K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE - 560109
DEPARTMENT OF CIVIL ENGINEERING
SESSION: 2021-2022 (EVEN SEMESTER)
I SESSIONAL TEST QUESTION PAPER
SET-A

USN ☐☐☐☐☐☐☐☐☐☐

Degree	B.E	Semester :	IV
Branch	Civil Engineering	Course Code :	18CV45
Course Title	Advanced Surveying	Date :	5/6/2022
Duration	90 Minutes	Max Marks :	30

Note: Answer ONE full question from each part.

<table>
<tr><th>Q No.</th><th>Question</th><th>Marks</th><th>K-Level</th><th>CO mapping</th></tr>
<tr><td colspan="5">PART-A</td></tr>
<tr><td>1(a)</td><td>Derive the expression for the horizontal distance, vertical height and the elevation of an inaccessible object by single plane method when instrument are at same level.</td><td>5</td><td>K3 Applying</td><td>CO1</td></tr>
<tr><td>(b)</td><td>Find the RL of a church spire C from the following observations taken from the station A and B 50m apart. Angle between BAC = 60° Angle ABC = 50°. Angle of elevation from A to the top of the spire = 30°, Angle of elevation from A to the top of the spire = 29°. Staff reading from A on BM of RL of 20.000m = 2.500m and staff reading from B on BM = 0.500m.</td><td>5</td><td>K3 Applying</td><td>CO1</td></tr>
<tr><td>(c)</td><td>Define an aerial photograph and explain the types of an aerial photograph.</td><td>5</td><td>K2 Understanding</td><td>CO2</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td>2(a)</td><td>Derive the expression for the horizontal distance, vertical height and the elevation of an inaccessible object by double plane method.</td><td>5</td><td>K3 Applying</td><td>CO1</td></tr>
<tr><td>(b)</td><td>Determine the top of a tower from the following observations and also the distances from B. Station B & A and the top of the tower are in the same vertical plane.
<table>
<tr><th>Instrument at</th><th>Reading on B.M</th><th>Vertical Tower</th><th>R.L of B.M</th><th>Distance between A & B</th></tr>
<tr><td>B</td><td>3.525M</td><td>16°30'</td><td rowspan="2">325.000M</td><td rowspan="2">50M</td></tr>
<tr><td>A</td><td>2.000M</td><td>10°30'</td></tr>
</table></td><td>5</td><td>K3 Applying</td><td>CO1</td></tr>
<tr><td>(c)</td><td>Explain the following: i) Exposure station ii) Flying height iii) Focal length iv) Principal point v) Nadir point</td><td>5</td><td>K2 Understanding</td><td>CO2</td></tr>
<tr><td colspan="5">PART-B</td></tr>
<tr><td>3(a)</td><td>Explain the measurement of horizontal angle by reiteration method.</td><td>5</td><td>K2 Understanding</td><td>CO1</td></tr>
<tr><td>(b)</td><td>Explain the measurement of horizontal angle by repetition method.</td><td>5</td><td>K2 Understanding</td><td>CO1</td></tr>
<tr><td>(c)</td><td>A line AB measures 11 cm on a photograph taken with a camera having a focal length of 21.5 cm. The same line</td><td>5</td><td>K3 Applying</td><td>CO2</td></tr>
</table>

	measures 3 cm on a map drawn to scale of 1/45,000. **Calculate** the flying height of the aircraft, if the average altitude is 350 m.			
	OR			
4(a)	**Explain** the following terms: i. Centering ii. Double Plane Method iii. Face Left Observation iv. Telescope Normal v. Theodolite	5	**K2 Understanding**	**CO1**
(b)	**Explain** the following terms: i. Trigonometric Levelling ii. Plunging iii. Swinging the Telescope iv. Single Plane Method. v. Telescope Invert.	5	**K2 Understanding**	**CO1**
(c)	A section line AB appears to be 10.16 cm on a photograph for which the focal length is 16 cm. The corresponding line measures 2.54 cm on a map which is to a scale 1/50,000. The terrain has an average elevation of 200 m above mean sea level. **Calculate** the flying altitude of the aircraft above the mean sea level, when the photograph was taken.	5	**K3 Applying**	**CO2**

Course Incharge

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I SESSIONAL TEST QUESTION PAPER
SET-B

USN

Degree	:	B.E	**Semester**	:	IV
Branch	:	Civil Engineering	**Course Code**	:	18CV45
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<tr><td>1(a)</td><td>Define the following terms:
i. Trigonometric Levelling ii. Plunging iii. Swinging the Telescope iv. Single Plane Method. v. Telescope Invert.</td><td>5</td><td>K1 Remembering</td><td>CO1</td></tr>
<tr><td>(b)</td><td>Explain the measurement of horizontal angle by repetition method.</td><td>5</td><td>K2 Understanding</td><td>CO1</td></tr>
<tr><td>(c)</td><td>Explain the following: i) Focal length ii) Principal point iii) Tilt iv) Exposure station v) Flying height</td><td>5</td><td>K2 Understanding</td><td>CO2</td></tr>
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<tr><td>(c)</td><td>Differentiate between the aerial photograph and map.</td><td>5</td><td>K2 Understanding</td><td>CO2</td></tr>
<tr><td colspan="5">PART-B</td></tr>
<tr><td>3(a)</td><td>Derive the expression for the horizontal distance, vertical height and the elevation of an inaccessible object by single plane method when A instrument station is higher than B instrument station.</td><td>5</td><td>K3 Applying</td><td>CO1</td></tr>
<tr><td>(b)</td><td>Find the elevation of the top of a chimney (Q) from the following data. Station A & B and the top of the chimney are in the same vertical plane.
<table>
<tr><th>Instrument Station</th><th>Reading on B.M</th><th>Vertical Angle</th><th>Remarks</th></tr>
<tr><td>A</td><td>2.870</td><td>$28^0 42'$</td><td>R.L of B.M</td></tr>
<tr><td>B</td><td>3.750</td><td>$18^0 06'$</td><td>325.000 M
Distance AB = 100 m</td></tr>
</table>
</td><td>5</td><td>K3 Applying</td><td>CO1</td></tr>
</table>

<table>
<tr><td>(c)</td><td>Two points A and B having elevations of 650 m and 250 m respectively above datum appear on the vertical photograph having the focal length of 250 mm and flying altitude of 2700 m above datum. Their correct photographic co-ordinates are as follows:
<table>
<tr><td>Point</td><td colspan="2">Photographic Co-ordinates</td></tr>
<tr><td></td><td>x (cm)</td><td>y (cm)</td></tr>
<tr><td>a</td><td>+3.65</td><td>+2.54</td></tr>
<tr><td>b</td><td>-2.25</td><td>+5.59</td></tr>
</table>
Calculate the length of the ground line AB.</td><td>5</td><td>K3
Applying</td><td>CO2</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td>4(a)</td><td>Derive the expression for the horizontal distance, vertical height and the elevation of an inaccessible object by double plane method.</td><td>5</td><td>K3
Applying</td><td>CO1</td></tr>
<tr><td>(b)</td><td>Determine the elevation of a point A, on the top of a hill a flag of staff AB of 3m height, was erected and the observations from two
stations M & N; , 50m apart, were made as given below:
Horizontal angle between B & N @ M = $65^0 25'$
Horizontal angle between B & M @ N = $72^0 30'$
Angle of elevation of B from M = $12^0 14' 29''$
Angle of elevation of B from N = $12^0 34' 32''$
Staff reading on B.M. when the instrument at M = 1.785m
Staff reading on B.M. when the instrument at N = 2.305m
If the R.L of the B.M is 200.000m. What is the R.L of A?</td><td>5</td><td>K3
Applying</td><td>CO1</td></tr>
<tr><td>(c)</td><td>A vertical photograph was taken at an altitude of 1200 m above mean sea level. Calculate the scale of the photograph for terrain lying at elevations of 80 m and 300 m if the focal length of the camera is 15 cm.</td><td>5</td><td>K3
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I SESSIONAL TEST SCHEME & SOLUTION

SET-A

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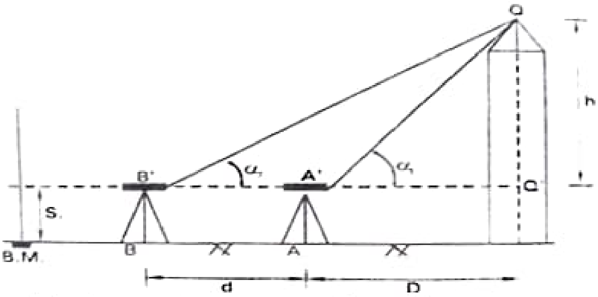
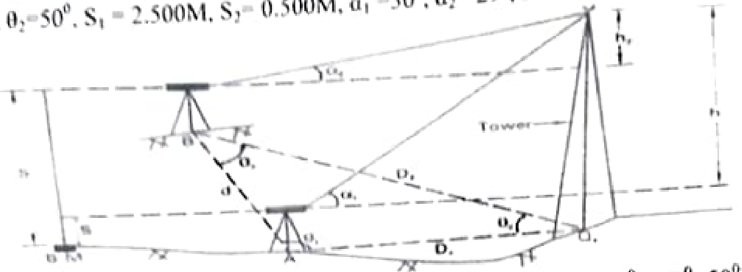
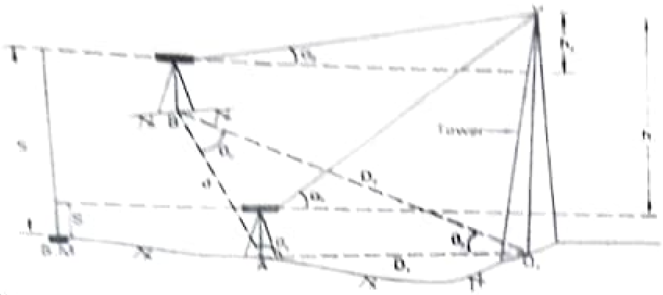
Q. No.	Questions with Scheme & Solution	Marks
	PART-A	
1(a)	**Derive** the expression for the horizontal distance, vertical height and the elevation of an inaccessible object by single plane method when instrument are at same level.. 	02
	let 'h' be the height of Q above the horizontal line of sight A'Q' $\acute{\alpha}_1$ = Angle of elevation at A $\acute{\alpha}_2$= Angle of elevation at B S_1= Staff reading on B.M. d= Horizontal distance between A and B D= Horizontal distance between A and Q From the triangle A'Q'Q, h = Dx tan $\acute{\alpha}_1$......... (1) from the triangle B'Q'Q, h = (d+D) tan $\acute{\alpha}_2$.......(2) equating (1) and (2) Dx tan $\acute{\alpha}_1$ = (d+D) tan $\acute{\alpha}_2$ **D =(dxtan $\acute{\alpha}_1$)/ (tan $\acute{\alpha}_1$- tan $\acute{\alpha}_2$)** Substituting the value of D in the equation 1 h = (d x tan $\acute{\alpha}_1$ x tan $\acute{\alpha}_2$)/ (tan $\acute{\alpha}_1$ - tan $\acute{\alpha}_2$) Therefore R.L of Q = R.L of B.M + S_1 + h	03
(b)	**Find** the R.L. of a church spire C from the following observations taken from two stations A & B, 50m apart. Angle BAC = 60^0, Angle ABC = 50^0. Angle of elevation from A to the top of the spire = 30^0 Angle of elevation from B to the top of the spire = 29^0 Staff reading from A on B.M. of R.L of 20.000m = 2.500m and the staff reading from B	

	on B.M = 0.500m. **Solution: Given Data:** $\theta_1 = 60^0, \theta_2 = 50^0$, $S_1 = 2.500M$, $S_2 = 0.500M$, $\alpha_1 = 30^0$, $\alpha_2 = 29^0$, R.L OF B.M = 20.000M  From triangle ABC, horizontal angle ACB = $\theta_3 = 180^0 - (\theta_1 + \theta_2) = 180^0 - (60^0+50^0) = 70^0$ Applying sine rule $AC/\sin\theta_2 = AB/\sin\theta_3 = BC/\sin\theta_1$ $D_1/\sin\theta_2 = d/\sin\theta_3 = D_2/\sin\theta_1$ The horizontal distance between the instrument station A and the church spire C ; $D_1/\sin\theta_2 = d/\sin\theta_3$ $D_1 = (d/\sin\theta_3) \times \sin\theta_2 = (50/\text{Sin}70^0) \times (\text{Sin } 50^0)$ = **40.76M** The horizontal distance between the instrument station B and the church spire C ; $d/\sin\theta_3 = D_2/\sin\theta_1 =$ $D_2 = (d/\sin\theta_3) \times \sin\theta_1 = (50/\sin 70^0) \times (\sin 60^0)$ = **46.08M** The height of the church spire above the instrument axis A $h_1 = D_1 \times \tan\alpha_1 = 40.76 \times \tan30^0$ = **23.53M** R.L to the top of the church spire above the instrument axis A = R.L OF B.M + $S_1 + H_1$ = 20.000+2.500+23.53 =**46.03M** The height of the church spire above the instrument axis B $h_2 = D_2 \times \tan\alpha_2 = 46.08 \times \tan29^0$ = **25.54M** R.L to the top of the church spire above the instrument axis A = R.L OF B.M + $S_1 + H_1$ = 20.000+0.500+25.54 =**46.04M**	02 03
(c)	**Define** an aerial photograph and **explain** the types of an aerial photograph. Aerial photograph is obtained as a result of photography of ground from air with a camera mounted on an aircraft. The image of the ground photographed is formed on the focal plane of the camera's objective where a sensitive film is placed. **Types:** **1.Vertical Photograph:** A vertical photograph is an aerial photograph made with the camera axis coinciding with the direction of gravity. **2.Oblique Photograph:** An oblique photograph is an aerial photograph taken with the camera axis directed intentionally between the horizontal and the vertical. If the apparent horizon is shown in the photograph it is said to be high oblique. If the apparent horizon is not shown, it is said to be low oblique. **3. Tilted photograph:** A tilted photograph is an aerial photograph made with the camera axis unintentionally tilted from the vertical by a small amount, usually less than 3°.	2 3
	OR	
2(a)	**Derive** the expression for the horizontal distance, vertical height and the elevation of an inaccessible object by double plane method. $\acute{\alpha}_1$ = Angle of elevation at A $\acute{\alpha}_2$= Angle of elevation at B θ_1= Horizontal angle between instrument station B and A to the object. θ_2= Horizontal angle between instrument station A and B to the object.	

S_1 - Staff reading on B.M from instrument station A
S_2 - Staff reading on B.M from instrument station B
Q' - Projection of Q on horizontal plane through A'
Q'' - Projection of Q on horizontal plane through B'
h_1 - Height of the Q above the horizontal plane through A'
h_2 - Height of the Q above the horizontal plane through B'
d - Horizontal distance between A and B
D_1 - Horizontal distance between A and Q_1
D_2 - Horizontal distance between B and Q_1



02

Calculation:

In the triangle ABQ_1

Horizontal Angle $\theta_3 = 180^0 - (\theta_1 + \theta_2)$

Apply sine rule,

$AQ_1 / \text{Sin } \theta_2 = BQ_1 / \text{Sin } \theta_1 = AB / \text{Sin } \theta_3$

$AQ_1 = D_1 = (d / \text{Sin } \theta_3) \times \text{Sin } \theta_2$

$BQ_1 = D_2 = (d / \text{Sin } \theta_3) \times \text{Sin } \theta_1$ 03

$h_1 = D_1 \times \tan \alpha_1$

R.L of Q = R.L of B.M. + S_1 + h_1

Check:

$h_2 = D_2 \times \tan \alpha_2$

R.L of Q = R.L of B.M. + S_2 + h_2

(b) **Determine** the top of a tower from the following observations and also the distances from B. Station B & A and the top of the tower are in the same vertical plane.

Instrument at	Reading on B.M	Vertical Tower	R.L of B.M	Distance between A & B
B	3.525M	$16^0 30'$	325.000M	50M
A	2.000M	$10^0 30'$		

Solution: Given Data:

S1 = 3.525m, S2 = 2.000M, d= 50M, R.L OF B.M = 325.000M, $\alpha 1 = 16^0 30'$, $\alpha 2 = 10^0 30'$

Since the instrument axis B is higher than A.

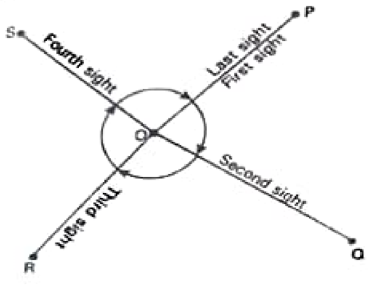
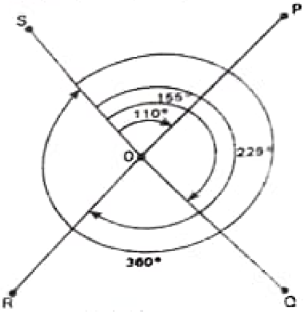
The distance equation is given by D = (dtan α_2-S) / (tan α_1- tan α_2)

S= S1-S2 = 3.525-2.000 = 1.525M 1

D = (50 X tan $10^0 30'$- 1.525) / (tan $16^0 30'$- tan $10^0 30'$) = 69.74M

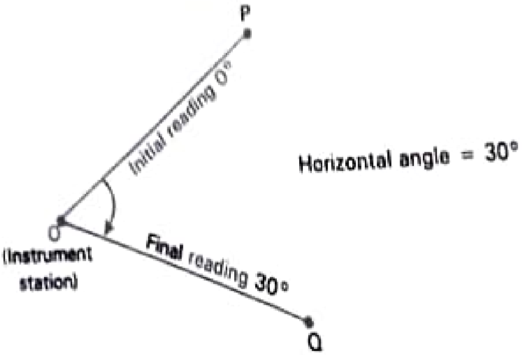
D= 69.74M

Height of top of tower above the instrument axis B

	$h_1 = D \times \tan \alpha_1 = 69.74 \times \tan 16^0 30' = 20.66M$ **h_1= 20.66M** R.L to the top of the tower = R.L of B.M + S_1 + h_1 = 325.000 + 3.525 + 20.66 **= 349.185m** **Check:** Height of top of tower above the instrument axis A $h_2 = (D+d) \times \tan \alpha_2 = (69.74+50) \times \tan 10^0 30' = 22.19M$ **h_1= 22.19M** R.L to the top of the tower = R.L of B.M + S_2 + h_2 = 325.000 + 2.000+22.19 **= 349.190M**	2 2
(c)	**Explain** the following: i) Exposure station ii) Flying height iii) Focal length iv) Principal point v) Nadir point **i) Exposure station:** is a point in space, in the air, occupied by the camera lens at the instant of exposure. Precisely, it is the space position of the front nodal point at the instant of exposure. **ii) Flying height:** is the elevation of the exposure station above sea level or any other selected datum. **iii) Focal length:** It is the distance from the front nodal point of the lens to the plane of the photograph. It is also the distance of the image plane from the rear nodal point. **iv) Principal point:** is appoint where a perpendicular dropped from the front nodal point strikes the photograph. (Also, it is the foot of a perpendicular to the image plane from the rear nodal point in a camera lens system free from manufacturing errors). This principal point is coincide with the intersection of the x-axis and y-axis. **v) Nadir point:** is appoint where a plumb line dropped from the front nodal point pierces the photograph. This point is also known as the photo nadir or photo plumb point.	5
	PART-B	
3(a)	**Explain** the measurement of horizontal angle by reiteration method.  *Fig. (a)*  *Fig. (b)* 1. Set up the instrument over the station O and do al the temporary adjustments. Keep the vertical circle to the left. 2.Set the vernier A to zero using the upper clamp and its tangent screw, 3.Loosen the lower clamp and direct the telescope to the signal at P. clamp the lower clamp and bisect P accurately using the lower tangent screw. Read both the verniers. 4. Loosen the upper clamp and turn the telescope clockwise until the signal at Q is bisected. Clamp the upper clamp and bisect Q exactly using the upper tangent screw. 5. Read both verniers. Mean of the vernier readings gives the horizontal angle POQ. 6.Loosen the upper clamp again and turn the telescope clockwise until the signal at R is bisected. Use the upper tangent screw for exact bisection. Read both the verniers an determine the angle QOR. The angle QOR is obtained by finding the difference between the readings to R and Q.	02 03

7. Similarly, determine the angles ROS.
8. Finally, sight the signal P and read both the verniers. Vernier A should now read 0° or 360°. If not, note the reading and find the error due to slip, etc. If the errors small, distribute it equally to all angles. If the error is large, repeat the above procedure and take a fresh set of readings.
9. Change the face of the instrument to right face. Repeat the process in step 2.
10. Loosen the upper clamp screw, rotate the telescope counter clock wise (swing left) and sight the station S. clamp the upper clamp and bisect the signal S exactly using the upper tangent screw. Read both the verniers and determine the angle POS.
11. Similarly, determine the angles SOR, ROQ and QOP by rotating the telescope in the counter clock wise direction. Distribute the error, if any, equally among all the angles.
12. Determine the average value of each angle obtained with the face left and the face right.
13. Record all the observations in the tabular form shown for the angle measured by this method.

(b) **Explain** the measurement of horizontal angle by repetition method.



Procedure:

1. Two points one on each of the lines say, P and Q are to be marked.
2. A transit theodolite is to be set at the point of intersection of the line say at O. Initially the instrument is in the face left condition and its temporary adjustment is done over the point O. 02
3. Both the upper and lower plate main screws are to released and get the vernier A to set to 0^0 mark on the main scale. After the clamping the upper main screw, index of the vernier. A is to be brought exactly to the zero to the main scale using the upper plate tangent screw.
4. At tis stage the reading of the vernier B should be 360^0.
5. Swing the telescope in the horizontal plane and the point it to be left say,P. Tighten the lower plate clamp screw, and bisect the signal at P exactly using the lower plate tangent screw.
6. Loosen the upper plate main screw and turn the telescope the signal at Q is sighted. Tighten the upper clamp screw and bisect the ranging pole at Q exactly using the upper plate tangent screw. 03
7. Read both the vernier A and B and record the readings. The reading of the vernier A is the angle POQ. The vernier B gives the value of the angle POQ after deducting from it 180^0. The mean of the two values of the angles obtained from the vernier A and B is required angle POQ.
8. Change the face of the instrument to the face right by transiting the telescope and swinging the telescope through 180^0.
9. Repeat the step 3 to 8 and determine another value of the angle POQ.
10. The mean of the face left and face right observation is the final reading angle POQ .

(c)	A line AB measures 11 cm on a photograph taken with a camera having a focal length of 21.5 cm. The same line measures 3 cm on a map drawn to scale of 1/45,000. **Calculate** the flying height of the aircraft, if the average altitude is 350 m. **Solution:** $\frac{\text{Photo Scale}}{\text{Map Scale}} = \frac{\text{Photo distance of line ab}}{\text{Map distance of line AB}}$ $\frac{s}{1/45{,}000} = \frac{11}{3}$ $S = \frac{11}{3} x \frac{1}{45{,}000} = \frac{1}{12.2723}$ Photo scale $= \frac{f}{H-h} = \frac{0.215}{H-350}$ $\therefore H = 2{,}638.69 + 350 = 2{,}988.69$ m	2 3
	OR	
4(a)	**Explain** the following terms: i. **Centering:** The process of the setting the theodolite exactly over the station mark is known as Centering. ii. **Double Plane Method:** If the chosen two instrument stations do not lie in the same vertical plane passing through the elevated object, then it is known as double plane method. iii. **Face Left Observation:** If the face of the vertical circle is to the left of the observer, the observation of the angle is known as face left observations. iv. **Telescope Normal:** A telescope is said to be normal, when the vertical circle is to the face left and the "bubble up". v. **Theodolite:** The theodolite is the most accurate instrument used mainly for measuring the horizontal and vertical angles. It can also be used for locating points on a line, prolonging survey lines, finding the difference in elevations, setting out of grades, ranging curves, etc.	5 X 1 = 5
(b)	**Explain** the following terms: i. **Trigonometric Levelling:** It is defined as the process of determining the difference of elevations of stations from observed vertical angles and known distances, which are assumed to be either horizontal or geodetic lengths at mean sea level. ii. **Plunging:** It is the process of turning the telescope in the vertical plane through 180 degree about trunnion axis. iii. **Swinging the Telescope:** It is the process of turning the telescope in the horizontal plane. If the telescope is rotated in the clock wise direction, known as right swing. If the telescope is rotated in the anti clock wise direction, known as left swing. iv. **Single Plane Method:** It is defined as if the two instrument stations so chosen lie in the same vertical plane passing through the elevated object. v. **Telescope Invert:** A telescope is said to be normal, when the vertical circle is to the face right and the "bubble down".	5 X 1 = 5
(c)	A section line AB appears to be 10.16 cm on a photograph for which the focal length is 16 cm. The corresponding line measures 2.54 cm on a map which is to a scale 1/50,000. The terrain has an average elevation of 200 m above mean sea level. Calculate the flying altitude of the aircraft above the mean sea level, when the photograph was taken. **Solution:** $\frac{\text{Photo Scale}}{\text{Map Scale}} = \frac{\text{Photo distance of line ab}}{\text{Map distance of line AB}}$ Here, map scale = 1/50,000; Let the photo scale be 1/n	2

$\frac{\frac{1}{n}}{\frac{1}{50,000}} = \frac{10.16}{2.54}$ $1/n = \frac{10.16}{2.54} x \frac{1}{50,000} = \frac{1}{12,500}$ or n= 12,500 Again, $S_{200} = \frac{1}{n} = \frac{f}{H-h}$ or $\frac{1}{12,500} = \frac{(\frac{16}{100})}{(H-200)m}$ $\therefore$ H = 2000 + 200 = 2,200 m	3

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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU-560109

DEPARTMENT OF CIVIL ENGINEERING

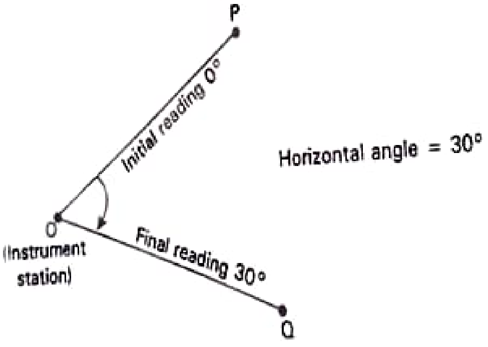
SESSION: 2021-2022(EVEN SEMESTER)

I SESSIONAL TEST SCHEME & SOLUTION

SET-B

Degree	:	**B.E**	**Semester**	:	**IV**
Branch	:	**Civil Engineering**	**Date**	:	**5-6-2022**
Course Title	:	**Advanced Surveying**	**Course Code**	:	**18CV45**
Duration	:	**90 Minutes**	**Max Marks**	:	**30**

Note: Answer ONE full question from each part

Q. No.	Questions with Scheme & Solution	Marks
	PART-A	
1(a)	**Define** the following terms: i. **Trigonometric Levelling:** It is defined as the process of determining the difference of elevations of stations from observed vertical angles and known distances, which are assumed to be either horizontal or geodetic lengths at mean sea level. ii. **Plunging:** It is the process of turning the telescope in the vertical plane through 180 degree about trunnion axis. iii. **Swinging the Telescope:** It is the process of turning the telescope in the horizontal plane. If the telescope is rotated in the clock wise direction, known as right swing. If the telescope is rotated in the anti clock wise direction, known as left swing. iv. **Single Plane Method:** It is defined as if the two instrument stations so chosen lie in the same vertical plane passing through the elevated object. v. **Telescope Invert:** A telescope is said to be normal, when the vertical circle is to the face right and the "bubble down".	5 x 1 =5
(b)	**Explain** the measurement of horizontal angle by repetition method.  **Procedure:** 1. Two points one on each of the lines say, P and Q are to be marked. 2. A transit theodolite is to be set at the point of intersection of the line say at O. Initially the instrument is in the face left condition and its temporary adjustment is done over the point O. 3. Both the upper and lower plate main screws are to released and get the vernier A to set to 0^0 mark on the main scale. After the clamping the upper main screw, index of the vernier. A is to be brought exactly to the zero to the main scale using the upper plate	02 03

	tangent screw. 4. At tis stage the reading of the vernier B should be 360^0. 5. Swing the telescope in the horizontal plane and the point it to be left say,P. Tighten the lower plate clamp screw, and bisect the signal at P exactly using the lower plate tangent screw. 6. Loosen the upper plate main screw and turn the telescope the signal at Q is sighted. Tighten the upper clamp screw and bisect the ranging pole at Q exactly using the upper plate tangent screw. 7. Read both the vernier A and B and record the readings. The reading of the vernier A is the angle POQ. The vernier B gives the value of the angle POQ after deducting from it 180^0. The mean of the two values of the angles obtained from the vernier A and B is required angle POQ. 8. Change the face of the instrument to the face right by transiting the telescope and swinging the telescope through 180^0. 9. Repeat the step 3 to 8 and determine another value of the angle POQ. 10. The mean of the face left and face right observation is the final reading angle POQ .	
(c)	**Explain** the following: i) Focal length ii)Principal point iii) Tilt iv) Exposure station v)Flying height **i) Focal length:** It is the distance from the front nodal point of the lens to the plane of the photograph. It is also the distance of the image plane from the rear nodal point. **ii) Principal point:** is a point where a perpendicular dropped from the front nodal point strikes the photograph. (Also, it is the foot of a perpendicular to the image plane from the rear nodal point in a camera lens system free from manufacturing errors). This principal point is coincided with the intersection of the x-axis and y-axis. **iii) Tilt:** is the vertical angle defined by the intersection, at the exposure station, of the optical axis with the plumb line. **iv) Exposure station:** is a point in space, in the air, occupied by the camera lens at the instant of exposure. Precisely, it is the space position of the front nodal point at the instant of exposure. **v) Flying height:** is the elevation of the exposure station above sea level or any other selected datum.	5
	OR	
2(a)	**Define** the following terms: **i. Centering:** The process of the setting the theodolite exactly over the station mark is known as Centering. **ii. Double Plane Method:** If the chosen two instrument stations do not lie in the same vertical plane passing through the elevated object, then it is known as double plane method. **iii. Face Left Observation:** If the face of the vertical circle is to the left of the observer, the observation of the angle is known as face left observations. **iv. Telescope Normal:** A telescope is said to be normal, when the vertical circle is to the face left and the "bubble up". **v. Theodolite:** The theodolite is the most accurate instrument used mainly for measuring the horizontal and vertical angles. It can also be used for locating points on a line, prolonging survey lines, finding the difference in elevations, setting out of grades, ranging curves, etc.	5 x 1 =5
(b)	**Explain** the measurement of horizontal angle by reiteration method.	

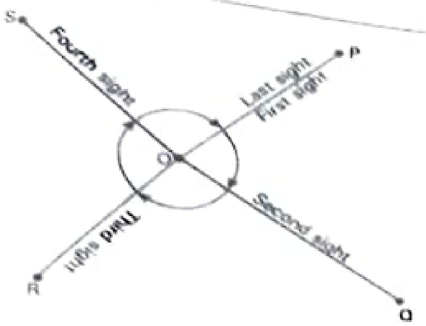


Fig. (a)

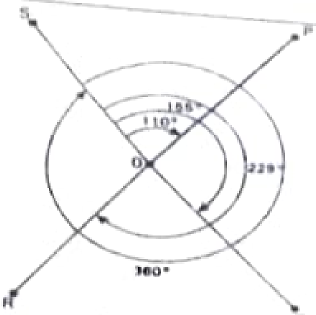


Fig. (b)

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1. Set up the instrument over the station O and do al the temporary adjustments. Keep the vertical circle to the left.
2.Set the vernier A to zero using the upper clamp and its tangent screw,
3.Loosen the lower clamp and direct the telescope to the signal at P. clamp the lower clamp and bisect P accurately using the lower tangent screw. Read both the verniers.
4. Loosen the upper clamp and turn the telescope clockwise until the signal at Q is bisected. Clamp the upper clamp and bisect Q exactly using the upper tangent screw.
5. Read both verniers. Mean of the vernier readings gives the horizontal angle POQ.
6.Loosen the upper clamp again and turn the telescope clockwise until the signal at R is bisected. Use the upper tangent screw for exact bisection. Read both the verniers an determine the angle QOR. The angle QOR is obtained by finding the difference between the readings to R and Q.
7. Similarly, determine the angles ROS.
8. Finally, sight the signal P and read both the verniers. Vernier A should now read 0^0 or 360^0. If not, note the reading and find the error due to slip, etc. If the errors small, distribute it equally to all angles. If the error is large, repeat the above procedure and take a fresh set of readings.
9. Change the face of the instrument to right face. Repeat the process in step 2.
10. Loosen the upper clamp screw, rotate the telescope counter clock wise (swing left) and sight the station S. clamp the upper clamp and bisect the signal S exactly using the upper tangent screw. Read both the verniers and determine the angle POS.
11. Similarly, determine the angles SOR, ROQ and QOP by rotating the telescope in the counter clock wise direction. Distribute the error, if any, equally among all the angles.
12. Determine the average value of each angle obtained with the face left and the face right.
13. Record all the observations in the tabular form shown for the angle measured by this method.

03

(c)

Differentiate between the aerial photograph and map.

Map	**Aerial Photograph**
1.Map is an orthogonal Projection	1. Aerial photograph is a central projection i.c perspective projection
2. Map has a single constant scale	2. Aerial photograph varies from point depending upon their elevations
3. The amount of detail on a map are selective.	3. In an aerial photograph information is more.

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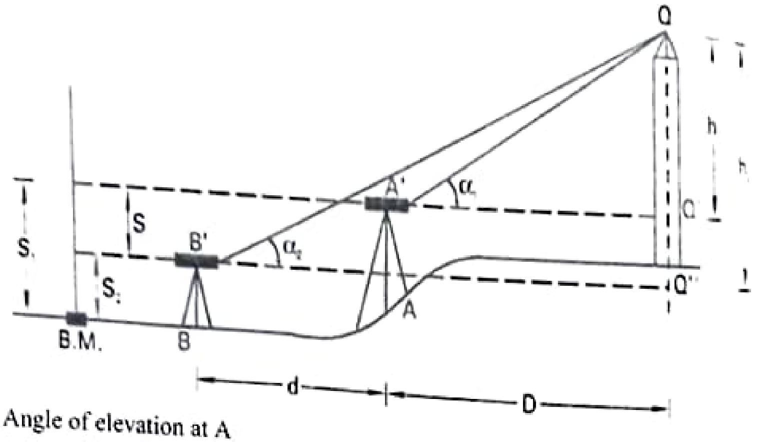
4. Due to symbolic representation of the clarity of details is more on maps.	4. No symbolic representation is there in the photo.

PART-B

3(a)

Derive the expression for the horizontal distance, vertical height and the elevation of an inaccessible object by single plane method when A instrument station is higher than B instrument station.

when the instrument axis at A is higher than that at B



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$\acute{\alpha}_1$ = Angle of elevation at A

$\acute{\alpha}_2$= Angle of elevation at B

S_1= Staff reading on B.M from instrument station A.

S_2= Staff reading on B.M from instrument station B

Q' = Projection of Q on horizontal plane through A'

Q'' = Projection of Q on horizontal plane through B'

h_1 = Height of the Q above the horizontal plane through A'

h_2 = Height of the Q above the horizontal plane through B'

d= Horizontal distance between A and B

D= Horizontal distance between A and Q

From the triangle A'Q'Q,

h_1 = Dx tan $\acute{\alpha}_1$......... (1)

from the triangle B'Q'Q,

h_2 = (d+D) tan $\acute{\alpha}_2$.......(2)

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Subtracting equation (2) from (1)

h_2- h_1 = Dx tan $\acute{\alpha}_1$ - (d+D) tan $\acute{\alpha}_2$

= D (tan $\acute{\alpha}_1$ - tan $\acute{\alpha}_2$) - Dx tan $\acute{\alpha}_2$

But h_2- h_1 = difference in levels of instrument axes

= S_2- S_1 = S

Therefore D (tan $\acute{\alpha}_1$ - tan $\acute{\alpha}_2$) – d x tan $\acute{\alpha}_2$ = S

Or D (tan $\acute{\alpha}_1$ - tan $\acute{\alpha}_2$) = S +d tan $\acute{\alpha}_2$

D =(dxtan $\acute{\alpha}_2$ - S)/ (tan $\acute{\alpha}_1$- tan $\acute{\alpha}_2$)

Substituting the value of D in the equation 1 and 2 to find h_2 and h_1

h_1 = Dx tan $\acute{\alpha}_1$

h_2 = (d+D) tan $\acute{\alpha}_2$

Therefore R.L of Q = R.L of B.M + S_1 + h_1

R.L of Q = R.L of B.M + S_2 + h_2

Find the elevation of the top of a chimney (Q) from the following data Station A & B and the top of the chimney are in the same vertical plane

Instrument Station	**Reading on B.M**	**Vertical Angle**	**Remarks**
A	2.870	$28^0 42'$	R.L of B.M =325.000
B	3.750	$18^0 06'$	M Distance AB =100 m

Solution:

Given Data:

S1 = 2.870m, S2 = 3.750m, d= 100M, R.L OF B.M = 325.000M, $\alpha 1 = 28^0 42'$, $\alpha 2 = 18^0 06'$

Since the instrument axis B is higher than A.

The distance equation is given by $D = (d\tan \alpha_2 + S) / (\tan \alpha_1 - \tan \alpha_2)$ 1

(b) $S = S1 - S2 = 2.870 - 3.750 = -0.88$m

$D = (100 \text{ X } \tan 28^0 42' + 0.88) / (\tan 28^0 42' - \tan 18^0 06') = 252.13$m

D= 252.13m

Height of top of tower above the instrument axis B

$h_1 = D \times \tan \alpha_1 = 252.13 \times \tan 28^0 42' = 138.03$M 2

h_1= 138.03m

R.L to the top of the tower = R.L of B.M + S_1 + h_1 = 325.000 + 2.870 + 138.03

= 465.900m

Check:

Height of top of tower above the instrument axis A

$h_2 = (D+d) \times \tan \alpha_2 = (252.13+100) \times \tan 18^0 06' = 115.09$m 2

h_1= 115.09m

R.L to the top of the tower = R.L of B.M + S_2 + h_2 = 325.000 + 3.750+115.09

= 349.190M

Two points A and B having elevations of 650 m and 250 m respectively above datum appear on the vertical photograph having the focal length of 250 mm and flying altitude of 2700 m above datum. Their correct photographic co-ordinates are as follows:

Point	Photographic Co-ordinates	
	x (cm)	y (cm)
a	+3.65	+2.54
b	-2.25	+5.59

Calculate the length of the ground line AB.

(c) **Solution:** 3

$X_a = \frac{H-h_a}{f} x_a = \frac{2700-650}{0.250}$ (+3.65/100) = **+299.3 m**

$Y_a = \frac{H-h_a}{f} y_a = \frac{2700-650}{0.250}$ (+2.54/100) = **+208.28 m**

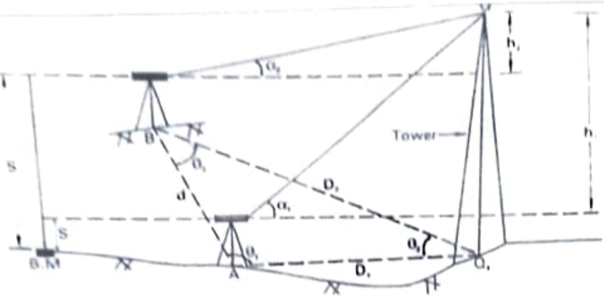
$X_b = \frac{H-h_b}{f} x_b = \frac{2700-250}{0.250}$ (-2.25/100) = **-220.5 m**

$Y_b = \frac{H-h_b}{f} x_a = \frac{2700-250}{0.250}$ (+5.59/100) = **+547.82 m** 2

$\therefore \text{AB} = \sqrt{(X_a - X_b)^2 + (Y_a - Y_b)^2} = \sqrt{(270.0192 + 11.5287)10^4} = 621 \text{ m}$

OR

4(a) **Derive** the expression for the horizontal distance, vertical height and the elevation of an inaccessible object by double plane method. 02

	 $\acute{\alpha}_1$ = Angle of elevation at A $\acute{\alpha}_2$= Angle of elevation at B θ_1= Horizontal angle between instrument station B and A to the object. θ_2= Horizontal angle between instrument station A and B to the object. S_1= Staff reading on B.M from instrument station A. S_2= Staff reading on B.M from instrument station B Q' = Projection of Q on horizontal plane through A' Q'' = Projection of Q on horizontal plane through B' h_1 = Height of the Q above the horizontal plane through A' h_2 = Height of the Q above the horizontal plane through B' d= Horizontal distance between A and B D_1= Horizontal distance between A and Q_1 D_2= Horizontal distance between B and Q_1 **Calculation:** In the triangle ABQ_1 Horizontal Angle $\theta_3 = 180^0 - (\theta_1 + \theta_2)$ Apply sine rule, $AQ_1/ \text{Sin } \theta_2 = BQ_1/ \text{Sin } \theta_1= AB/ \text{Sin } \theta_3$ $AQ_1 = D_1= (d/ \text{Sin } \theta_3) \times \text{Sin } \theta_2$ $BQ_1 = D_2= (d/ \text{Sin } \theta_3) \times \text{Sin } \theta_1$ $h_1 = D_1 x \tan \acute{\alpha}_1$ R.L of Q = R.L of B.M. + $S_1 + h_1$ Check: $h_2 = D_2 x \tan \acute{\alpha}_2$ R.L of Q = R.L of B.M. + $S_2 + h_2$	03
(b)	**Determine** the elevation of a point A, on the top of a hill a flag of staff AB of 3m height, was erected and the observations from two stations M &; , 50m apart, were made as given below: Horizontal angle between B & N @ M = 65 0 25' Horizontal angle between B & M @ N = 72 0 30' Angle of elevation of B from M = 12 0 14'29" Angle of elevation of B from N = 12 0 34'32" Staff reading on B.M, when the instrument at M = 1.785m Staff reading on B.M, when the instrument at N = 2.305m If the R.L of the B.M is 200.000m. What is the R.L of A? Horizontal Angle $\theta_3 = 180^0 - (\theta_1 + \theta_2) = 180^0 - (65^0 25' + 72^0 30') = 42^0 5'$ Apply sine rule, $MB_1/ \text{Sin } \theta_2 = NB_1/ \text{Sin } \theta_1= MN/ \text{Sin } \theta_3$	

$MB_1 = D_1 = (50/ \text{Sin } \theta_3) \times \text{Sin } \theta_2$ 2

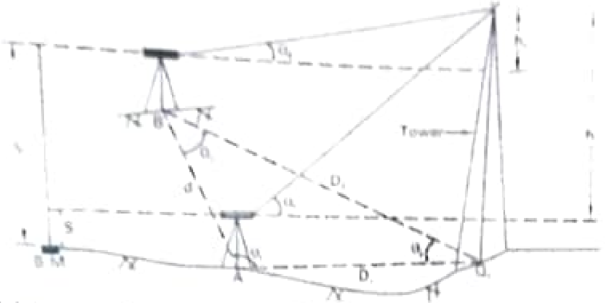
$= (50 / \text{Sin } 42^0 5') \times \text{Sin } 72^0 30'$

$D_1 = 71.15$m

$BQ_1 = D_2 = (d/ \text{Sin } \theta_3) \times \text{Sin } \theta_1$

$= (50 / \text{Sin } 42^0 5') \times \text{Sin } 65^0 25'$

$D_2 = 67.84$m



Height of top of the of the flag above the instrument axis through A

h_1 = Dx tan $\acute{\alpha}_1$ = 71.15 x tan $12^0 14'29''$ = **15.43 m**

R.L. to the top of the church spire = R.L. of B.M+ S_1+ h_1 -3= 200.000+ 1.785+ 15.43-3

R.L. to the top of the hill = 214.215m

Check:

Height of top of the flag above the instrument axis through A

h_1 = Dx tan $\acute{\alpha}_2$ = 67.84 x tan $12^0 34'32''$ = **15.13 m** 3

R.L. to the top of the hill = R.L. of B.M+ S_1+ h_1-3 = 200.000+ 2.305+ 15.13-3 = 214.435m

R.L. to the top of the hill = 214.435m

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

Solution:

The scale at any height h is given by

$$S_h = \frac{f}{H - h}$$ 2

When h is 80 m

$$S_{80} = \frac{15\ cm}{1200 - 80} = \frac{1\ cm}{74.67\ m}$$

$\therefore 1\ cm = 74.67\ m$

When h is 300 m

$$S_{300} = \frac{15\ cm}{1200 - 300} = \frac{1\ cm}{60\ m}$$ 3

$\therefore 1\ cm = 60\ m$

Course Incharge

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