B. Tech.
(SEM. III) ODD SEMESTER THEORY EXAMINATION, 2016-17
SURVEYING

Time : 3 Hours   Total Marks : 100

Section-A

Attempt all parts. Each part carries equal marks :   (10 × 2 = 20)

1. Correction due to refraction is given by :
   a. $0.0112 D^2$ b. $0.0673 D^2$
   c. $0.785 D^2$ d. $0.0012 D^2$

   Ans. Refer Q. 3.22, 2 Marks Questions, Page SQ–10B, Unit-3.

2. What do you mean by working from whole to part ?

   Ans. Refer Q. 1.8, 2 Marks Questions, Page SQ–2B, Unit-1.

3. What is levelling and why it is important in survey work ?

   Ans. Refer Q. 3.23, 2 Marks Questions, Page SQ–10B, Unit-3.

4. Write relationship between level line and horizontal line.

   Ans. Refer Q. 2.16, 2 Marks Questions, Page SQ–5B, Unit-2.

5. For an open traverse, which is correct
   a. Σ latitude = 0   b. Σ departure = 0
   c. Both (a) and (b)   d. None of the above

   Ans. Refer Q. 4.13, 2 Marks Questions, Page SQ–14B, Unit-2.

6. What is magnetic declination ?

   Ans. Refer Q. 2.14, 2 Marks Questions, Page SQ–5B, Unit-2.

7. What is the basic importance of provision of curves in highway ?

   Ans. Refer Q. 5.9, 2 Marks Questions, Page SQ–16B, Unit-5.

8. Explain the elements of simple curve, with neat sketch.

   Ans. Refer Q. 5.8, 2 Marks Questions, Page SQ–16B, Unit-5.

9. What is triangulation ?

   Ans. Refer Q. 4.14, 2 Marks Questions, Page SQ–14B, Unit-4.

10. What is resection ?

    Ans. Resection is a method of orientation employed when the table occupies a station whose position is not yet available on drawing sheet.

Section-B

Attempt any three questions :   (3 × 10 = 30)

1. The distance measured between two points on a sloping ground is 450 m. Find the correction to be applied and horizontal distance if :
   a. The angle of slope is 10°.
   b. The slope is 1 in 5.
   c. The difference in elevation between two point is 45 m.

   Ans. Refer Q. 2.10, Page 2–11B, Unit-2.

2. A closed traverse has the following lengths and bearings :

Line	Length (m)	Bearing
AB	200.0	ROUGHLY EAST
BC	98.0	178°
CD	NOT REQUIRED	270°
DA	86.4	1°

   The length CD could not be measured due to some obstruction to chaining. The bearing of AB could not be taken, as station A is badly affected by local attraction, find the exact bearing of the side AB and calculate length C.

   Ans. Refer Q. 4.8, Page 4–14B, Unit-4.

3. Explain the two point problem of plane tabling with a neat sketch.

   Ans. Resection after Orientation by Two Points :
   The two-point problem consists of locating the position of a plane table station on the drawing sheet by observation of two well-defined points, whose positions have already been plotted on plan.
   Procedure :
   i. Let A and B be the two stations plotted as a and b on the drawing sheet Fig. 1. It is required to plot station C, where the plane tabling is to be done.
   ii. Choose an arbitrary station D such that CD is approximately parallel to AB. ∠CAD and ∠CBD should not be very acute, which is the necessary condition for good intersection of points.
   iii. Set up the plane table at D. Orient it approximately by eye judgment such that ab is parallel to AB. Clamp the table.
   iv. Pivot the alidade against a, sight A, and draw a back ray. Pivot the alidade against b, sight B, and draw a back ray. The two rays intersect at d_1.
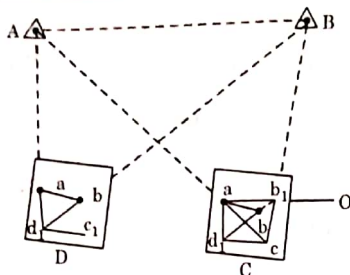
Fig. 1.

v. This will not be the correct position of D as the orientation at D is not exact.

vi. Pivot the alidade against d_1 and sight C. Draw a ray d_1C and fix the position of C_1 by estimation.

vii. Shift the table to station C. Set up the table and orient it by back sighting at station D.

viii. Pivot alidade against a, sight A and draw a back ray resecting the line d_1c_1 in c.

ix. Pivot the alidade at c and sight B. Draw a ray to B. If the ray passes through the plotted point b, the orientation of the table is correct and c is the correct position of C. Whereas, if this ray cuts the previously plotted line d_1b at some other point, say b_1, then the position c is not the correct position of C.

x. To eliminate this error the table must be rotated by the $\angle b_1ab$. To do this a ranging rod O is fixed, in line with ab_1 far away from the plane table. The alidade is kept along ab_1 and O is bisected.

xi. The alidade is kept along ab and the table is rotated till the ranging rod at O is bisected. It is oriented now. The table is then clamped.

xii. With alidade touching a sight A and draw a back ray to C. Then, with alidade touching b, sight B and draw a back ray to C. The resection of these two rays gives the position of C.

4. **A road 8 m wide is to deflect through an angle of 60° with the centre line radius of 300 m, the chainage of intersection points being 3605.0 m. A transition curve is to be used at each end of circular curve of such a length that rate of gain of radial acceleration is 0.5 m/sec³. When speed is 50 kmph. Find out :**
a. **Length of transition curve.**
b. **Superelevation.**
c. **Chainage of all junction points.**
Ans. Refer Q. 5.23, Page 5–32B, Unit-5.

5. **A 80 m long steel tape is supported at the ends. Find the normal tension for the tape with the following details :**

Cross section of the tape = 4 mm², unit weight of the tape material = 78600 N/m³, $E = 2 \times 10^{11}$ N/m², the pull at which the tape is standardized is 100 N.
Ans. Refer Q. 2.6, Page 2–8B, Unit-2

Section-C

Attempt any five questions : $(5 \times 10 = 50)$

1. **Explain curvature and refraction correction in levelling. The eye of an observer is 7.5 m above sea level and he was able to see a light house 50 m high just above the horizontal. Find the distance between observer and lighthouse.**
Ans. **Curvature and Refraction Correction :** Refer Q. 3.15, Page 3–18B, Unit-3.
Numerical : Refer Q. 3.18, Page 3–21B, Unit-3.

2. **Define a contour. Discuss the method of contouring. What are the various method of interpolating contour? State the stability of each one of them.**
Ans. **Contour :** Refer Q. 3.21, Page 3–23B, Unit-3.
Method of Interpolating Contour and Stability : Refer Q. 3.22, Page 3–24B, Unit-3.

3. **What are the different check in closed traverse and open traverse ?**
Ans. Refer Q. 4.3, Page 4–6B, Unit-4.

4. **State the three point problem, explain how it is solved by the graphical method ?**
Ans. **Three Point Problem :** Refer Q. 6(b), Page SP-9B, Solved Paper 2013-14.
Procedure :

1. Set the table at S, keep the alidade along ba, unclamp and rotate the table to sight A clamp the table. Centre the alidade about b and sight C. Draw ray xy through b sighting C.
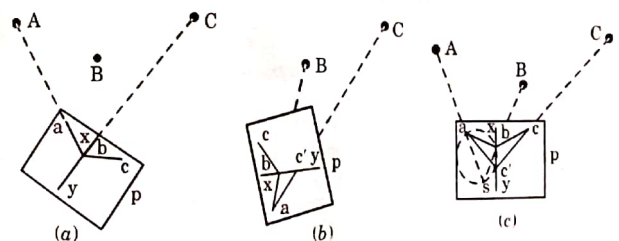

Fig. 2. Three point problem-Bessel's method.

2. Keep the alidade along ab. Unclamp the table and rotate till B is bisected. Clamp the table, centre the alidade about a and sight c. Draw ray ac' cutting ray xy in c'.

3. Keep the alidade along $c'c$. Unclamp the table and rotate till C is bisected. Clamp the table. The table is correctly oriented.

4. Centering the alidade about b sight B and draw back ray bB to intersect cc' in s. Now centre the alidade about a sight A and draw back ray which should pass through s, if the work is correct.

5. **What are the essential requirements of a transition curve ? Derive an expression for an ideal transition curve.**

Ans. Requirements of Transition Curve : Refer Q. 5.14, Page 5–20B, Unit-5.
Expression : Refer Q. 5.16, Page 5–24B, Unit-5.

6. **The apex distance of a 3° circular curve is 82.45 m. Determine the deflection angle, tangent length and length of long chord.**

Ans. Refer Q. 5.10, Page 5–15B, Unit-5.

7. **Explain the indirect method of contouring. What are the advantages and disadvantages of these method ?**

Ans. Indirect Method : Refer Q. 3.22, Page 3–24B, Unit-3.
Advantages and Disadvantages of Indirect Method : Refer Q. 3.24, Page 3–27B, Unit-3.

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SP–23 B (CE-Sem-3)

B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION, 2017-18
SURVEYING

Time : 3 Hours   Max. Marks : 70

Note : Attempt **all** sections. If required any missing data; then choose suitably.

SECTION – A

1. Attempt **all** questions in brief.   (2 × 7 = 14)

a. **What are the initial and final sub-cords ?**

Ans. When the chainage of the first tangent point of a curve is an odd figure, then some length is provided to make this chainage a round figure. The length provided is known as the initial sub-chord. After the initial sub-chord, a number of full chords (20 m or 30 m) are provided. At the end of the curve, fractional length may be required to reach the second tangent point. This length is known as the final sub-chord.

b. **What is a 12 cm compass ?**

Ans. The size of a compass is designated by its diameter. Therefore, a 12 cm compass is a compass of diameter 12 cm.

c. **In a map, it is found that two consecutive contours cross each other. What would you comment.**

Ans. In general, contour lines cannot cross each other, except in the case of an overhanging cliff. Therefore, the area represented in the map includes an overhanging cliff. But the contour line should be dotted line at the point of crossing to indicate that one location is below the other.

d. **How is a chain folded and unfolded ?**

Ans. **Chain Folding Process :** In order to fold the chain, a chainman moves forward by pulling the chain at the middle so that two halves come side by side. Then he places the pair of links on his left hand with his right hand until the two brass handles appear at the top.
Chain Unfolding Process : To unfold the chain, a chainman holds the two brass handles in his left hand and throws the bunch with his right hand. Then one chainman stands at a station holding one handle and another chainman moves forward by holding the other handle.

e.   What do you mean by normal tension ?

Ans. The tension at which the effect of pull is neutralised by the effect of sag is known as normal tension. At this tension, the elongation due to pull is balanced by the shortening due to sag.

$$(P_n - P_0)P_n^2 = \frac{W^2 AE}{24}$$

where, P_n = Normal pull or tension.

f.   What is index sketch ?

Ans. During reconnaissance survey, a neat hand sketch is prepared showing the framework of the survey. This sketch is known as the index sketch.

g.   What is an azimuth ?

Ans. The true bearing of a line is also known as its azimuth.

SECTION-B

2.   Attempt any **three** of the following :   **(7 × 3 = 21)**

a.   Classify surveying on the basis of instruments used and name all equipments necessary for the field work involving any one of them.

Ans. Refer Q. 1.4, Page 1–4B, Unit-1.

b.   Explain how details can be surveyed by offset from survey lines. Discuss the relative merits of different types of offsets. Why are short offsets preferred to long ones ?

Ans.

1.   Perpendicular Offsets :
i.   When the lateral measurements are taken perpendicular to the chain line, they are known as perpendicular offsets, as shown in Fig. 1.
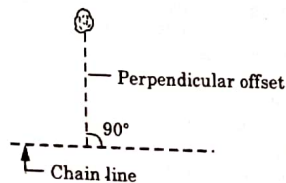

Fig. 1.

ii.   Perpendicular offsets may be taken in the following ways :
a.   By setting a perpendicular by swinging a tape from the object to the chain line. The point of minimum reading on the tape will be the base of the perpendicular, as shown in Fig. 2.
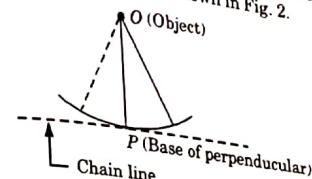

Fig. 2.

b.   By setting a right angle in the ratio 3:4:5, as shown in Fig. 3.

c.   By setting a right angle with the help of builder's square or tri-square, as shown in Fig. 4.

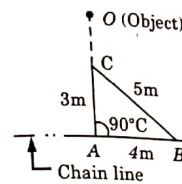d.   By setting a right angle by cross-staff or optical square.
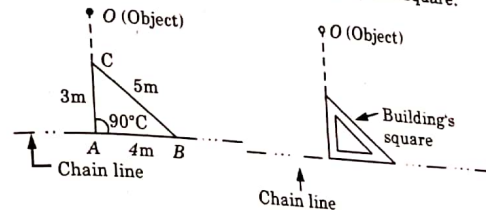

Fig. 3.   **Fig. 4.**

2.   Oblique Offsets :

i.   Any offset not perpendicular to the chain line is said to be oblique.

i..   Oblique offsets are taken when the objects are at a long distance from the chain line or when it is not possible to set up a right angle due to some difficulties.

iii.   Such offsets are taken in the following manner :

a.   Suppose AB is a chain line and p is the corner of a building.

b.   Two points 'a' and 'b' are taken on the chain line.

c.   The chainages of 'a' and 'b' are noted.

d.   The distances 'ap' and 'bp' are measured and noted in the field book.

e.   Then 'ap' and 'bp' are the oblique offsets, as shown in Fig. 5.

f. When the triangle *adp* is plotted, the apex point *p* will represent the position of the corner of the building.
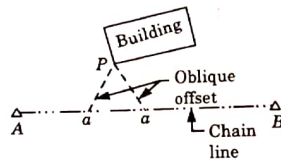

Fig. 5.

Relative Merits : Perpendicular offsets are preferred for the following reasons :

1. They can be taken very quickly.
2. The progress of survey is not hampered.
3. The entry in the field book becomes easy.
4. The plotting of the offsets also becomes easy.

Reasons for Choose Short Offset :

1. The offsets should as far as possible be short ones as they are less liable to be erroneous due to incorrect length of tape or incorrect direction than if they are long.
2. Short offsets can be measured more quickly and accurately than long ones.
3. Tie lines should be drawn to avoid long offsets.

c. The staff readings for a survey work were as follows :
1.810, 2.110, 1.225, 1.455, 0.905, 2.435, 2.810, 2.675 and 1.765.

The level was shifted after the 4th and 7th readings. The first reading was taken on a bench mark of RL 50.000 rule out a page of level book and enter the readings :

i. work out the RLs of all stations.

ii. If the staff were held invert and readings on a ceiling from last instrument position was 3.500, Find the RL of the ceiling.

iii. Work out the staff readings on the top of 4 pegs at 20 m intervals from the last station to give an upgrade of 1 in 100.

Ans.

Given : RL of bench mark = 50
Staff shifted after 4th and 7th readings, Inverted reading = 3.5 m
Pegs interval = 20 m, Gradient = 1 in 100
To Find : RL of all stations, ceiling and staff reading at pegs.

1. The reduced levels of the points are calculated by rise and fall method and tabulated and table 1.

Table 1.

Station	Readings			Rise	Fall	RL	Remark
	BS	IS	FS				
1	1.810					50.000	BM
2		2.110			0.300	49.700	
3		1.225		0.885		50.585	
4	0.905		1.455		0.230	50.355	CP1
5		2.435			1.53	48.825	
6	2.675		2.810		0.375	48.450	CP2
7			1.765	0.91		49.36	End point
Σ	5.39		6.03	1.795	2.435		

2. **Arithmetic check :**

ΣBS – ΣFS	= ΣRise – ΣFall	= Last RL – First RL
= 5.39 – 6.03	= 1.795 – 2.435	= 49.36 – 50.00
= – 0.64	= – 0.64	= – 0.64

3. RL of floor = 49.36

Staff reading on floor = 1.765

Inverted staff reading = 3.500

Height of ceiling above floor = 1.765 + 3.5 = 5.265

RL of ceiling = 49.36 + 5.265 = 54.625 m

4. The first peg is at end point with staff reading 1.765, the staff reading of the subsequent pegs at 20 m interval will depend upon the rising gradient which is 1 in 100

5. Difference in level between two consecutive readings = Distance/gradient = 20/100 = 0.2 m.

The ground is rising by 0.2 m between the consecutive pegs.

6. Subsequent staff readings at pegs will be :

Peg 1 = 1.765

Peg 2 = 1.765 – 0.2 = 1.565 m

Peg 3 = 1.565 – 0.2 = 1.365 m

Peg 4 = 1.365 – 0.2 = 1.165 m

d. What is Shift ? Prove that a transition curve bisects the shift and that the shift bisects the transition curve.

Ans. **Shift :** When a transition curve is introduced in circular curve, then the circular curve is found to be shifted by some distance towards the centre. This distance is known as the shift of the curve.

Proof : Refer Q. 5.15, Page 5–21B, Unit-5.

e. Why is a curve provided ? Derive an expression for an ideal transition curve.

Ans. **Necessity :** Refer Q. 5.1, Page 5–2B, Unit-5.

Derivation : Refer Q. 5.16, Page 5–24B, Unit-5.

SECTION-C

3. Attempt any **one** part of the following :   **(7 × 1 = 10)**

a. A steel tape was exactly 30 m long at 20°C when supported throughout its length under a pull of 10 kg. A line measured with this tape under a pull of 15 kg and at a mean temperature of 32°C and found to be 780 m long. Cross-section area of the tape = 0.03 cm², and its total weight = 0.693 kg. α for steel = 11 × 10⁻⁶ per°C and E for the steel = 2.1 × 10⁶ kg/cm².

Ans. Refer Q. 2.7, Page 2–9B, Unit-2.

b. What are the sources of error in chaining ? What precautions would you take to guard against them ?

Ans. **Sources of Error :** Refer Q. 1.10, Page 1–10B, Unit-1.

Precautions : The following precautions should be taken to guard against errors and mistakes.

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, the number of arrows carried by the follower and leader should always tally with the total numbers of arrows taken.

4. While noting the measurement from the chain, the teeth of the tally should be verified with respect to the correct end.

5. The chainman should call the measurement loudly and distinctly and the surveyor should repeat them while booking.

6. Measurement should not be taken with the tape in suspension in high winds.

7. In stepping operations, horizontally and verticality should be properly maintained,

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.

4. Attempt any **one** part of the following :

a. The following are the observed fore and back bearings of lines of a closed traverse. Correct them where necessary for local attraction.   **(7 × 1 = 7)**

Line	FB	BB
AB	292° 15′	11°45′
BC	221°45′	41°45′
CD	90°05′	270°00′
DE	80°35′	261°40′
EA	37°00′	216°30′

Ans.

1. On examining, it is found that fore and back bearings of line BC differ exactly by 180°. Stations B and C are therefore, free from local attraction. Consequently, bearing taken at B and C are correct.

2. **Correction in Bearing :**

$\therefore$ Fore and back bearings of BC are correct.

Also FB of CD = 90° 05′ (correct)

Add = 180° 00′

Correct BB of CD = 270° 05′

But observed BB of CD = 270° 00′

difference = 0° 05′ = error at D.

As the observed back bearing of CD is less than the corrected one, therefore, the error at D is –ve and the correction is +ve.

Observed FB of DE = 80° 35′

Correction at D = 0° 05′

∴ Corrected FB of *DE*   = 80° 40′
Add   = 180° 00′
Correct BB of *DE*   = 260° 40′
But observed BB of *DE*   = 261° 40′
difference   = 1° 00′ = error at *E*.
This error is +ve, therefore, correction at *E* must be – ve.

Observed FB of *EA*   = 37° 00′
Correction at *E*   = – 1° 00′
∴ Corrected FB of *EA*   = 36° 00′
Add   180° 00′
Corrected BB   = 216° 00′
But observed BB of *EA*   = 216° 30′
difference   = 0° 30′ = the error at *A*.
This error is +ve, therefore, the correction will be – ve.

Observed FB of *AB*   = 292° 15′
Correction at *A*   = – 0° 30′
∴ Correct FB of *AB*   = 291° 45′
Check : Subtract   180° 00′
correct BB of *AB*   = 111° 45′, which agrees to the given BB of *AB* observed at the station *B*, which is free from local attraction.

3. **Corrected Bearings :**

The result may be tabulated as shown below :

Line	Observed		Correction	Corrected		Remarks
	FB	BB		FB	BB	
AB	292°15′	111°45′	– 30′ at A	291°45′	111°45′	Station A, D and E are affected by local attraction
BC	221°45′	41°45′	0 at B	221°45′	41°45′	
CD	90°05′	270°00′	0 at C	90°05′	270°05′	
DE	80°35′	261°40′	+ 5′ at D	80°40′	260°40′	
EA	37°00′	216°30′	– 1° at E	36°00′	216°00′	

b. **What do you understand by balancing the traverse ? Describe any three methods of adjusting traverse.**

Ans. Refer Q. 4.4, Page 4–7B, Unit-4.

5. Attempt any **one** part of the following :   (7 × 1 = 7)
a. **What is orientation ? What are the methods of orientation ? Describe the methods with sketch.**
Ans. **Orientation :** Refer Q. 4.(e), Page, SP–3B, Solved paper 2012-13
Method : Refer Q. 4, Page, SP–15B, Solved paper 2015-16.
b. **What do you mean by contour ? Describe the characteristics of contour. State the uses of contour map and contours.**
Ans. **Contour and its Uses :** Refer Q. 3.21 Page 3–23B, Unit-3.
Characteristics : Refer Q. 3.23 Page 3–25B, Unit-3.

6. Attempt any **one** part of the following :   (7 × 1 = 10)
a. **What does the term 'sensitiveness' mean in the context of a bubble ? How the sensitiveness of a bubble is determined ?**
Ans. **Sensitiveness of the Bubble :**

1. The term sensitiveness in the context of a bubble means the effect caused by the deviation of the bubble per division of the graduation of the bubble tube.

2. Sensitiveness is expressed in terms of the radius of curvature of the upper surface of the tube or by an angle through which the axis is tilted for the deflection of one division of the graduation.

   Determining Sensitiveness :

1. Consider Fig. 6. Suppose the level was set up at *O* at a distance *D* from the staff at *P*.

2. The staff reading is taken with the bubble at the extreme right end (*i.e.*, at *E*). Say it is *PA*.

3. Another staff reading is taken with the bubble at the extreme left end (*i.e.*, at *E*$_1$). Let it be *PB*.
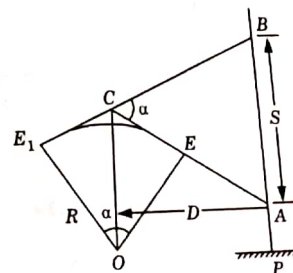

Fig. 6.

4. Let
D = Distance between the level and staff,
S = Intercept between the upper and lower sights,
n = Number of divisions through which the bubble is deflected,
R = Radius of curvature of the tube,
α = Angle subtended by arc EE_1, and
d = Length of one division of the graduation, expressed in the same units as D and S.

5. Movement of centre of bubble = $EE_1 = nd$.

6. Triangle OEE_1 and ACB are similar.
Here $R\alpha$ = arc EE_1

$$\alpha = \frac{EE_1}{R} = \frac{nd}{R} \qquad \qquad ...(1)$$

(as arc EE_1 = chord EE_1)

7. Again $\dfrac{EE_1}{R} = \dfrac{S}{D}$ (height of $\triangle OEE_1$ may be considered as R)

$$\frac{nd}{R} = \frac{S}{D} \qquad \qquad ...(2)$$

8. From eq. (1) and (2), we get

$$\alpha = \frac{nd}{R} = \frac{S}{D} \qquad \qquad ...(3)$$

$$R = \frac{nd \times D}{S}$$

9. Let α' = Angular value for one division in radians.

$$\alpha' = \frac{\alpha}{n} = \frac{S}{D} \times \frac{1}{n} \text{ radians}$$

or $\alpha' = \dfrac{S}{Dn} \times 206, 265 \text{ secs}$ ($\because$ 1 radian = 206.265 secs)

b. **What do you mean by traversing? Describe various methods of traversing.**

Ans. **Traversing :**
1. Surveying which involves a series of connected lines is known as 'traversing'. The sides of the traverse are known as 'traverse legs'.
2. In traversing, the lengths of the lines are measured by chain and the directions are fixed by compass or theodolite or by forming angles with chain and tape.
Method : Q. 4.2, Page 4–3B, Unit-4.

7. Attempt any **one** part of the following :   (7 × 1 = 10)
a. **Two straight intersect at angle of 122°. The maximum allowable speed of the vehicle on the curve is 80 km/hr, centrifugal ratio is ¼ and the rate of change of radial acceleration is 30 cm/sec². Calculate the radius of the circular curve and the length of the transition curve.**

Ans.

Given : Intersect angle = 122°, Speed, V = 80 kmph
Centrifugal ratio = 1/4
Rate of change of radial acceleration, C = 30 cm/sec²
To Find : Radius of circular curve and length of transition curve.

1. The deflection angle,
$$\Delta = 180° - 122° = 58°$$
2. Speed of vehicle,
$$v = \frac{80 \times 1000}{3600} \text{ m/sec} = 22.222 \text{ m/sec}$$
3. The centrifugal ratio
$$= \frac{\text{Centrifugal force}}{\text{Weight of the vehicle}} = \frac{F}{W} = \frac{Wv^2}{gR} \times \frac{1}{W} = \frac{v^2}{gR}$$

$\therefore \qquad \dfrac{v^2}{gR} = \dfrac{1}{4}$

$$\frac{22.222^2}{9.81 \times R} = \frac{1}{4}$$

Radius of curve,
$$R = \frac{22.222^2 \times 4}{9.81}$$
$$= 201.35 \text{ m}$$

4. Length of the transition curve,

$$L = \frac{v^3}{CR}$$

$$\therefore \quad L = \frac{22.222^3}{0.3 \times 201.35} = 181.67 \text{ m}$$

b. What is the necessity of transition curve ? Describe the different method of finding out its length.

Ans. Necessity : Refer Q. 5.14, Page 5–20B, Unit-5.
Method : Refer Q. 5.15, Page 5–21B, Unit-5.

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Measurment of Horizontal angle by repetition Method

This Method is used for very accurate work. In this Method. The same angle is added several times Mechanically and the correct value of the angle is Obtained by dividing the accumulated reading by the no of repetitions.

The no. of repetitions made usually in this method Six, three with the face left and three with the face right. In this way angles can be measured to a finer degree of accuracy than that obtainable with the least count of the Vernier

Horizontal angle AOB
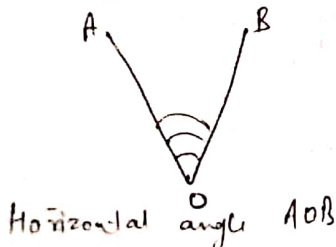
Measurment of horizontal angle by Reiteration Method

• This Method is another precise and Comparetively less tedious method of measuring the horizontal angles.
• It is generally preffered when the several angles are to be measured at a perticular stations.
• This method consists in measuring several angles successively and finally closing the horizon at the starting point.
• The final reading of the Vernier A should be same as its initial readings.