

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 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*

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**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 m<sup>2</sup>. 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      |

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

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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

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- (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.

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(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 km<sup>2</sup>

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

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**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<sup>2</sup> and the unit weight of the steel may be taken as 75 kN/m<sup>3</sup>. 10

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

| Line | Bearing |
|------|---------|
| AB   | 140°30' |
| BC   | 80°30'  |
| CD   | 340°0'  |
| DE   | 290°30' |
| EA   | 230°30' |

Calculate the included angles.

3. Describe the following in brief: 4 × 5

- (a) MSL and level surface
- (b) Sensitivity of the bubble
- (c) Trigonometric levelling
- (d) 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°43'22"  | 3      |
| B     | 74°32'39"  | 2      |
| C     | 101°13'44" | 2      |
| D     | 99°29'50"  | 3      |

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

- (b) 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°30' and + 5°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
- (c) 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**

- 5. (a) 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
- (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°25'32" and angle CSA = 54°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
- 6. (a) Describe the principles and applications of any two of the following instruments : (i) Geodimeter, (ii) Tellurometer, and (iii) Distomat. 5 + 5
- (b) 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

**S'12:6 FN:CV 406 (1432)**

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**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

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

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

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

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

- (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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( 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:  $4 \times 5$

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

**Group C**

9. Differentiate between the following :  $10 \times 2$

- (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.

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( 4 )

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

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**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             | 1.335 m              | A        | 0.890 m       |

Determine the difference in levels between A and B, and the amount of collimation error in the instrument.

- (b) Discuss the characteristics of contours. Give suitable sketches in support of your answer.
- (c) What are the advantages and disadvantages of plane table surveying?
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 =  $58^{\circ}01'16''$ .
- (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.
- (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  $0.3 \text{ m/sec}^2/\text{sec}$ .

**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.

- (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.

6. (a) Determine the number of photographs required to cover an area of  $100 \text{ km}^2$ , 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%.
- (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?
7. (a) Describe the properties of electromagnetic waves as applicable in the method of electromagnetic distance measurement.
- (b) Describe in brief the considerations upon which selection of triangulation stations is based.
8. (a) Explain basic principles of remote sensing.
- (b) Describe an idealised remote sensing system.

**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

**W'13 : 6 FN : CV 406 (1432)**

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**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  $60^{\circ}$ . 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  $25^{\circ}$ . 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  $40 \text{ cm/sec}^3$ . 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 | $0^{\circ}$   | $0'$  | $0''$  |
| B | $132^{\circ}$ | $18'$ | $30''$ |
| C | $232^{\circ}$ | $24'$ | $6''$  |
| D | $296^{\circ}$ | $6'$  | $11''$ |

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 tacheometers.
- (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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**Group A**

1. (a) Describe the method of reading of a survey map. 3
- (b) What are the common sources of error in the measurement of distances with chain ? Describe various precautions to be taken in the measurement of linear distances with tapes. 6 + 6
- (c) Explain the graphical approach for adjustment of compass traverse. 5
2. (a) Following bearings are observed in running a closed traverse :

| Line | Fore Bearing | Back Bearing |
|------|--------------|--------------|
| AB   | 150°0'       | 329°45'      |

| Line | Fore Bearing | Back Bearing |
|------|--------------|--------------|
| BC   | 77°30'       | 256°0'       |
| CD   | 41°30'       | 222°45'      |
| DE   | 314°15'      | 134°45'      |
| EA   | 220°15'      | 40°15'       |

At what stations do you suspect the local attraction ? Determine the correct magnetic bearings. If the declination was 5°10'E, what are the true bearings ? 10

- (b) What are the guidelines to be followed for preparation of contour maps ? 5
  - (c) Describe the advantages of method of resection in plane table surveying. 5
3. (a) Explain the repetition method of measurement of horizontal angles. Differentiate it from the method of reiteration. 4 + 2
- (b) Following observations were taken in reciprocal levelling:

| Instrument at | Staff Reading at |         |
|---------------|------------------|---------|
|               | A                | B       |
| A             | 1.325 m          | 2.245 m |
| B             | 0.425 m          | 1.105 m |

Determine the RL of B if that of A is 100.250 m. Also, calculate the angular error in collimation, if the distance between A and B is 1000 m. 6

- (c) The angles of a triangle PQR were recorded as follows:

P = 77°14'20" weight 4  
 Q = 49°40'35" weight 3  
 R = 53°04'52" weight 2

Determine the corrected values of the angles. 8

- 4. (a) Show that the grade should change uniformly throughout the vertical curve to produce best riding qualities. 4
- (b) In a road curve between two straights having deflection angle of 108°, Bernoullie's lemniscate is used as a curve transitional throughout. Make necessary calculations for setting out the curve, if the apex distance is 20 m. 8
- (c) Two straights AB and BC are intersected by a line D<sub>1</sub>D<sub>2</sub>. The angles BD<sub>1</sub>D<sub>2</sub> and BD<sub>2</sub>D<sub>1</sub> are 40°30' and 36°24', respectively. The radius of first arc is 600 m and that of second arc is 800 m. If the chainage of intersection point B is 8248.1 m, find the chainages of tangent points and the point of compound curvature. 8

**Group B**

- 5. (a) Describe the purpose of triangulation and trilateration. 4
- (b) What is the significance of well-conditioned triangle with respect to triangulation figures ? 4
- (c) Describe the method of determining intervisibility of stations. 4
- (d) It is desired to find the weight of the tape by measuring its sag when suspended in catenary both ends level. If the tape is 20 m long and the sag amounts to 20.35 cm at the mid-span under a tension of 10 N, what is the weight of the tape ? 8

6. (a) What are the objectives of GIS ? Describe essentials of GIS. 4 + 6
- (b) Describe geodimeter with its principles and applications. 10
7. (a) A tower, 50 m high, appears in a vertical photograph taken at a flight altitude of 2500 m above mean sea level. The distance of the image of the top of the tower is 6.35 m. Compute the displacement of the image of top of the tower with respect to image of its bottom. The elevation of bottom of the tower is 1250 m. 6
- (b) A photogrammetric survey is carried out to a scale of 1:2000. A camera with a wide angle lens of  $f=150$  mm was used with 23 cm  $\times$  23 cm plate size for a net 60% overlap along the line of flight. Find the error in height given by an error of 0.1 mm in measuring the parallax of the point. 10
- (c) Describe the significance of stereoscopy. 4
8. (a) Describe data acquisition and processing in remote sensing. 10
- (b) Explain the significance of atmospheric windows. 6
- (c) Differentiate between sensors and platforms. 4

### Group C

9. Answer the following in brief: 10  $\times$  2
- (i) Describe Indian topographic series.
- (ii) Differentiate between cumulative errors and compensating errors.

- (iii) Explain reasons of local attraction.
- (iv) Differentiate between fore bearing and back bearing.
- (v) Describe satellite station.
- (vi) Explain trigonometric levelling.
- (vii) Define contour gradient.
- (viii) Describe subtense bar.
- (ix) What is strength of figure ?
- (x) Differentiate between crab and drift.

**W'14 : 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 objectives of surveying. 6  
(b) Describe the classification of surveys based on instruments used. 6  
(c) The plan of an area has shrunk such that a line originally 10 cm now measures 9.75 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 95 m and (iv) correct area corresponding to a measured area of 15,000 m<sup>2</sup>. 4 × 2
2. (a) Determine the sag correction for a 30 m steel tape under a pull of 70 N in three bays of 10 m each. The

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

- (b) 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   | $150^\circ 30'$ | $329^\circ 45'$ |
| BC   | $78^\circ 00'$  | $256^\circ 30'$ |
| CD   | $42^\circ 30'$  | $223^\circ 45'$ |
| DE   | $315^\circ 45'$ | $134^\circ 15'$ |
| EA   | $220^\circ 15'$ | $40^\circ 15'$  |

3. (a) Describe the following in brief:  $2 \times 5$
- MSL and level surface.
  - Curvature and refraction effects.
- (b) Explain indirect methods of contouring. 10
4. (a) A  $+1.4\%$  grade meets a  $-0.6\%$  with rate of change of grade as  $0.1\%$  per 20 m chain. Find length of the vertical curve. 4
- (b) Describe the effect of friction on superelevation and obtain expressions for (i) maximum superelevation and (ii) maximum friction.  $4 + 4$
- (c) Explain 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

### Group B

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

|   |                      |
|---|----------------------|
| A | $0^\circ 0' 0''$     |
| B | $132^\circ 18' 30''$ |
| C | $232^\circ 24' 6''$  |
| D | $296^\circ 6' 11''$  |

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

- (b) Following are the observed values at stations A, B and C. The angles are 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. 8

6. (a) Explain the principle of working and applications of *any one* of the following: 12
- Total Station
  - GPS
- (b) Define base net. Describe the method of extension of base net. 8
7. (a) Show that the relief displacements on a vertical photograph are radial from principal point. 10

- (b) 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
8. Write short notes on the following : 4 × 5
- (a) Basic principles of remote sensing  
 (b) Satellite imageries and their interaction  
 (c) EMR and spectrum  
 (d) Atmospheric windows
- Group C**
9. (A) Write correct option as an answer to the following questions : 4 × 2
- (i) 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.
- (ii) The final setting of plates, when taking a foresight is achieved by using the
- (a) upper clamp screw.  
 (b) upper tangent screw.  
 (c) lower clamp screw.  
 (d) lower tangent screw.
- (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 three above.
- (iv) 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 three above.
9. (B) Differentiate between the following : 6 × 2
- (i) Height of instrument method and rise and fall method of levelling  
 (ii) Direct and indirect methods of locating contours  
 (iii) Vernier and microptic theodolites  
 (iv) Observation equation and condition equation in adjustment of error  
 (v) Aerial photographs and satellite imagery  
 (vi) Differential levelling and reciprocal levelling

**S'15: 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 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) Describe basic principles of surveying. 4
- (b) Differentiate between *any two* of the following : 3 × 2
  - (i) Plane surveying and geodetic surveying
  - (ii) Plans and maps
  - (iii) Direct vernier and retrograde vernier
- (c) A 30 m chain used for surveying was found to be 30.05 m at the beginning and 30.15 m at the end of the work. The area of the plan drawn to a scale of 1 cm = 10 m was measured with the help of a planimeter and was found to be 60.50 cm<sup>2</sup>. Find the true area of the field. 5

- (d) It is desired to find the weight of the tape by measuring its sag when suspended in catenary with both ends level. If the tape is 30 m long and the sag amounts to 30.25 cm at the mid-span under a tension of 100 N, what is the weight of the tape? 5
2. (a) Classify the errors in compass survey work. 3
- (b) Differentiate between surveyors and prismatic compass. 7
- (c) Describe the characteristics of contours. Enlist the important uses of contour maps. 5 + 5
3. (a) Determine the gradient from a point P to a point Q from the following observations made with a tachometer fitted with an anallactic lens. The constant of the instrument was 100 and the staff was held vertically: 10
- | Inst. Station | Staff Point | Bearing | Vertical Angle | Staff Reading       |
|---------------|-------------|---------|----------------|---------------------|
| X             | P           | 134°    | + 10° 32'      | 1.360, 1.915, 2.470 |
|               | Q           | 224°    | + 5° 6'        | 1.065, 1.885, 2.705 |
- (b) What are the fundamental lines of a transit theodolite? Describe the desired relation which should exist between these lines. 2 + 3
- (c) An instrument was set up at A and the angle of elevation to a vane 3 m above the foot of the staff held at B was 10°. The horizontal distance between A and B was known to be 1500 m. Determine the R.L. of the staff station B, given that the R.L. of the instrument axis was 3000.50 m. 5
4. (a) Obtain expressions for radius R and tangent distance T of a simple circular curve, which passes through a fixed point, say, P. Given the angle Δ and two tangents of undetermined length. 9

- (b) Determine the maximum allowable radius for the reverse curve (with same radius on each side) to connect two parallel railway lines 10 m apart. The maximum distance between tangent points as measured parallel to the straight is to be 40 m. 6
- (c) A vertical curve is to be provided to connect two uniform grades of + 1.2% and - 0.8%. The rate of change of grade is 0.1% per 30 m chain. Determine the length of vertical curve. 5

**Group B**

5. (a) Describe the laws of accidental errors. 6
- (b) Explain general principles of least squares. 6
- (c) The angles of a triangle ABC were recorded as follows:  
 A = 77° 14' 20" weight 4  
 B = 49° 40' 35" weight 3  
 C = 53° 04' 52" weight 2  
 Give the corrected values of the angles. 8
6. (a) Compare the principles of working of tellurometer and distomat. 12
- (b) Establish the significance of satellite station by describing its application. 8
7. (a) Describe the principle of radial line triangulation. Mention its assumptions, limitations and sources of error. 10
- (b) Write short notes on (i) stereoscopy and (ii) paralax bar. 5 + 5
8. (a) Explain interaction of EM radiation with earth surface. 10

- (b) Describe interpolation of aerial photographs and satellite imageries. 10

**Group C**

9. (A) Differentiate between the following : 6 × 2

- (i) True meridian and magnetic meridian
- (ii) Whole circle bearing and reduced bearing
- (iii) Differential levelling and reciprocal levelling
- (iv) Loose needle method and fast needle method of traversing
- (v) Vertical photograph and tilted photograph
- (vi) Orientation and re-section in plane table surveying

- (B) Define the following : 8 × 1

- (i) Magnetic declination
- (ii) Mean Sea Level (MSL)
- (iii) Local attraction
- (iv) Sensitivity of the bubble
- (v) Telescopic alidade
- (vi) Strength of figure
- (vii) Weight of an observation
- (viii) Normal equation

**W'15: 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 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. Explain objectives of surveying. 2 + 4
- (b) Describe the classification of surveys based on instruments used. 7
- (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) Following observations were made in a trigonometric levelling :
 

|                      |             |
|----------------------|-------------|
| Observed altitude    | = +3°10'49" |
| Height of instrument | = 1.24 m    |

Height of signal = 5.32 m  
 Horizontal distance = 4935 m  
 Coefficient of refraction = 0.07

If  $R \sin^2 \theta = 30.88$  m ( $R = 6370$  km), correct the observed altitude for the height of signal, refraction and curvature. 10

- (b) 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? 10
- 3. (a) Define indirect method of contouring. Describe various indirect methods of contouring with the mention of conditions in which the use of each method may be recommended. 8
- (b) Distinguish between repetition method and reiteration method of measurement of horizontal angles. Describe reiteration method of measurement of horizontal angles. 6
- (c) Establish the significance of resection in plain table surveying. Describe *any one* method of solving three point problem. 6
- 4. (a) Describe Rankine's method of tangential or deflection angle for setting out a circular curve. 10
- (b) Describe advantages of balancing back sight and foresight. 5
- (c) Find the radius of curvature of the bubble tube from the following average reading of the ends of bubble and of a staff 80 m away: 5

|                                    | I       | II      |
|------------------------------------|---------|---------|
| Staff Readings                     | 1.680 m | 1.602 m |
| Eye piece-end of bubble reading    | 20      | 10      |
| Object glass-end of bubble reading | 10      | 20      |

**Group B**

- 5. (a) Show that the relief displacement on a vertical photograph is radial from the principal point. 8
- (b) Describe the principles and applications of the following: 6 + 6
  - (i) EDM
  - (ii) Total Station
- 6. (a) 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 base net. Explain the method of extension of base net. 8
- 7. (a) Describe the method of computation of length of line between points of different elevation from measurements on a vertical photograph. 10
- (b) 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

8. (a) Describe the following in the context of remote sensing:  $2 \times 5$
- (i) Basic principles of remote sensing
  - (ii) EMR and spectrum
- (b) Describe data acquisition and processing in remote sensing. 10

**Group C**

9. (A) Define the following in brief:  $10 \times 2$
- (i) Contour gradient
  - (ii) Double sighting
  - (iii) Strength of figure
  - (iv) Transition curve
  - (v) Stereoscopy
- (B) Differentiate between the following :
- (i) Height of Instrument Method and Rise and Fall method of levelling
  - (ii) Direct method and indirect method of locating contours
  - (iii) Observation equation and condition equation in adjustment of error
  - (iv) Crab and drift
  - (v) Sensors and platforms

S'16 : 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 basic principles of surveying. 5  
(b) Describe various functional classifications of surveying. 8  
(c) The length of a survey line was measured with a 20 m chain and was found to be equal to 1200 m. As a check, the length was again measured with a 25 m chain and was found to be 1212 m. On comparing the 20 m chain with the test gauge, it was found to be 1 decimeter too long. Find the actual length of the 25 m chain used. 7
2. (a) 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

( Turn Over )

- staff was  $8^{\circ}30'$ , determine the R.L. of the station Q. The R.L. of instrument axis was 150.45 m. 10
- (b) In leveling between two points A and B on opposite banks of a river, the level was set up near A, and the staff readings on A and B were 1.285 m and 2.860 m, respectively. The level was then moved and set up near point B and the respective readings on points A and B were 0.860 m and 2.220 m. Find true difference of level between points A and B. 5
- (c) The horizontal angle subtended at a theodolite by a subtense bar with vanes 3 m apart is  $10^{\circ}30'$ . Calculate the horizontal distance between the instrument and the bar. 5
3. (a) Describe the following forms of curves and give an example of the field conditions where the use of each of these is recommended : 3 × 5
- (i) Lemniscate curve
- (ii) Reverse curve
- (iii) Compound curve
- (b) A +1.6% grade meets a -0.4% with a rate of change of grade as 0.1% per 20 m chain. Find length of the vertical curve? 5
4. (a) Two straights  $T_1V$  and  $VT_2$  of a road curve meet at an angle of  $80^{\circ}$ . Find radius of the curve which will pass through a point P, 30 m from the P.I. (V), the angle  $T_1VP$  being  $30^{\circ}$ . 10
- (b) Describe, with the help of neat sketches, the characteristics of contours. 5
- (c) Explain, with neat sketches, the uses of contour maps. 5

S'16 : 6 FN : CV 406 (1432) (2) (Continued)

**Group B**

5. (a) What is tilt distortion? Prove that, in a tilted photograph, tilt distortion is radial from the isocentre. 10
- (b) Following are three angles  $P$ ,  $Q$  and  $R$  observed at station  $O$ , closing the horizon, along with their standard errors : 10
- $\angle P = 84^{\circ}15'12'' \pm 3''$
- $\angle Q = 125^{\circ}13'15'' \pm 4''$
- $\angle R = 150^{\circ}31'12'' \pm 5''$
- Determine the correct angles.
6. (a) Establish the significance of satellite station by describing its application. 10
- (b) Describe the principles and applications of any two of the following instruments : 5 + 5
- (i) Geodimeter
- (ii) Tellurometer
- (iii) Distomat
7. (a) Describe briefly the Arundel method of surveying from air photographs, mentioning successfully all the stages involved in operation. 10
- (b) Derive the parallax equation for aerial photographs. 10
8. (a) Describe the method of interpolation of aerial photographs and satellite imagery. Also, explain their interaction. 10
- (b) Differentiate between sensors and platforms. 5

S'16 : 6 FN : CV 406 (1432) (3) (Turn Over)

- (c) Establish the significance of atmospheric windows in remote sensing. 5

**Group C**

9. Differentiate between the following : 10 × 2

- (i) Cumulative errors and compensating errors
- (ii) Gunter's chain and engineers' chain
- (iii) Method of repetition and method of reiteration for measurement of horizontal angle
- (iv) Free and fast needle methods of traversing
- (v) Bowditch's and Transit methods of balancing the traverse
- (vi) Consecutive co-ordinates and independent co-ordinates
- (vii) Datum and bench mark
- (viii) Dumpy level and tilting level
- (ix) Contour interval and contour gradient
- (x) Linear and angular methods of setting out curves

**W'16: 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 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) Describe basic Principles of Surveying. 5
- (b) Differentiate between Surveyors Compass and Prismatic Compass. 7
- (c) Define Local Attraction. What are the various methods of elimination of Local Attraction? 8
2. (a) Enumerate the sources of errors in Compass Survey. Describe the precautions adopted to eliminate these. 2 + 4
- (b) Differentiate between the following : 4
  - (i) Plane Surveying and Geodetic Surveying
  - (ii) Direct Vernier and Retrograde Vernier

*( Turn Over )*

- (c) Describe the characteristics of Contours. Enlist the important uses of Contour maps. 5 + 5
3. (a) Describe reiteration method of measurement of Horizontal angles. 6
- (b) The following observations were taken in reciprocal levelling: 7
- | Instrument at | Staff Reading at |         |
|---------------|------------------|---------|
|               | A                | B       |
| A             | 1.325 m          | 2.245 m |
| B             | 0.425 m          | 1.105 m |
- Determine the RL of B if that of A is 100.250 m. Also calculate the angular error in collimation if the distance between A and B is 1000 m.
- (c) Explain significance of resection in Plain Table Surveying. Describe a method of solving three point problem. 2 + 5
4. (a) A plus + 1.4% grade meets a - 0.6% with a rate of change of grade as 0.1% per 20 m chain. Find the length of the vertical curve. 5
- (b) The horizontal angle subtended at a theodolite by a subtense bar with vanes 3 m apart is  $10^{\circ}30'$ . Calculate the horizontal distance between the instrument and the bar. 5
- (c) Two distances of 20 m and 100 m were accurately measured out and the intercepts on the staff between the outer stadia webs were 0.196 m at the former distance and 0.996 m at the latter. Calculate the tacheometric constants. 4
- (d) What is transition (or easement) curve? Why is it used? Define shift of a curve. 6

W\*16 : 6 FN : CV 406 (1432) ( 2 ) (Continued)

**Group B**

5. (a) Explain the significance of well conditioned triangle with respect to triangulation figures. 4
- (b) Explain the procedure of determining intervisibility of stations. 4
- (c) Describe in brief flight planning for determination of number of photographs necessary to cover a given area. 12
6. (a) Explain essentials of GIS. What are the objectives of GIS? 6 + 4
- (b) Describe the principles and applications of Geodimeter. 10
7. (a) Define base net and describe the method of extension of base net. 6
- (b) A photogrammetric survey is carried out to a scale of 1:20000. A camera with a wide angle lens of  $f = 150$  mm was used with 23 cm  $\times$  23 cm plate size for a net 60% overlap along the line of flight. Find the error in height given by an error of 0.1 mm in measuring the parallax of the point. 10
- (c) Explain the significance of stereoscopy. 4
8. (a) Describe data acquisition and processing in remote sensing. 5 + 5
- (b) Explain the following in the context of remote sensing: 2  $\times$  5
- (i) Interaction mechanisms
- (ii) EMR and Spectrum

W\*16 : 6 FN : CV 406 (1432) ( 3 ) ( Turn Over )

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**Group C**

9. (A) Define the following in brief: 10 × 1
- (i) Sensitivity of Bubble
  - (ii) Magnetic Declination
  - (iii) Telescopic Alidade
  - (iv) Mean Sea Level
  - (v) Tacheometer
  - (vi) Strength of Figure
  - (vii) Oblique Photograph
  - (viii) Normal Equation
  - (ix) Atmospheric Windows
  - (x) Weight of an Observation
- (B) Distinguish between any *five* of the following: 5 × 2
- (i) Whole Circle Bearing and Reduced Bearing
  - (ii) Plan and Map
  - (iii) Differential levelling and Reciprocal levelling
  - (iv) Vertical Photograph and Tilted Photograph
  - (v) Sensors and Platforms
  - (vi) Triangulation and Trilateration

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