

S'06 : 6 FN: CV 406 (1432)**PRINCIPLES OF GEOINFORMATICS***Time : Three hours**Maximum marks : 100*

*Answer FIVE questions, taking ANY TWO from Group A,
ANY TWO from Group B and ALL from Group C.*

*All parts of a question (a, b, etc) should be
answered at one place.*

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mented with neat sketches. Unnecessary long answers
may result in loss of marks.*

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Group A

1. (a) Define surveying. What are the principles of surveying? Explain them briefly. 6
- (b) Discuss briefly the different types and sources of errors in surveying. 6
- (c) A line was measured with a steel tape which was exactly 30 m at a temperature of 20 °C and a pull of 10 kg. The measured length was 1650 m. The temperature during measurement was 30 °C and the pull applied was 15 kg. Find the true length of the line, if the cross-sectional area of the tape was 0.025 cm². The coefficient of expansion of the material of the tape per °C is 3.5×10^{-6} and modulus of elasticity of the material of tap is 2.1×10^6 kg/cm². 8

2. (a) What is meant by local attraction ? How is it detected and how are the observed bearings corrected for local attraction ? 5
- (b) Sketch the fundamental lines of a theodolite. State the direct relationship between them. 4
- (c) Following is a page of a level book. Fill in the missing readings and calculate the reduced level of all the points. Apply the usual checks. 6

Station	B.S.	I.S.	F.S.	Rise	Fall	R.L.	Remarks
1	3-250					?	BM
2	1-755		?		0-750	?	CP
3		1-950				?	
4	?		1-920			?	
5		2-340		1-500		?	
6		?		1-000		?	
7	1-850		2-185			250-00	CP
8		1-575				?	
9		?				?	
10	?		1-895		1-650	?	CP
11			1-350	0-750		?	Last point

- (d) State the advantages and disadvantages of Plane Tabling ? 5
3. (a) Explain how the procedure of reciprocal levelling eliminates the effect of refraction and curvature as well as error of collimation. 5
- (b) It was required to determine the distance between two points *A* and *B* by a tacheometer fitted with an anallactic lens ($k = 100, c = 0$). With the instrument at *A* and staff at *B*, the observations made were at a vertical angle of $+9^{\circ} 46'$ and staff intercept of 1-915 m. What is the horizontal distance *AB*? Later on it was found that the constants of the instrument were 100 and 0-5. What would be the percentage error in the horizontal distance computed ? 5

(c) State the three point problem. Explain how it is solved by the graphical method. 5

(d) Define contour. State various characteristics of contour lines. 5

4. (a) Following are the bearings taken in a closed traverse : 5

Line	Fore Bearing	Back Bearing
AB	S 37° 30' E	N 37° 30' W
BC	S 43° 15' W	N 44° 15' E
CD	N 73° 00' W	S 72° 15' E
DE	N 12° 45' E	S 13° 15' W
EA	N 60° 00' E	S 59° 00' W

Compute the interior angles and correct them for observational errors.

(b) List various methods of setting out a simple circular curve. Explain briefly the Rankine method of deflection angles. 5

(c) Two straight *AB* and *BC* intersect at a chainage of 4242-0 m. The angle of intersection is 140° . It is required to set out a 5° simple circular curve to connect by the straights. Calculate all the data necessary to set out the curve by the method of offsets from the chord produced with an interval of 30 m. 5

(d) Explain the reiteration method of horizontal angle measurement. 5

Group B

5. (a) Sketch and explain the principle of electronic distance measuring (EDM) instrument. 6

(b) From a satellite station *S*, 5.8 m from the main triangulation station *A*, the following directions were observed :

<i>A</i>	0°	0'	0"
<i>B</i>	132°	18'	30"
<i>C</i>	232°	24'	6"
<i>D</i>	296°	6'	11"

The length *AB*, *AC* and *AD* were computed to be 3265.5 m, 4022.2 m and 3086.4 m respectively. Determine the directions of *AB*, *AC* and *AD*. 8

(c) What is meant by triangulation? In what does it differ from traversing. 6

6. (a) Define remote sensing. How it differs from photogrammetry. 5

(b) How do you determine the intervisibility of triangulation stations? 5

(c) Derive an expression for the height displacement in a vertical photograph. 5

(d) What is meant by base net? Explain how you would extend a base line. 5

7. (a) What is idealized remote sensing system? Explain. 7

(b) What are the various forms of remotely collected data? Briefly describe data acquisition and its interpretation. 6

(c) Explain, with reference to aerial photographs, what is meant by end overlap and side overlap and why they are provided. 7

8. (a) What do you understand by Global positioning system (GPS)? Give an overview of GPS. 5

(b) Derive the parallax equation for determining elevation and ground coordinates of a point. 7

(c) Discuss briefly electromagnetic energy and electromagnetic spectrum. 4

(d) Compare the various triangulation figures mentioning their suitability. 4

Group C

9. Choose the correct answer: 1 × 20

(i) The main principle of surveying is to work from

(a) Higher level to lower level

(b) Lower level to higher level

(c) Part to whole

(d) Whole to part

(ii) The survey in which the curvature of earth is taken into account is called

(a) Geodetic survey

(b) Plane survey

(c) Preliminary survey

(d) Hydrographic survey

- (iii) Cross staff is used for
- (a) Setting out right angles
 - (b) Measuring horizontal angles
 - (c) Both (a) and (b)
 - (d) Measuring bearing of line
- (iv) Invar tape is made of an alloy of
- (a) Copper and Steel
 - (b) Brass and Nickle
 - (c) Brass and Steel
 - (d) Steel and Nickle
- (v) A building is an obstackle to
- (a) Chaining but not ranging
 - (b) Ranging but not chaining
 - (c) Both chaining and ranging
 - (d) Neither chaining nor ranging
- (vi) Bearing of a line is the horizontal angle it makes with
- (a) True meridian
 - (b) Magnetic meridian
 - (c) Arbitrary meridian
 - (d) All of the above
- (vii) The whole circle bearing of line, whose quardanal bearing is S 19° 30' E is
- (a) 19° 30'
 - (b) 199° 30'
 - (c) 160° 30'
 - (d) 340° 30'
- (viii) If the magnetic bearing of a line is 34° 30' and the magnetic declination 3° 30' W, the true bearing of the line will be
- (a) 37°
 - (b) 38°
 - (c) 30°
 - (d) 31°
- (ix) Removal of parallax may be achieved by
- (a) Refocussing the objective
 - (b) Refocussing the eyepiece
 - (c) Refocussing the eyepiece and the objective
 - (d) Moving the shifting centre
- (x) The closing error can be eliminated by
- (a) Bowditch rule
 - (b) Transit rule
 - (c) Working accurately latitudes
 - (d) Either (a) or (b) as applicable

(xix) The usual longitudinal overlap in aerial photogrammetry is

(a) 25%

(b) 30%

(c) 50%

(d) 60%

(xx) Ground control points are established in aerial photogrammetry to control

(a) Height distortion

(b) Tilt distortion

(c) Relief displacement

(d) Scale.

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Group A

1. (a) Discuss in details various classification of survey. 6
- (b) Discuss briefly about Indian topographic series. 7
- (c) In chaining a pond, station P and Q well selected on the opposite side of the pond. A line PA , 200 m long was set out to the left of PQ and a line PB was set out on the right side such that A , Q and B are collinear. The length of PB was 250 m. $AQ = 125$ m, $QB = 150$ m. Determine PQ . 7
2. (a) Explain a prismatic compass with a neat sketch. Compare it with surveyors compass. 6
- (b) What are various methods of plane table surveying? Explain Bessel's methods in details. 6

- (c) A and B are two main stations whose coordinates are given below :

Station	N	E
A	1056.9	585.1
B	1426.5	992.7

from a line AC , 154.4 m long, is run on a bearing of $132^\circ 18'$ and from C a line CD of length 544 m is run parallel to AB . Find length and bearing of BD . 8

3. (a) Find the most probable value of angles A , B and C of triangle ABC from the following observations:
 $A = 68^\circ 12' 36''$, $B = 53^\circ 46' 12''$,
 $C = 58^\circ 1' 16''$. 6
- (b) Explain a level tube with a diagram. Define sensitivity and prove that sensitivity of a level tube depends on the radius of curvature of the internal surface. 6
- (c) Following readings were taken with a level and a 4 m staff on a sloping ground at 30 m interval:
 0.78, 1.535, 1.955, 2.43, 2.985, 3.48, 1.155, 1.96, 2.365, 3.64, 0.935, 1.045, 1.63 and 2.545.
 Reduced level of First point was 180.75 m. Rule out a page of a level field-book to enter the above readings. Calculate reduced level of the points by rise and fall method. 8
4. (a) Up to what vertical angle can sloping distance be taken as horizontal values in stadia tacheometry, so that the error does not exceed 1 in 250. Assume that instrument is fitted with anallactic lens and the staff is vertical. 5
- (b) Explain the principle and use of a micrometer microscope. 5

- (c) Derive an expression for length and shift of a transition curve. 5
- (d) Two tangents intersect at chainage of 1192.0 m, the deflection angle being $50^\circ 30'$. Calculate the necessary data for setting out a curve of 300 m radius to connect two tangents. Set out the curve by Rankine's method of tangential angles. Peg interval is 20 m. 5

Group B

5. (a) The slope distance between two stations A and B of elevations 1572.25 m and 4260.46 m, corrected for meteorological conditions is 33449.215 m. Determine sea-level distance. $R = 6370$ km. 8
- (b) Explain satellite station and the process of reduction to centre. 6
- (c) Discuss in details about strength of a triangulation figure. 6
6. (a) Explain with required diagrams about the principle of EDM. Define their categories also. 6
- (b) Derive a relationship to determine elevation by stereoscopic parallax. 6
- (c) Explain the working of GPS in brief and its advantages over conventional surveying. 4
- (d) A tower was photographed from an elevation of 800 m above datum. The radial distances of the top and bottom of the tower from principal point are 112.2 mm and 81.6 mm. If the bottom of the tower has an elevation of 250 m, determine height of the tower. 4
7. (a) Explain with neat sketches the interaction of electromagnetic energy with matter. 5

- (b) Determine the most probable values of the angles A , B and C of a triangle ABC from the following observed angles and the respective probable errors:
- $\angle A = 64^\circ 12' 40'' \pm 3''$
 $\angle B = 55^\circ 14' 23'' \pm 2''$
 $\angle C = 64^\circ 33' 21'' \pm 3''$
- 5
- (c) Explain stereoscopy and depth perception in details. 5
- (d) Explain different characteristics of features required for photo interpretation in details. 5
8. (a) Define following with diagrams: 8
- (i) Rayleigh scattering
(ii) Mie scatter
(iii) Atmospheric window
(iv) Nonselective scatter.
- (b) Explain in detail about principle of radial line triangulation. 8
- (c) Discuss briefly about different remote sensing sensors in India. 4
- Group C**
9. Answer the following: 1 × 20
- (i) In chain surveying, field work is limited to
- (a) Linear measurements only
(b) Angular measurements
(c) Linear and Angular measurement
(d) All the above
- (ii) The magnetic bearing of a line is $38^\circ 24'$. Its true bearing is — if the magnetic declination is $5^\circ 38' E$.
- (iii) During levelling, the bubble has been displaced by 3 divisions when the length of sight is 120 m. If sensitivity of the bubble is 20 seconds, the error in staff reading is —.
- (iv) The benchmarks established in India by survey of India are known as —.
- (v) Local attraction may be detected by comparing the — and — bearing of a line.
- (vi) Anallactic lens provided in a tacheometer is
- (a) Convex lens
(b) Concave lens
(c) Plane-convex lens
(d) Plane lens
- (vii) The principle use of tacheometry are
- (a) —
(b) —
(c) —.
- (viii) The definition of the degrees of a curve may be based on the standard length of — or —.
- (ix) Two broad approaches for setting out vertical curves are (a) — (b) —.
- (x) Two special methods for precise measurement of horizontal angles in triangulation are (a) — (b) —.

(xi) The angles of a triangle ABC are, $A = 60^\circ 25' 30''$, weight = 1, $B = 63^\circ 48' 15''$, weight = 2, $C = 55^\circ 49' 20''$, weight = 1, the corrected angles are A — B — C —.

(xii) The relation between air base (B), photographic base (b), flying height (H), and focal length of the camera for vertical photographs

(a) $B = \frac{bH}{f}$

(b) $B = \frac{f}{BH}$

(c) $B = \frac{b}{fH}$

(d) $B = \frac{H}{Bf}$

(xiii) Examination of pairs of photographs taken with axes parallel is said to be —.

(xiv) Electronic distance measurement is based on (a) — and (b) —.

(xv) In GPS, microwave signals are sent with carrier wavelength of — and —.

(xvi) For remote sensing data collection, a sun synchronous satellite moves in an orbit of — and — km.

(xvii) If angles are of unequal weight, the correction to the angle is — to the weight of the angles.

(xviii) Phase of a signal when observations are made on bright portions is

(a) $\frac{s \cos^2 \theta/2}{D \sin 1''}$

(b) $\frac{s \cos \theta/2}{\sin 1''}$

(c) $\frac{s^2 \cos \theta/2}{D}$

(d) $\frac{s \sin \theta/2}{D \cos 1''}$

(xix) The EMR range used for visible range is —.

(xx) Mie scatter occurs when atmospheric particle diameter is — to the energy wavelength being sensed.

PRINCIPLES OF GEOINFORMATICS

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Group A

1. (a) A 30 m steel tape, weighing 6 newton, is used in sag in a sloping grand having 1 : 100 downgrade. What is the plan length between two supports, if field pull is 100 N? 10

- (b) A four-sided theodolite traverse is having following measurements having two lengths unknown: $AB = 212$ m, $44^\circ 30'$ bearing, $BC = 289$ m, $WCB = 132^\circ 45'$, CD and DA having calculated bearings of $225^\circ 0'$ and $312^\circ 15'$, respectively. Make an approximate sketch and compute the lengths of sides CD and DA . 10
2. (a) What is meant by magnetic declination? An open traverse has the following fore and back bearings: $PQ = 22^\circ 0'$, $203^\circ 0'$; $QR = 314^\circ 30'$, $135^\circ 0'$; $RS = 203^\circ 30'$, $23^\circ 30'$; $ST = 298^\circ 0'$, $117^\circ 30'$. Check and correct the values. 10
- (b) Give one example each of application of reverse and vertical curves. Chainage of intersection of an existing road and a proposed straight is 3576.84 m, the angle of intersection being 90° . Determine the chainage, along curve, of the apex point of a simple curve of 219 m radius and its distance from the intersection. 10
3. (a) A dumpy level is set at A and the staff readings at A and a distant station B are 0.95 m and 2.87 m. When the instrument is set at B , the observed sights are 0.46 m at A and 1.01 m at B . If $AB = 300$ m, express the collimation error in degree. Also, assume a reasonable value of radius of earth and estimate the curvature error. 10
- (b) Compare between mapping by plane table and chain-offset survey. Briefly explain radiation *versus* intersection methods of plane tabling. 10
4. (a) Grid RLs of four stations of a uniform sloped surface are: (0N, 0E, RL 2 m), (30N, 0E, 8 m RL), (0N, 40 E, 14 m above datum) and (30, 40, 20). Plot these in a suitable scale and draw contours at 5 m interval. 10
- (b) Derive the expression of distance, d , as function of target-gap, S , and angle subtended in a subtense bar. An anallatic tacheometer ($k = 100$) placed at A (axis 1.2 m above ground) is directed to staff at B , at a vertical angle of $+5^\circ$. The staff readings are 0.85 m, 1.20 m, 1.55 m. What is the level difference of A and B ? 10

Group B

5. (a) What is the criterion assumed for a triangle to declare well conditioned? A triangular net, with a central station, is having the following observed angles: $OAB = OBC = 30.5^\circ$, $OAC = OCA = 29.5^\circ$, $OBA = OCB = 30^\circ$, $AOB = 120^\circ$, $BOC = COA = 119.5^\circ$. Check the triangle, apex and peripheral conditions. Comment on corrections. 10
- (b) List various types of signals in triangulation. Instead of measuring from A , a nearby station S , 6 m from A , is selected, the observed angles being $ASB = 35^\circ 16' 00''$ and $ASC = 72^\circ 49' 8''$, B and C being on opposite sides of extended AS line. The measured lengths are $AB = 2125$ m, $BC = 3098$ m approximately. Compute angles SAB and SBC , assumig, if necessary, $\sin x = .x$ radian for small values. 10

6. (a) What is meant by stereophotography? Two distant objects, at left and right of phototheodolite line of sight, made an angle of 47° on the instrument station. In the positive print, they are seen to be 70 mm left and 60 mm right of the photocentre. Calculate the focal length of the camera lens. 10
- (b) Enumerate various types of electronic distance measuring equipment. Distance of P , in the north-east quadrant, from two observing base stations, A (0N, 30 mE) and B (40 mN, 0E) are: $AP = 120$ m, $BP = 130$ m. Estimate coordinate of P . 10
7. (a) Compare, in brief, between triangulation and trilateration. Two peaks are 200 m and 300 m above the intervening ground which is the plane 0 m datum surface, distance between peaks being 120 km. Compute the minimum clearance of the line of sight above ground. Assume h (metre) $= 0.067 (D \text{ (km)})^2$. 10
- (b) Write short notes on *any two* of the following: 5×2
- (i) Digital theodolite
- (ii) Total station
- (iii) GPS.
8. (a) Draw sketch of a parallax bar. An aircraft, with 150 mm focal length camera, flies 3 km above a field. The film size is 120 mm \times 120 mm. Estimate total number of photographs to cover an area of 25 km long and 15 km wide. Assume 50% overlap and no sidelap. 10

- (b) Explain *any two* of the following: 5×2
- (i) EMR
- (ii) Atmospheric window
- (iii) Satellite imagery.

Group C

9. Choose the *correct* answer for the following: 1×20
- (i) Art of making map from survey is called
- (a) topography
- (b) cadastral
- (c) cartography
- (d) telemetry
- (ii) Two mirrors are used for offsetting in
- (a) cross-staff
- (b) optical square
- (c) Miner's dial
- (d) prism compass
- (iii) Compass traverse is graphically adjusted using
- (a) Bowditch rule
- (b) Simpson rule

- (c) Transit rule
- (d) Prismoid rule
- (iv) The average MSL equipotential surface is nearly a shape termed as
- (a) trapezoid
- (b) ellipsoid
- (c) spheroid
- (d) geoid
- (v) Sensitivity of a bubble tube depends on its
- (a) length
- (b) curvature
- (c) material
- (d) diameter
- (vi) Height difference found through theodolite is called
- (a) autocad altimetry
- (b) direct contouring
- (c) barometric altitude
- (d) trigonometric levelling
- (vii) Three point problem in PT is a method of
- (a) radiation
- (b) resolution
- (c) resection
- (d) intersection
- (viii) The matrix equation of variance minimization by normalizing $AX = B$ is
- (a) $A^{-1}AX = A^{-1}B$
- (b) $X = A^{-1}B$
- (c) $AA^{-1}X = A^{-1}B$
- (d) $A^2X = A^2B$
- (ix) The multiplicative constant in a tacheometer with focal length, f , and stadia wire interval, i , is
- (a) f/i
- (b) $i + f$
- (c) i/f
- (d) $f \times i$
- (x) Straight distance between the end points of a circular curve (radius R , arc angle I) is
- (a) $2R \sec I/2$
- (b) $2R \sin I/2$
- (c) $2R \tan I/2$
- (d) $2R \cos I/2$

(xi) A vertical summit/valley curve is set out assuming it to be an equation of

- (a) hyperbola
- (b) ellipse
- (c) parabola
- (d) catenary

(xii) Tellurometer is an instrument used for

- (a) GPS
- (b) EMR
- (c) GTS
- (d) EDM

(xiii) Observation of two photographs simultaneously is called

- (a) orthography
- (b) perspectomy
- (c) spectrometry
- (d) stereoscopy

(xiv) Radial line method is used in

- (a) photogrammetry
- (b) trilateration

(c) plane table

(d) total station

(xv) Which one of these is a long wavelength radiation ?

- (a) Ultraviolet
- (b) X-ray
- (c) Infrared
- (d) Gamma ray

(xvi) Geostationary satellites have

- (a) same distance from earth's centre
- (b) same speed as earth's rotation
- (c) same mass as global weight
- (d) same angle with geodetic stations

(xvii) Radiations remotely sensed from objects are measured as

- (a) parallax
- (b) reconnaissance
- (c) acquisition
- (d) reflectance

(xviii) Log-sine correction is made in triangulation to satisfy

- (a) apex condition

- (b) opposite angles
- (c) side condition
- (d) peripheral sum
- (xix) Using distance equations to find out object coordinate is called
- (a) triangulation
- (b) trilateration
- (c) traverse
- (d) trijunction
- (xx) The distances of images of top and bottom of a tower, in a print taken from H above ground, are D and d from principal point, respectively. The height is then
- (a) $H(D - d) / D$
- (b) Hd/D
- (c) $HD/(D + d)$
- (d) $HD/(D - d)$

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Group A

1. (a) What is local attraction ? Following are the observed bearings of a closed compass traverse. Assuming the bearings of line *CD* be free from any error, compute corrected bearings of the traverse : 2+8

<i>Line</i>	<i>Fore bearing</i>	<i>Back bearing</i>
<i>AB</i>	110° 30'	290° 00'
<i>BC</i>	227° 00'	47° 30'
<i>CD</i>	323° 30'	143° 30'
<i>DA</i>	38° 00'	217° 00'

- (b) A steel tape of nominal length 30 m, cross-sectional area 3 mm² and weight 7.5 N was used to measure a base line of about 240 m length. The tape was used

in suspension with a pull of 88 N at a field temperature of 34.5°C . The tape was checked for standardisation while lying on horizontal ground without pull at 27°C and was found to be 29.95 m in length. Compute length of base line at mean sea level, if the following data are given:

Modulus of elasticity of tape material = 220 kN/mm^2

Coefficient of linear expansion = $6.5 \times 10^{-6}/^{\circ}\text{C}$

Ground elevation = 395 m above mean sea level

Radius of earth = 6370 km. 10

2. (a) A dumpy level having 1 : 1000 downwards collimation error was used to find RL of a staff station at far end bank of a river of width 2525 m. If the staff reading is 2.875 m and height of instrument is 1.505 m, find correct RL of far end staff station. It is given that coefficient of refraction is 0.07 and radius of earth is 6370 km. The RL of instrument station is 429.850 m. 10
- (b) Describe Bessel's graphical method of solving three point problem in plane table surveying. 10
3. (a) Compute necessary data to trace a simple circular curve on the ground using method of offsets from extended chord. Following data are given:
Chainage of point of intersection = 755.0 m
Angle of intersection = 55°
Radius of curve = 120.0 m
Length of normal chord = 10.0 m. 10
- (b) Vertical angles to top and bottom of a TV tower of height 225 m, situated on the top of a hill, were measured with the help of a transit fixed at a distant point and were found to be $13^{\circ} 17' 45''$ and $8^{\circ} 54' 30''$, respectively. Compute RL of top of hill if the RL of instrument station is 224.5 m and height of instrument is 1.55 m. 10

4. (a) Two ends of a proposed tunnel AB across a hill are joined with the help of a theodolite traverse as under:

Line	Length	w.c.b.
AP	1835 m	$171^{\circ} 15' 25''$
PQ	1076 m	$107^{\circ} 45' 05''$
QR	853 m	$62^{\circ} 25' 45''$
RB	1472 m	$15^{\circ} 50' 10''$

Compute correct length and bearing of the tunnel AB . 10

- (b) Write short notes on *any two* of the following: 5×2

- (i) Contour interval
(ii) Contour gradient
(iii) Horizontal equivalent.

Group B

5. (a) Prove that the tilt distortion is radial from iso-centre in a tilted aerial photograph. 10
- (b) Two peaks A and B of elevation 345 m and 1326 m, respectively above m.s.l. are 125 km apart. Another peak C , in the line AB , has an elevation of 762 m above m.s.l. and is 83 km from A . If the line of sight AB is to pass at least 3 m above the intervening ground, check whether the points A and B are intervisible or not. If not, compute the height of signal required at B . Assume radius of earth as 6370 km and coefficient of refraction as 0.07. 10
6. (a) Differentiate between triangulation and trilateration.
Photo co-ordinates of a point P appearing in two photographs taken from extremes of a line, AB , running west to east are respectively $(+73.5, \dots)$ and

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(- 61.6, ...) mm. The length of line AB is 120 m and axis of camera at both the stations is perpendicular to the base line. Focal length of camera is 150 mm. If ground coordinates of A are (150 m, 200 m), compute coordinates of point P . 2+8

(b) Describe various steps in acquisition of data from remote sensing. 10

7. (a) Angles were measured at a triangulation station closing the horizon, and are given as under :

Angle	Observed Value	Weight
A	$73^{\circ} 45' 18''$	2
B	$87^{\circ} 18' 45''$	1
C	$69^{\circ} 13' 53''$	2
D	$65^{\circ} 33' 08''$	3
E	$64^{\circ} 08' 31''$	3

Compute correct values of angles. 10

(b) Image of a 3225 m long runway strip measures 107.5 mm in a vertical aerial photograph. Top and bottom of a communication tower near runway are respectively 125 mm and 123.5 mm from principal point of the photograph. Compute height of tower, if the focal length of camera used is 150 mm. 10

8. (a) A satellite station was set at a distance of 12.5 m north of main triangulation station P and bearings were measured as under :

Point Sighted	w.c. Bearing
P	180°
A	$53^{\circ} 27' 35''$
B	$125^{\circ} 12' 50''$
C	$223^{\circ} 41' 17''$
D	$317^{\circ} 34' 25''$

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(Continued)

The distances of A, B, C and D from point P are respectively 3780 m, 4715 m, 2985 m, and 4240 m. Compute bearings of lines AP, BP, CP and DP . 8

(b) Write short notes on *any three* of the following : 4×3

(i) Principle of GPS

(ii) Tellurometer

(iii) Photointerpretation

(iv) Atmospheric windows.

Group C

9. Choose the correct answer for the following : 1 x 20

(i) A distance measured by a tape, which is too long, is

(a) more than the distance recorded

(b) less than the distance recorded

(c) equal to the distance recorded

(d) None of the above

(ii) Sag correction is

(a) additive

(b) subtractive

(c) compensating

(d) Above all

(iii) A level surface is

(a) a parabolic surface

(b) an elliptical surface

(c) a spherical surface

(d) a plane surface

W*07:6 FN: CV 406 (1432) (5)

(Turn Over)

- (iv) Index error in a transit theodolite is due to
- (a) non-verticality of the axis
 - (b) non-horizontality of turnion axis
 - (c) line of sight not perpendicular to horizontal axis
 - (d) index frame not in correct position
- (v) In chain and compass traverse, corrections are applied graphically by using
- (a) axis rule
 - (b) Bowditch's rule
 - (c) transit rule
 - (d) Simpson's rule
- (vi) U-forke is an instrument used in
- (a) chain surveying
 - (b) compass surveying
 - (c) tacheometric surveying
 - (d) plane table surveying
- (vii) Latitude of a line is
- (a) projection of line on meridian
 - (b) horizontal projection
 - (c) projection of line on east-west line
 - (d) None of the above
- (viii) Type of error due to local attraction is
- (a) cumulative error
 - (b) compensation error
 - (c) accidental error
 - (d) constant error
- (ix) Curvature correction in trigonometrical levelling is
- (a) always additive.
 - (b) always subtractive.
 - (c) additive to angle of elevation but subtractive to angle of depression .
 - (d) subtractive to angle of elevation and additive to angle of depression .
- (x) Correct sequence of steps in temporary adjustment of plane table surveying is
- (a) orientation-levelling-centring
 - (b) centring-levelling-orientation
 - (c) levelling-centring-orientation
 - (d) centring-orientation-levelling
- (xi) Subtense bar is used in
- (a) fixed hair tacheometry
 - (b) movable hair, vertical base tacheometry
 - (c) tangential tacheometry
 - (d) horizontal base, movable hair tacheometry

(xii) Length of offset from long chord is equal to

(a) $R - \sqrt{R^2 - x^2}$

(b) $\sqrt{R^2 - x^2} - \sqrt{R^2 - L^2/4}$

(c) $\sqrt{R^2 - L^2/4} - x^2$

(d) $\sqrt{R^2 - x^2} - \sqrt{R^2 - L^2}$

(xiii) An ideal transition curve is

(a) a chlothoid

(b) a paraboloid

(c) an ellipsoid

(d) a catenary

(xiv) Laplace station in triangulation survey is a point where

(a) base line is measured

(b) satellite station observations are made

(c) trigonometrical levelling is done

(d) astronomical observations are made

(xv) Side-condition correction in adjustment of triangulation figure is also known as

(a) least square correction

(b) log-sine correction

(c) equal shift correction

(d) weighted correction

(xvi) Relief displacement in a vertical aerial photograph is radial from

(a) ground nadir point

(b) ground principal point

(c) photo-principal point

(d) isocentre

(xvii) Two marks on glass plates of parallex-bar are known as

(a) floating marks

(b) fiducial marks

(c) movable and fixed half marks

(d) None of the above

(xviii) Wavelength of visible light is of the range

(a) 3×10^{-5} m to 7×10^{-5} m

(b) 3×10^{-7} m to 7×10^{-7} m

(c) 3×10^{-9} m to 7×10^{-9} m

(d) 3×10^{-12} m to 7×10^{-12} m

(xix) Remote sensing satellites are

(a) Geostationary satellites

(b) Equatorial satellites

(c) Communication satellites

(d) Polar satellites

xx) Geodimeter makes use of

- (a) visible light for distance measurement
- (b) microwaves for distance measurement
- (c) infra-red wave for distance measurement
- (d) radiowaves for distance measurement.

PRINCIPLES OF GEOINFORMATICS

Time : Three hours

Maximum marks : 100

*Answer FIVE questions, taking ANY TWO from Group A,
ANY TWO from Group B and ALL from Group C.*

*All parts of a question (a, b, etc.) should be
answered at one place.*

*Answer should be brief and to-the-point and be supple-
mented with neat sketches. Unnecessary long answer
may result in loss of marks.*

*Any missing or wrong data may be assumed suitably
giving proper justification.*

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) Reciprocal observations made from stations *A* and *B* are as follows: Distance between stations = 7224 m. Angle of elevation at *A* to *B* = $1^{\circ}34'56''$; angle of depression at *B* to *A* = $0^{\circ}56'42''$. Height of instrument at *A* and *B* = 1.2 m and 1.3 m. Height of signal at *A* and *B* = 4.2 m and 3.0 m. Find the difference in level between stations. 10
- (b) Write in detail about trial and error method of resection in plane table surveying, explaining Lehman's rules clearly. Also, explain about strength of fix. 7+3

2. (a) In a closed traverse *ABCDEA*, the bearing of two lines could not be observed. Compute the bearings of these two lines from the following data: 10

Line	AB	BC	CD	DE	EA
Length (m)	230.5	250.2	210.8	240.3	265.4
Bearing	N36°45' E	S82°48' E	?	S63°3'36" W	?

- (b) Determine the most probable value of the angles *A*, *B* and *C* from the following observed values by the method of differences:

$$A = 39^{\circ}14'15.3", \quad B = 31^{\circ}15'26.4",$$

$$C = 42^{\circ}18'18.4", \quad A + B = 70^{\circ}29'45.2",$$

$$B + C = 73^{\circ}33'48.3". \quad 10$$

3. (a) The consecutive readings taken during a levelling operation are as follows:

0.685, 1.315, -1.825, -0.635, 1.205, 1.235, 2.631, 1.355, -2.015.

The instrument was shifted after third and sixth reading. Third reading was taken to a benchmark of 100 m elevation. Find the reduced level of other points by rise and fall method. 10

- (b) A combined curve has a circular arc of radius 300 m with 75 m long transition curve at both ends. The deflection angle between the tangents is 60°. The circular curve is to be set with 20 m peg interval and the transition curve with 10 m peg intervals. Find necessary angles for obtaining the points on the first transition curve. 10

S'08 : 6 FN : CV 406 (1432)

(2)

(Continued)

4. (a) As chaining was not possible, a traverse was conducted using tacheometry. The line of sight was horizontal in all cases. The following data were obtained:

Line	Bearing	Instrument at	Staff at	Reading
<i>AB</i>	70° 30'	<i>A</i>	<i>B</i>	1.535, 2.214, 2.893
<i>BC</i>	120° 45'		<i>D</i>	2.018, 2.70, 3.708
<i>CD</i>	223° 30'		<i>C</i>	
<i>DA</i>	320° 47'	<i>C</i>	<i>B</i>	1.033, 1.733, 2.432
			<i>D</i>	1.363, 2.243, 3.123
			<i>A</i>	

Find length of sides and length and bearing of line *AC*. Also, find the gradient from *A* to *C*, if reading on a staff held at a benchmark is 2.415 from *A* and 0.645 from *C*. $K = 100, C = 0.3$. 10

- (b) Write short notes on *any two* of the following: 5 × 2

- (i) Measurement of horizontal angle by repetition method
- (ii) Curvature and refraction effect in levelling
- (iii) Transition curve.

Group B

5. (a) Write in detail about the interaction of electromagnetic radiation with atmosphere. What is atmospheric window? 8+2
- (b) Prove that best well-conditioned triangle is an isoceles triangle with bore angle of 56°14' each. 10

S'08 : 6 FN : CV 406 (1432)

(2)

(Continued)

Group C

6. (a) Explain about the basic idea behind the working of GPS. Why is fourth satellite needed to find exact coordinates? 7+3
- (b) In a pair of overlapping photographs, the mean distance between two principal points lying on the datum is 6.385 cm. The flying height of the aircraft at the time of photography was 580 m above the datum. Determine the difference of parallax for top and bottom of the tower of height 115 m having base in the datum surface. The focal length of the camera is 150 m. 10
7. Write about the following in detail: 5×4
- (a) Various types of signals in triangulation
- (b) Electromagnetic radiation and various wavelength used in remote sensing
- (c) Stereoscopy and minor stereoscope
- (d) Principle of EDM.
8. (a) Derive a relationship for relief displacement on a vertical photograph. 10
- (b) The following observations were made at satellite station S , the direction of true station P was $0^{\circ}0'00''$. The directions of M and N were $70^{\circ}60'40''$ and $145^{\circ}24'20''$, respectively. The direction of O was $212^{\circ}42'10''$. Given the distance PS was 25.24 m and PM, PN, PO were 7567 m, 8435 m and 6694 m, respectively. Reduce the observed angles to the true station. 10

9. Choose the *correct* answer for the following: 1×20
- (i) If the standard deviation of a quantity is $\pm 1''$, the maximum error would be
- (a) 2.39"
- (b) 3.29"
- (c) 2.93"
- (d) 9.23"
- (ii) If the vertical angle from one station to another station 100 m apart is 60° , the staff intercept for a tachometer with $K = 100$ and $C = 0$ will be
- (a) 1
- (b) 4
- (c) 5
- (d) 0.1
- (iii) Modern EDM instruments work on the principle of measuring
- (a) the reflected energy generated by EM waves
- (b) total time taken by EM wave in travelling the distance
- (c) the change in frequency of EM wave
- (d) the phase difference between the transmitted and the reflected EM waves

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(Continued)

S'08 : 6 FN : CV 406 (1432) (5)

(Continued)

- (iv) Sensitivity of bubble tube depends on
- radius of curvature
 - the length of the vapour bubble
 - the smoothness of the inner surface of the bubble tube
 - All of the above.
- (v) The transit rule of balancing a traverse is applied when
- the linear and angular measurements are of same precision.
 - linear measurements are more precise.
 - the angular measurements are more precise.
 - linear and angular measurements are αl and $\alpha (1/l)$, where l is the length of line.
- (vi) Theory of error is applied to minimise the
- gross errors.
 - systematic errors.
 - random errors.
 - All of the above.
- (vii) For a transition curve, the shift S of a circular curve is given by
- $L/24 R^2$
 - $L^2/24 R^2$
 - $L^3/24 R^2$
 - $L^2/24 R$
- (viii) The following value of the change in radial acceleration passes unnoticed by the passengers :
- 0.003 m/sec²/sec
 - 0.03 m/sec²/sec
 - 0.3 m/sec²/sec
 - 3.0 m/sec²/sec
- (ix) Alidade is an instrument used for
- measuring distance.
 - measuring elevation of points.
 - taking sight toward a point.
 - All of the above.
- (x) Suppose the sensitivity of a bubble tube is 30" per 2 mm division. What would be the error in a vertically held staff at a distance of 200 m when bubble is out of centre by 2.5 division ?
- 0.054 m
 - 0.079 m
 - 0.073 m
 - 0.12 m
- (xi) To determine difference in elevation by stereoscopic parallax, one uses
- $\frac{\Delta p}{p_1 + \Delta p} \cdot Bf$

$$(b) \frac{\Delta p}{p_1 \cdot \Delta p} \cdot Bf$$

$$(c) \frac{\Delta p}{p_1 (p_1 + \Delta p)} \cdot Bf$$

$$(d) \frac{p_1 \cdot \Delta p}{p_1 + \Delta p} \cdot Bf$$

(xii) Phase correction, when observations are made on bright line, is

$$(a) (s \cos^2 \alpha/2)/d$$

$$(b) (s \cos \alpha/2)/d \sin \alpha$$

$$(c) (s \sin^2 \alpha/2)/d$$

$$(d) (s \cos \alpha/2)/d$$

(xiii) Mie scattering is defined as

(a) when particle dia is greater than wavelength of GMR.

(b) when particle dia is equal to the wavelength of GMR.

(c) when particle dia is less than the wavelength of GMR.

(d) when particle dia is very large in comparison to the wavelength of GMR.

(xiv) Length of combined curve in setting out of a transition curve is

$$(a) (R + S) \tan \Delta/2 + L/2 (1 - s/5R)$$

$$(b) R \tan \Delta/2 + L/2 (1 - s/2R)$$

$$(c) (R + S) \tan \Delta/2 + s/5R$$

$$(d) (R + S) \tan \Delta/2 + L (1 - s/5R)$$

(xv) A parallax bar is used

(a) to measure horizontal distance on ground.

(b) in plane table surveying.

(c) to measure distances on photograph.

(d) to measure parallax to determine height of objects.

(xvi) Strength of figure is determined by a factor

$$(a) (D-C)/C \{ \delta_A^2 + \delta_A \delta_B + \delta_B^2 \}$$

$$(b) D/(C-D) \{ \delta_A^2 + \delta_A \delta_B + \delta_B^2 \}$$

$$(c) (D-C)/D \{ \delta_A^2 + \delta_B^2 + \delta_A \delta_B \}$$

$$(d) (D/C) \{ \delta_A + \delta_A \delta_B + \delta_B^2 \}$$

(xvii) A thermal scanner works within

(a) 8-14 μm

(b) 1-2.5 μm

(c) 6-16 μm

(d) 0.4-0.7 μm

(xviii) Limiting length of an offset by taking both errors in laying direction and length is

$$(a) \sqrt{2}(l/s)$$

$$(b) l/s$$

$$(c) (s/4\sqrt{2}) \operatorname{cosec} \delta\alpha$$

$$(d) (s/\sqrt{2}) \operatorname{cosec} \delta\alpha$$

(xix) Principle of radial line triangulation is used to

- (a) find angles in a triangle.
- (b) update an existing map using photographs.
- (c) find height of points using photographs.
- (d) All of the above.

(xx) Degree of curve is defined by

- (a) $1420/D$
- (b) $1146/D$
- (c) $(1520 R)/D$
- (d) $100/D$

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PRINCIPLES OF GEOINFORMATICS*Time : Three hours**Maximum Marks : 100*

*Answer FIVE questions, taking ANY TWO from Group A,
ANY TWO from Group B and ALL from Group C.*

*All parts of a question (a, b, etc.) should be
answered at one place.*

*Answer should be brief and to-the-point and be supple-
mented with neat sketches. Unnecessary long answer
may result in loss of marks.*

*Any missing or wrong data may be assumed suitably
giving proper justification.*

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) To carry over the level from one bank of a 1.725 km wide lake to the other bank, following observations were made:

Level instrument at	Staff held near level instrument	Staff held at far end
Bank A	1.645 m	2.745 m
Bank B	1.575 m	1.105 m

If the R.L. of staff station at Bank A is 243.355 m, find R.L. of staff station at Bank B. Apply all corrections required and find amount of error in line of collimation in the instrument, if any. Take radius of earth as 6370 km.

5+5

- (b) Describe method of ranging across a depression in chain surveying. 4
- (c) Describe characteristics of contours. 6
- 2. (a) Describe Bessel's graphical method of solving three point problem in plane table surveying. 10
- (b) Given the following set of tacheometric surveying observation, compute slope of line AB in the form 1 : n: 10

Instrument at	Staff Reading at A	Vertical Angle	
	0.350		$k = 100$
P	1.395	$+3^{\circ} 14' 35''$	$c = 0.35$
	2.445		
	Subtense Bar at B	Vertical Angle	Subtense Angle
P		$-0^{\circ} 28' 45''$	$0^{\circ} 47' 50''$

Horizontal angle $\angle APB = 78^{\circ} 37' 20''$
 Length of subtense bar = 3 m
 Height of bar above ground = 1.175 m.

- 3. (a) Adjust the bearings of a clockwise running closed compass traverse. Assume the bearing of line AE to be free from error. Given data are: 13

Line	Fore Bearing	Back Bearing
AB	$11^{\circ} 30'$	$192^{\circ} 00'$
BC	$84^{\circ} 00'$	$265^{\circ} 00'$
CD	$137^{\circ} 30'$	$317^{\circ} 00'$
DE	$215^{\circ} 00'$	$36^{\circ} 00'$
EA	$287^{\circ} 30'$	$108^{\circ} 00'$

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(Continued)

- (b) Describe various errors in angle measurement by a transit theodolite and methods of correcting them while taking field observations. 7
- 4. (a) Describe Rankine's deflection angle method of plotting a simple circular curve in field. Derive necessary expressions required for the same. 10
- (b) Using method of differences and normal equations, compute most probable values of angles closing the horizon: 10

Angle	Magnitude	Weight
A	$83^{\circ} 28' 36''$	3
B	$107^{\circ} 49' 18''$	2
C	$115^{\circ} 12' 52''$	2
D	$53^{\circ} 29' 32''$	3
A + B	$191^{\circ} 17' 40''$	1
B + C	$223^{\circ} 02' 24''$	1
C + D	$168^{\circ} 42' 10''$	1

Group B

- 5. (a) Draw neat and clean line sketch of a geodimeter and explain its construction and working. 8
- (b) Two triangulation stations A and B are 120 km apart and are respectively have elevations of 384 m and 1175 m above mean sea level. A peak P in line AB and 72 km from A has an elevation of 627 m above mean sea level. Ascertain if the points A and B are intervisible. If not, find height of signal required at B so that the line of sight is at least 3 m above the intervening ground. Take radius of earth as 6370 km and coefficient of atmospheric refraction as 0.072. 12

W'08:6FN:CV 406 (1432) (3)

(Turn Over)

6. (a) What is trilateration surveying? Write merits of trilateration over triangulation. 6

(b) An area of size $128 \text{ km} \times 57 \text{ km}$ is to be surveyed by aerial photography. From the data given below, find number of photographs required:

Longitudinal overlap	66%
Transverse overlap	28%
Size of photograph	$23 \text{ cm} \times 23 \text{ cm}$
Focal length of camera	18 cm
Scale of photograph	1 : 25000
Least count of intervalometer	0.1 sec
Average elevation of terrain	240 m above M.S.L.
Speed of airplane	410 km/h

Also, compute number of photographs in one flight line, total number of flight lines, height of flight, spacing of successive photographs in ground distance, spacing of flight line, and exposure interval of camera. 14

7. (a) Prove that tilt distortion from isocentre is tilted aerial photograph. 14

(b) From a satellite station (S), near main triangulation station C , angles were measured to triangulation stations A and B , and are respectively as

$$\angle CSA = 53^\circ 17' 25''; \angle A = 55^\circ 22' 32''$$

$$\angle ASB = 75^\circ 37' 45''; \angle B = 48^\circ 55' 27''$$

$$\text{Distance } CS = 78 \text{ m}$$

$$\text{Distance } AB = 6350 \text{ m}$$

Points A and S are on opposite sides of line BC .

Compute $\angle ACB$. 6

8. (a) Describe different stages of data acquisition in remote sensing. 8
- (b) What are radial line assumptions? Describe Arundel's method of plotting details using aerial photogrammetry. 8
- (c) Describe strength of figure and well conditioned triangle. 4

Group C

9. Choose the *correct* answer for the following: 20×1

(i) Visible band of electromagnetic spectrum has a range of wavelength from

(a) $0.04 \mu\text{m}$ to $0.07 \mu\text{m}$

(b) $4 \mu\text{m}$ to $7 \mu\text{m}$

(c) $0.4 \mu\text{m}$ to $0.7 \mu\text{m}$

(d) 4 mm to 7 mm

(ii) Remote sensing satellites are mostly

(a) polar orbiting satellites

(b) sun-synchronous satellites

(c) both (a) and (b) above

(d) None of the above

(iii) Probable error of a single observation of unit weight is

(a) $\pm 0.7979 \sqrt{(\sum r^2 / n - 1)}$

(b) $\pm 0.6745 \sqrt{(\sum r^2 / n - 1)}$

(c) $\pm 0.6745 \sqrt{(\sum r^2 / n)}$

(d) $\pm 0.6745 \sqrt{(\sum r^2 / n + 1)}$

(iv) Example of constant error in a transit theodolite is

- (a) index error.
- (b) error due to imperfect adjustment of plate levels.
- (c) error due to eccentricity of inner and outer axes.
- (d) error of line of collimation.

(v) Taking both face observation will eliminate

- (a) index error.
- (b) error due to non-horizontality of turnion axis.
- (c) line of collimation error.
- (d) All of the above.

(vi) Error due to local attraction is a

- (a) compensating error.
- (b) constant error.
- (c) commutative error.
- (d) personal error.

(vii) Curvature correction in levelling is

- (a) $C_v = d^2/2R$
- (b) $C_v = d^2/R$
- (c) $C_v = d/2R$
- (d) $C_v = d/R$

(viii) Distance measured by a chain, which is too-long, will be

- (a) equal to actual distance.
- (b) less than actual distance.
- (c) more than actual distance.
- (d) None of the above.

(ix) U-fork in plane table surveying is used to

- (a) level the table.
- (b) orient the table.
- (c) sight a point.
- (d) centre the table.

(x) Method of repetition can be used in measurement of

- (a) vertical angle.
- (b) horizontal angle.
- (c) both (a) and (b) above.
- (d) None of the above.

(xi) Analytic lens in tacheometer is used to make

- (a) distance between stadia wires equal to zero.
- (b) multiplying constant equal to 100.
- (c) additive constant equal to zero.
- (d) additive constant equal to focal length.

(xii) In addition of least square condition, the number of condition equations in a braced quadrilateral is

- (a) 2
- (b) 3
- (c) 4
- (d) 5

(xiii) Axis signal correction in trigonometrical levelling is given by

$$(a) \tan \delta_1 = \frac{(s_2 - h_1) \cos^2 (\alpha + \theta)}{d \cos (\theta / 2)}$$

$$(b) \tan \delta_1 = \frac{(s_1 - h_2) \cos^2 (\alpha + \theta)}{d \cos (\theta / 2)}$$

$$(c) \tan (\delta_1 / 2) = \frac{(s_2 - h_1) \cos^2 (\alpha + \theta)}{d \cos (\theta / 2)}$$

$$(d) \tan (\delta_1 / 2) = \frac{(s_1 - h_2) \cos^2 (\alpha + \theta)}{d \cos (\theta / 2)}$$

(xiv) A vertical angle from lower station to higher station in trigonometrical levelling will be an angle of depression, if

- (a) height of instrument is equal to height of signal.
- (b) distance between two stations and difference in elevation are equal.
- (c) distance is less than difference in elevation.
- (d) difference in elevation is much less as compared to the distance.

(xv) Scale of a vertical aerial photograph

- (a) increases as height of flight increases.
- (b) does not change with change in height.
- (c) decreases with increase in height.
- (d) None of the above.

(xvi) Parallex bar is used to measure

- (a) elevation of a point.
- (b) distance between two points.
- (c) absolute parallex of a point.
- (d) differential parallex of two points.

(xvii) Basic principle of GPS is similar to

- (a) resection by two point problem.
- (b) resection by three point problem.
- (c) resection by three point problem and check by fourth point.
- (d) None of the above.

(xviii) The intrinsic equation of an ideal transition curve is

$$(a) x = l; y = l^3 / 6RL$$

$$(b) y = l^3 / 6RL$$

$$(c) y = x^3 / 6RL$$

$$(d) x = l^2 / 2RL$$

(xix) The length of perpendicular offset from tangent, for plotting circular curve by offset from tangent, is given by

$$(a) O_x = \sqrt{R^2 + x^2} - R$$

$$(b) O_x = \sqrt{R^2 + x^2/4} - R$$

$$(c) O_x = \sqrt{R^2 + 4x^2} - R$$

$$(d) O_x = \sqrt{4R^2 + x^2} - R$$

(xx) Parallax equation for determining elevation in stereoscopy is given by

$$(a) \Delta h = \frac{(H-h) \Delta p}{(H-h)^2 \Delta p + bH}$$

$$(b) \Delta h = \frac{(H-h)^2 \Delta p}{(H-h) \Delta p + bH}$$

$$(c) \Delta h = \frac{(H-h) \Delta p + bH}{(H-h)^2 \Delta p}$$

$$(d) \Delta h = \frac{(H-h)^2 + \Delta p}{(H-h) \Delta p + bH}$$

S'09 : 6 FN : CV 406 (1432)**PRINCIPLES OF GEOINFORMATICS***Time : Three hours**Maximum Marks : 100*

*Answer FIVE questions, taking ANY TWO from Group A,
ANY TWO from Group B and ALL from Group C.*

*All parts of a question (a, b, etc.) should be
answered at one place.*

*Answer should be brief and to-the-point and be supple-
mented with neat sketches. Unnecessary long answers
may result in loss of marks.*

*Any missing or wrong data may be assumed suitably
giving proper justification.*

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) Two roads meeting at 6492 m chainage, at right angle, need a simple circular curve of radius 300 m to set by a 20 second theodolite at first tangent point. Calculate the chainages of two ends of the curve, and reading to fix in vernier for the peg at 6210 m on the curve. 10
- (b) A steel tape is 1 mm thick, 1.5 cm wide, 30 m long in standard pull of 120N. Calculate the total correction, if the field pull is 150N. Take modulus of elasticity of steel as 200 kN/mm² and specific weight = 80 kN/m³. 10

(Turn Over

2. (a) A five-sided compass traverse has the following fore and back bearings, respectively (side are nearly equal):
 $AB = 161^\circ 30'$, 342° , $BC = 90^\circ$, 270° , $CD = 19^\circ$, $199^\circ 30'$, $DE = 306^\circ 30'$, 126° , $EA = 235^\circ$, $54^\circ 30'$.
 Compute the internal angles and express the correct forebearings in 'reduced' bearing system. 10
- (b) A tacheometer, with multiplicative constant 90 and additive constant 0.3 m, is placed with axis 1.2 m above P and directed to a vertical staff held at Q . The readings are 1.1 m, 2.3 m, 3.5 m at an elevation angle of 5° . Compute the slope distance PQ . 10
3. (a) A quadrilateral net is surveyed by theodolite, the measurements being:
 $AB = 322$ m, Angle $A = 89^\circ 15' 0''$, $AD = 401$ m, Angle $B = 96^\circ 28' 20''$, $BC = 375$ m, $ABCD$ named anticlockwise.
 Determine the length CD , angles C and D (assume AD as reference northline for finding bearings). 10
- (b) Write short notes on (i) sensitivity of bubble, and (ii) vertical curve. 2×5
4. (a) Staff readings on a sloping ground by dumpy level are 0.35 m, 1.94 m, 2.68 m, 1.07 m, 2.59 m, 3.46 m. Tabulate these in a standard form and calculate RL of first and last point, if change point is 65.80 m above MSL, with usual checks. 10
- (b) Draw sketches of radiation and intersection methods of plane tabling. Compare their advantage/disadvantage briefly. 10

S'09:6FN:CV 406 (1432)

(2)

(Continued)

Group B

5. (a) (i) What is meant by well-conditioned triangle? 2
 (ii) Two peaks, 70 km apart, have RL 65.5 m and 93.0 m, intervening ground being 17 m above MSL. Check the intervisibility, assuming suitable radius of earth and refraction coefficient. 8
- (b) Briefly distinguish between aerial photograph and satellite imagery in terms of acquisition process and application in mapping the earth surface. 10
6. (a) A low height vertical photographic print shows the images of bottom and top of a 5 m tower, at 5 mm and 6 mm, respectively from the principal point. If the focal length of the camera lens is 150 mm, sketch the elevation. Determine the distance of the tower from the plumb line on ground, and scale of photograph. 10
- (b) Write short notes on EDM and GPS. 5+5
7. (a) (i) What is trilateration? 2
 (ii) The distances from C to other two stations are $CA = 900$ m, $CB = 750$ m. The angles are, however, measured from a satellite station S , 10 m from C (outside the triangle ABC , A and B are on the same side of CS) as $CSA = 120^\circ$, $CSB = 60^\circ$. Find the angle ACB . 8
- (b) Briefly explain two instruments used for viewing and measuring on a pair of photographs in a laboratory. 10
8. (a) A ground 9.6 km \times 4.8 km is covered by photographs with 60% longitudinal overlap and 20% sidelap. If the print size is 120 mm \times 120 mm and scale is 1 : 10000, estimate the number of photographs. 10
- (b) Illustrate in short (i) adjustment of triangulation net, and (ii) electromagnetic spectrum. 5+5

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(3)

(Turn Over)

Group C

9. Choose the *correct* answer for the following: 20 × 1

(i) Number of links in 30 m chain is

- (a) 30
- (b) 66
- (c) 100
- (d) 150

(ii) Angle between true north and magnetic north is

- (a) dip.
- (b) declination.
- (c) departure.
- (d) deviation.

(iii) Slope correction is

- (a) always positive.
- (b) positive or negative.
- (c) always negative.
- (d) compensating type.

(iv) Width of one division in levelling staff is

- (a) 5 mm
- (b) 1 mm
- (c) 10 mm
- (d) 2 mm

(v) Contours are lines of equal

- (a) length.
- (b) height.
- (c) bearing.
- (d) latitude.

(vi) Alidade is an instrument used in

- (a) plane tabling.
- (b) levelling.
- (c) tape surveying.
- (d) curve setting.

(vii) East component of a traverse line is called

- (a) longitude.
- (b) latitude.
- (c) departure.
- (d) azimuth.

(viii) The road/rail curve, with continuously changing radius, is called

- (a) reverse
- (b) vertical
- (c) compound
- (d) transition

S'09 : 6FN : CV 406 (1432)

(4)

(Continued)

S'09 : 6FN : CV 406 (1432)

(5)

(Turn Over)

(ix) Square of standard deviation is

- (a) variance
- (b) covariance
- (c) weightage
- (d) matrix

(x) For distance calculation, the tacheometer observes

- (a) prismatic compass.
- (b) levelling staff.
- (c) Gunter's chain
- (d) metallic tape.

(xi) A braced quadrilateral has — observation stations.

- (a) 5
- (b) 3
- (c) 6
- (d) 4

(xii) Trilateration in triangle measures three

- (a) angles.
- (b) areas.
- (c) distances.
- (d) bearings.

(xiii) Sum of angles closing the horizon is

- (a) 180°
- (b) 270°
- (c) 360°
- (d) 540°

(xiv) Coefficient of refraction is nearly

- (a) 0.14
- (b) 0.02
- (c) 0.50
- (d) 0.07

(xv) Radial line triangulation is carried out in

- (a) imagery.
- (b) photography.
- (c) signalling.
- (d) total station.

(xvi) Matrix form for solving simultaneous equations is

- (a) square
- (b) rectangular
- (c) identity
- (d) orthogonal

(xvii) Atmospheric window is a subject matter of

- (a) plane tabling.
- (b) remote sensing.
- (c) contour survey.
- (d) intervisibility.

(xviii) Distortion in print due to rotation of camera is termed as

- (a) relief.
- (b) aerial.
- (c) tilt.
- (d) parallax.

(xix) Projection in photogrammetry is

- (a) perspective.
- (b) orthogonal.
- (c) lambert.
- (d) third angle.

(xx) Side conditions in a network is adjusted by

- (a) equal shift.
- (b) weighting.
- (c) spectrum.
- (d) log sine.

PRINCIPLES OF GEOINFORMATICS*Time : Three hours**Maximum marks : 100*

*Answer FIVE questions, taking ANY TWO from Group A,
ANY TWO from Group B and ALL from Group C.*

*All parts of a question (a, b, etc.) should be
answered at one place.*

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mented with neat sketches. Unnecessary long answers
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giving proper justification.*

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) The length of a survey line, when measured with a chain of 20 m nominal chain length, was found to be 841.5 m. When the chain was compared with a standard, it was found to be 0.1 m too long. Find the correct length of the line. 3
- (b) The length of a survey line was measured with a 30 m chain and was found to be 315.4 m. When the chain was compared with a standard, it was found to be 0.2 m too short. Find the correct length of the line. 3
- (c) The distance between two points measured along a slope is 518 m. Find the horizontal distance between these, if the (i) slope angle is 6° , and (ii) slope is 1 in 5. 4

(d) A compass traverse ABCDEA was run anti-clockwise and the following bearings were taken where local attraction was suspected:

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'

Determine the local attraction at stations and the correct bearings of lines. 10

2. (a) What is sensitivity of a level tube? Derive a relation between the sensitivity and the radius of the tube. 5
- (b) A theodolite was set up at a station *P*, and a staff was kept at a station *Q* at a distance of 3000 m. If the angle of elevation to a vane 3 m above the foot of the staff was 8° 30', determine the R.L. of the station *Q* after applying correction for curvature and refraction. The R.L. of the instrument axis was 150.45 m. 10
- (c) What is resection? Describe *any one* method of resection. 5
3. (a) How would you measure a horizontal angle by repetition? What are its advantages? 8
- (b) The following angles were measured at a station *O* so as to close the horizon:
 - $LAOB = 83^\circ 42' 28''.75$ weight 3
 - $LBOC = 102^\circ 15' 43''.26$ weight 2
 - $LCOD = 94^\circ 38' 27''.22$ weight 4
 - $LDOA = 79^\circ 23' 23''.77$ weight 2
 Find out the adjusted values of angles. 12

4. (a) A tacheometer, fitted with an anallactic lens and having the multiplying constant 100, was set up at *P* which is an intermediate point on a traverse course AB. The following readings were taken with staff held vertical:

Staff station	Bearing	Vertical Angle	Intercept, m	Axial Hair Reading, m
A	40° 35'	- 4° 24'	2.21	1.99
B	22° 35'	- 5° 12'	2.02	1.50

Calculate the length of AB and the difference in level between A and B. 7

- (b) Discuss the subtense bar method of tacheometric surveying. What are its advantages? 3
- (c) A parabolic vertical curve is to be set out to connect two uniform grades of + 0.9% and - 1.1%. If the rate of change of grade is - 0.25% per 100 m, calculate the reduced levels of pegs on the curve, if the R.L. of the point of intersection is 215.35 m. The chainage of the point of intersection is 2540.00 m. 10

Group B

5. (a) Describe the considerations upon which the selection of triangulation stations is based. 10
- (b) Explain how would you prolong a given baseline. 5
- (c) Describe Total Station Instrument method of setting out a circular curve. 5
6. (a) The scale of an aerial photograph is 1 cm = 100 m. The photograph is of the size of 20 cm × 20 cm. Determine the number of photographs required to cover an area of 10 km × 10 km, if the longitudinal lap is 60% and the side lap is 30%. 8

- (b) From an eccentric station S, 12.25 m to the West of the main station B, the following angles were measured:

$$\angle BSC = 76^\circ 25' 32''; \angle CSA = 54^\circ 32' 20''$$

The stations S and C are to the opposite sides of the line AB. Calculate the correct angle ABC, if the lengths AB and BC are 5286.5 m and 4932.2 m, respectively. 12

7. (a) The ground length of a line AB is known to be 545 m and the elevations of A and B are respectively 500 m and 300 m above m.s.l. A vertical photograph taken with a camera having focal length of 20 cm, includes the images *a* and *b* of these points, and their photographic co-ordinates are:
- $$x_a = +2.65 \text{ cm}; y_a = +1.36 \text{ cm} \text{ and}$$
- $$x_b = -1.92 \text{ cm}; y_b = +3.65 \text{ cm}$$
- The distance *ab* scaled directly from the photograph is 5.112 cm. Compute the flying height above the mean sea level. 12
- (b) Two triangulation stations A and B are 60 km apart and have elevations 240 m and 280 m, respectively. Find the minimum height of signal required at B so that the line of sight may not pass near the ground than 2 m. The intervening ground may be assumed to have a uniform elevation of 200 m. 8
8. (a) Describe in brief the working of an EDM equipment distomat. 8
- (b) Enlist the sensors used in Indian Remote Sensing (IRS) satellites. Describe in brief the main applications of remote sensing. 12

Group C

9. Choose the *correct* answer for the following: 10×2

(i) The length of long chord and tangent of a circular curve of radius *R* will be equal, if the angle of deflection is

- (a) 30°
 (b) 60°
 (c) 90°
 (d) 120°

(ii) If the degree of curve (specified length 30 m) is 3° , the radius of the curve is approximately

- (a) 382 m
 (b) 573 m
 (c) 1910 m
 (d) None of the above

(iii) The equation of a cubic spiral is given by

- (a) $y = l^3/6RL$
 (b) $y = x^3/6RL$
 (c) $x = y^2/RL$
 (d) None of the above

(iv) The shape of the vertical curve is generally a

- (a) circle
 (b) parabola
 (c) spiral
 (d) hyperbola

(v) For a well-conditioned triangle, no angle should be less than

- (a) 45°
- (b) 30°
- (c) 15°
- (d) 60°

(vi) The graduations in a prismatic compass

- (a) are inverted.
- (b) have zero at south.
- (c) are from 0° to 360° .
- (d) All of the above.

(vii) The surface perpendicular to direction of gravity is a

- (a) horizontal surface.
- (b) level surface.
- (c) horizon.
- (d) None of the above

(viii) For a representative fraction of $1/1000$, the permissible centring error is

- (a) 0.25 m
- (b) 0.3 m
- (c) 0.5 m
- (d) 0.01 m

(ix) While taking a back sight, the screw used is

- (a) lower clamp.
- (b) upper clamp.
- (c) upper tangent.
- (d) None of the above.

(x) The omitted measurements can be computed if they are not more than

- (a) 4
- (b) 3
- (c) 2
- (d) 1

S'10 : 6 FN : CV 406 (1432)**PRINCIPLES OF GEOINFORMATICS***Time : Three hours**Maximum marks : 100*

*Answer FIVE questions, taking ANY TWO from Group A,
ANY TWO from Group B and ALL from Group C.*

*All parts of a question (a, b, etc.) should be
answered at one place.*

*Answer should be brief and to-the-point and be supple-
mented with neat sketches. Unnecessary long answers
may result in loss of marks.*

*Any missing or wrong data may be assumed suitably
giving proper justification.*

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) A steel tape was exactly 30 m long at 20°C when supported throughout its length under a pull of 10 kg. A line was measured with this tape under a pull of 15 kg and at mean temperature of 32°C and found to be 780 m long. The cross-sectional area of the tape = 0.03 cm², its total weight = 0.693 kg. α of steel = $11 \times 10^{-6}/^{\circ}\text{C}$, E of steel = 2.1×10^6 kg/cm². Compute the true length of the line, if tape was supported at every 15 m.
- (b) Write briefly about the classification of survey.

(c) Following bearings of the lines of a traverse are measured. Find stations affected by local attraction : 5

Line	FB	BB
AB	191° 45'	13°
BC	39° 30'	222° 30'
CD	22° 15'	200° 30'
DE	242° 45'	62° 45'
EA	330° 15'	147° 45'

2. (a) Following reciprocal observations were made from two points *P* and *Q*:
 $d = 33128$ m, angle of depression of *Q* at *P* = 6' 20", angle of depression of *P* at *Q* = 8' 10", height of signal at *P* and *Q* = 4.87 m and 4.07 m, height of instrument at *P* and *Q* = 1.27 m and 1.34 m, $R \sin 1 = 30.88$ m. Calculate reduced level of *Q* if that of *P* = 1248.65 m and average coefficient of refraction at the time of observation. 10
- (b) Write about various methods of contouring. Explain about indirect methods in detail. 5
- (c) A bubble tube of a level has a sensitivity of 20"/2 mm division. Find the error in reading on the staff held at a distance of 100 m from the level when the bubble is deflected by two divisions from the centre. 5
3. (a) What is 3-point problem? Explain, with a suitable diagram, about Bessel's method. 6
- (b) Explain about horizontal angle measurements by repetition method in brief. 4

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(2)

(Continued)

(c) Following observations of three angles, *A*, *B* and *C*, were taken at one station : 10

$$A = 75^\circ 32' 46".3, \text{ weight} = 3$$

$$B = 55^\circ 09' 53".2, \text{ weight} = 2$$

$$C = 108^\circ 09' 28".8, \text{ weight} = 2$$

$$A + B = 130^\circ 42' 41".6, \text{ weight} = 2$$

$$B + C = 163^\circ 19' 22".5, \text{ weight} = 1$$

$$A + B + C = 238^\circ 52' 9".8, \text{ weight} = 1$$

Determine the most probable value of each angle.

4. (a) Explain briefly various types of tacheometric surveying. 4
- (b) Following observations were taken with a transit theodolite : 6
- | Instrument Station | Staff at | Target | Vertical Angle | Staff Reading |
|--------------------|----------|--------|----------------|---------------|
| 0 | A | Lower | 4° 30' | 0.950 |
| | | Upper | 6° 30' | 3.25 |
- RL of the instrument axis = 255.50 m. Calculate horizontal distance between the instrument station and the staff as well as RL of staff station A.
- (c) Two tangents *AB* and *BC* intersect at *B*. Another line *DE* intersects *AB* and *BC* at *D* and *E* such that $\angle ADE = 150^\circ$ and $\angle DEC = 140^\circ$. The radius of first curve = 200 m and that of second curve = 300 m. Chainage of *B* = 950 m. Calculate necessary data for setting out compound curve by angular method. 10

Group B

5. (a) Write about triangulation and trilateration in brief. 4

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(3)

(Turn Over)

- (b) Altitude of two stations A and B , 110 km apart, are 440 m and 725 m. The elevation of a peak P situated at 65 km from A has an elevation of 410 m. Ascertain if A and B are intervisible, and, if necessary, find by how much B should be raised so that line of sight nowhere be less than 3 m above the surface of ground. $m = 0.07$, radius of earth = 6400 km. 10
- (c) Write in brief about various triangulation figures and their advantages over others. 6
6. (a) Explain in brief about the working of an electronic distance measurement device using phase comparison method. 6
- (b) Derive a relationship, with a suitable diagram, to determine scale of a vertical photograph. 6
- (c) A section line AB appears to be 10.16 cm on a photograph for which the focal length is 16 cm. The corresponding line measures 2.54 cm on a map which is to the scale of $1/50,000$. The terrain has an average elevation of 200 m above MSL. Calculate the flying altitude of the aircraft above MSL, when the photograph was taken. 8
7. (a) Explain in brief the working of a GPS system. Name various components of this system. 5
- (b) Draw a neat diagram showing various wavelengths used in remote sensing. 5
- (c) In a pair of overlapping vertical photographs, the mean distance between two principal points which lie on the datum is 6.375 cm. At the time of photography, the aircraft was 600 m above the datum. The camera has the focal length of 150 mm. In the common overlap, a tall chimney, 120 m high with its base in the datum surface, is observed. Determine difference of parallax for top and bottom of chimney. 10
8. (a) Explain in brief about EMR interaction with atmosphere. Write about various types of scattering in detail. 10
- (b) What is an ideal remote sensing system? Explain with a suitable diagram. 5
- (c) Observations were made from instrument station A to the signal at B . The sun makes an angle of 60° with the line BA . Calculate phase correction, if the observations are made on bright line and bright portion. $AB = 9460$ m and diameter of the signal = 12 cm. 5

Group C

9. Choose the *correct* answer for the following: 10×2
- (i) If the difference in levels of two ends of a 50 m long line is 1 m and its end are out of alignment by 5 m, then the corrections for slope (C_s) and alignment (cm) are related to each other as
- (a) $C_s = 4$ cm
- (b) $C_s = 0.4$ cm
- (c) $C_s = 0.04$ cm
- (d) $C_s = 0.004$ cm

S'10:6FN: CV 406 (1432)

(4)

(Continued)

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(5)

(Turn Over)

(ii) When a level is in adjustment, the line of sight of the instrument is perpendicular to the

- (a) vertical axis of the instrument and parallel to the bubble tube axis.
- (b) vertical axis of the instrument and bubble level axis.
- (c) bubble tube axis and parallel to the vertical axis.
- (d) None of the above.

(iii) Closing error in a closed traverse is adjusted by

- (a) Lehman's rule
- (b) Bowditch's rule
- (c) Slide rule
- (d) None of the above.

(iv) Apex distance in a simple circular curve is given by

- (a) $R (\sec \varphi/2 - 1)$
- (b) $R (\cos \varphi/2 - 1)$
- (c) $R (\sin \varphi/2 - 1)$
- (d) $R (\cos \varphi - 1)$

(v) Tangent length of a combined curve is

- (a) $(R - S) \tan (\Delta/2) + L/2$
- (b) $(R + S) \tan (\Delta/2) + L/2 [1 - (S/R)]$
- (c) $(R + S) \tan (\Delta/2) + L/2 [1 - (S/5R)]$
- (d) $(R + S) \tan (\Delta/2) - L/2 [1 + (S/2R)]$

(vi) When line of sight is inclined and staff is held vertical, the horizontal distance is given by

- (a) $(f/i) s \cos^2 \theta + (f + d) \sin \theta$
- (b) $(f/i) s \cos^2 \theta + (f + d) \cot \theta$
- (c) $(f/i) s \cos^2 \theta + (f + d) \cos \theta$
- (d) $(f/i) s \sin^2 \theta + (f + d) \cot \theta$

(vii) Visible range of EMR used in remote sensing lies within the range of

- (a) 0.03-3 nm
- (b) 0.4-0.7 nm
- (c) 0.4-0.7 μm
- (d) 0.3-0.9 μm

(viii) Time interval between the exposure of photographs can be calculated by

- (a) $360 V/L$
- (b) $V/3600L$
- (c) $3600L/V$
- (d) $36 L/V$

(ix) A parallax equation can be written as

- (a) $H \Delta p/p_1$
- (b) $(H-h) \Delta p / (p_1 + \Delta p)$
- (c) $(H-h) / (p_1 + \Delta p)$
- (d) $H \Delta p / (p_1 + \Delta p)$

(x) The distance of visible horizon for a point having an elevation of 637.5 m is

(a) 6.735 km

(b) 67.35 km

(c) 10 km

(d) 100 km

W'10 : 6 FN : CV 406 (1432)
PRINCIPLES OF GEOINFORMATICS

Time : Three hours

Maximum Marks : 100

*Answer FIVE questions, taking ANY TWO from Group A,
 ANY TWO from Group B and ALL from Group C.*

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 answered at one place.*

*Answer should be brief and to-the-point and be supple-
 mented with neat sketches. Unnecessary long answers
 may result in loss of marks.*

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 giving proper justification.*

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) A tape is exactly 30 m at 150 N pull and 35°C. The field pull is 200 N and temperature 15°C. Find correction (in mm) in flat ground. The cross-sectional area is 6 mm²; modulus of elasticity = 200×10^3 MPa; coefficient of expansion = 12×10^{-6} per °C. 10
- (b) Magnetic bearings of an open traverse are $AB = 71^\circ$, $BA = 250^\circ$, $BC = 110^\circ$, $CB = 292^\circ$, $CD = 161^\circ$, $DC = 341^\circ$, $DE = 219^\circ$, $ED = 40^\circ$. Express correct forebearings in quadrantal system, if declination is $1^\circ 15' W$. 10
2. (a) The included angles of $ABCD$, named anticlockwise, measured by theodolite, are $B = 89^\circ 0' 20''$ and $C = 91^\circ 1' 40''$. The lengths are $AB = 81.7$ m, $BC = 65.4$ m, $CD = 83.2$ m. If co-ordinate of A is (0N, 0E), compute co-ordinate of D . Assume AB as $N 0^\circ E$. 10

- (b) Following are the readings by level and staff. Determine the RL of first and last points. BS 0.683, (3.877 and 0.451 CP), 2.676 (BM, 31.125 RL), (3.999 and 1.834 CP), 1.706 FS. 10
3. (a) Explain briefly, with graphical presentation, the method of correcting plane table traverse, using Bowditch's rule. 10
- (b) Find most probable values of x and y up to three decimal from the following observations of equal weightage: 10
- $$3x + 2y = 42; \quad 2x - y = 16; \quad x + y = 14;$$
- $$-x + 3y = 7.$$
4. (a) A theodolite, set at A (RL = about 16 m AMSL) with its axis above 1.2 m from ground, is directed to a target 3 m high held at B , about 2 km from A , horizontally. The observed elevation angle is $11^\circ 52' 40''$. Show it in a sketch and correct for curvature/refraction with assumed R and m . Use these to estimate RL of B . How could these approximate corrections be avoided? 10
- (b) A road needs a diversion from chainage 1354.98 to a right turn at angle 90° . To smoothen, a curve of radius 200 m is proposed. Calculate the chainage of first tangent point, and deflection angles from tangent to pegs at chainage 1170, 1200 and 1230. 10

Group B

5. (a) Two peaks are of height 256 m and 472 m from the intervening ground being uniform level. A signal of 4 m height at A makes it visible from B . What is the distance AB ? Assume radius 6400 km and suitable refraction coefficient. 10

- (b) The distances of a station P , inside ABC , measured by EDM, are $AP = 360$, $BP = 283$, $CP = 201$ m. The co-ordinates of the control stations are $A(0,0)$, $B(500\text{m},0)$, and $C(300,400)$. Estimate the co-ordinate of P . 10

6. (a) Write short explanatory notes on GPS and GIS. 5+5
- (b) How many photographs will be needed to cover $12\text{ km} \times 6\text{ km}$ area from 2 km height with camera lens focal length 160 mm and print size $200\text{ mm} \times 200\text{ mm}$. Take overlap 60% and side lap 30%. 10
7. (a) Briefly enumerate the applications of remote sensing in society. 10
- (b) Determine convergence of meridian between two stations (latitude 20°N , longitude 120°) and (latitude 50°N , longitude 190°). 10
8. (a) What are usual principles of digitizing distance in a 'Total Station'? Why is the reflector a corner cube prism? 10
- (b) From a satellite station S , 8 m from main station C , angles measured are $CSA = 54^\circ 19' 20''$, $CSB = 75^\circ 38' 40''$. A and B are on same side of CS . Approximate distances are $CA = 4\text{ km}$ and $CB = 3\text{ km}$. Find the angle ABC . 10

Group C

9. Choose the best *alternative* for the following: 10 × 2
- (i) Sag correction varies
- (a) directly as pull.
- (b) inversely as pull.
- (c) directly as square of pull.
- (d) inversely as square of pull.

(ii) Which one does not deflect magnet in compass?

- (a) Copper wire
- (b) Tripod stand
- (c) Electric current
- (d) Steel chain

(iii) Accuracy of bubble tube in dumpy level is called

- (a) connectivity.
- (b) relativity.
- (c) sensitivity.
- (d) resistivity.

(iv) The instrument for levelling in plane table survey is

- (a) Clinometer
- (b) Geodiameter
- (c) Barometer
- (d) Planimeter

(v) The axis of rotation of theodolite is called — axis.

- (a) trunnion
- (b) traverse
- (c) telescopic
- (d) trough

(vi) Vertical curve in Road Grade is usually

- (a) circular.
- (b) parabolic.
- (c) elliptic.
- (d) hyperbolic.

(vii) The global mean sea level surface is nearly as

- (a) spheroid.
- (b) ellipsoid.
- (c) geoid.
- (d) clothoid.

(viii) Log sine correction is done to satisfy

- (a) apex condition
- (b) periphery condition.
- (c) triangle condition.
- (d) side condition.

(ix) Perpendicular sighted photo from baseline is called

- (a) orthophoto.
- (b) stereophoto.
- (c) terrestrophoto.
- (d) aerial photo.

(x) Speed of electromagnetic wave in vacuum is

- (a) $300 \text{ E } 06 \text{ m/s}$**
- (b) $108 \text{ E } 09 \text{ kmph}$**
- (c) Both (a) and (b) above**
- (d) None of the above.**

S'11:6 FN:CV 406 (1432)**PRINCIPLES OF GEOINFORMATICS***Time : Three hours**Maximum Marks : 100*

Answer FIVE questions, taking ANY TWO from Group A, ANY TWO from Group B and ALL from Group C.

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches. Unnecessary long answers may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) Describe functional classification of surveying. 6
- (b) The plan of an area has shrunk such that a line originally 10 cm now measures 9.5 cm. If the original scale of the plan was 1 cm = 10 m, determine the (i) shrinkage factor, (ii) shrunk scale, (iii) correct distance corresponding to a measured distance of 98 m, and (iv) correct area corresponding to a measured area of 10,000 m². 4 × 2
- (c) A survey line was measured to be 60 m. It was found that there was misalignment and the line was 1 m off the straight line at the middle. Determine the correct length. 6

(Turn Over)

2. (a) A compass traverse ABCDEA was run anti-clockwise and the following bearings were taken where local attractions were suspected. Determine the included angles : 10

Line	Fore Bearing	Back Bearing
AB	150°30'	329°45'
BC	78°00'	256°30'
CD	42°30'	223°45'
DE	315°45'	134°15'
EA	220°15'	40°15'

- (b) The following readings were observed successively with a levelling instrument. The instrument was shifted after fifth and eleventh readings. Take A as benchmark with R.L. 136.44.
 (i) 0.585 (ii) 1.010 (iii) 1.735 (iv) 3.295
 (v) 3.775 (vi) 0.350 (vii) 1.300 (viii) 1.795
 (ix) 2.575 (x) 3.375 (xi) 3.895 (xii) 1.735
 (xiii) 0.635 (xiv) 1.605 m
 Enter R.L. of all points on the page of a level book. 10

3. (a) Describe indirect methods of contouring. 10

- (b) Find the radius of curvature and sensitivity of the bubble tube from the following :

Staff Readings	1.452 m	1.370 m	
Eye piece-end of bubble reading	20	11	
Objective end of bubble reading	11	20	5

- (c) Describe advantages of balancing backsight and foresight. 5

S'11 : 6 FN : CV 406 (1432)

(2)

(Continued)

4. (a) Describe the method of determining horizontal distance and R.L. of a point Q having both the angles as angles of depression from the instrument station P to the point Q. 8

- (b) Describe the effect of friction on superelevation and obtain expressions for (i) maximum superelevation, and (ii) maximum friction. 4 + 4

- (c) Find the length of vertical curve, if grade of the first straight, $g_1 = +1\%$ is followed by the second straight with grade $g_2 = -1.4\%$. Take $r = 0.3$ per 100 m. 4

Group B

5. (a) The following are the observed values of A, B, C at station, the angles being subject to the conditions that $A + B = C$:

$$A = 30^\circ 12' 28'' .2$$

$$B = 35^\circ 48' 12'' .6$$

$$C = 66^\circ 00' 44'' .4$$

Find the most probable values of A, B and C. 12

- (b) Describe the procedure of baseline measurement. 8

6. (a) Describe functioning of Tellurometer. 10

- (b) Explain the principle of working and applications of any one of the following : (i) Total Station, (ii) GPS. 5 + 5

7. (a) The distance from two points on a photograph to the principal line is 68.24 mm to the left and 58.48 mm to the right. The angle between the points measured with a transit is $44^\circ 30'$. Determine focal length of the lens. 10

S'11 : 6 FN : CV 406 (1432)

(3)

(Turn Over)

(b) Show that the relief displacements on a vertical photograph are radial from the principal point. 10

8. Write short notes on *any two* of the following : 2 × 10

- (i) Remote sensing system
- (ii) Interpolation of aerial photographs
- (iii) Satellite imagery and their interaction.

Group C

9. Choose the *correct* answer for the following : 10 × 2

- (i) The angle of dip at the magnetic pole is
 - (a) 0
 - (b) 90°
 - (c) 45°
 - (d) None of the above
- (ii) The main principle of surveying is to work from
 - (a) part to the whole.
 - (b) whole to the part.
 - (c) lower to higher level.
 - (d) higher to lower level.
- (iii) The quadrantal bearing of a line is determined by a
 - (a) prismatic compass.
 - (b) surveyor's compass.
 - (c) celestial observation.
 - (d) None of the above

(iv) The following type of levelling cannot be done with the dumpy level :

- (a) Differential levelling
- (b) Reciprocal levelling
- (c) Trigonometric levelling
- (d) Profile levelling.

(v) The process of determining the plotted position of the station occupied by the plane table by means of sight taken towards points of known location is called

- (a) resection.
- (b) intersection.
- (c) orientation.
- (d) None of the above.

(vi) The final setting of the plates when taken aforesight is achieved by using the

- (a) upper clamp screw.
- (b) upper tangent screw.
- (c) lower clamp screw.
- (d) lower tangent screw.

(vii) The following method of fast needle traversing is generally preferred :

- (a) Direct method with transiting
- (b) Direct method without transiting
- (c) Back bearing method
- (d) None of the above.

(viii) Sag correction in tape is

- (a) positive.
- (b) always positive.
- (c) always negative.
- (d) None of the above.

(ix) Given that

Scale of photograph is 1 cm = 100 m

Size of photograph = 23 cm × 23 cm

Area to be covered = 150 km²

Longitudinal overlap = 60%

Side overlap = 30%

The total number of photographs required for covering the above area is

- (a) 143
- (b) 101
- (c) 158
- (d) None of the above.

(x) An aircraft is flying at a ground speed of 200 km/h.

The focal length of the camera is 200 mm. The ground distance covered along the flight line between exposures is 2 km. The time interval between exposures is given by

- (a) 18 sec
- (b) 36 sec
- (c) 72 sec
- (d) 180 sec

W' 11:6FN:CV 406(1432)**PRINCIPLES OF GEOINFORMATICS**

Time : Three hours

Maximum Marks : 100

Answer FIVE questions, taking ANY TWO from Group A, ANY TWO from Group B and ALL from Group C.

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches. Unnecessary long answers may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification.

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) Explain objectives of surveying. 5
- (b) Describe various functional classifications of surveying. 8
- (c) A rectangular plot in plan is 10 cm × 30 cm, drawn to scale of 1 cm = 100 m. If the same plot is re-drawn on a toposheet to a scale of 1 cm = 1 km, what would be its area on the toposheet ? Also, determine R.F. in each case. 7
2. (a) Determine the sag correction for a 30 m steel tape under a pull of 70 N in 3 bays of 10 m each. The

area of cross-section of the tape is 8 mm^2 and the unit weight of the steel may be taken as 75 kN/m^3 . 10

- (b) Following bearings were observed for a closed traverse ABCDEA: 10

Line	Bearing
AB	$140^\circ 30'$
BC	$80^\circ 30'$
CD	$340^\circ 0'$
DE	$290^\circ 30'$
EA	$230^\circ 30'$

Calculate the included angles.

3. Describe the following in brief: 4 × 5

- MSL and level surface
- Sensitivity of the bubble
- Trigonometric levelling
- Curvature and refraction effects

4. (a) Following round of angles was observed from central station to the surrounding stations of a triangulation survey:

Angle	Value	Weight
A	$93^\circ 43' 22''$	3
B	$74^\circ 32' 39''$	2
C	$101^\circ 13' 44''$	2
D	$99^\circ 29' 50''$	3

In addition, one angle ($A + B$) was measured separately as combined angle with a mean value of $168^\circ 16' 06''$ (weight 2). Determine the most probable values of the angles A, B, C and D. 10

- The vertical angles to vanes fixed at 1 m and 3 m above the foot of the staff held vertically at a station A were $+ 2^\circ 30'$ and $+ 5^\circ 48'$, respectively. Find reduced level of A, if the height of the instrument was determined from observation on to a bench mark is 438.556 m above datum. 6
- A $+ 1.4\%$ grade meets a -0.6% with rate of change of grade as 0.1% per 20 m chain. Find the length of the vertical curve. 4

Group B

- The altitudes of two proposed stations A and B, 100 km apart, are respectively 400 m and 705 m. The intervening obstruction situated at C, 70 km from A, has an elevation of 476 m. Ascertain if stations A and B are intervisible and, if necessary, find by how much station B should be raised so that the line of sight must nowhere be less than 3 m above the surface of the ground. 10
 - From an eccentric station S, 12.25 m to the West of the main station B, the following angles were measured: Angle BSC = $76^\circ 25' 32''$ and angle CSA = $54^\circ 32' 20''$. The stations S and C are to the opposite of line AB. Calculate the correct angle ABC, if lengths AB and BC are 5286.5 m and 4932.2 m, respectively. 10
- Describe the principles and applications of any two of the following instruments: (i) Geodimeter, (ii) Tellurometer, and (iii) Distomat. 5 + 5
 - Describe the method of computation of length of

line between points of different elevation from measurements on a vertical photograph. 10

7. (a) A camera, having focal length of 20 cm, is used to take a vertical photograph to a terrain having an average elevation of 1800 m. What is the height above sea level at which an aircraft must fly in order to get the photograph to a scale of 1 : 7500. 10
- (b) The scale of an aerial photograph is 1 cm = 100 m. The photograph size is 20 cm × 20 cm. Determine the number of photographs required to cover an area of 7.5 km × 15 km, if the longitudinal lap is 60% and side lap is 30%. 10
8. (a) Describe in brief remote sensing system with specific mention of data acquisition and processing. 10
- (b) Explain the method of interpolation of aerial photographs and satellite imagery. Also, describe their interaction. 10

Group C

9. Define the following in brief: 10 × 2
- (i) Local attraction
 - (ii) Contour gradient
 - (iii) Resection method
 - (iv) Double sighting
 - (v) Reverse curve
 - (vi) Strength of figure
 - (vii) Transition curve
 - (viii) Satellite station
 - (ix) Stereoscopy
 - (x) Atmospheric windows

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PRINCIPLES OF GEOINFORMATICS

Time : Three hours

Maximum Marks : 100

*Answer FIVE questions, taking ANY TWO from Group A,
ANY TWO from Group B and ALL from Group C.*

*All parts of a question (a, b, etc.) should be
answered at one place.*

*Answer should be brief and to-the-point and be supple-
mented with neat sketches. Unnecessary long answer may
result in loss of marks.*

*Any missing or wrong data may be assumed suitably
giving proper justification.*

Figures on the right-hand side margin indicate full marks

Group A

1. (a) Compare the methods of measurement of distance
by chain and measurement of distance by tape. 6
- (b) Describe various corrections to be applied to
measured length. 7
- (c) Explain the classification of surveys based on
instruments used. 7
2. (a) Describe the method of adjustment of compass
traverse using the graphical approach. 7
- (b) R. L. of factory floor is 50.500 m. Staff reading on
floor is 1.500 m and staff reading when the staff is
held inverted with bottom touching the tie beam of

(Turn Over)

the roof truss is 3.500 m. Find the height of tie beam above the floor.

6

- (c) Following interior angles were measured with a sextant in a closed traverse. The bearing of the line AB was measured as $60^{\circ}00'$ with prismatic compass. Calculate the bearing of all other lines, if $\angle A = 140^{\circ}10'$; $\angle B = 99^{\circ}8'$; $\angle C = 60^{\circ}22'$; $\angle D = 69^{\circ}20'$.

7

3. (a) Discuss various indirect methods of contouring and mention the conditions in which you will recommend the use of each method.

8

- (b) What is the significance of re-section in plain table surveying? Describe *any one* method of solving three point problem.

6

- (c) Differentiate between repetition method and reiteration method of measurement of horizontal angles. Describe reiteration method of measurement of horizontal angles.

6

4. (a) Two parallel railway lines are to be connected by a reverse curve, each section having the same radius. If the lines are 12 m apart and the maximum distance between tangent points measured parallel to the straights is 48 m, find the maximum allowable radius.

6

- (b) Adjust the following angles closing the horizon :

7

$\angle A = 110^{\circ}20'48''$ wt.4

$\angle B = 92^{\circ}30'12''$ wt.1

$\angle C = 56^{\circ}12'00''$ wt.2

$\angle D = 110^{\circ}57'04''$ wt.3

- (c) Following observations were taken with a tacheometer at the station P to a staff at Q held normal to the line of sight :

7

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(2)

(Continued)

Staff readings = 1.450 ; 1.915 ; 2.380

Angle of depression = $15^{\circ}30'$

R. L. of P = 201.45 m

Height of trunnion axis above the peg at P = 1.315 m

Determine the horizontal distance between P and Q, and the R. L. of Q. Take $k = 100$ and $C = 0^{\circ}0'$

Group B

5. (a) Show that the relief displacement on a vertical photograph is radial from the principal point. 8

- (b) Describe in brief flight planning for determination of number of photographs necessary to cover a given area. 12

6. (a) Describe the principles and applications of the following : (i) EDM, and (ii) Total station. 12

- (b) Define base net. Describe the method of extension of base net. 8

7. (a) Two points A and B having elevations of 500 m and 300 m, respectively above datum appear on the vertical photograph having focal length of 20 cm and flying altitude of 2500 m above datum. Their corrected photographic co-ordinates are as follows :

Point	Photographic Co-ordinates	
	x, cm	y, cm
a	+ 2.65	+ 1.36
b	-1.92	+ 3.65

Determine the length of ground line AB. 12

- (b) The distance from principal point to an image on photograph is 6.44 cm, and the elevation of the object above the datum (sea level) is 250 m. What is the relief displacement of the point, if the datum

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(3)

(Turn Over)

scale is 1/10,000 and the focal length of the camera is 20 cm ? 8

8. Describe the following in the context of remote sensing: 4 × 5

- (i) Basic principles of remote sensing
- (ii) EMR and spectrum
- (iii) Interaction mechanisms
- (iv) Atmospheric windows

Group C

9. Differentiate between the following: 10 × 2

- (i) True bearing and magnetic bearing
- (ii) Prismatic compass and surveyors compass
- (iii) Height of instrument method and rise and fall method of levelling
- (iv) Direct method and indirect method of locating contours
- (v) Observation equation and condition equation in adjustment of error
- (vi) Crab and drift
- (vii) Aerial photographs and satellite imagery
- (viii) Data acquisition and processing in the context of remote sensing
- (ix) Differential levelling and reciprocal levelling
- (x) Sensors and platforms.

W'12: 6 FN: CV 406 (1432)

PRINCIPLES OF GEOINFORMATICS

Time : Three hours

Maximum Marks : 100

*Answer FIVE questions, taking ANY TWO from Group A,
ANY TWO from Group B and ALL from Group C.*

*All parts of a question (a, b, etc.) should be
answered at one place.*

*Answer should be brief and to-the-point and be supple-
mented with neat sketches. Unnecessary long answer may
result in loss of marks.*

*Any missing or wrong data may be assumed suitably
giving proper justification.*

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) Explain the objectives of surveying. 6
- (b) Differentiate between plane surveying and geodetic surveying. 6
- (c) Describe functional classification of surveying. 8
2. (a) Differentiate between true bearing and magnetic bearing. 4
- (b) Compare a surveyor's compass with a prismatic compass. 8
- (c) Define local attraction and describe the method of correction for local attraction. 8

3. (a) Reciprocal levelling between two points A and B, 630.5 m apart on opposite side of a river, gave the following results :

Instrument at	Height of Instrument	Staff at	Staff Reading
A	1.360m	B	1.585 m
B	1.335m	A	0.890 m

- Determine the difference in levels between A and B, and the amount of collimation error in the instrument. 7
- (b) Discuss the characteristics of contours. Give suitable sketches in support of your answer. 7
- (c) What are the advantages and disadvantages of plane table surveying? 6
4. (a) Find the most probable values of angles A, B and C of triangle ABC from the observation equations :
 $A = 68^{\circ}12'36''$; $B = 53^{\circ}46'12''$; and $C = 58^{\circ}01'16''$. 8
- (b) A theodolite was set up at a station P, and a staff was kept at a station Q at a distance of 3000 m. If the angle of elevation to a vane 3 m above the foot of the staff was $8^{\circ}30'$, determine the R.L. of the station Q. The R.L. of the instrument axis was 150.45 m. 6
- (c) A transition curve is required for a circular curve of radius 300 m. The maximum superelevation is restricted to 100 mm for a gauge of 1.0 m. Determine the length of transition curve and the design speed, if the rate of change of radial acceleration is $0.3 \text{ m/sec}^2/\text{sec}$. 6

Group B

5. (a) A vertical photograph was taken at an altitude of 1200 m above mean sea level. Determine the scale of the photograph for terrain lying at elevations of 80 m and 300 m, if the focal length of camera is 15 cm. 10

- (b) A vertical photograph of a flat area, having an average elevation of 250 m above mean sea level, was taken with a camera having a focal length of 20 cm. A section line AB, 250 m long in the area measures 8.50 cm on the photograph. A tower TB in the area also appears on the photograph. The distance between the images of the top and bottom of the tower measures 0.46 cm on the photograph. The distance of the image of the top of the tower is 6.46 cm. Determine height of the tower. 10

6. (a) Determine the number of photographs required to cover an area of 100 km^2 , if the scale of aerial photograph is $1 \text{ cm} = 100 \text{ m}$, size of the photograph is $20 \text{ cm} \times 20 \text{ cm}$. The longitudinal lap is 60% and side lap is 30%. 8
- (b) A pair of photographs was taken with an aerial camera from an altitude of 5000 m above mean sea level. The mean principal base measured is equal to 90 mm. The difference in parallax between two points is 1.48 mm. Find the difference in height between the two points, if the elevation of lower point is 500 m above datum. What will be the difference in elevation, if the parallax difference is 15.5 mm? 12
7. (a) Describe the properties of electromagnetic waves as applicable in the method of electromagnetic distance measurement. 12
- (b) Describe in brief the considerations upon which selection of triangulation stations is based. 8
8. (a) Explain basic principles of remote sensing. 10
- (b) Describe an idealised remote sensing system. 10

Group C

9. Explain the following in brief : 10 × 2
- (i) Curvature and refraction effects
 - (ii) Trigonometric levelling
 - (iii) Telescopic alidade
 - (iv) Subtense bar
 - (v) Compound curve
 - (vi) Triangulation
 - (vii) Sensitivity of bubble
 - (viii) Sensors
 - (ix) Bowditch's rule
 - (x) Satellite imagery

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PRINCIPLES OF GEOINFORMATICS

Time : Three hours

Maximum Marks : 100

Answer FIVE questions, taking ANY TWO from Group A, ANY TWO from Group B and ALL from Group C.

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches. Unnecessary long answer may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification.

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) Define surveying. What are the objectives of surveying? 6
- (b) Describe in brief classification of surveys. 6
- (c) In a linear measurement of a distance of 4000 m, a survey chain was found to be 10 cm, too long after a distance of 2000 m was measured. At the end of measuring the remaining distance of 2000 m, the chain was found to be 15 cm too long. If the survey chain was correct before starting the measurement, what is the true distance measured by the chain ? 8
2. (a) In stadia work with error not exceeding 1 in 400, up to what value of vertical angle, sloping distances may

be assumed to be horizontal distances when the staff is held vertical and tachometer is having anallactic lens. 5

- (b) Define local attraction. How is it determined? 2 + 3
- (c) Describe in brief guidelines for preparation of contour maps. 5
- (d) Explain in brief the reiteration method of measurement for horizontal angles. 5
- 3. (a) Describe Rankine's method of tangential/deflection angle for setting out a circular curve. 10
- (b) Explain the method of resection for determining the plotted position of station occupied by plane table. 10
- 4. (a) Following are the observed values of angles A, B and C at a station, the angles being subject to the condition that $A + B = C$:

$$A = 20^{\circ}12'28''.2$$

$$B = 25^{\circ}48'12''.6$$

$$C = 46^{\circ}0'44''.4$$

Find the most probable values of A, B and C: 5

- (b) Two straights T_1V and VT_2 of a road curve meet at an angle of 60° . Find the radius of curve which will pass through a point P, 45 m from the point of intersection (V), the angle T_1VP being 25° . 8
- (c) A transition curve is required for a circular curve of 150 m radius, the gauge being 1.5 m and maximum superelevation restricted to 15 cm. The transition is to be designed for a velocity such that no lateral pressure is imposed on the rails and the rate of gain of radial acceleration is 40 cm/sec^3 . Calculate the required length of the transition curve and design speed. 7

Group B

- 5. (a) From a satellite station S, 5.8 m from the main triangulation station A, following directions were observed:

A	0°	0'	0"
B	132°	18'	30"
C	232°	24'	6"
D	296°	6'	11"

The lengths AB, AC and AD were computed to be 3265.5 m, 4022.2 m and 3086.4 m, respectively. Determine the direction of AB, AC and AD. 12

- (b) Triangulation stations, X and Y, with respective elevations of 250 m and 270 m are situated 55 km apart. What should be the minimum height of signal at Y in order to ensure that line of sight does not pass near the ground less than 2 m. The ground between stations X and Y is having a uniform elevation of 210 m. 8
- 6. (a) Differentiate between principles and applications of tellurometer and distomat. 10
- (b) Describe principles and applications of (i) digital theodolite, and (ii) total station. 5 + 5
- 7. (a) Explain the principle of radial line triangulation. 10
- (b) Describe the assumptions on which radial triangulation is based. Specify its limitations and errors. 10
- 8. Describe the method of interpolation of aerial photographs and satellite imagery. Also, explain their interaction. 20

Group C

9. Answer the following : 10 × 2

- (i) The horizontal angle subtended at a theodolite by a subtense bar with vanes 3 m apart is $12'33''$. Compute the horizontal distance between the instrument and the bar.
- (ii) Describe atmospheric window.
- (iii) Explain sensitivity of the bubble tube.
- (iv) Describe telescopic alidade.
- (v) Differentiate between vernier and microptic theodolites.
- (vi) Describe auto-reduction tachometers.
- (vii) Explain extension of base net.
- (viii) Define reverse curve.
- (ix) Describe principles of geodetic survey.
- (x) Explain the tilted photograph.

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