CODE:3012

COURSE:SURVEYING -II VERSION:2015

BLUE PRINT

Sl No.	Module	Type of Questions							
		Part A		Part B		Part C		Total	
		No. of Question	Score	No. of Question	Score	No. of Question	Score	No. of Question	Score
1	I	1	2	2	12	2	30	5	44
2	II	1	2	2	12	2	30	5	44
3	III	1	2	2	12	2	30	5	44
4	IV	2	4	1	6	2	30	5	40

Signature:

Name:

Designation:

Institution:

QUESTIONWISE ANALYSIS

COURSE: SURVEYING II

VERSION:2015

Qn. No.	Specific Outcome (as per syllabus)	Module	Content Details	Score	Time in minutes
I.1	1.1.1	I	Identify the different types of theodolites, their parts and functions	2	5
I.2	2.1.1	II	List the types of traverse	2	5
I.3	3.2.0	III	Apply the principle of tacheometric survey to find elevations of stations.	2	5
I.4	4.1.2	IV	Explain transition curve.	2	5
I.5	4.2.1	IV	Identify the different parts of equipments like electronic theodolite, total station and GPS.	2	5
II.1	1.1.5	I	Explain the deferent methods of horizontal angle measurement (general, repetition and reiteration) and their relative advantages and disadvantages.	6	10
II.2	1.1.8	I	Measure deflection angle	6	10
II.3	2.1.10	II	Explain the methods of balancing the traverse- Bowditch's rule and transit rule.	6	10
II.4	2.1.12	II	Calculate the independent co-ordinates	6	10
II.5	3.2.10	III	Describe the cases of tangential tacheometry	6	10
II.6	3.2.4, 3.2.5	III	State the constants of stadia tacheometry Explain the determination of stadia constants	6	10
II.7	4.1.3	IV	Calculate the elements of simple circular curve.	6	10
III a)	1.1.11	I	Perform the permanent adjustments of theodolite.	10	17
III b)	1.1.5	I	Explain the deferent methods of horizontal angle measurement (general, repetition and reiteration) and their relative advantages and disadvantages.	5	8
IV a)	1.1.9	I	Explain the methods of prolonging a straight line	10	17
IV b)	1.1.2	I	State the important axis of theodolite and	5	8

			their inter relations		
V a)	2.1.8	II	Calculate the consecutive co-ordinates – from the length and bearing	10	17
V b)	2.3.0	II	**Find out the omitted measurements when**	5	8
VI a)	2.1.13	II	Explain Gales traverse table	10	17
VI b)	2.1.3	II	**Explain the methods of traversing by the** observation of bearing,	5	8
VII a)	3.2.8	III	Find the horizontal distance, reduced level **and level difference from the given data by** Stadia tacheometry (line of sight horizontal, inclined and staff held vertical)	10	17
VII b)	3.2.5	III	**Explain the determination of stadia** constants	5	8
VIII a)	3.1.3	III	**Find the elevation of a tall object whose** base is accessible.	10	17
VIII b)	3.1.5	III	Find the elevation of tall object (base inaccessible)- instruments in the same plane and different plane.	5	8
IX a)	4.1.4	IV	Explain the different methods of setting out circular curves-offsets from long chord, offsets from long tangent, offsets from chord produced, rankines method.	10	17
IX b)	4.2.5	IV	**Describe the photogrammetry- aerial and** terrestrial.	5	8
X a)	4.1.4	IV	Explain the different methods of setting out circular curves-offsets from long chord, offsets from long tangent, offsets from **chord produced, rankines method.**	10	17
X b)	4.2.4	IV	**Explain GIS and its application in Civil** Engineering.	5	8
Total Time					295min

Signature:

Name:

Designation:

Institution:

SCHEME OF VALUATION

(Scoring Indicators)

<table>
<tr><td colspan="5">Revision: 2015 Course Code:3012
Course Title: Surveying II</td></tr>
<tr><th>Qn. No.</th><th>Scoring indicator</th><th>Split up Score</th><th>Sub Total</th><th>Tota 1</th></tr>
<tr><td colspan="5">PART A</td></tr>
<tr><td>I.1</td><td>Transit theodolite – Thoedolite in which the telescope can be rotated in a vertical plane through 180^0 about the horizontal axis
Non transit theodolite – Theodolite in which the telescope can not be rotated in a vertical plane through 180^0 about the horizontal axis</td><td>1
1</td><td>2</td><td rowspan="5">8</td></tr>
<tr><td>I.2</td><td>Open traverse
Closed traverse</td><td>1
1</td><td>2</td></tr>
<tr><td>I.3</td><td>A transit theodolite fitted with stadia diaphragm is a tacheometer</td><td>2</td><td>2</td></tr>
<tr><td>I.4</td><td>A curve whose radius varies from infinity at a straight to the radius of a circular curve.
It gradually introduces centrifugal acceleration while negotiating a curve</td><td>1
1</td><td>2</td></tr>
<tr><td>I.5</td><td>Total station is a combination of electronic theodolite, electronic distance meter
Built in data collector and micro processor</td><td>1
1</td><td>2</td></tr>
<tr><td colspan="5">PART B</td></tr>
<tr><td>II.1</td><td>
<table>
<tr><th rowspan="3">Inst At</th><th rowspan="3">Sight to</th><th colspan="8">Left face, Right swing</th><th colspan="8">Right face, Left swing</th></tr>
<tr><th colspan="3">A</th><th colspan="2">B</th><th colspan="3">Mean</th><th colspan="3">A</th><th colspan="2">B</th><th colspan="3">Mean</th></tr>
<tr><th>°</th><th>′</th><th>″</th><th>′</th><th>″</th><th>°</th><th>′</th><th>″</th><th>°</th><th>′</th><th>″</th><th>′</th><th>″</th><th>°</th><th>′</th><th>″</th></tr>
<tr><td>O</td><td>P</td><td>41</td><td>42</td><td>20</td><td>43</td><td>40</td><td>41</td><td>43</td><td>0</td><td>41</td><td>40</td><td>0</td><td>35</td><td>40</td><td>41</td><td>37</td><td>50</td></tr>
<tr><td>O</td><td>Q</td><td>110</td><td>29</td><td>40</td><td>29</td><td>0</td><td>110</td><td>29</td><td>20</td><td>110</td><td>24</td><td>20</td><td>24</td><td>20</td><td>110</td><td>24</td><td>20</td></tr>
</table>

Completing the table (2 marks)</td><td>2</td><td>6</td><td>42</td></tr>
</table>

Angle POQ in face left= $110^0 29'20''-41^0 43'0'' = 68^0\ 46'\ 20''$ 1

Angle POQ in face right= $110^0 24'20''-41^0 37'50''= 68^0\ 46'\ 30''$ 1

Average angle POQ = $(68^0\ 46'\ 20'' +68^0\ 46'\ 30'')/2 = 68^0\ 46'\ 25''$ 2

II.2 Deflection angle is the angle by which a survey line deviates from the preceding line. It is designated as right or left depending on the direction of deflection. Its value varies from 0^0 to 180^0.

1. Set the instrument at Q and level it.
2. Set initial reading to 0^0 and take back sight to P
3. Reverse the telescope so that line of sight is in the direction of PQ with reading of vernier at 0^0.
4. unclamp the upper clamp and turn the telescope clockwise to take the foresight on R. Take the average of both the vernier readings 6 6
5. Unclamp the lower clamp and turn the telescope again to P.
6. Plunge the telescope so that it becomes again in the direction of PQ. Vernier still have the same reading as in A.
7. Unclamp the upper screw and turn the telescope to Q and take the vernier readings. It will be almost double the previous reading. Half of the final reading gives the deflection angle at Q.

II.3 **Bowditch's method: total error in departure and latitude is distributed in proportion to the lengths of sides.** 1

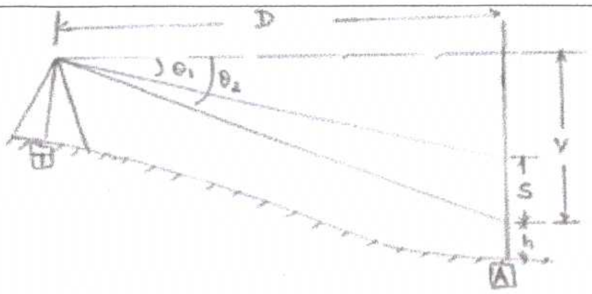
$$Correction\ to\ latitude\ (or\ departure) of\ any\ side$$
$$= Total\ error\ in\ latitude\ (or\ departure) \times \frac{length\ of\ side}{Perimeter\ of\ side}$$ 2

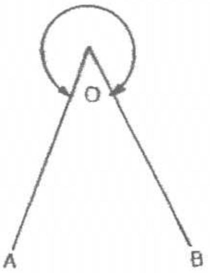
Transit method: The method is adopted when angular measurements are more precise compared to linear measurements. 1 6

$$Correction\ to\ latitude\ (or\ departure) = Total\ error\ in\ latitude\ (or\ departure) \times \frac{latitude\ (or\ departure) of\ that\ side}{arithmetic\ sum\ of\ all\ latitudes\ (or\ departures)}$$ 2

II.4

Line	Latitude		Departure		Station	Northing	Easting
	Northing	Southing	Easting	Westing	A	600.00	700.00
AB		364.30	627.00		B	235.70	1327.00
BC	440.50		940.74		C	676.20	2267.74
CD	991.00			761.90	D	1667.20	1505.84
DE		538.00		777.00	E	1129.20	728.84
EA		529.20		28.84	A	600.00	700.00

II.5	 $V = Dtan\theta_2$ $V - s = D\ tan\theta_1\ then$ $s = D(tan\theta_2 - tan\theta_1)$ $D = \frac{s}{(tan\theta_2 - tan\theta_1)}$ Vertical distance, $V = Dtan\theta_2 = \frac{s\ tan\theta_2}{(tan\theta_2 - tan\theta_1)}$ Elevation of station A = HI-V-h	1 1 1 1 1 1	6	
II.6	D1 = 100 m S1 = 1.990-1.000 = 0.990m D2 = 150 m S2 = 2.350-0.850 = 1.500 m D=kS+C $100 = k \times 0.990 + C$ ……………………..(1) $150 = \ k \times 1.500 + C$…………………… (2) Solving equations 1 and 2, k=98.04, C= 2.94	1 1 1 1 2	6	
II.7	$Deflection\ angle, \Delta = 180 - 120 = 60^0$ $a) Tangent\ distance = Rtan\frac{\Delta}{2} = 2500 \times tan\frac{\Delta}{2} = 1443.4\ m$ $b)\ Length\ of\ curve = \frac{\pi R\Delta}{180} = \frac{\pi \times 600 \times 60}{180} = 628\ m$	1 1 1	6	

	$c)\ Chainage\ of\ point\ of\ curvature$ $= Chainage\ of\ point\ of\ intersection$ $- tangent\ distance$ $= 2500 - 1443.4 = 1056.6\ m$ $d)\ Chainage\ of\ point\ of\ tangency$ $= Chainage\ of\ point\ of\ cuvature$ $+ length\ of\ curve = 1056.6 + 628 = 1684.6m$	1.5 1.5		
PART C				
III	a) Second adjustment is the adjustment of line of sight. This is to be done after adjusting the axis of plate level perpendicular to vertical axis. 1. Set up the instrument on a fairly level ground at O and level it. Fix a peg at A about 100 m from O. Bisect A and clamp both upper and lower plates. 2. Transit the telescope and fix another peg at point B about 100 m from O in line of sight. 3. Unclamp the upper screw, swing the telescope through 180^0 and again bisect A. Clamp the upper screw. 4. Transit the telescope again. If the point B is now again bisected by cross hair, the adjustment is correct. Adjustment: 1. If point B is not on line of sight, establish another point C in the line of sight opposite B. The apparent error BC is 4 times the actual error. 2. Mark a point D at one fourth distance from C. 3. Move the diaphragm by means of the horizontal diaphragm screws until vertical hair is on D. b) To measure the horizontal angle AOB by the method of repetition proceed as follows:   • Set up the instrument over O and level it accurately. • Set the vernier A to 0°. Loosen the lower clamp, direct the telescope to the left hand station A, and bisect A exactly by using the lower clamp and lower tangent screw. • Check the reading of the vernier A to see that no slip has occurred, and read the other vernier B.	6 4 5	15	120

	• Unclamp the upper or vernier plate, turn the telescope clockwise and bisect the right-hand station B exactly by using the upper clamp and upper slow motion screw. • Read both verniers. The object of reading the verniers is to obtain the approximate value of the angle <AOB. • Leaving the verniers unchanged, unclamp the lower plate and turn the telescope clockwise until the station A is again bisected accurately, using the lower clamp and lower tangent screw. Check the vernier reading which must the same as before. • Release the upper plate, turn the telescope clockwise and again bisect the station B exactly using the upper clamp and its slow motion screw. The verniers will now read twice the value of the angle < AOB. • Repeat the process until the angle is repeated the required number of times, say n. • Read both verniers. The final reading after n repetition should be n x <AOB, Add 360° for every complete revolution to the final reading and divide the sum by the number of repetition. The result gives the correct value of the angle AOB. • Change the face. Repeat the whole series of observations in exactly the same manner. • The average of the two values of the angle thus obtained gives a very precise value of the angle AOB.			
IV	a) Method 1 – set the instrument at A and level it accurately. Sight to B. Establish a point C in the line of sight. Shift the instrument to B, sight C and establish D. Continue the process until P is established. Method 2 – set the instrument at B and take a back sight to A. with both the clamps locked, plunge the telescope and establish C in the line of sight. Shift the instrument to C, Back sight to B, plunge the telescope and establish D. the process is continued till P is established. If the instrument is in adjustment, B, C, and D etc. will be in straight line. If the instrument is in poor adjustment, Method 3 can be adopted.	5		
	Method 3 – Double sighting Set the instrument at B and take a back sight on A. Plunge the telescope and establish point C1. Change the face. Take back sight on A again and plunge the telescope to establish another point C2 at the same distance. If the instrument is in permanent adjustment, both C1 and C2 coincide. If not, establish C midway between C1 and C2. Shift the instrument to C and repeat the process to establish other points till P is established. (any two methods – 5 marks each)	5	15	
	b) Fundamental axes of a theodolite are vertical axis, horizontal axis, axis of plate level, axis of telescope, line of collimation, axis of altitude level. Relationship of fundamental lines:	2		

	1. Axis of plate levels must be perpendicular to the vertical axis 2. Line of collimation should coincide with the axis of telescope. It should be at right angles to the horizontal axis 3. Horizontal axis must be perpendicular to vertical axis 4. Axis of telescope level or altitude level must be parallel to the line of collimation 5. Vertical circle vernier must read zero when the line of collimation is horizontal	3		
V	a) Lcosθ = (840.78-500.25) = 340.53 Lsinθ = (315.60-640.75) = - 325.15 The line AB is in the fourth quadrant. length AB = $\sqrt{340.53^2 + 325.15^2} = 470.83$ units $\tan\theta = \frac{D}{L} = \frac{325.15}{340.53}$ Θ= 43040’ 35” in the NW quadrant N43040’ 35”W b) Sometimes in a closed traverse survey, due to some obstructions, length or bearing of some of the sides of traverse could not be observed. In such case, principles of latitude and departure may be employed to determine omitted measurements provided they are not more than two in number. General cases are 1 a) When bearing of one side is omitted b) when length of one side is omitted c) when bearing and length of one side is omitted 2) when length of one side and bearing of another side are omitted 3) when lengths of two sides are omitted 4) when bearings of two sides are omitted	3 3 2 2 2 3	15	
VI	It is the systematic tabular form for recording and computing theodolite traverse data. Procedure: 1. Adjust the interior angles to satisfy the geometric condition as sum of interior angles = (2N-4)x90^0 where N is the number of sides of traverse. 2. Starting with the observed bearing of one line, calculated the bearings of one line, calculate the bearings of all other survey lines using the corrected included angles.	5		

3. Reduce the WCB of lines to QB

4.Calculate the consecutive coordinates using the length and reduced bearings

5 Calculate ∑L and ∑D algebraically.

6. Apply necessary corrections to the latitude and departures so that ∑L=0 and ∑D=0 and balance the traverse.

7. Using the corrected consecutive coordinates, calculate total coordinates or independent coordinates of points so that the entire traverse lie in the NE quadrant.

15

It is the systematic tabular form for recording and computing theodolite traverse data.

										Consecutive Coordinates				Corrections				Corrected Consecutive Coordinates				Independent Coordiates	
Inst.Stn	Angles	Correction	Corrected angles	WCB	Reduced Bearing	Quadrant	Line	Length	Point	Northing	Southing	Easting	Westing	Northing	Southing	Easting	Westing	Northing	Southing	Easting	Westing	Northing	Easting

5

b) Traversing can be done either by measuring angles between lines or by measuring bearings of lines.

Traversing by bearings using a non transit theodolite:

1) Telescope is centred and leveled at the first station A. Vernier A is set to read zero degree. Telescope is directed to magnetic North.

2) Loosen the upper clamp and turn the telescope to B. Sight B exactly using upper tangential screw. Read both verniers.

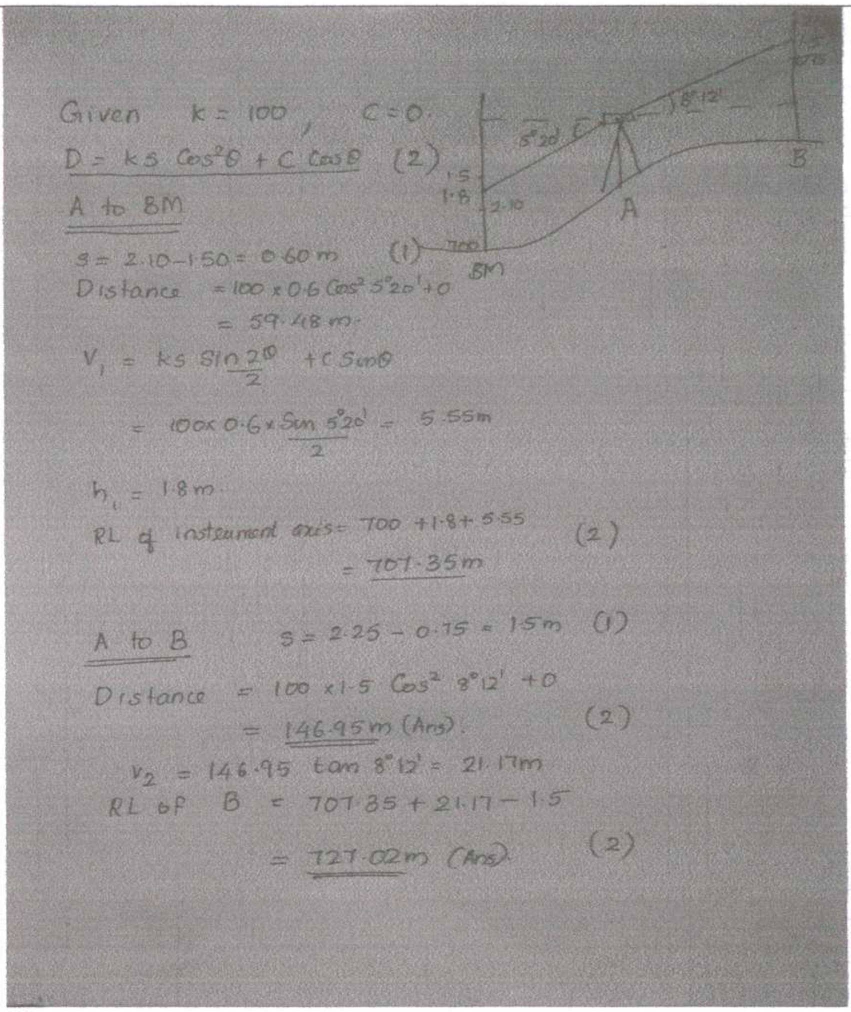
3) Shift the instrument and set is at B. Check whether the reading remains the same on the vernier. Using lower clamp, back sight to A

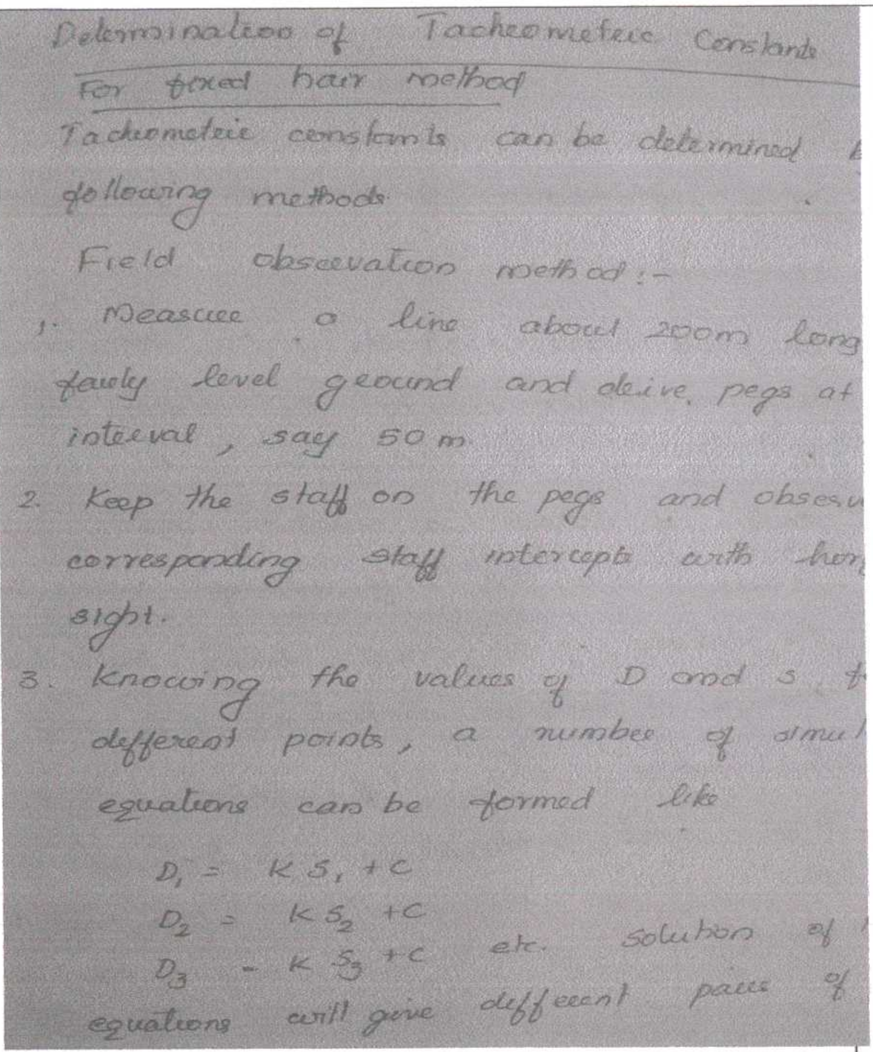
5

4) Upper screw is then released and telescope is turned to C. now the angle have 180 ^{0} difference with the previous reading. Hence, a correction of 180^0 is to be applied to the readings at the verniers. If the reading is more than 180^0, subtract 180^0. If reading is less than 180^0, add 180^0.

5) Instrument is shifted to C. At C, telescope back sighted to B. Loosen the upper screw and rotate the telescope by 360^0. So no correction is required.

Thus 180^0 correction is necessary only at the even instrument stations.

VII	 Given k = 100 , C = 0. $D = ks\ Cos^2\theta + C\ Cos\theta$ (2) A to BM s = 2.10 − 1.50 = 0.60 m (1) Distance = 100 × 0.6 Cos^2 5°20' + 0 = 59.48 m. $V_1 = ks\ \frac{Sin 2\theta}{2} + C\ Sin\theta$ $= 100 \times 0.6 \times \frac{Sin\ 5°20'}{2}$ = 5.55m h_1 = 1.8 m. RL of instrument axis = 700 + 1.8 + 5.55 (2) = 707.35m A to B s = 2.25 − 0.75 = 1.5m (1) Distance = 100 × 1.5 Cos^2 8°12' + 0 = 146.95m (Ans). (2) v_2 = 146.95 tan 8°12' = 21.17m RL of B = 707.35 + 21.17 − 1.5 = 727.02m (Ans) (2) b)	2 1 2 1 2 2	15	



Determination of Tacheometric Constants

For fixed hair method

Tacheometric constants can be determined

following methods.

Field observation method:-

1. Measure a line about 200m long fairly level ground and drive pegs at interval, say 50 m.
2. Keep the staff on the pegs and obse corresponding staff intercepts with hor sight.
3. Knowing the values of D and S different points, a number of simul equations can be formed like

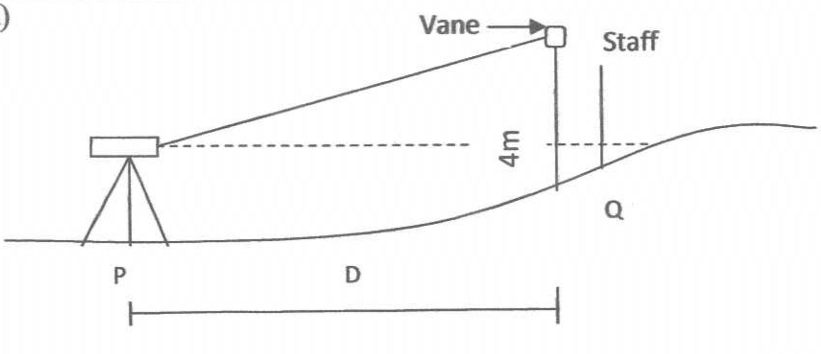
$D_1 = K S_1 + C$

$D_2 = K S_2 + C$

$D_3 - K S_3 + C$ etc. solution of

equations will give different pairs of

VIII a)



2

15

Height of vane above instrument axis = Dtanα

= 2000tan $9^{0}30'$ = 334.68 m — 1

As D is very large, it has to corrected for curvature of earth and refraction

	$\mathrm{C} = 0.06728\left(\frac{\mathrm{D}}{1000}\right)^2$ $\mathrm{C} = 0.06728 \times \left(\frac{2000}{1000}\right)^2$ = 0.27 m (+ve)	2		
	Corrected height of vane above instrument axis = 334.68+0.27 = 334.95 m	1		
	Reduced level of vane = 334.95 +2650.38 = 2985.33 m	2		
	Reduced level of staff station = 2985.33 – 4 = 2981.33 m	2		
	b) The single plane observation method is adopted when the base of the target object is inaccessible and instrument stations can be positioned in the same vertical plane as that of the target.	2		
	To find the reduced level of the point Q on the building, the following procedure was adopted. • Instrument was set up at A. Temporary adjustments were done. Levelling was done with altitude bubble. • Loosen the vertical circle clamping screw and sight to point Q. Note the vertical verniers C and D and observe vertical angle. • Face of the instrument is then changed and vertical angle is again measured. Average vertical angle is then to determine for both the faces. Note it as α_1. • The vertical vernier was set to read zero degree and take the staff reading S_1. • Telescope is then transited and establish a point B on ground in a line with A and Q. Measure distance AB. • Set instrument at B and do the temporary adjustments. • The point Q is then observed in both faces and vertical angle α_2 is to be determined. • Vernier was then set to read zero degree and the staff reading S_2 is noted. Then, h_1= D tan α_1; h_2= D tan α_2; $D = \frac{s-btan\propto_2}{tan\propto_2-tan\propto_1}$	3		
IX	a) Rankine's tangential method for setting out a curve: 1. Locate T_1 and T_2 and calculate their chainages 2. Determine the lengths of first and last sub-chords and total deflection angles for all points on the curve.			