Model Set Questions with Answers

MODEL – 1

[Code - CET - 303]

Full Marks – 70 **Time – 3 Hours**

*Answer any **five** questions.*

Figures in the right-hand margin indicate marks.

1. (a) Write down the formula for correction for pull.[2
   (b) The back sight reading on a levelling staff held vertically on a bench mark having R.L. 500 m is 1.585 m and the foresight on the staff held vertically inverted against a beam soffit is 2.415 m. What is the R.L. of the beam soffit ? [4
   (c) The distance between two points measured by a 20m chain was recorded as 720 m. It was afterwards fround that the chain used was 4 cm tooling. Find out the true distance between the points. [8
2. (a) Define isogonic line. [2
   (b) Draw the conventional signs for footpath, pipeline, Railway over road, Swamp, power line. [4
   (c) The following perpendicular offsets were taken at 10 m intervals from a chain line to an irregular boundary line.

   3.10 4.20 5.35, 6.45, 7.15, 8.25, 7.95 and 5.20 m.

   Find the area by (i) trapezoidal rule (ii) Simpson's rule. [8
3. (a) Name the different types of chains used in surveying. [2
   (b) Draw a comparision between chain surveying and compass surveying. [4
   (c) A line CAB crosses a river A and B are on near and distant banks of the river respectively. Perpendiculars AD and CE are 30.5 m and 50.5 m respectively, such that B, D and E are in astaight line. If the chainage of C and A are 505.5m, calculate the chainage of B. [8
4. (a) Draw the symbol of [2
   1. a pucca wall
   2. Road culvert
   3. Electric culvert
   4. School Building.
   (b) Explain principle of plane table surveying. [4
   (c) A line measured on a rising gradient of 1 in 12 was found to be 500m. It was found later than the 30m chain was 5cm too long. Find correct horizontal length of the line. [8
5. (a) The bearing of a survey line is 220°. State the system of bearing and convert it into the other system. [2
   (b) The magnetic bearing of a line AB is 125° 30′. Find out its turre bearing if magnetic declination at A is (i) 9° 30′ W (ii) 5° 30′E. [4
   (c) The following bearing were observed in a closed traverse ABCDA. Find the stations affected by local attraction. Calculate the corrected bearings. [8

Line	F.B.B.B.
AB124° 30′	304° 30′
BC68° 15′	246° 00′
CD310° 30′	135° 15′
DA200° 15′	17° 45′

6. (a) What is closing error ? Show with diagram. [2
   (b) A steel tape 20 m long, standardised at 15° C with a pull of 10 kg was used to measure distance along a slope of 4°. If the mean temperature during measurement was 25° C and the pull applied 16 kg, determine the correction required per tape length. Assume co-efficient of expansion 112×10^{-7} per °C, cross-sectional area of tape = 0.08 cm^2 and Young's modulus E = 2.1×10^6 kg/cm^2. [4
   (c) Describe the procedure of setting up plane table over a station. [8
7. (a) Define well conditioned and ill conditioned triangles in surveying. [2
   (b) Explain with a neat sketch the operating principle of a line ranger. [4
   (c) Draw the neat sketch of a prismatic compass showing the following parts and briefly explain their functions :
   (i) Magnetic needle
   (ii) Pivot
   (iii) Brake pin.
   (iv) Agate cap. [8

ANSWER TO MODEL - 1

1.(a) Write down the formula for correction for pull.

Ans. The correction for pull (C_p) is given by the expression.

$$C_p = \frac{(P_m - P_o)L}{A \times E}$$

Where C_p = pull correction (m)

P_m = pull applied during measurment (kg)

P_o = pull at which the tape was standardised (kg)

L = Length of tape (m)

A = Cross-sectional area of tape (cm^2)

E = Modulus of elasticity (Young's modulus)

(b) The back sight reading on a levelling staff held vertically on a bench mark having R.L. 500 m is 1.585 m and the foresight on the staff held vertically inverted against a beam soffit is 2.415 m. What is the R.L. of the beam soffit ?

Ans. RL of Bench Mark = 500 M

Backsight reading on a levelling staff = 1.585 M

∴ High of instrument = 500 + 1.585

= 501.585 M

Foresight on the staff held vertically invested against a beam soffit = 2.415 M.

∴ RL of beam soffit = 501.585 + 2.415 = 504 M.

(c) The distance between two points measured by a 20m chain was recorded as 720 m. It was afterwards fround that the chain used was 4 cm tooling. Find out the true distance between the points.

Ans. True length of a chain L = 20M.

Error in chain C = 0.04 M too long.

∴ L′ = L + e = 20.04 M.

Measured length ML = 720 M.

True length of line

$$= \frac{L'}{L} \times ML = \frac{20.04}{20} \times 720\ m = 721.44\ m$$

2.(a) Define isogonic line.

Ans. Lines passing through points of equal declination are called isogonic lines.

(b) Draw the conventional signs for footpath, pipeline, Railway over road, Swamp, power line.

Ans. Advantages of compass surveying.

1. The direction of different station points are identified.
2. It is applicable when the area is large, undulating and rowded with many details.

Disadvantages - This method is not applicable where local attraction is suspected.

(c) The following perpendicular offsets were taken at 10 m intervals from a chain line to an irregular boundary line.

3.10 4.20 5.35, 6.45, 7.15, 8.25, 7.95 and 5.20 m.

Find the area by (i) trapezoidal rule (ii) Simpson's rule.

Ans. By trapezoidal rule

$$\text{Required area} = \frac{10}{2}\{3.10 + 5.20 + 2(4.2 + 5.35 + 6.45 + 7.15 + 8.25 + 7.95)\}$$

$$= \frac{10}{2}\{8.3 + 78.7\} = 435\ m^2$$

(ii) Simpson's rule – If this rule is to be applied, the number of ordinates must be odd. But here the number of ordinate is even (eight).

So, Simpson's rule is applied from O_1 to O_7 and area between O_7 and O_8 is found by the trapezoidal rule.

$$A_1 = \frac{10}{3}\begin{Bmatrix} 3.10 + 7.95 + 4(4.2 + 6.45 + 8.25) \\ +2(5.35 + 7.15) \end{Bmatrix}$$

$$= \frac{10}{3}\{11.05 + 75.6 + 25\} = 372.17 m^2$$

$$A_2 = \frac{10}{2}(7.95 + 5.20) = 65.75$$

Total area = $A_1 + A_2$ = 372.17 + 65.75 = 437.92 m^2

3.(a) Name the different types of chains used in surveying.

Ans. Different types of chains used in surveying are

1. Metric chain.
2. Steel chain.
3. Engineers chain.
4. Gunter's chain.
5. Revenue chain.

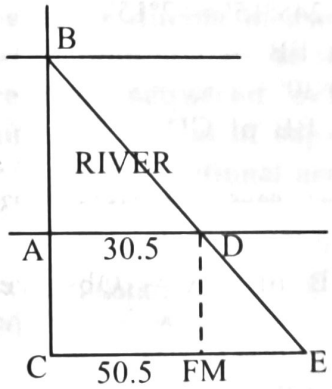
(c) Draw a comparision between chain surveying and compass surveying.

Ans. Chain Sruveying – In chain surveying the area to be surveyed is divided into a number of small triangles which should be well-conditioned. In chain serveying the sides of the triangles are measured directly on the field by chain or tape and no angular measurements are taken. The tie lines and check lines control the accuracy of work. This method is suitable for fairly level ground covering small areas.

Compass Surveying – In compass surveying the frane work consists of a number of connected lines. The lengths are measured by chain or tape and the directions indentified by compass. This method is suitable when the area is large, undulating and crowded with many details.

(d) A line CAB crosses a river A and B are on near and distant banks of the river respectively. Perpendiculars AD and CE are 30.5 m and 50.5 m respectively, such that B, D and E are in astaight line. If the chainage of C and A are 505.5m, calculate the chainage of B.

Ans.



Construction

Drop a perpendicular CF on line CE.

Now triangle BAD and triangle DFE are similar.

$[\because \angle ABD = \angle FDE, \angle BAD = \angle DFE = 90^\circ]$

$$\therefore \quad \frac{AB}{AD} = \frac{DE}{EF}$$

$$\Rightarrow \quad \frac{AB}{30.5} = \frac{AC}{CE - CF}$$

$$\Rightarrow \quad \frac{AB}{AD} = \frac{AC}{CE - AD}$$

AC = chainage of A = chainge of C

= 550.5 M – 505.5 M = 45M

$$\therefore \quad \frac{AB}{30.5} = \frac{45}{50.5 - 30.5}$$

$$\Rightarrow \quad AB = 68.625$$

∴ Chainage of B = chaining of A + AB

= 550.5 + 68.625 = 619.125M.

4.(a) Draw the symbol of

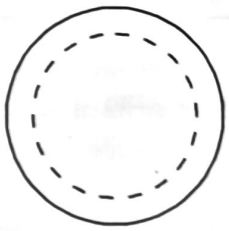
1. a pucca wall

2. Road culvert

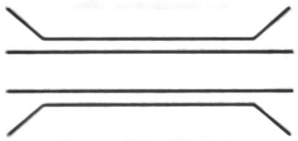
3. Electric culvert

4. School Building.

Ans. 1. a pucca wall

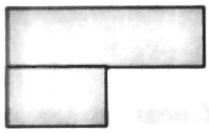


2. Road culvert



3. Electric line.

4. School Building.



(b) Explain principle of plane table surveying.

Ans. Principle of plane table surveying

→ The principle of plane tabling is based on the fact that the lines joining the points on the plane table, are made to lie parallel to their corresponding lines joining the ground points while working at each station.

→ The principle can be best understood by considering the graphical reduction of a triangle to the given dimensions.

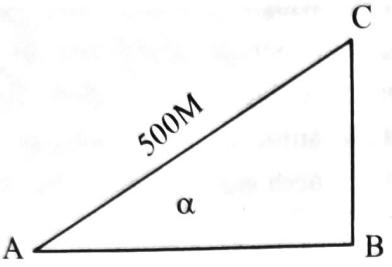
→ The base of the triangle is plotted on the desired scale and the base angles are plotted directly by turning the alidade at each end.

→ The intersection of the rays gives the desired location of the triangle vertex.

→ The plane table surveying may be defined as graphical construction of straight lines, angles and triangles for plotting detail points.

(c) A line measured on a rising gradient of 1 in 12 was found to be 500m. It was found later than the 30m chain was 5cm too long. Find correct horizontal length of the line.

Ans. Let AC be the slope measured.



Angle of slope $\alpha = \tan^{-1}\left(\frac{1}{12}\right) = 4°45'$

Correct slope distance

$$AC = \frac{\ell^1}{\ell} \times \text{Measured length}$$

Length of chain = 30M = l.

True length of chain

$$\ell^1 = (30 + 0.05)\text{M} = 30.05\text{M}$$

∴ Correct slope distance AC

$$= \frac{30.05}{30} \times 500 = 500.833\text{ M}$$

Correct horizontal distance AB = AC cosα

= 499.10 M

5.(a) The bearing of a survey line is 220°. State the system of bearing and convert it into the other system.

Ans. The bearing of a survey line is 220°. The system of bearing is whole circle bearing.

(b) The magnetic bearing of a line AB is 125° 30′. Find out its turre bearing if magnetic declination at A is (i) 9° 30′ W (ii) 5° 30′E.

Ans. Magnetic bearing of line AB = 125° 30′

(i) Declination at A = 9° 30′ W

bearing of line AB = Mb – declination

= 125° 30′ – 9° 30′ = 116°

(ii) Declination at A is = 5° 30′ E

True bearing of line AB = Mb – declination

= 125° 30′ – 5° 30′ = 120°

(c) The following bearing were observed in a closed traverse ABCDA. Find the stations affected by local attraction. Calculate the corrected bearings.

Line	F.B.	B.B.
AB	124° 30′	304° 30′
BC	68° 15′	246° 00′
CD	310° 30′	135° 15′
DA	200° 15′	17° 45′

Ans.

Line	F.B.	B.B	Difference
AB	124°30′	304°30′	180°00′
BC	68°15′	246°00′	177°45′
CD	310°30′	135°15′	175°15′
DA	200°15′	17°45′	182°30′

Fore bearing of AB = 124°30′

Back bearing of AB = 304°30′

∴ Difference of bearing = 304°30′ – 124°30′ = 180°00′

∴ Stations A and B are free from local attraction.

FB of BC = 68°15′ is correct.

Correct BB of BC = 68°15′ + 180°00′ = 248°15′

Observed BB of BC = 246°00′

∴ Error = Observed bearing – True bearing.

= 246°00′ – 248°15′ = –2°15′

∴ Correct FB of CD = observed bearing + correction = 310°30′ + 2°15′ = 312°45′

∴ Correct BB of CD = 312°45′ – 180°00′ = 132°45′

Error at D = 135°15 – 132°45′ = +2°30′

Correction at D = –2°30′

Correct FB of DA = Observed bearing – Correction

= 200°15′ – 2°30′ = 197°45′

The correct FB and BB of lines are tabulated under.

Line	F.B.	B.B
AB	124°30′	304°30′
BC	68°15′	246°00′
CD	310°30′	135°15′
DA	200°15′	17°45′

Calculation of included angles

= The difference in bearing of AB and AD

= 124°30′ – 17°45′ = 106°45′

The included angle B

= The difference in bearing of BC and BA.

= (68°15′ + 360°) – 304°30′ = 123°45′

The included angle C

= The difference in bearing of CD and CB.

$= 312°45' - 248°15' = 64°30'$

The included angle D

= The difference in bearing of DA and DC.

$= 197°45' - 132°45' = 65°00'$

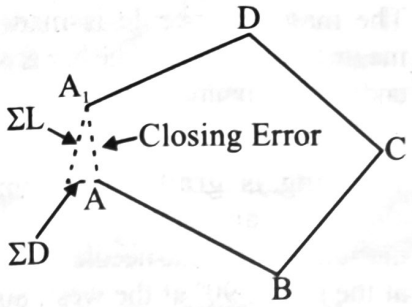
Check

Included angle A + included angle B + included angle C + included angle D

$= 106°45' + 123°45' + 64°30' + 65°00' = 360°.$

6.(a) What is closing error ? Show with diagram.

Ans. The distance by which a traverse fails to close is called closing error.



(b) A steel tape 20 m long, standardised at 15° C with a pull of 10 kg was used to measure distance along a slope of 4°. If the mean temperature during measurement was 25° C and the pull applied 16 kg, determine the correction required per tape length. Assume co-efficient of expansion 112×10^{-7} per °C, cross-sectional area of tape = 0.08 cm^2 and Young's modulus E = 2.1×10^6 kg/cm^2.

Ans. Given data :

$L = 20$ m $A = 0.08$ cm^2

$T_0 = 15°$ C $\alpha = 112 \times 10^{-7}$ per °C

$P_0 = 10$ kg $E = 2.1 \times 10^6$ kg/cm^2

$Tm = 25°$ C $Pm = 16$ kg

(i) Temperature correction, $C_t = \alpha (T_m - T_0)$

$= 112 \times 10^{-7} (25 - 15)\ 5\ 20$

$= 0.00224$ m

(ii) Pull correction, $C_p = \dfrac{(P_m - P_0)L}{A \times E}$

$= \dfrac{(16-10)20}{0.08 \times 2.1 \times 10^6} = 0.00071$ m

(iii) Slope correction, $C_n = L (1 - \cos \theta)$

$= 20 (1 - \cos 4°) = 0.04872$ m

Total correction = 0.0024 + 0.00071 + 0.04872

= 0.05167.

(c) Describe the procedure of setting up plane table over a station.

Ans. The setting up operation consists of the following -

(i) Levelling the plane table

(ii) Centering the plane table

(iii) Orienting the plane table

(i) Levelling - In this operation the table top is made truely horizontal.

Procedure - Set up plane table at the convenient height by spreading the leg to keep the table approximately levelled.

Place a spirit level on the plane table such that its longitudinal axis is parallel to longer edge of the table with the help of thirdleg by moving it right or left bring the bubble of the sprit level central.

Rotate the table top through 180° check of the bubble remains central in all position.

(ii) Centering the plane table :

In this operation, the location of plane table station on the paper is brought exactly vertical above the ground station position.

Procedure : Place onw end of u-fork touching the plotted location & the plumb bob hanging from the other end below the table points towards the ground point.

(iii) Orienting the plane table :

In this operation the plane table is set at a station such that its edges make a fixed angle with a fixed direction.

Incase the table is not correctly oriented at each station, the location of detail points obtained by any one of the methods of plane tabling.

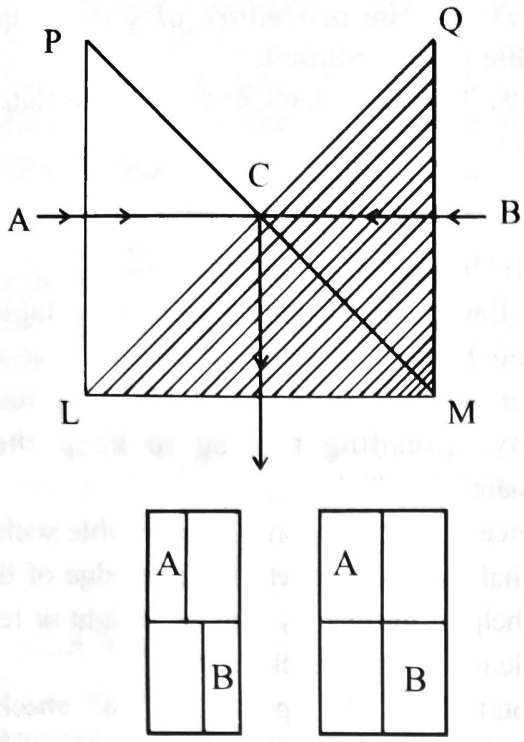
i.e. Radiation, Resection or intersection.

7.(a) Define well conditioned and ill conditioned triangles in surveying.

Ans. A triangle is said to be well-conditioned. When no angle in it is less than 30° or greater than 120°. A triangle in which an angle is less than 30° or more than 120° is said to be ill-conditioned.

(b) Explain with a neat sketch the operating principle of a line ranger.

Ans. It is a reflecting instrument used for fixing intermediate points on a chain line. It consists of two right angled isoseles triangular prisms placed one above the other.



Operating Principle of a Line Ranger :

→ Suppose A and B are the ends of a line and C is an intermediate pont to be fixed on this line. Following steps are followed for locating the intermediate point C.

(i) Stand approximately in line near C and hold the line ranger at eye level.

(ii) Observe the ray of light from A, which enters the upper prism, gets reflected from the hypotenuse LQ and enters the eye at right angles to AB.

(iii) Similarly, observe the ray of light from B, which enters the lower prism, gets reflected from the hypotenuse pm and enters the eye at right angle to BA.

(iv) Observe the images of the ranging rods A and B in upper and lower prism at the same time.

(v) If the point C isn't in line with AB two images will appear to be separated as per the figure.

(vi) Move the instrument backward and foreward at right angles to the line until two images appear one above the other exactly in same vertical line.

(vii) The centre of the instrument defines the location of C on line AB.

(c) Draw the neat sketch of a prismatic compass showing the following parts and briefly explain their functions :

(i) Magnetic needle

(ii) Pivot

(iii) Brake pin.

(iv) Agate cap.

Ans. The prismatic compass

In this compass, the readings are taken with the help a prism. The following are the essential parts of this compass.

i. **Compass Box** – The compass box is a circular metallic box (the metal should be non-magnetic) of diameter 8 to 10 cm. A pivolt with a sharp point is provided the centre of the box.

ii. **Magnetic Needle and Graduatd Ring** – The magnetic needle is made of a broad, magnetised iron bar. The bar is pointed at both ends. The magnetic needle is attached to a graduated aluminium ring.

The ring is graduated from 0° to 360° clockwise, and the graduations begin, from the south end of the needle. Thus 0° is marked at the south, 90° at the west, 80° at the north and 270° at the east. The degrees are again subdivided into half-degrees. The figures are written upside down. The arrangement of the needle and ring contains and agate cap pivoted on the central pivot point. A rider of brass of silver coil is provided with the needle to cournterbalnce its dip.

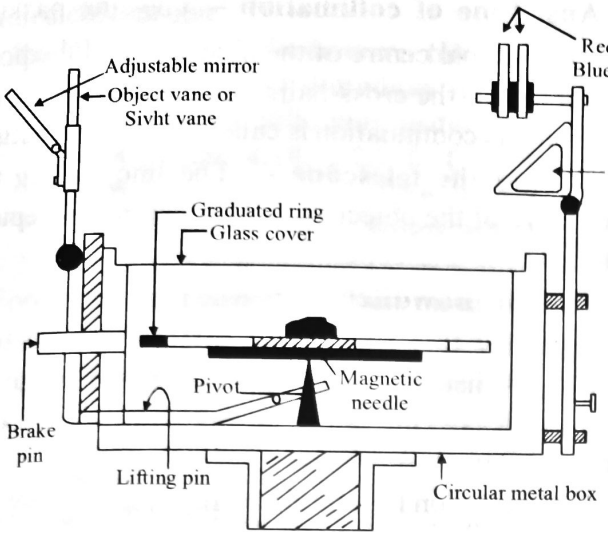
iii. **Sight Vane and Prism** – The sight vane and the reflecting prism are fixed diametrically opposite to the box. The sight vane is hinged with the metal box and consists of a horsehair at the centre. The prism consists of a sighting slit at the top and two small circular holes, one at the bottom of the prism and the other at the side of the observer's eye.

iv. **Adjustble Mirror** – Mirror is provided with the sight vane. The mirror can be powered or raised, and can also be inclined. If any object is too low or too high with respect to the line of sight, the mirror can be adjusted to observe it through reflection.

v. **Brake Pin** – A brake pin is provided just at the base of the sight vane. If pressed gently, it stops the oscillations of the ring.

vi. **Lifting Pin** – A lifting pin is provided just below the sight vane. When the sight vane is folded, it presses the lifting pin. The lifting pin then lifts the magnetic needle out of the pivot point to prevent damage to the pivot head.

vii. Glass Cover – A cover is provided on top of the box to protect the aluminium ring from dust.



MODEL – 2

[Code - CET - 303]

Full Marks – 70 **Time – 3 Hours**

*Answer any **five** questions.*

Figures in the right-hand margin indicate marks.

1.(a) Draw frrband sketches for the following conventional signs used in surveying.

Temple, Building, Orchard, Level crossing, Chainline. [2

(b) The length of asurvey line measured with a 30 m chain was found to be 315.4 m . Afterwards it was found that the chain was 5 cm too long. What is the correct length of the line ? [4

(c) The back sight reading on a levelling staff held vertically on a bench mark having R.L. 500 m is 1.585 m and the foresight on the staff held vertically inverted against a beam soffit is 2.415 m. What is the R.L. of the beam soffit ? [8

2.(a) What is the difference between the line of collimation and the axis of the telescope ? [2

(b) Explain Bowditch rule. [4

(c) Reciprocal levelling was done to determine the difference in level between two points A and B on the opposite banks of a river. The following readings were taken

Position of level	Staff reading	
	A	B
level near A	2.570	2.170
level near B	2.360	1.410

If R.L. of B is 300.250 m what is the R.L of A ?[8

3.(a) What is a contour line ?

(b) A series of offsets were taken from a chain line to a curved doundary line at an interval of 8 m in the following order

0.2.85, 3.20, 4.10, 2.20, 0. Calculate the area between the chain line and the curved boundary line using Simpson's rule.

(c) Draw the beat sketch of a prismatic compass and show in it the following parts.

Pivot, box, sightvane, magnetic needle, glass top and graduated arc.

4.(a) Define Horizonatal equivalent.

(b) Write the procedural steps in plane tabling.

(c) Explain the different steps in the method and traversing in plane table survey.

5.(a) State the least count of Gunter's chain.

(b) Explain the method using a planimeter.

(c) The following offsets were taken from a chain line to a hedge :

Distance in metre	0	10	20	30	40	60	80	100	120	140	160
Offset in metre	0	2	2.5	2.2	3	3.4	2.8	2.6	3.2	2.9	2.7

Calculate the area enclosed between the chain line and hedge by Simpson's rule.

6.(a) Define III conditioned triangle.

(b) Steel bands

(c) Bowditch's rule

7.(a) Draw the conventional symbols of metalled road and wire fencing.

(b) What are the obstables of chaining ?

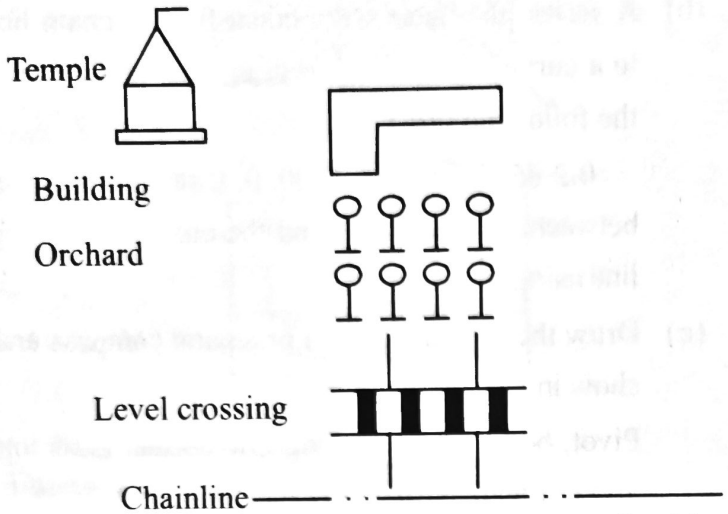
(c) What is two point and three point problems ? Explain with neat sketches and procedures of solving above problems.

ANSWER TO MODEL - 2

1.(a) Draw frrband sketches for the following conventional signs used in surveying.

Temple, Building, Orchard, Level crossing, Chainline.

Ans.



(b) The length of asurvey line measured with a 30 m chain was found to be 315.4 m . Afterwards it was found that the chain was 5 cm too long. What is the correct length of the line ?

Ans. Given data :

The length of chain L = 30 M

Error in chain (e) = 5 cm = 0.05m too long.

$L^1 = L + e = 30 + 0.05 = 30.05M$

Measured length = 315.4 M

$$\text{True length of line} = \frac{L^1}{L} \times ML$$

$$= \frac{30.05}{30} \times 315.4M = 315.92 \text{ m}$$

(c) The back sight reading on a levelling staff held vertically on a bench mark having R.L. 500 m is 1.585 m and the foresight on the staff held vertically inverted against a beam soffit is 2.415 m. What is the R.L. of the beam soffit ?

Ans. RL of Bench Mark = 500 M

Backsight reading on a levelling staff = 1.585 M

$\therefore$ High of instrument = 500 + 1.585

= 501.585 M

Foresight on the staff held vertically invested against a beam soffit = 2.415 M.

$\therefore$ RL of beam soffit = 501.585 + 2.415 = 504 M.

2.(a) What is the difference between the line of collimation and the axis of the telescope ?

Ans. Line of collimation – The line passing through the optical centre of the objective and the point of intersection of the cross-hairs stretched in fron of the eyepiece and its continuation is called line of collimation.

Axis of the telescope – The line joining the optical centre of the objective and the centre of eyepiece is called axis of telescope.

(b) Explain Bowditch rule.

Ans. By this rule, the total error in latitude (departure) is distributed in proprtion to the lengths of the traverse legs. This is the most common method of traverse adjustment.

(i) Correction to latitude of any side

$$= \frac{\text{Length of that side}}{\text{Perimeter of traverse}} \times \text{total error in latitude}$$

(ii) Correction to departure of any side

$$= \frac{\text{Length of that side}}{\text{Perimeter of traverse}} \times \text{total error in depature}$$

(c) Reciprocal levelling was done to determine the difference in level between two points A and B on the opposite banks of a river. The following readings were taken

Position of level	**Staff reading**	
	A	**B**
level near A	**2.570**	**2.170**
level near B	**2.360**	**1.410**

If R.L. of B is 300.250 m what is the R.L of A ?

Ans. When the instrument is at A

Apparent difference of level between

AB = 2.570 – 2.170 = 0.40 (rise from A to B)

When the instrument at B

Apparent difference of level

= 2.360 – 1.410

= 0.95M (rise from A to B)

True difference of level

$$= \frac{0.40 + 0.95}{2} = 0.675 \text{ M} (\text{Rise from A to B})$$

RL of B = 300.250 M

RL of A = (300.250 – 0.675)M

= 299.575 M

3.(a) What is a contour line ?

Ans. An imaginary line, on the ground joining the points of equal elevation above the assumed datum is called contour line.

(b) A series of offsets were taken from a chain line to a curved doundary line at an interval of 8 m in the following order

0.2.85, 3.20, 4.10, 2.20, 0. Calculate the area between the chain line and the curved boundary line using Simpson's rule.

Ans. If Simpson's rule is to be applied, the number of ordinates must be odd. But here the number of ordinate is even (six).

So, Simpson's rule is applied from O_1 to O_5 and the area between O_5 and O_6 is found out by the trapezoidal rule.

$$A_1 = \frac{8}{3}\{0 + 2.20 + 4(2.85 + 4.10) + 2 \times 3.2\}$$

$$= \frac{8}{3}\{2.20 + 27.8 + 6.4\} = 57.067\ M^2$$

$$A_2 = \frac{8}{2}(2.20 + 0) = 8.8\ M^2$$

(c) Draw the beat sketch of a prismatic compass and show in it the following parts.

Pivot, box, sightvane, magnetic needle, glass top and graduated arc.

Ans. Survey Compas is a plain compass, also known as surveyor's Compass. Miner's Dial or Circumferenter and almost obsolete now-a-days, consists of the following parts as shown in figure.

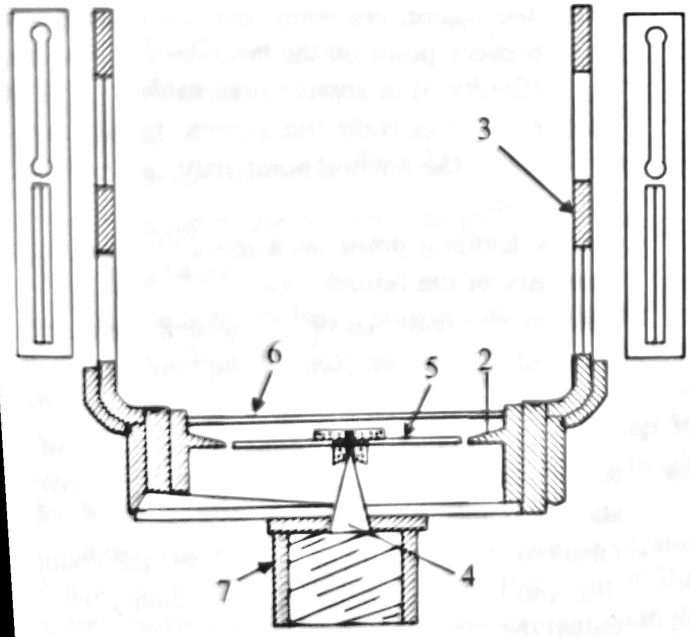


Fig. Survey compass.

(i) A circular box about 125 mm in diameter.

(ii) A circular graduated ring fixed to the inside rim of the box a its top.

The graduation may be either in whole circle measurement or in Quadrantal system. But in both cases it is graduated i anticlockwise direction.

(iii) A pair of sight-vanes, one of which is on the object side and the other on the observer's side. They are screwed at the bottom outside the box and can be folded by hinge arrangement.

(iv) A hard steel pointed pivot placed vertically at the centre of the bottom of the box.

(v) An edge bar magnet that floats on the pivot point with the help of a bearing fitted at its centre and placed on the pivot point.

(vi) A glass over at the top.

(vii) Light tripod stand on which the compass may be placed with the help of ball and socket arrangement. In some cases tripod stand with some arrangement for the adjustment of height of the instrument may be employed for the convenience of taking obserations in situations like surveying in woods.

Problem – Why the graduated ring in the Surveyor's Compass is graduated in counter clockwise direction ?

Solution – In the measurement of bearing with a surveyor's compass the needle point towards north and since the bearing is measured clockwise from north the object vane at zero on the graduaed ring is to be rotated clockwise to put the line of sight along the line the bearing of when is to be taken. The bearing is recorded by the graduation at the north pole of the magnet. This being situated in the anticlockwise direction with respect to the zero of the graduation, the graduations must be increasing in the counter clockwise direction.

4.(a) Define Horizonatal equivalent.

Ans. The least horizontal distance between two consecutive contours is called horizontal equivalent.

(b) Write the procedural steps in plane tabling.

Ans. Principle of plane table surveying

→ The principle of plane tabling is based on the fact that the lines joining the points on the plane table, are made to lie parallel to their corresponding lines joining the ground points while working at each station.

→ The principle can be best understood by considering the graphical reduction of a triangle to the given dimensions.

→ The base of the triangle is plotted on the desired scale and the base angles are plotted directly by turning the alidade at each end.

→ The intersection of the rays gives the desired location of the triangle vertex.

→ The plane table surveying may be defined as graphical construction of straight lines, angles and triangles for plotting detail points.

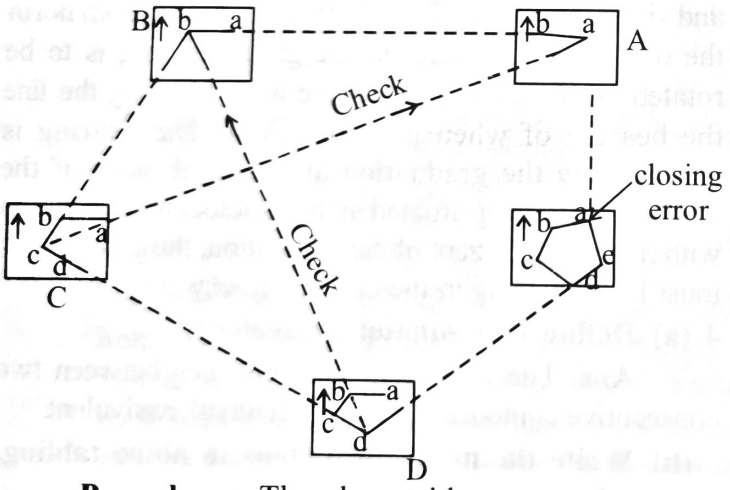
(c) Explain the different steps in the method and traversing in plane table survey.

Ans. Plane table surveying may be carried out by one of the following methods :

- Radiation method
- Intersection method
- Traversing method
- Resection method

Traversing Method : The method of traversing by a plane table is similar to that of compass and theodolite traverse. In plane table traverse, the table is set at each successive station, a foresight is taken to the rent station and its location is plotted on the foresight, by measuring the distance directly between the two stations.

Principle of Traversing Method : The principle of traversing is similar to that of radiation method. Plane table traversing is always carried out in a closed circuit or it may originate from and close on known points or other resected points.



Procedure : The plane table traverse is carried out as follows :

- Recommoitre the area to be surveyed for selecting a number of stations, sufficiently for a part, ascertaining their intervisibility and feasibility of chaining.
- Set up the plane table over the strting station A. Transfer the ground point with a U-fork on the sheet.
- Orient the plane table approximately so that the area to be surveyed, falls on the table.
- Draw a magnetic north line with a box compass.
- With the alidade pivoted at a, the assumed location of A, sight the neat station B. Draw a ray along the fidacial edge of the alidade and also its exttremitites are marked on both the edges of the plane table.
- Measure the distance AB accurately and plot a line ab on the scale of survey.
- Shift the table to station B. Centre the plane table such that ray ab passes vertically above the ground point B.
- Place the alidade along the ray ba. Rotate the table till ground station A is sighted, clamp it.
- Pivoting the alidade about b, sight next station C. Measure BC and plot be on the ray drawn towards the station C. The plane table is set-up on other succeding stations till the last station is plotted. The plotted position of the last station should normally coincide with the location of the first station, in case of a closed circuit. The distance between the two locations of the starting station, if any is known as 'closing error'.

5.(a) State the least count of Gunter's chain.

Ans. Least count of Gunter's chain = 0.66 ft.

(b) Explain the method using a planimeter.

Ans. Use of a Planimeter : The areaof a plan may be determined with a planimeter as explained below.

- Set the index mark on the bevelled edge of the slide to the scale to which the plan is drawn.
- Fix the anchor point firmly in the paper outside or inside the figure, ensuring that the tracing point reaches every point on the boundary line without any difficulty. It is always preferable to keep the anchor point outside the figure. However, for larger area, the anchor point may be kept inside the figure.
- Set the training point on a marked point on the boundary of the figure.
- Observe the readings on the wheel, the counting disc and the vernier. Record the reading which is called the initial reading (I.R.).
- Move the tracing point along the periphery of the area in a clockwise direction until it reaches the starting point.
- Observe the readings on the wheel, the counting disc and the vernier. Record the reading which is called the final reading (F.R.).

- Keep on watching the number of times the zero mark of the dial passes the index mark in a clockwise or anticlowise direction.
- The area of the figure may be calculated from the formula,

  Area A = M (FR – IR ± I0 N + C)

  Where, M = a multiple whose value is marked on the tracing arm.

  N = Number of times of zero mark of the dial passes the fixed mark.

  C = A constant marked on the tracing arm just above scale divisions and is added only when the anchor point is inside the figure.

(c) The following offsets were taken from a chain line to a hedge :

Distance in metre	0	10	20	30	40	60	80	100	120	140	160
Offset in metre	0	2	2.5	2.2	3	3.4	2.8	2.6	3.2	2.9	2.7

Calculate the area enclosed between the chain line and hedge by Simpson's rule.

Ans. As per Simpson's rule

Area, $A = \frac{d}{3}$ [Sum of the first and last offsets + Twice the sum of remaining odd offsets + Four times the sum of remaining even offsets].

Area from 0m to 40 m

$$A = \frac{10}{3}\left[0+3+4(2+2.2)+(2\times 2.5)\right]$$

$$= 3.33\ [3 + 5 + 16.8]$$

$$= 82.58$$

Area from 40m to 160 m

$$A = \frac{20}{3}\left[3+2.7+2(2.8+3.2)+4(3.4+2.6+2.9)\right]$$

$$= 6.66\ [3 + 2.7 + 12 + 35.6]$$

$$= 354.97$$

∴ The area enclosed between the chain line and hedge, $= 82.58 + 354.97 = 437.55\ m^2$.

6.(a) Define III conditioned triangle.

Ans. The triangle having angles smaller than 30° or greater than 120° are known as ill-conditioned triangle.

(b) Steel bands

Ans. The steel band consists of ribbon of steel with a brass swivel handle at each end. It is 20m or 30m long and 16mm wide. The graduations are marked in the following manner :

- The band is divided by brass studs at every 0.2m and numbered at every one metre. The first and last links are sub-divided into centimetres and millimeetres.
- The graduations are etched as metres, decimetres, centimetres on one side and 0.2m links on the otherside.

The band is wound on an open steel cross or metal reel in a closed case.

(c) Bowditch's rule

Ans. By this rule, the total error in latitude (departure) is distributed in proprtion to the lengths of the traverse legs. This is the most common method of traverse adjustment.

(i) Correction to latitude of any side

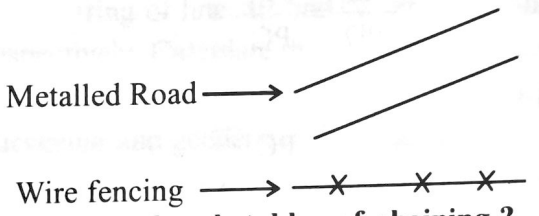
$$= \frac{\text{Length of that side}}{\text{Perimeter of traverse}} \times \text{total error in latitude}$$

(ii) Correction to departure of any side

$$= \frac{\text{Length of that side}}{\text{Perimeter of traverse}} \times \text{total error in depature}$$

7.(a) Draw the conventional symbols of metalled road and wire fencing.

Ans.



(b) What are the obstables of chaining ?

Ans. A chain line may be interrupted in the following situations.

1. When chaining is free, but vision is obstructed.
2. When chaining is obstructed, but vision is free
3. When chaining and vision are both obstructed.

Chaining free but vision obstructed

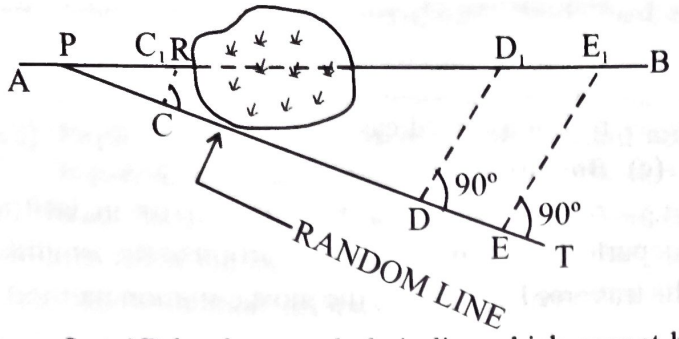
Such a problem arises when a rising ground or a jungle area interrupts the chain line. Here the end stations are not intervisible. There may be two cases.

Case I

The end stations may be visible from some intermediate points on the rising ground. In this case, reciprocal ranging is resorted to and the chainng is done by the stepping method.

Case II

The end stations are not visible from intermediate points when a jungle area comes across the chain line. In this case the obstacle may be crossed over using a random line as explained below.



Let AB be the actual chain line which cannot be ranged and extended because of interruption by a jungle. Let the chain line be extended up to R. A poi nt P is selected on the chain line and a random line PT is taken in a suitable direction. Points C, D and E are selected on the random line, and perpendicular are projected from them. The perpendicular at C meets the chain line at C_1.

Theoretically, the perpendiculars at D and E will meet the chain line at D_1 and E_1. Now the distances PC, PD, PE and CC_1 are measured from triangles PDD_1 and PCC_1.

$$\frac{DD_1}{PD} = \frac{CC_1}{PC}$$

$$DD_1 = \frac{CC_1}{PC} \times PD$$

Again, from triangles PEE, and PCC_1

$$\frac{EE_1}{PE} = \frac{CC_1}{PC}$$

$$EE_1 = \frac{CC_1}{PC} \times PE$$

From (1) and (2) the lengths DD_1 and EE_1 are calculated. These calculated distances are measured along the perpendicular at D and E. Points D_1 and E_1 should lie in the chain line AB, which can be extended accordingly.

Distance $PE_1 = \sqrt{PE^2 + EF_1^2}$

2. Chaining obstructed but vision free

Such a problem arises when a pond or a river comes across the chain line. The situations may be tackled in the following ways.

Case 1

When a pond interrupts the chain line, it is possible to go around the obstruction.

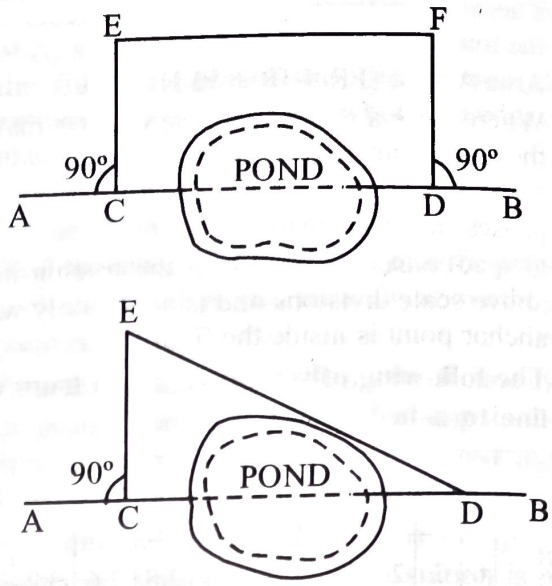


Fig (a), (b)

Suppose AB is the chain line. Two points C and D are selected on it on opposite banks of the pond. Equal perpendiculars CE and DF are erected at C and D. The distance EF is measured.

Here, CD = EF (Fig. (a))

The pond may also be crossed by forming a triangle as shown in fig. (b). A point C is selected on the chain line. The perpendicular CE is set out at C and a line ED is suitably taken. The distances CE and ED are measured.

So $CD = \sqrt{ED^2 - CE^2}$

Case II

Sometimes it is not possible to go around the obstruction.

i. Imagine a small river comes across the chain line. Suppose AB is the chain line. Two points C and D are selected on this line on opposite banks of the river. At C a perpendicular CE is erected and bisected at F. A perpendicular is set out at E and point G is so selected on it that D, F and G are in the same straight line.

From triangles DCF and GEF,

GE = CD

This distance GE is measured, and thus the distance CD is obtained indirectly.

ii. Consider the case when a large river interrupts the chain line.

Let AB be the chain line. Points C, D and E are selected on this line such that D and E are on opposite banks of the river. The perpendicular DF and CG are erected on the chain line in such a way that E, F and G are on the same straight line. The line FH is taken parallel to CD.

Now, from triangles DEF and HFG

$$\frac{ED}{DF} = \frac{FH}{HG} \qquad \text{Where } FH = CD$$

$$ED = \frac{FH}{HG} \times DF \qquad CH = DF$$

$$= \frac{CD}{CG - DF} \times DF \qquad HG = CD - CH$$

$$\therefore HG = CH - DF$$

The distances CD, DF and CD are measured. Thus the required distance ED can be calculated.

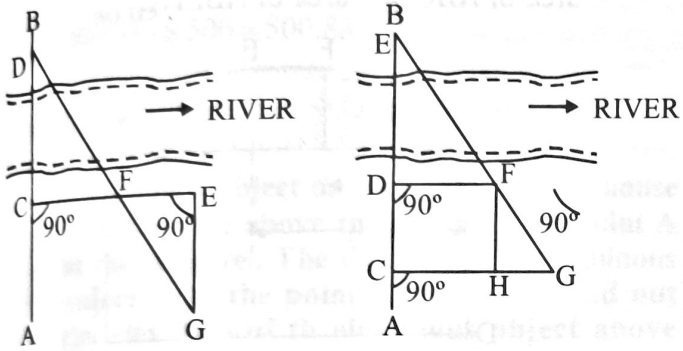


Fig (a) and (b)

(c) What is two point and three point problems ? Explain with neat sketches and procedures of solving above problems.

Ans. Refer to 2014(W), Q. No. 5.(c)

MODEL – 3

[Code - CET - 303]

Full Marks – 70 **Time – 3 Hours**

*Answer any **five** questions.*

Figures in the right-hand margin indicate marks.

1. (a) What are the methods of computation of an area ? [2

(b) A surveyor measured the distance between two points on the plan draw to scale of 1 cm = 40 m and the result was 460 m. Later, however he discovered that he used a scale of 1 cm = 20m. Find the true distance between the points. [4

(c) Write short notes on computation of area. [8

2. (a) Differentiate between open traverse and close traverse. [2

(b) A line mesured on a rising gradient of 1 in 12 was found to be 500m. It was after words found that the 30 m chain was 5 cm too long what is the correct horizontal length of the line. [4

(c) A luminous object on the top of a light house is just visible above the horizon at a point A at the sea level. The distance of the luminous object from the point A is 50 km. Find out the elevation of th eluminous object above sea level assuming radius of earth is 6400 km. [8

3. (a) What is indirect ranging ? State the circumstances in which one would go for indirect ranging. [2

(b) A series of offsets were taken from a chain line to a curved doundary line at an interval of 8 m in the following order

0.2.85, 3.20, 4.10, 2.20, 0. Calculate the area between the chain line and the curved boundary line using Simpson's rule. [4

(c) Explain with neat sketch the principle and use of an optical square. [8

4. (a) The bearing of line AB and AE are 210° and 70° respectively. Calculate the interior angle ∠A. [2

(b) State the fundametnal difference between plane surveying and geodetic surveying. [4

(c) Describe the field procedure of chain survey. [8

5. (a) Define 'dip' and 'declination' [2

(b) Method of intersection. [4

(c) Write short notes on any two [8

(i) Errors in compass surveying.

(ii) Planimeter

(iii) Bowditch's correction.

6. (a) What is meant by positive cumulative errors. [2

(b) types of chains and tapes. [4

(c) What are the sources of error in chaining ? What precautions would you take to guard against them ? [8

7. (a) What is meant by index sketch in chain surveying. [2

(b) Mention the various errors and it's precautions taken in plane table surveying. [4

(c) The following offsets were taken at 15m intervals from a survey line to an irregular Boundary line : 1.85, 2.35, 4.20, 5.30, 6.80, 5.65, 4.85, 3.75, 2.65, 1.95.

Calculate the area enclosed between the survey line, the irregular boundary line and the first and last offsets by

i.the trapezoidal rule

ii. Simpson's rule. [8

ANSWER TO MODEL - 3

1.(a) What are the methods of computation of an area ?

Ans. Methods of computation of an area

(i) Graphical Method

(ii) Instrumental Method

(b) A surveyor measured the distance between two points on the plan draw to scale of 1 cm = 40 m and the result was 460 m. Later, however he discovered that he used a scale of 1 cm = 20m. Find the true distance between the points.

Ans. RF of wrong scale = $\frac{1}{20\times100} = 5\times10^{-4}$

RF of correct scale = $\frac{1}{40\times100} = 2.5\times10^{-4}$

Measured length = ML = 460 M.

True distance = $\frac{\text{RF of wrong scale}}{\text{RF of correct scale}} \times \text{ML}$

$= \frac{5\times10^{-4}}{2.5\times10^{-4}} \times 460 = 920$ M.

(c) Write short notes on computation of area.

Ans. Composition of area - This done in two steps.

Step – 1

In case staff survey, the area of field can be directly calculated from field notes. During survey work the whole area is divided into some geometrical figures, such as triangles, rectangles and trapeziums and then the area is calculated as follows

i. Area of traingle = $\sqrt{S(S-a)(S-b)(S-c)}$

Where a, b and c are the sides.

and $S = \frac{a+b+c}{2}$

or Area of triangle = $\frac{1}{2}bh$

Where b = base

h = altitude

ii. Area of rectnagle = a × b.

Where a and b are the sides

iii. Area of trapezium = $\frac{1}{2}(a+b)\times h$

Where a and b are parallel dises and h is the perpendicular distance between them.

Step – 2

The area along the boundaries is calculated as follows.

O_1, O_2 = ordinates

x_1, x_2 = chainages.

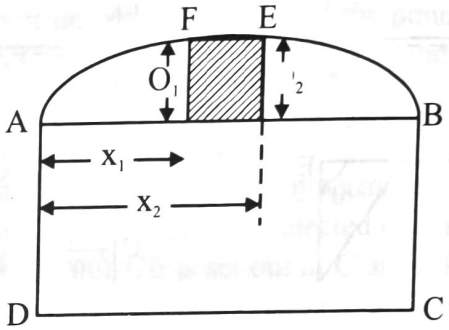
Area of shaded portion $= \frac{O_1+O_2}{2} \times (x_2 - x_1)$

Similarly, the areas between all pairs of ordinates are calculated and added to obtain the total boundary area.

∴ Total area of the field.

= area of geometrical fig + boundary area

= area of ABCD + area of ABEFA.



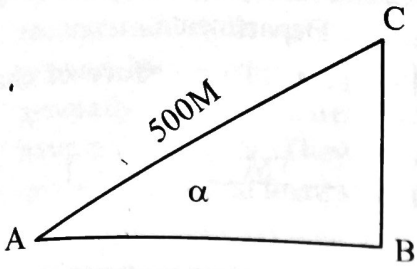
2.(a) Differentiate between open traverse and close traverse.

Ans. Open Traverse – When a sequence of connected lines extend along a general direction and does not return to the starting point, it is known as open traverse. It is suitable for the survey of roads, rivers, coast lines etc.

Closed traverse – When a series of connected lines form a closed circuit it is called a closed traverse. It is suitable for the survey of boundaries of ponds forests estates etc.

(b) A line mesured on a rising gradient of 1 in 12 was found to be 500m. It was after words found that the 30 m chain was 5 cm too long what is the correct horizontal length of the line.

Ans. Let AC be the slope measured.



Angle of slope $\alpha = \tan^{-1}\left(\frac{1}{12}\right) = 4°45'$

Correct slope distance

$AC = \frac{\ell^1}{\ell} \times$ Measured length

Length of chain = 30M = l.

True length of chain

$$\ell^1 = (30 + 0.05)\,M = 30.05M$$

$\therefore$ Correct slope distance AC

$$= \frac{30.05}{30} \times 500 = 500.833\ M$$

Correct horizontal distance AB = AC cosα

$= 499.10$ M

(c) A luminous object on the top of a light house is just visible above the horizon at a point A at the sea level. The distance of the luminous object from the point A is 50 km. Find out the elevation of th eluminous object above sea level assuming radius of earth is 6400 km.

Ans. Let h be the elevation of the luminous object above sea level. Due to the combined effect of curvature and refraction the top of light house just appears above the horizon.

The combined correction due to

Curvature and refraction $= \frac{6}{7}\left(\frac{d^2}{2R}\right)$

Where d = horizontal distance between the two points.

R = Radious of earth.

$$= \frac{6}{7} \times \frac{(50)^2}{2 \times 6400} = 0.16741\ km = 167.41\ meter.$$

3.(a) What is indirect ranging ? State the circumstances in which one would go for indirect ranging.

Ans. When the end stations are not intervisible due to there being high ground between them, indirect ranging is adlopted.

Fixing of intermidiate ranging rods on the line in an indirect way is called indirect or reciprocal ranging.

(b) A series of offsets were taken from a chain line to a curved doundary line at an interval of 8 m in the following order 0.2.85, 3.20, 4.10, 2.20, 0. Calculate the area between the chain line and the curved boundary line using Simpson's rule.

Ans. In order to apply Simpson's Rule, the number of offsets should be odd. In this problem the number of offsets is even. Hence the last offset is ignored for calculating the area of the remaining portion and the area between last two offsets is calculated by trapezoidal rule and added to get the required area.

$$\therefore \text{Area} = \frac{4}{3}\left[\begin{matrix} 0 + 2.46 + 2(1.62 + 2.04) \\ +4(2.26 + 2.80 + 2.22) \end{matrix}\right] + \frac{4}{2}(2.46 + 0)$$

$$= \frac{4}{3}[2.46 + 7.32 + 29.12] + 4.92 = 56.786\ M^2$$

(c) Explain with neat sketch the principle and use of an optical square.

Ans. Optical Square

An optical square is also used for setting out right angles. It consists of a small circular metal box of diameter 5 cm and depth 1.25 cm. It has a metal cover which slides round the box to cover the slits. The following are the internal arrangements of the optical square.

1. A horizon glass H is fixed at the bottom of the metal box. The lower half of the glass is unsilvered and the upper half is silvered.
2. An index glass is also fixed at the bottom of the box which is completely silvered.
3. The angle between the index glass and horizon glass is maintained at 45°.
4. The opening 'e' is a pinhole or eye E, 'b' is a small rectangular hole for ranging rod B, 'P' is a large rectangular hole for object P.

5. The line EB is known as horizon sight and IP as index sight.
6. The horizon glass is placed at an angle of 120° with the horizon sight. The index glass is placed at an angle of 105° with the index sight.
7. The ray of light from P is first reflected from I, then it is further reflected from H, after which it ultimately reaches the eye E.

Principle – According to the principle of reflecting surfaces, the angle between the first incident ray and the last reflected ray is twice the angle between the mirrors. In this case, the angle, between the mirrors is fixed at 45°. So, the angle between the horizon sight and index sight will be 90°.

4.(a) The bearing of line AB and AE are 210° and 70° respectively. Calculate the interior angle ∠A.

Ans. The bearing of line AB = 210°

The bearing of line AE = 70°

∴ Interior angle ∠A

= Bearing of AB - Bearing of AE

= 210° – 70° = 140°.

(b) State the fundametnal difference between plane surveying and geodetic surveying.

Ans. Plane Surveying

(i) In plane surveying, the curvature of earth is not taken into consideration. In such surveying a line joining any two points is considered to be straight 2.0.

(ii) The triangles formed by any three points is considered as a plane triangle and the angles are considered to be plane angles.

(iii) Plane surveying is carried out on an area of less than 250 km^2.

(iv) Plane surveying is conducted by state agencies.

Geodetic Surveying

(i) In geodetic surveying, the curvature of earth is taken into consideration. The line joining any two points is considered as a curved line.

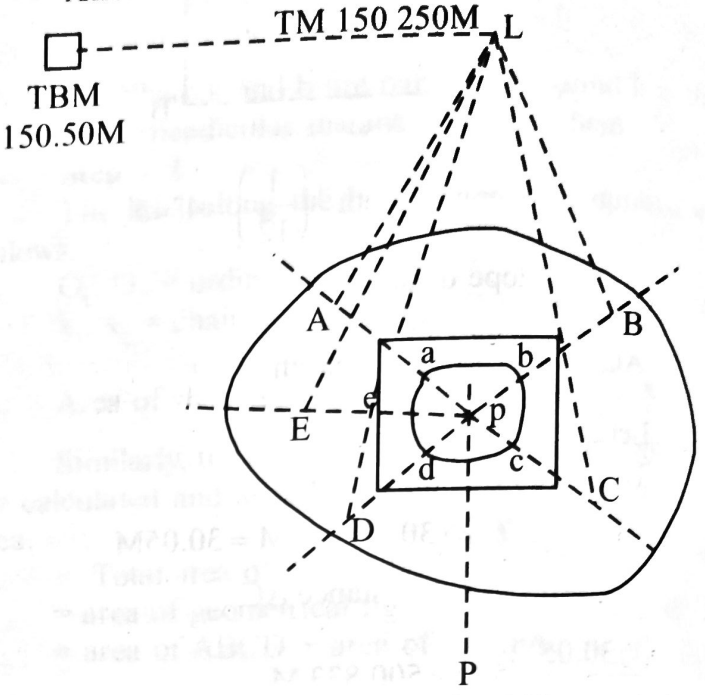
(ii) The triangle formed by any three points is considered to be spherical and the angels are considered to be spherical angles.

(iii) Geodetic surveying is carried out over an area exceeding 250 km^2.

(iv) Geodetic surveying is conducted by the survey of India Department.

(c) Describe the field procedure of chain survey.

Ans.



Field work of chain survey should be carried out according to the following steps.

1. Recomnaissance – Before starting survey work, the surveyor should walk over the whole area to the surveyed in order to examine the ground and determine the possible arrangement of frame work of survey. During this investigation, he should examine the intervisibility of the main survey stations. He should ensure that the whole area is enclosed by main survey line in such a way that the objects can be located by short the objects can be located by short offsets and it is possible to form well - conditioned triangle. The base line should preferable be taken through the centre of the area and on fairly level ground.
2. Index sketch – After preliminary inspection of the area, the surveyor should prepare a neat hand sketch showing the arrangement of the framework and approximate position of objects. He should note the rarus of the stations on the sketch maintaining some order. The field work should be executed according to this index sketch. The base line should be clearly indicated in the index sketch.

3. Marking the stations on the ground – after reconnaisance, the stations are marked on the ground by wooden pegs. These pegs are generally 2.5 cm square and 15M long and have pointed ends. They are driven into the ground firmly and there should be a height of 2.5cm above the ground. The station point is marked with across so that it can be traced if the wooden peg is removed by somebody.

4. Reference sketch – To take precaution against station pegs being removed or misszed a reference sketch should be made for all main stations. It is nothing but a hand sketch of the station showing atleast two measurements from some permanent objects. A third measurement may also be taken.

5. Taking measurements of survey lines and noting them int he field book – Ranging and chaining is started from the base line which should be measured carefully. The magnetic bearings of the base line are measured by a compass. These measurements are noted in the field book showing the offsets to the left or right according to their position. Then the other survey lines are ranged and chained maintaining the sequence of the traverse. The offsets and other field receords are noted simultaneously. The cheek lines and tie lines are also measured and noted at the proper place. The station marks are preserved carefully until field work is completed.

5.(a) Define 'dip' and 'declination'

Ans. Dip : If a needle is perfectly balanced before magnetisation, it does not remain in the balanced position after it is magnetised. This is due to the magnetic influence of the earth. The inclination of the needle with the horizontal is called as dip.

Declination – The horizontal angle between the magnetic meridian and true meridian is called as magnetic declination.

(b) Method of intersection.

Ans. In this method either the coordinates of at least two accessible & intervisible points must be known or the distance between then is measured directly in the field. These points are plotted on the required convenient scale. The location of other detail pts are determined by drawing rays from each end station after proper orientation of the table. The intersection of rays gives the location of detail pt. It is thus evident that it is very essential to have at least two pts whose locations are plotted before the survey may be started. The line joining the locations of the given stations is known as the base line

(c) Write short notes on any two

(i) Errors in compass surveying.

(ii) Planimeter

(iii) Bowditch's correction.

Ans. 1. Sources of Error in Compass

The following are the kinds of error which may occur while taking readings with a compass.

i. Instrumental Errors

a. The needle may not be perfectly straight and might not be balanced properly.
b. The pivot point may be eccentric.
c. The graduations of the ring may not be uniform.
d. The ring may not rotate freely on account of the pivot point being blunt. This may occur due to the head of the pivot being broken because of careless handling.
e. The sight vane may not be vertical.
f. The horse hair may not be straight and vertical.

ii. Personal Errors.

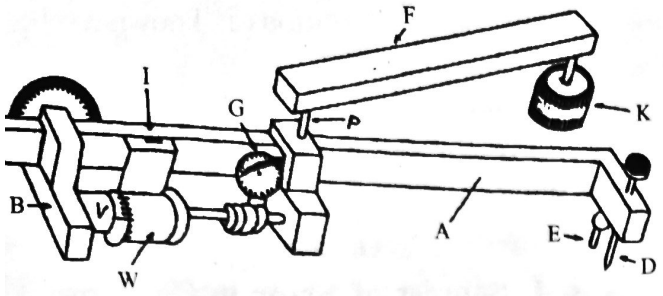
a. The centring may not be done perfectly over the station.
b. The graduated ring may not be levelled.
c. The object might not be bisected properly.
d. The readings may be taken or entered carelessly.
e. The observer may be carrying magnetic substances.

iii. Other Sources of Error

a. There may be local attraction due to the presence of magnetic substances near the station.
b. The magnetic field could vary on account of some natural causes.
c. The magnetic declination might vary.

2. The instrument used for computation of area from a plotted map is the planimeter. The area obtained by planimeter is more accurate than that obtained by the graphics method. There are various types of planimeter in use. But the

Amslar Polar Planimeter is the most commonly used now. The constructional details of this planimeter shown in fig.



A = Tracing Arm

B = Carriage

D = Tracing Point.

E = Adjustable Support.

F = Anchor point.

I = Index Mark

K = Fulcrum point.

P = Pivot point

W = Measuring wheel

V = Vernier Scale

G = Counting Disc.

a. It consists of two arms. The arm A is known as the tracing arm. Its length can be adjusted and it is graduated. The tracing arm carries a tracing point D which is moved along the boundary line of the area. There is an adjustable support E which always keeps the tracing point just clear of the surface.

b. The other arm F is known as the pole arm or anchor arm, and carrier a needle pointed weight or fulcrum K at one end. The weight forms the centre of rotation. The other end of the pole arm can be pivoted at point P by a ball-and-socket arrangement.

c. There is a carriage B which can be set at various points of the tracing arm with respect to the vernie of the index mark I.

d. The carriage consists of a measuring wheel W and a vernier V. The wheel is divided into 100 divisions and the vernier into 10 divisions. The wheel and the vernier measure readings upto three places of decimal (i.e. 0.125, 0.174 etc)

e. The wheel is gearted to a counting disc which is graduated into 10 divisions. For ten complete revolutions of the wheel, the disc shows a reading of one divisions.

Thus, the planimeter shows a reading of four digits (i.e. 1.125, 1.174, etc)

The counting disc shows - units.

The wheel shows - tenth and hundredth and the vernier shows - thousandth.

f. The planimeter rests on the tracing point. Anchor point and the periphery of the wheel.

3. **Bowditch's correction** – By this rule, the total error in latitude (departure) is distributed in proportion to the lengths of the traverse legs. This is the most common method of traverse adjustment.

(i) Correction to latitude of any side

$$= \frac{\text{Length of that side}}{\text{Perimeter of traverse}} \times \text{total error in latitude}$$

(ii) Correction to departure of any side

$$= \frac{\text{Length of that side}}{\text{Perimeter of traverse}} \times \text{total error in depature}$$

6.(a) What is meant by positive cumulative errors.

Ans. The errors which occur in the same direction and tend to accumulate or to add up, are called cumulative errors. Such an errormakes the apparent measurment either too long or too short. The error which make the measured length more than the actual, is known as positive cumulative error.

(b) types of chains and tapes.

Ans. The chain used in surveying are generally of the following types.

Gunter's chain - It is 66ft long & is divided into 100 links. Each link measures 0.66ft.

Engineer's chain - It is 100ft long & is divided into 100 links. Each link measures 1ft.

Metric chain - It is 20m or 30m long & is divided into 100 or 150 link respectively. Each link measures 20cm.

Tapes - Depending upon the material, tapes are classified as under :

cloth or liken tape
metalic tape
steel tape
Invar tape.

(c) What are the sources of error in chaining ? What precautions would you take to guard against them ?

Ans. Errors in chaining

Errors in chaining may be caused due to variation in temperatured and pull, defects in instruments. They may be either.

1. Compensating error – Errors which may occur in both directions and which finally tend to compensate are known as compensating errors. These errors do not affect survey work seriously. They are proportional to $\sqrt{L}$ where L is the length of the line such errors may be caused by
   - i. Incorrect holding of the chain.
   - ii. Horizontality and veritcally of steps not being properly maintained during the stepping operations.
   - iii. Fractional parts of the chain or tape, not being, uniform throughout its length
   - iv. Inaccurate measurements of right angles with chain and tape.
2. Cunculative errors – errors which may occur in th same direction and which finally tend to accurrreate are said to be cumulative. They seriously affect the accuracy of the work and are proportional to the length of the line. The errors may be positive or negative.

   Positive errors – When the measured length is moe than the actual lenght, the error is said to be position. Such errors occur due to
   - (i) The length of chain or tape being shorter than the standard length.
   - (ii) Slope correction not being applied.
   - (iii) Correction for sag not being made.
   - (iv) Measurement being taken with faulty alignment.
   - (v) Measurement bing taken in high winds with the tape in suspensions.

   Negative errors – When the measured length of the lineis less than the actual length, the error is said to be negative. These errors is said to be negative. These errors occurs when the length of the chain or tape is greater than the standard length due to the following reasons.
   - (i) The opening of ring joints.
   - (ii) The applied pull being much greater the standard pull.
   - (iii) The temperature during measurement being much higher than the standard temperature.
   - (iv) Wearing of connecting rings.
   - (v) Elongnation of the links due to heavy pull.
3. Mistake errors occuring due to the carelessness of the chainmean are called mistakes. The following are a few common on mistake.
   - (i) Displacement of arrows - Once an arrow is withdrawn from the ground durin g chaining. It may not be replaced in proper position, if required due to some reasons.
   - (ii) A full chain length may be amutted or added. This happens when arrows are lost or wronglycounted.
   - (iii) A reading may be taken from the wrong and of the chain. This happens when the tooth of the tallty is noted without observing the central tally.
   - (iv) The numbers may be read from the wrong direction, for instance a '6' may be read as '9'.
   - (v) Some numbers may be called wrongly fore example 50.2 may be called as fifty two without the decimal point being mentioned.
   - (vi) While making enteries in the field book, the figures may be interchanbged due to carelessness for intances 245 may be entered intead of 254.

Precautions against errors :

The following precautions should be taken to gurard against errors.

1. The point where the arrow is fixed on the ground should be marked with a cross.
2. The zero end of the chain or tape should be properly held.
3. During chaining by the followr and leaders should always tally with the total number of arrors taken.
4. While noting the measurement from the chain, the teeth of the tally should be varified with respect to the correct end.

5. The chainman should call the measurement loudly and distinctly and the surveryor should repeat them while booking.
6. Measurements should not be taken with the tape is suspension in high winds.
7. In stepping operations, horizontality and vertically should be properly maintaned.
8. Ranging should be done accurately.
9. No measurement should be taken with the chain in suspension.
10. Care should be taken so that the chain is properly extended.

7.(a) What is meant by index sketch in chain surveying.

Ans. The neat hand sketch of the area which is prepared during recommaisance survey is known as index sketch or key plan. The sketch shows the skeleton of the survey work, it indicates the main survey work. It indicates the main survey stations, Sub-stations, tie stations base line, arrangement for frame work of triangles and the approximate position of different objects.

(b) Mention the various errors and it's precautions taken in plane table surveying.

Ans. The various errors in plane table surveying are - (i) Instrumental error

(ii) errors of plotting.

(iii) Errors of manipulation & sighting.

(iv) Error due to in a clurate centerring.

The following precautions are to be taken in plane table surveying.

This surveying is n't done in rainy season.

This survey is alson't carried on moist weather.

It is only done in dry weather.

Due to simultaneously angular, linear measurement & plotting in the field. It should be done properly & consiously.

Setting instrument is done carefully.

Working operation i.e. fixing the plane table on tripod, setting up plare table sighting the ground stations intersected point should be done carefully & properly.

(c) The following offsets were taken at 15m intervals from a survey line to an irregular Boundary line :

1.85, 2.35, 4.20, 5.30, 6.80, 5.65, 4.85, 3.75, 2.65, 1.95.

Calculate the area enclosed between the survey line, the irregular boundary line and the first and last offsets by

i.the trapezoidal rule

ii.Simpson's rule.

Ans. Common distance = 15m.

By trapezoidal rule.

The area

$$A = \frac{d}{2}[\text{first offset} + \text{Last offset} + 2 \times \text{sum of remaining offsers}]$$

$$= \frac{15}{2}[1.85 + 1.95 + 2(2.35 + 4.2 + 5.3 + 6.8 + 5.65 + 4.85 + 3.75 + 2.65)]$$

$$= 651.75 m^2$$

By simpson's rule :

The area

$$A = \frac{d}{3}[h_1 + h_{10} + 2(h_3 + h_5 + h_7 + h_9) + 4(h_2 + h_4 + h_6 + h_8)]$$

$$= \frac{15}{3}[1.85 + 1.95 + 2 \times (4.20 + 6.8 + 4.85 + 2.65) + 4 \times (2.35 + 5.3 + 5.65 + 3.75)]$$

$$= 5\,(1.85 + 1.95 + 37 + 68.2)$$

$$= 545 m^2$$

MODEL – 4

[Code - CET - 303]

Full Marks – 70 **Time – 3 Hours**

*Answer any **five** questions.*

Figures in the right-hand margin indicate marks.

1.(a)What is fly levelling ? [2

(b) Describe briefly the source of error in levelling.[4

(c) Describe breiefly the temporary adjustment of level. [8

2. (a) What is an index sketch ? [2

(b) The following offsets were taken from a chain line to an irregular boundary line at an interval of 5m.

0, 2.6, 3.5, 4.5, 4.8, 3.5 m.

Compute the area between the chain line, the irregular boundary line and the end offsets by trapezoidal rule. [4

(c) Describe briefly the types of tapes. [8

3. (a) Define isogonic line. [2

(b) The length of a line measured on a slope of 20° was recorded as 600m. But it was found that the 20m chain was 005m too long. Calculate the true horizontal distance of the line. [4

(c) What are the advantage and disadvantages of compass surveying ? [8

4. (a) What is the fundamental difference between the prismatic compass and surveyor's compass. [2

(b) A steel tape 20 m long, standardised at 15 °C with a pull of 10 kg was used to measure distance along a slope of 4°25′. If the mean temperature during measurement was 10°C and the pull applied 16 kg, determine the correction required per tape length. Assume co–efficient of expansion = 112×10^{-7} per °C, cross- sectional area of tape = 0. 08 cm^2 and Young's Modulus $E = 2.1 \times 10^6$ kg / cm^2.[4

(c) The following fore bearing and back bearing were observed while traversing an area with a compass.

Line	FB	BB
PQ	44°30′	226°30′
QR	124°30′	303°15′
RS	181°0′ 1°0′	
SP	289°30′	108°45′

At what station do you suspect local attraction ? Find corrected bearing of lines and also calculate all the interior angles of the traverse. [8

5. (a) What are the methods of computation of an area ? [2

(b) Mention the various errors and its precautions taken in plane table surveying. [4

(c) State and explain with sketches the trapezoidal rule, Simpson's rule and ordinate rule. Whatare the limitations of Simpson's rule ? [8

6. (a) A lamp on the top of a lighthouse is visible just above the horizon at a certain station at the sea level. The distance of the top of the lightouse from the station of observation in 60 km. What is the height of the lamp above sea level ? [2

(b) A steel tape 30 m long standardised at 30 °C with a pull of 40 kg was used for measuring a base line. Find the correction per tape length if at the time of measurement the temperature was 52 °C and pull exerted 45 kg weight of steel per cubic centrimetre equals 7. 75 gm weight of tape 0.68 kg. $E = 2.11 \times 10^6$ kg / cm^2, $a = 12 \times 10^{-6}$ per °C.[4

(c) What is ranging ? Describe briefly for ranging across a high ground. [8

7. (a) Basing on the instruments used what are the different types of survey ? [2

(b) The magnetic bearing of a line AB is 125°25′. Find out its true bearing if magnetic declination at 'A' is

(i) 9° 35′ W

(ii) 5°30′ E [4

(c) A survey line BAC crosses a river. A and C being the near and opposite banks respectively A perpendicular AD 50 mt long is set at A. IF the bearing of AD and DC are 35° 45 and 280° 30° respectively. Find the width of the river. [8

ANSWERS TO MODEL - 4

1.(a) What is fly levelling ?

Ans. The operation of spirit levellin which is employed to determine the deviations of a number of points some distance apart to establish Bench Marks in the area regardless of the horizontal positions of the points, is called fly levelling.

(b) Describe briefly the source of error in levelling.

Ans. Sources of error in levelling.

1. Instrmental errors.

(i) The permanent adjustment of the instrument may not be prefect. That is the line of collimation may not be paralled to the axis of bubble tube.

(ii) The internal arrangement of the focussing tube is not perfect.

(iii) The graduations of the levelling staff may not be perfect.

2. Personal error.

(i) The instrument may not be levelled perfectly.

(ii) The focussing of the eyepiece and object glass may not be perfect and the parallex may not be eliminated entirely.

(iii) The position of the staff may be displaced at the change point at the time of taking FS and BS readings.

(iv) The staff may appear inverted when viewed through the telescope. By mistake, the staff readings may be taken upward intead of downward.

(v) The reading of the stadia hair rather than the central collimation hair may be taken by mistake.

(vi) A wrong entry may be made in the level book.

(vii) The staff may not be properly and faily extended.

ffect of high winds and a shining sun
esult in a wrong staff reading.

breiefly the temporary adjustment

porary adjustment of a level
tments which are made for every setting
called temporary adjustments these

on of suitable position – A suitable position
setting the level. From this position, it
sible to take the gratest number of
thout any difficulty. The ground should
nd fixed.

g level with tripod stand – The tripod
at the reequired position with its legs well
sed firmly into the ground. The level is
of the tripod stand acording to the fixing
ovided for that particular level. It should
that the level is not to be set up at any
e alignment.

roximate levelling by legs of tripod stand
rews are brought to the centre of their
the tripod stand are firmly fixed into the
e third leg is moved to the left or right, in
bble is approximately at the centre of its

fect levelling by foot screw as the
bble is on the top of the telescope, the
paralled to any pair of foot screws and
rought to the centre by turning the foot
either both inwards or both outwards.
s then turned through 90° and brought
ot screw and the bubble is brough to the
ning this footscrew clockwise or
The telescope is again brought to its
and bubble is brought to the centre. The
ted several times till the bubble remains
osition in the first as well as the second

ing the eyepiece – A piece of white paper
of the object glass and the eye-piece is
by turning it clockwise or anticlock are
airs can be seen celarly.

verify whether the graduations of the staff remains fixed relative to the cross hairs.

(vii) Taking the staff readings – The levelling of the instrument is verified by turning the telescope in any direction. When the bubbles remain in central position for any direction of the telescope the staff readings are taken.

2.(a) What is an index sketch ?

Ans. The neat hand sketch prepared during reconnaissance survey showing boundaries, main features, positions of chainlines and stations is called index sketch or key plan.

(b) The following offsets were taken from a chain line to an irregular boundary line at an interval of 5m.

0, 2.6, 3.5, 4.5, 4.8, 3.5 m.

Compute the area between the chain line, the irregular boundary line and the end offsets by trapezoidal rule.

Ans. Common distance = 5M

The area $A = \frac{d}{2}$

[First offset + Last offset + 2 × sum of remaining offsets]

$$A = \frac{5}{2}\left[0 + 3.5 + 2(2.6 + 3.5 + 4.5 + 4.8)\right]$$

$$= \frac{5}{2}\left[3.5 + 2 \times 15.4\right]$$

$$= \frac{5}{2}\left[3.5 + 30.8\right]$$

$$= 85.75 \text{ sqm.}$$

(c) Describe briefly the types of tapes.

Ans. Tapes are classified depending upon the material

(i) Cloth or Liner tapes – Liner tapes are closely to resist moisture. They are generally 10 meters to 30 meters in length and 12 MM to 15 MM in width. One end of the tape is provided with a ring whose length is

included in the total length of tape. Cloth tapes are generally used for measuring offset measurements due to the following reasons

1. It is easily affected by moisture and thus gets shrunk.
2. Its, length gets altered by stutching.
3. It is likely to tweist and tangle.
4. It is not strong as a chain or steel tape.
5. It is light and flexible and it does not remain straight in strong wind.

(ii) Metallic Tape – A liner tape reinforced with brass or copper wires to prevent is called a metallic tape. As the wires are inter woven and the tape is varnished, these wires are visible to naked eyes. These tapes are also available in different lengths but tapes of 20M and 30M lengths are more common. These are supplied in leather cases, with a winding device. Each nutre is divided into decinutere and each decinutres is further divided into centrinutre. A nuthallic tape can be used for measuring accurate distances but it is commonly used for taking offset distances in chain surveying.

(iii) Steel tape – Steel tapes are available with different accuracy of graduations. A steel tape of lowest degree of accuracy is generally superior to a metallic or cloth tape for linear measurements. Steel tapes which consist of a light strip of width 6 mm to 10 mm are accurately graduated. Steel tapes are available in different lengths but 15m, 30m steel tapes are usually used for survey meaurements. At the end of the tape, a brass ring is provided. The length of the metal ring is included in the length of the tape. It is wound in a leather metal case having a suitable winding device. As steel tapes are delicate they are generally not used in terrain with vegetations or rocky ground.

(iv) Invar Tape – Invar tapes are made of an alloy of nickel (36%) and steel (64%) having very low co-effocient of thermal expansion. These are 6MM wide and are available in length of 30m, 50m and 100m. Invar tapes are used mainly for high degree of precission required for base measurements.

Disadvantages of Inver tapes

1. These are more expansive, softer and get defoineed more easily than steel tapes
2. These develop creep with time.
3. Their coefficient of thermal expansion goes on charging.
4. More assistants are required to stretch and handle hem.
5. These need greater care to handle them to avoid bending and kinking.
6. They cannot be used for ordinary work.

3.(a) Define isogonic line.

Ans. Lines passing through points of equal declination are called isogonic lines.

(b) The length of a line measured on a slope of 20° was recorded as 600m. But it was found that the 20m chain was 005m too long. Calculate the true horizontal distance of the line.

Ans. Slope of AC

$\alpha = 20°$

$$\text{Correct slope distance} = \frac{L^1}{L} \times \text{Measured length}$$

L^1 = Incorrect length of chain = (20 + 0.05)M = 20.05M

L = Correct length of chain = 20M.

Correct slope distance

$$= \frac{20.05}{20} \times 600\text{M} = 601.5\text{M}$$

Correct horizonal distance

$= 601.5 \times \cos 20° = 565.23\text{M}.$

(c) What are the advantage and disadvantages of compass surveying ?

Ans. Advantage of compass surveying

1. It is recommended when a large area is to be surveyed.
2. It is applied to survey the course of a river or coast line.
3. It is not required to divide the area into a number of triangle.

Disadvantage of compass surveying

1. It is not applied to areas where local attraction is suspected due to the presence of magnitude substance due to the presence of magnitic substances like steel structures, iron are deposits, electric cables conveying currents and so on.

4.(a) What is the fundamental difference between the prismatic compass and surveyor's compass.

Ans. The graduations in prismatic compass are in WCB system having 0° at South, but the graduations in surveyor's compass are in QB system having 0° at North and South and 90° at East and West.

(b) A steel tape 20 m long, standardised at 15 °C with a pull of 10 kg was used to measure distance along a slope of 4°25′. If the mean temperature during measurement was 10°C and the pull applied 16 kg, determine the correction required per tape length. Assume co–efficient of expansion = 112×10^{-7} per °C, cross- sectional area of tape = 0. 08 cm^2 and Young's Modulus E = 2.1×10^6 kg / cm^2.

Ans. Given data :

$L = 20$ m, $A = 0.08\ cm^2$

$T_0 = 15°C$ $\alpha = 112 \times 10^{-7}$ per°C

$P_0 = 10$ kg $E = 2.1 \times 10^6$ kg/cm^2

$T_m = 10°C$ $P_m = 16$ kg

(i) Temperature correction, $C_t = \alpha(T_m - T_0)L$

$= 112 \times 10^{-7}(10 - 15) \times 20$

$= -0.00112$ M

(ii) Pull correction, $C_P = \dfrac{(P_m - P_0)L}{A \times E}$

$= \dfrac{(16-10)\times 20}{0.08 \times 2.1 \times 10^6} = 0.00071$ M

(iii) Slope correction, Ch = L(1 – cos θ)

$= 20(1 - \cos 4°25^{-1})$

$= 0.05940$ M

Total correction = –0.00112 + 0.00071

= –0.05940 = –0.05981

(c) The following fore bearing and back bearing were observed while traversing an area with a compass.

Line	FB	BB
PQ	44°30′	226°30′
QR	124°30′	303°15′
RS	181°0′	1°0′
SP	289°30′	108°45′

At what station do you suspect local attraction ? Find corrected bearing of lines and also calculate all the interior angles of the traverse.

Ans.

Line	F.B.	B.B.	Differene
AB	44°30′	226°30′	182°00′
BC	124°30′	303°15′	178°45′
CD	181°00′	1°00′	180°00′
DE	289°30′	108°45′	180°45′

It is found that the difference of FB and BB of line CD is exactly 180°. Therefore CD are free from local attraction.

Therefore FB and BB of line CD, FB of line DA and BB of line BC are correct.

Correct FB of line DA = 289°30′

∴ True BB of line DA = 289°30′ – 180°00′ = 109°30′

∴ Error at A = 108°45′ – 109°30′ = –00°45′

Correction at A = +45′

True BB of line AB = 45°15′ + 180°00′ = 225°15′

Error at B 226°30′ – 225°15′ = 1°15′

Correction at B = –1°15′

True FB of line BC = 124°30′ – 1°15′ = 123°15′

Line	Corrected FB	Corrected BB
AB	45°15′	225°15′
BC	123°15′	303°15′
CD	181°00′	1°00′
DE	289°30′	109°30′

5.(a) What are the methods of computation of an area ?

Ans. Methods of computation of an area

(i) Graphical Method

(ii) Instrumental Method

(b) Mention the various errors and its precautions taken in plane table surveying.

Ans. The various errors in plane table surveying are - (i) Instrumental error

(ii) errors of plotting.

(iii) Errors of manipulation & sighting.

(iv) Error due to in a clurate centerring.

The following precautions are to be taken in plane table surveying.

This surveying is n't done in rainy season.

This survey is alson't carried on moist weather.

It is only done in dry weather.

Due to simultaneously angular, linear measurement & plotting in the field. It should be done properly & consiously.

Setting instrument is done carefully.

Working operation i.e. fixing the plane table on tripod, setting up plare table sighting the ground stations intersected point should be done carefully & properly.

(c) State and explain with sketches the trapezoidal rule, Simpson's rule and ordinate rule. Whatare the limitations of Simpson's rule ?

Ans. Refer to 2012(W), Q. No. 5.(c)

6.(a) A lamp on the top of a lighthouse is visible just above the horizon at a certain station at the sea level. The distance of the top of the lightouse from the station of observation in 60 km. What is the height of the lamp above sea level ?

Ans. The lamp is visible above the horizon due to the combined effect of curvature and refraction.

We know that

$$h = 0.0673\ D^2$$
$$= 0.0673 \times (60)^2$$
$$= 242.28\ M$$

Hence height of Lamp is 242.28 m.

(b) A steel tape 30 m long standardised at 30 °C with a pull of 40 kg was used for measuring a base line. Find the correction per tape length if at the time of measurement the temperature was 52 °C and pull exerted 45 kg weight of steel per cubic centrimetre equals 7. 75 gm weight of tape 0.68 kg. E = 2.11×10^6 kg / cm², a = 12×10^{-6} per °C.

Ans. Let A = Area of cross-section of the tape in cm².

Then, $A \times 30 \times 100 \times 0.00775 = 0.68$

$$A = \frac{0.68}{3000 \times 0.00775} = 0.029$$

$$\text{Correction for pull} = \frac{(p - p_0)L}{AE}$$

$$= \frac{(45 - 40) \times 30}{0.029 \times 2.11 \times 10^6} = 0.0024$$

Correction for temperature $= \alpha\ (t - t_0)\ l$.

$= 12 \times 10^{-6} \times (52 - 30) \times 30 = 0.0079$

$\therefore$ Total correction per tape length

$= 0.0024 + 0.0079 = 0.0103$ cm.

(c) What is ranging ? Describe briefly for ranging across a high ground.

Ans. Refer to 2014(W), Q. No. 5.(b)

7.(a) Basing on the instruments used what are the different types of survey ?

Ans. Basing on the instruments used different types of survey are

1. Chain survey.
2. Compass survey
3. Plane table survey
4. Theodolite survey
5. TachEoMetric survey.
6. Photographic survey.

(b) The magnetic bearing of a line AB is 125°25′. Find out its true bearing if magnetic declination at 'A' is

(i) 9° 35′ W

(ii) 5°30′ E

Ans. Magnetic bearing of line AB = 125°25′.

(i) Declination of A = 9° 35′ W

bearing of line AB = MB – declination

125°25′ – 9° 35′ = 115°50′.

(ii) Declination at A is 5°30′ E.

$\therefore$ True bearing of line AB = MB – declination

= 125°25′ – 5° 30′ = 130°55′.

(c) A survey line BAC crosses a river. A and C being the near and opposite banks respectively A perpendicular AD 50 mt long is set at A. IF the bearing of AD and DC are 35° 45 and 280° 30° respectively. Find the width of the river.

Ans. Refer to 2012(W), Q. No. 7.(c)

PRACTICE SETS

SET – 1

[Code - CET - 303]

Full Marks – 70 **Time – 3 Hours**

*Answer any **five** questions.*

Figures in the right-hand margin indicate marks.

1. (a) What is the fundamental difference between the prismatic compass and surveyor's compass. [2

(b) A steel tape 20 m long, standardised at 15 °C with a pull of 10 kg was used to measure distance along a slope of 4°25′. If the mean temperature during measurement was 10°C and the pull applied 16 kg, determine the correction required per tape length. Assume co–efficient of expansion = 112×10^{-7} per °C, cross- sectional area of tape = 0. 08 cm^2 and Young's Modulus E = 2.1×10^6 kg / cm^2.[4

(c) The following fore bearing and back bearing were observed while traversing an area with a compass.

Line	FB	BB
PQ	44°30′	226°30′
QR	124°30′	303°15′
RS	181°0′ 1°0′	
SP	289°30′	108°45′

At what station do you suspect local attraction ? Find corrected bearing of lines and also calculate all the interior angles of the traverse. [8

2. (a) What are the methods of computation of an area ? [2

(b) Mention the various errors and its precautions taken in plane table surveying. [4

(c) State and explain with sketches the trapezoidal rule, Simpson's rule and ordinate rule. Whatare the limitations of Simpson's rule ? [8

3. (a) A lamp on the top of a lighthouse is visible just above the horizon at a certain station at the sea level. The distance of the top of the lightouse from the station of observation in 60 km. What is the height of the lamp above sea level ? [2

(b) A steel tape 30 m long standardised at 30 °C with a pull of 40 kg was used for measuring a base line. Find the correction per tape length if at the time of measurement the temperature was 52 °C and pull exerted 45 kg weight of steel per cubic centrimetre equals 7. 75 gm weight of tape 0.68 kg. E = 2.11×10^6 kg / cm^2, a = 12×10^{-6} per °C.[4

(c) What is ranging ? Describe briefly for ranging across a high ground. [8

4. (a) Basing on the instruments used what are the different types of survey ? [2

(b) The magnetic bearing of a line AB is 125°25′. Find out its true bearing if magnetic declination at 'A' is

(i) 9° 35′ W

(ii) 5°30′ E [4

(c) A survey line BAC crosses a river. A and C being the near and opposite banks respectively A perpendicular AD 50 mt long is set at A. IF the bearing of AD and DC are 35° 45 and 280° 30° respectively. Find the width of the river. [8

5. (a) What is fly levelling ? [2

(b) Describe briefly the source of error in levelling.[4

(c) Describe breiefly the temporary adjustment of level. [8

6. (a) What is an index sketch ? [2

(b) The following offsets were taken from a chain line to an irregular boundary line at an interval of 5m.

0, 2.6, 3.5, 4.5, 4.8, 3.5 m.

Compute the area between the chain line, the irregular boundary line and the end offsets by trapezoidal rule. [4

(c) Describe briefly the types of tapes. [8

7. (a) Define isogonic line. [2

(b) The length of a line measured on a slope of 20° was recorded as 600m. But it was found that the 20m chain was 005m too long. Calculate the true horizontal distance of the line. [4

(c) What are the advantage and disadvantages of compass surveying ? [8

SET – 2

[Code - CET - 303]

Full Marks – 70 **Time – 3 Hours**

*Answer any **five** questions.*

Figures in the right-hand margin indicate marks.

1. (a) The bearing of a survey line is 220°. State the system of bearing and convert it into the other system. [2

(b) The magnetic bearing of a line AB is 125° 30′. Find out its turre bearing if magnetic declination at A is (i) 9° 30′ W (ii) 5° 30′E. [4

(c) The following bearing were observed in a closed traverse ABCDA. Find the stations affected by local attraction. Calculate the corrected bearings. [8

Line	F.B.B.B.
AB	124° 30′	304° 30′
BC	68° 15′	246° 00′
CD	310° 30′	135° 15′
DA	200° 15′	17° 45′

2. (a) What is closing error ? Show with diagram. [2

(b) A steel tape 20 m long, standardised at 15° C with a pull of 10 kg was used to measure distance along a slope of 4°. If the mean temperature during measurement was 25° C and the pull applied 16 kg, determine the correction required per tape length. Assume co-efficient of expansion 112×10^{-7} per °C, cross-sectional area of tape = 0.08 cm^2 and Young's modulus E = 2.1×10^6 kg/cm^2. [4

(c) Describe the procedure of setting up plane table over a station. [8

3. (a) Define well conditioned and ill conditioned triangles in surveying. [2

(b) Explain with a neat sketch the operating principle of a line ranger. [4

(c) Draw the neat sketch of a prismatic compass showing the following parts and briefly explain their functions :

(i) Magnetic needle

(ii) Pivot

(iii) Brake pin.

(iv) Agate cap. [8

4. (a) Write down the formula for correction for pull. [2

(b) The back sight reading on a levelling staff held vertically on a bench mark having R.L. 500 m is 1.585 m and the foresight on the staff held vertically inverted against a beam soffit is 2.415 m. What is the R.L. of the beam soffit ? [4

(c) The distance between two points measured by a 20m chain was recorded as 720 m. It was afterwards fround that the chain used was 4 cm tooling. Find out the true distance between the points. [8

5. (a) Define isogonic line. [2

(b) Draw the conventional signs for footpath, pipeline, Railway over road, Swamp, power line. [4

(c) The following perpendicular offsets were taken at 10 m intervals from a chain line to an irregular boundary line.

3.10 4.20 5.35, 6.45, 7.15, 8.25, 7.95 and 5.20 m.

Find the area by (i) trapezoidal rule (ii) Simpson's rule. [8

6. (a) Name the different types of chains used in surveying. [2

(b) Draw a comparision between chain surveying and compass surveying. [4

(c) A line CAB crosses a river A and B are on near and distant banks of the river respectively. Perpendiculars AD and CE are 30.5 m and 50.5 m respectively, such that B, D and E are in astaight line. If the chainage of C and A are 505.5m, calculate the chainage of B. [8

7. (a) Draw the symbol of [2

1. a pucca wall
2. Road culvert
3. Electric culvert
4. School Building.

(b) Explain principle of plane table surveying. [4

(c) A line measured on a rising gradient of 1 in 12 was found to be 500m. It was found later than the 30m chain was 5cm too long. Find correct horizontal length of the line. [8

SET – 3

[Code - CET - 303]

Full Marks – 70 **Time – 3 Hours**

*Answer any **five** questions.*

Figures in the right-hand margin indicate marks.

1. (a) How many minimum no. of ranging rods are required for ranging a line both in direct ranging and indirect ranging ? [2

(b) The following readings are successively taken with a level.

0.355, 0.485, 0.625, 1.755, 1.895, 2.350, 1.780, 0.345, 0.685, 1.230 and 2.150.

The instrument was shifted after the fourth and seventh readings. Prepare a level book and calculate the RLS of different points. The RL of the first point is 254.0 m. [4

(c) What are the different methods of contouring ?

Describe any method along with sketch. [8

2. (a) Give the formula for calculation of area by Simpson's rule and trapeoidal rule. [2

(b) What is meant by folding and unfolding of chain ? [4

(c) To measure a base line, a steel tape 30 m long standardised at 15°C with a pull of 15 kg was used. Find the correction per tape length, if the temperature at the time of measurement was 20°C and the pull exerted was 20 kg. Weight of 1 cubic cm of steel is 7.86 gm, wt. of the tape = 0.8 kg. $E = 2.1 \times 10^6$ kg/cm^2 co-efficient of expansion of the tape per 1°C = 7.1×10^{-7}. [8

3. (a) Draw the conventional symbols of metalled road and wire fencing. [2

(b) Briefly explain the operating principle of a line ranger. [4

(c) A series of offsets were taken at 4m. intervals in the following order from a chain line to a curved hedge.

0, 2.26, 1.62, 2.80, 2.04, 2.22, 2.46, 0 m

Calculate the area enclosed between the chain line, the hedge by Simpson's Rule. [8

4. (a) Basing on the instruments used what are the different types of survey ? [2

(b) Explain Bowditch rule. [4

(c) Fore bearing of lines AB, CD, PQ are 119°48′ S 12°24′E and N86°12′W respectively. Find out their back bearings in their respective system of bearings and convert them into the other system. [8

5. (a) Define Reduced Bearing. What is the RB of 345° – 35° ? [2

(b) Ranging of a line [4

(c) Explain the method of continuing a chain line facing the following obstacles.

(i) A tall building.

(ii) A River. [8

6. (a) The magnetic bearing of a line is 48°30′. Calculate the true bearing if magnetic declination is 5°35′ East. [2

(b) To measure a base line, a steel tape 30m long standardised at 15°C with a pull of 15 kg was used. Find the correction per tape length, if the temperature at the time of measurement awas 20°C and the pull exerted was 20 kg. Weight of 1 cubic cm of steel is 7.86 gm., wt. of the tape = 0.8 kg, E $= 2.1 \times 10^6$ kg/cm^2. Coefficient of expansion of the tape per 1°C $= 7.1 \times 10^{-7}$. [4

(c) Explain the method of continuing a chain line facing the following obstacles :

(i) A residential building.

(ii) A pond. [8

7. (a) What are the different types of instrumental errors one would come across in surveying ? [2

(b) The fore bearings of the lines AB, BC, CD and DE are 45°20′, 120°30′, 200°30′ and 280°30′ respectively. Find angles ∠B, ∠C and ∠D. [4

(c) The following fore and back bearings were taken in running a compass traverse. Correct the bearings for local attraction.

Line	F.B.	B.B.
AB	44°30′	226°30′
BC	124°30′	303°15′
CD	181°00′	1°00′
DE	289°30′	108°45′ [8

SET – 4

[Code - CET - 303]

Full Marks – 70 **Time – 3 Hours**

*Answer any **five** questions.*

Figures in the right-hand margin indicate marks.

1. (a) Define Horizonatal equivalent. [2

(b) Write the procedural steps in plane tabling. [4

(c) Explain the different steps in the method and traversing in plane table survey. [8

2. (a) State the least count of Gunter's chain. [2

(b) Explain the method using a planimeter. [4

(c) The following offsets were taken from a chain line to a hedge : [8

Distance in metre	0	10	20	30	40	60	80	100	120	140	160
Offset in metre	0	2	2.5	2.2	3	3.4	2.8	2.6	3.2	2.9	2.7

Calculate the area enclosed between the chain line and hedge by Simpson's rule.

3. (a) Define III conditioned triangle. [2

(b) Steel bands [4

(c) Bowditch's rule [8

4. (a) Draw the conventional symbols of metalled road and wire fencing. [2

(b) What are the obstables of chaining ? [4

(c) What is two point and three point problems ? Explain with neat sketches and procedures of solving above problems. [8

5. (a) Draw frrband sketches for the following conventional signs used in surveying.

Temple, Building, Orchard, Level crossing, Chainline. [2

(b) The length of asurvey line measured with a 30 m chain was found to be 315.4 m . Afterwards it was found that the chain was 5 cm too long. What is the correct length of the line ? [4

(c) The back sight reading on a levelling staff held vertically on a bench mark having R.L. 500 m is 1.585 m and the foresight on the staff held vertically inverted against a beam soffit is 2.415 m. What is the R.L. of the beam soffit ? [8

6.(a) What is the difference between the line of collimation and the axis of the telescope ? [2

(b) Explain Bowditch rule. [4

(c) Reciprocal levelling was done to determine the difference in level between two points A and B on the opposite banks of a river. The following readings were taken

Position of level	Staff reading	
	A	B
level near A	2.570	2.170
level near B	2.360	1.410

If R.L. of B is 300.250 m what is the R.L of A ?[8

7.(a) What is a contour line ?

(b) A series of offsets were taken from a chain line to a curved doundary line at an interval of 8 m in the following order

0.2.85, 3.20, 4.10, 2.20, 0. Calculate the area between the chain line and the curved boundary line using Simpson's rule.

(c) Draw the beat sketch of a prismatic compass and show in it the following parts.

Pivot, box, sightvane, magnetic needle, glass top and graduated arc.