called vertical circles.

(4). Prime Vertical:

The vertical circle perpendicular to the observer's meridian and passes through the east and west points of the horizon is called prime vertical.

(5). Observer's meridian:

The vertical circle which passes through observer's zenith and Nadir and the poles is called the observer's meridian

(6). Circumpolar star: A star is called circumpolar if it always remains above the horizon and therefore, it does not set. Such a star appears

to the observer to describe a circle above the pole.

(7) celestial sphere:

on a clear night millions of stars and planets are visible to the naked eye. The imaginary sphere on which these heavenly bodies appear to lie is known as celestial ~~spar~~ sphere.

Q. 4(b)

Calculate the sun's hour angle (H) and Azimuth (A) at sunrise for a place in latitude 26° when it's declination is 18° N.

Hour angle (H)

cos (90° —

Latitude of the observer = θ = 26° N.
Declination = δ = 18° N.

Hour angle

$$\cos H = \tan\theta \cot\delta$$

$$= \tan(26) \cot 18^\circ$$

$$= \tan 26 \times \frac{1}{\tan 18}$$

$$\cos H = 1.50$$

$$H = \cos^{-1} 1.5$$

Azimuth (A)

$\sin A = \cos \delta \cdot \sec \theta$

$= \cos(18) \cdot \frac{1}{\cos(26)}$

$\sin A =$

$A = \sin^{-1}(1.058)$

Q.5 (a) Refer - Paper - 16/1/13

Q.5 (b) Classify the sensors and explain briefly each of them.

Ans:

There are two types of sensors.

(1) Passive sensor
(2) Active sensor

Passive sensor:

Passive sensor senses natural radiation which is either emitted or reflected from the target. The sun's energy is either reflected, as it is for visible wavelengths, or absorbed and then re-emitted, as it is for thermal infrared wavelength.

Passive sensor can only be used to direct naturally occuring energy. There is no reflected energy available from the sun at night. The amount of solar radiation present at polar latitudes is often insufficient for visible light sensors limiting the use of passive sensors to lower latitudes.

Active sensors:

The sensors which produces its own electromagnetic radiation of a specific wave length or band of wavelengths and the interaction of this radiation with the target is

is studied for target identification are called active sensors.

The active sensor direct a burst of radiations at the target and use sensor to measure how the target interacts with the energy. most often the sensor detects the reflection of the energy, measuring the angle reflection or the amount of time it took for the energy to return.

Synthetic Aperture Radar (SAR) is one of the best example of active remote sensing. This sensing system operates in the microwave region of electromagnetic spectrum and include radiation with wavelength longer than 1 mm.

Doppler Radar: is another example of an active remote sensing technology. A Doppler radar is a ground based system that emits radio energy in a radial pattern as the transmitter rotates. A sensor measure the reflection or echoes of this energy off such atmospheric particles as dust, raindrops and even birds. These echoes when plotted on a regional map, assist a meteorologist in determining the exact location of storm centre

Sensors are further classified

(i) OIR sensors

(ii) microwave sensors

(iii) Imaging sensors

(iv) Non-imaging sensors.

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER – II • EXAMINATION – WINTER 2012

Subject code: X 20601 **Date: 16/01/2013**

Subject Name: Advanced Surveying

Time: 10.30 am - 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Discuss instruments used in tacheometry.	**07**
	(b)	What are the different errors in tacheometry? What are the permissible errors?	**07**
Q.2	**(a)**	A Staff was held vertically at a distance of 50 m and 100 m from the centre of a theodolite fitted with stadia hairs and the staff intercepts with the telescope horizontal were 0.5 and 1 m respectively. The instrument was set over the station A f RL is 1050.50 m and the height of instrument was 1.45 m. The stadia hair readings of a staff held vertically at a station B were 1.000, 1.850 and 2.7000 m while the vertical angle was -9^0 20'. Find the distance AB and RL of B.	**07**
	(b)	Write a short note on "Anallatic lens"	**07**
		OR	
	(b)	Explain the elements of simple circular curve with neat sketch.	**07**
Q.3	**(a)**	What are the objectives of field astronomy? Explain	**07**
	(b)	Explain – Zenith, Nadir, Celestial Poles, Vertical Circle	**07**
		OR	
Q.3	**(a)**	What are the purposes of Total Station?	**07**
	(b)	What are the advantages of EDM instruments?	**07**
Q.4	**(a)**	Explain the terms of photogrammetry: (i) Tilt (ii) Exposure station (iii) Principal Plane (iv) Azimuth (v) Swing	**07**
	(b)	Explain the components of Remote Sensing?	**07**
		OR	
Q.4	**(a)**	Define remote sensing. Explain principle of remote sensing.	**07**
	(b)	Explain the field application of GIS.	**07**
Q.5	**(a)**	Explain key components of GIS.	**07**
	(b)	Write a short note on "Transition Curve"	**07**
		OR	
Q.5	**(a)**	Enlist the methods of sounding. Explain any one in detail.	**07**
	(b)	Differentiate between Fixed hair method & Movable hair method.	**07**

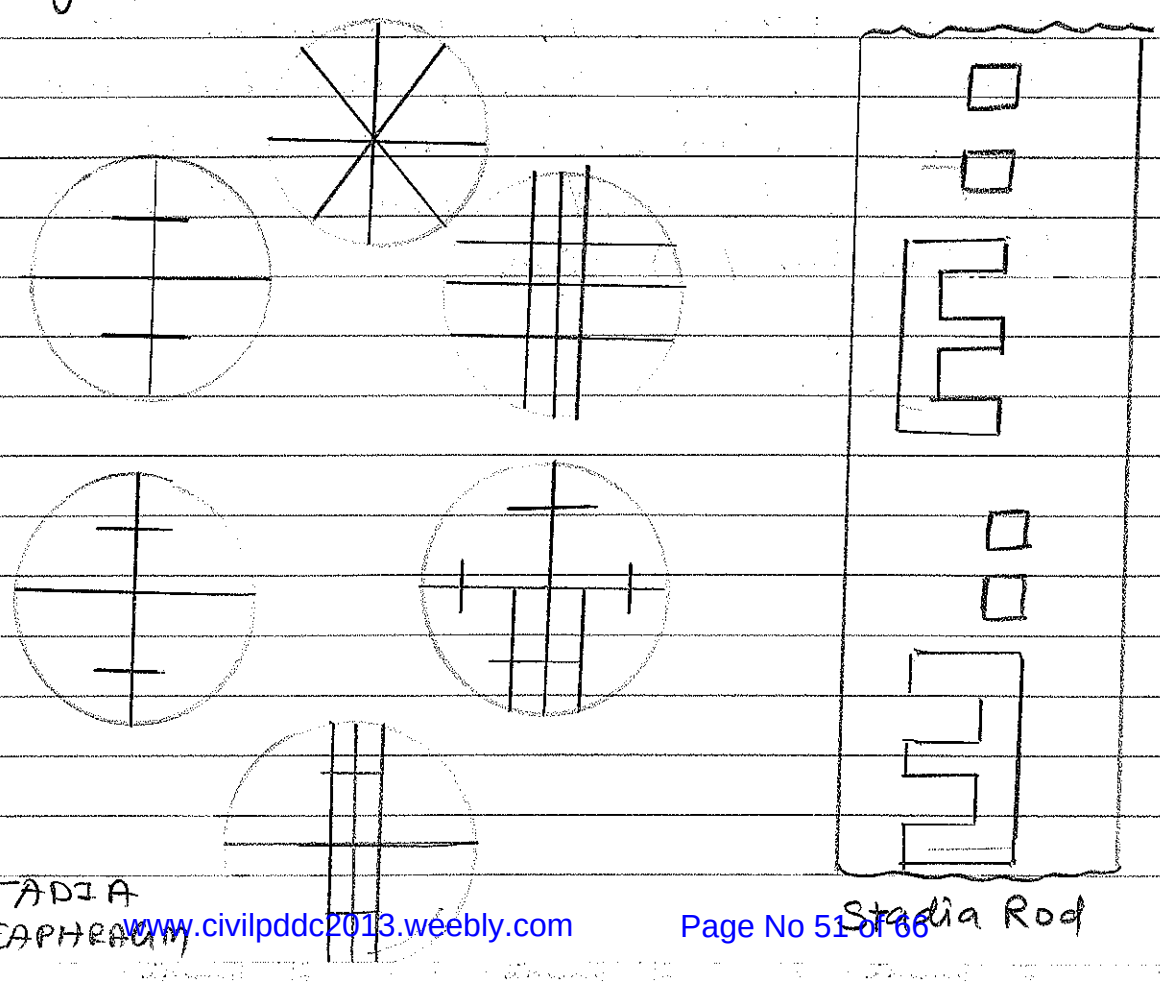
****

Q.1 (a) Discuss instruments used in tacheometry.

Ans:
The following instruments are used.

(1) Tacheometer
(2) Staff and stadia rod.

Tacheometer:
A tacheometer is a theodolite (generally a vernier theodolite) fitted with a stadia diaphram. The stadia diaphram consists of one stadia hair above and the other at equal distance below the horizontal cross hair. Various types of stadia diaphragm are shown in fig.



Staff and Stadia Rod:

For short distance say upto 100 m or so, ordinary levelling staves are used. The levelling staff is generally 4m long and can be folded into three parts or telescopic. The graduations are so marked that a minimum reading of 0.005 m (5 mm) can be taken.

For long distance, a specially designed large staff, called a stadia rod is generally used.

The stadia rod is generally 3 to 5 m long, 50 to 150 mm wide and may be folded or telescopic. The graduations are bold and simple so that the reading can be taken from long distances. The stadia rods are generally graduated in meters decimeter and centimeters. The staff or stadia rod can be held either vertical or normal to the lined of sight.

Q.2(a).

First we will find constant A & B

$D = AS + C$

$D_1 = 50\,m \qquad S_1 = 0.5\,m$

$D_2 = 100\,m \qquad S_2 = 1\,m$

$\therefore 100 = A(1.00) + C$ —— (1)

$50 = A(0.5) + C$ —— (2)

$50 = 0.5A$

$\therefore A = 50/0.5$

$= 100$

Put 100 in eqn (1)

$100 = 100 + C$

$\therefore C = 0$

Given Data

$S = 2.70 - 1 = 1.7\,m$

$H.I = 1.45\,m$

$\theta = -9^\circ 20^\circ$

$\therefore V = A \times S \times \frac{\sin 2\theta}{2}$

$= \frac{100 \times 1.7 \times \sin 2(9^\circ 20^\circ)}{2}$

$= 27.57\,m$

$D = A \times S \times \cos^2 \theta$

$= 100 \times 1.7 \times (\cos 9^\circ 20')^2$

$= 165.39 m$

R.L of B = R.L of Instrument + H.I − V − h

$= 1050.50 + 1.45 - 27.57 - 1.850$

$= 1022.53 m.$

Q.2(b) Write a short note on "Anallatic lens"

Ans:

An additional convex lens is provided between the eye-piece and the object glass at a fixed distance from the object glass is known as an anallatic lens. The object of providing the anallatic lens in the telescope is to make the additive constant (f+d) exactly zero.

Anallatic lens is provided in the external focussing telescope, and is not required in the internal focussing telescope.

Advantages of an anallatic lens:

① As the additive constant (B) is zero the calculation of distance and heights is very much simplified.

$D = A \cdot S + B$ if $B = 0$ then $d = A \cdot S$

(2) If the multiplying constant is 100, the distance are directly objected by multiplying the staff intercepts by 100.

Disadvantages of an Anallatic lens:

① The Anallatic lens absorbs some of the incident light which consequently results is reduction of the brightness of the images. It also adds to the initial cost of the instrument because of one extra lens.

Q3 (a) What are the objectives of field astronomy? Explain.

Ans:

(1) Main object of study of field Astronomy for civil engineers is to determine latitude and longitude of survey stations. and azimuth of survey lines. Latitude and longitude are independent co-ordinates.

(2) Azimuth is true bearing of survey line. Survey work done with reference to true north is more accurate, than work done using magnetic bearing. Because magnetic bearing is measured with compass having magnetic needle, which may not show true magnetic north direction for many reasons.

(3) When position of survey stations for survey project is fixed by measuring distance from well defined points like corners of building or electric poles etc. it is known as relative referencing. Relative references are not reliable. Hence survey stations are fixed by their independent co-ordinates. Independent co-ordinates of any point on earth are latitude and longitude.

(4). Scientists may study astronomy to discover secrets of evolutions of universe or for launching of satellites.

⑤ maintenance of precise time and calender all over world is very much important. To measure time and apply co-arrections to time, knowledge of field astronomy is useful.

Q.3

(b) Explain

- zenith (Refer Paper 20.12.13).
- Nadir :

Vertical Axis of instrument projected downward intersect on opposite side with celestial sphere at a point known as nadir point.

- Celestial poles :

Axis of rotation of earth is extended on both the direction to intersect with celestial sphere. There points known as celestial poles are P and P' in fig. (Paper 20.12.13).

- Vertical circle :

Great cicles on celestial ~~pole passing~~ sphere passing through zenith and nadir points are known as vertical circles. There can be infinite number of vertical circles.

Q.3(a) What are the purposes of Total Station?

Purpose of Total Station

- It measures distance and displays horizontal distance and also slope distance
- It gives difference in height or elevation

- It measure angles and displays horizontal as well as vertical angle also.
- It measured height above datum
- It measures coordinates also.

Special purpose of total station
- Distance stake out measurement
- Lot Staking measurement
- Offset point measurement
- Remote elevation measurement
- Remote distance measurement
- Co-ordinate measurement
- Resection measurement
- Traverse measurement
- Coordinate stakeout.

Q.3 (b) What are the advantages of EDM instruments?

- Traversing on grandiose, with much greater control of swing errors,
- setting out and photogrammetric control over large areas by polar co-ordinates from a single base line
- offshore position fixing by such techniques as the Tellurometer Hydrodist systems
- Deformation monitoring to sub-millimetre accuracies using high precision EDM.

- Absolute circle reading
- EDM instruments give a very high accuracy in distance measurement

- An accuracy of 1 in 10^5 can be achieved without much difficulty for sights up to 100 km

- These methods/instruments are extremely useful for indirect measurement of distance over difficult terrains and where a high accuracy is required for example base line measurement in traingulation, trilateration and precise traverse.

Q. 4 (a) & b – Refer paper. 20.12.2013.

or

Q.4 (a) Define remote sensing. Explain principle of remote sensing.

Ans:

Defination:

Remote sensing is the science and art of obtaining information about an object, area or phenomenon through an ~~any~~ analysis of the data acquired by a device which is not in contact with the object, area or phenomenon under investigation. Therefore, it consists of collecting and interpreting information about an object area or phenomenon without being in physical contact with them. Remote sensing is the methodology employed to study from a distance the physical and/or chemical characteristics of objects.

Principle of Remote Sensing:

The basic principle lies in mapping earth surface features by reflected electromagnetic energy which is difficult for different object is measured by sensors on remote platform (satellite)

Now consider, if the energy being remotely sensed comes from the sun, the energy is radiated by atomic particles at the source (the sun) propagates through the

vacuum of space at the speed of light interacts with the earth's atmosphere interacts with the earth's surface, some amounts of energy reflects back, interacts with the earth's atmosphere once again and finally reaches the remote sensors which are mounted on satellite.

Q.4(b) Explain the field application of GIS.

Field Application of GIS are as follows.

(1) Technical Applications:
- Water Resources Managements.
- Environment
- Agriculture
- Forestry
- military
- Transportation
- Urban planning
- Civic Taxation
- Regional Planning
- Telecommunication network.

(2) Commercial Applications:

- To locate site of production
- To locate business centre for marketing
- To locate areas of Raw materials.
- To assess Regions of demand-supply gap for particularly comodity

(3) Social Application
- To Locate under developed areas.
- prepare Development Plans.

(4) Defense Applications:
- military intelligence
- Air force base for landing and takeoff location
- Naval operation.

Q.5(a) Explain key components of GIS.

Ans:

Key components of GIS are as follows.

(1) computer System
(2) GIS software
(3) procedure to operate GIS
(4) Data and Information
(5) End users of GIS.

1. Computer System:

Computer system is hardware and operating system. GIS software run on operating system, computer hardware may be personal computer or super computer. And operating system should support all operations of GIS software. Usually to run GIS software fast processors and huge data storage memory capacity is required.

2. GIS Software:

GIS software: has many function and tools.

- Store digitized maps.
- Editing of maps and storing in separate layers.
- Data base models for: (a) spatial Data
  (b) Attribute Data.
- Interation and analysis data
- Ability to update and modify Data.

- Present data as output in form of
  - Tabular form • map form • statics form
  - pictorial form etc.

(3) Data and Information:
  (i) Data capturing from existing maps and satellite images.
  (ii) collection and Data entry of spatial Data for Georeferencing of pixels of digitised images.
  (iii) collection and Data entry of attribute data of various features like roads rivers canals, villages towns etc.

(4) procedure to operate GIS:
  - Data capture
  - Input of attribute data
  - manipulation
  - Transformation
  - Visualisation
  - Combination
  - Query
  - Analysis
  - output generation for end users.

(5). End users of GIS.
  - Individual or group of users in organization
  - scientis, students.
  - Agriculture, forest, marine
  - Government Department

Q.5 (b) Write a short note on "Transition Curve".

Ans:

Transition Curves are used in road and Railway Curves to avoid the suddenness of changes from a straight line to a curve of finite radius on a curve, the vehicle is subjected to forces that tend to throw the vehicle outward due to centrifugal action. Such forces are resisted either by the frictional forces developed between the tyres of vehicles and the road surface or by the cant or superelevation provided on the outer edge of the road. In the case of railway curves the forces are resisted by the outer flages pressing against the outer rails. A transition curve, also known as the easement curve, serves the purpose of reducing the effect of a sudden change in curvature from zero to a finite value.

Transition curves serve the following purposes.

(a) They effect the change in radius gradually by a curve of varying radius.

(b) They provide superelevation gradually from zero to stipulated value at the beginning of the curve.

OR.

Q.5(b). Differentiate between fixed hair method & movable Hair method.

	Fixed Hair method	movable Hair method.
1.	In this method, stadia hair are kept at fixed interval i = constant.	1. In this method the stadia hair are adjusted by micrometer screws such that the upper hair bisects the upper target and the lower hair bisects the lower one $i \neq$ constant
2.	In this method, the staff interval or intercept on the levelling staff varies, depending upon the Horizontal distance between the instrument station and the staff $S \neq$ constant.	2. In this method the staff interval is kept constant S = constant.
3.	The fixed hair method is most commonly used in practice as it is convenient to take the staff reading speedy	3. This method is generally not used because it is unconvenient to measure the stadia interval accurately.
(4)	Tacheometer and staff or stadia rod are used.	4. Subtense theodolite and target staff are used.