31 8/11/2023 (14) Nov-23

SCORING INDICATORS

COURSE NAME: ADVANCED SURVEYING

COURSE CODE:3011 **QID: 2109230024**

Qs. No.	Scoring indicators	Split score	Sub Total	Total Score
	PART A			**9**
I.1	Vertical cliff.	1	1	
I.2	Trunnion axis / Horizontal axis - Axis about which the telescope can be rotated in a vertical plane.	1	1	
I.3	Closing error = $\sqrt{\Sigma L^2 + \Sigma D^2}$, ΣL,ΣD – Algebraic sum of Latitude and Departure	1	1	
I.4	i) k = f/i is called the multiplying constant or stadia interval factor ii) (f + d) =C is known as the additive constant of the tacheometer	0.5 0.5	1	
I.5	D = $\frac{1718.9}{R}$, D- Degree of curve R- Radius of curve	1	1	
I.6	Presence of an LCD display	1	1	
I.7	The prism	1	1	
I.8	Geographical information systems (GIS)	1	1	
I.9	Aerial photogrammetry	1	1	

	PART B			**24**
II.1	**Simpson's formula/ rule** $= \frac{h}{3}\ ((First\ area + Last\ area) + (4\ x\ \Sigma\ all\ odd\ areas) + (2\ x\ \Sigma all\ even\ areas))$ **Trapezoidal formula/ rule** $= \frac{h}{2}\ ((First\ area + Last\ area) + (2\ x\ \Sigma\ all\ other\ areas))$ h – contour interval	1.5 1.5	3	
II.2	**Plunging**:- It is the process of rotating the telescope about the horizontal axis through 180°. This process is also known as plunging or reversing. **Swinging**:- It is the process of rotating the telescope about the vertical axis for the purpose of pointing the telescope in different directions. **Changing face:-**It is the operation of changing from face left to face right and vice versa. This is done by transiting the telescope and swinging it through 180°.	1 1 1	3	
II.3	In a perfectly adjusted instrument, the fundamental lines bear relations 1. The vertical cross hair should lie in a plane perpendicular to the horizontal axis. 2. The axis of each plate level should lie in a plane perpendicular to the vertical axis 3. The horizontal axis should be perpendicular to the vertical axis. 4. The axis of the telescope level should be parallel to the line of sight. 5. The line of sight should be perpendicular to the horizontal axis at its intersection with the vertical axis. Also, the optical axis, the axis of the objective slide & the line of sight should coincide.	Any 3 points 3 x 1	3	

<table>
<tr><td>II.4</td><td>Latitude is the projection of line which lies in north-south direction; North latitudes are positive, South are negative.

Latitude = L cos θ

Departure is the projection of line which lies in the east-west direction. East departures are positive and West are negative

Departure = L sin θ

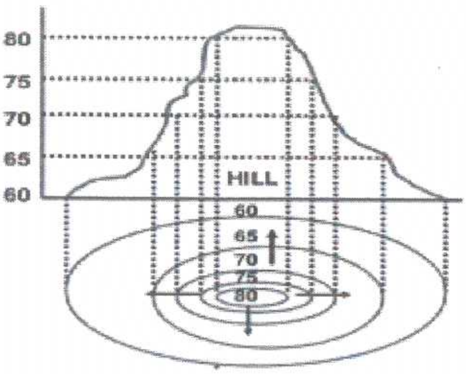
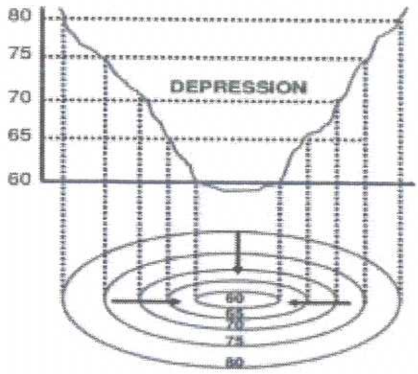
θ - Bearing of line from North</td><td>1.5

1.5</td><td>3</td><td></td></tr>
<tr><td>II.5</td><td>There are two types of traverse surveying.
1.Closed traverse: When the lines form a circuit which ends at the starting point, it is known as a closed traverse.
2. Open traverse: When the lines form a circuit ends elsewhere except starting point, it is said to be an open traverse.</td><td>1.5

1.5</td><td>3</td><td></td></tr>
<tr><td>II.6</td><td>Only latitudes calculation.
<table>
<tr><th>Sides</th><th>Length</th><th colspan="2">Consecutive coordinates</th></tr>
<tr><th></th><th></th><th>Departure(x)</th><th>Latitude (y)</th></tr>
<tr><td>PQ</td><td>110.80</td><td>105.86</td><td>-32.70</td></tr>
<tr><td>QR</td><td>100.80</td><td>57.69</td><td>82.66</td></tr>
<tr><td>RS</td><td>99.80</td><td>-71.70</td><td>69.42</td></tr>
<tr><td>ST</td><td>95.80</td><td>-85.74</td><td>-42.74</td></tr>
<tr><td>TP</td><td>101.80</td><td>2.08</td><td>-101.78</td></tr>
</table></td><td>for latitude & calculation
3 marks</td><td>3</td><td></td></tr>
<tr><td>II.7</td><td>Components of total station

Handle
Handle securing screw
Data input/output terminal
Instrument height mark
eyepiece
Horizontal clamp
A horizontal fine motion screw
</td><td>List any 6</td><td>3</td><td></td></tr>
</table>

	• Battery cover • Operation panel • Tribrach clamp • Peep sight • Instrument centre mark • Telescope eyepiece • Telescope focusing ring • Data input/output connector • External power source connector • Plate level • Plate level adjusting screw • Vertical clamp • A vertical fine motion screw	$6 \times \frac{1}{2}$		
II.8	1. Setting up the tripod 2. Mounting total station on the tripod 3. Centering & Levelling the Total station 4. Verifying the level Electronically 5. Adjusting the image & Focusing the Cross-hair 6. Taking the measurements	$6 \times \frac{1}{2}$	3	
II.9	• A GPS receiver can only work when it is in the line of sight of at least three satellites. Each satellite sends a signal encrypted with the satellite's location at the time of transmission and when it sent the signal. • A receiver uses the site from three satellites sending signals to the same receiver and the time difference from the time of signal transmission to when it was received. • It then uses a mathematical equation to determine the distance of the satellites from it and each other, therefore deducing its location via latitude and longitude coordinates. Using the fourth satellite, the receiver can verify the accuracy of the information it gives and, therefore, avoid the need for an atomic clock.	1 1 1	3	

II.10	A geographic information system consists of integrated computer hardware and software that store, manage, analyze, edit, output, and visualize geographic data. Much of this often happens within a spatial database, however, this is not essential to meet the definition of a GIS.	3	3	
	PART C			**42**
III	  OR	Each sketch 3.5 marks	7	7
IV	Permanent adjustment of theodolite is done by four steps:			
	1.Adjustment of Plate Level:- The first Permanent adjustment of the theodolite is plate level adjustment. Plate level adjustment is done for making the axis of plate bubble perpendicular to the vertical axis when the bubble is central.	2		
	2. Adjustment of line of sight:- Line of Sight is the imaginary line passing through the intersection of the crosshair on the diaphragm and the optical centre of the objective lens. When a line of sight comes in a horizontal plane, it is called a line of collimation. The line of sight generates a vertical plane when the horizontal axis is perpendicular to the vertical axis. The line of sight should coincide with the optical axis of the telescope.	2		
	3.**Adjustment of the horizontal axis:-** The adjustment of the horizontal axis is done by the spire test. In this test horizontal axis should be perpendicular to the vertical axis.	2		

	4.Adjustment of altitude level :-Adjustment of altitude level or vertical axis of the frame. This adjustment can be done with the help of tangent screws and clip screws.	2		
V	**Simpson's formula/ rule** $= \frac{h}{3}\ ((\,First\ area + Last\ area) + (\,4\ x\ \Sigma\ all\ odd\ areas) + (\,2\ x\ \Sigma all\ even\ areas))$	1	7	7
	$= \frac{5}{3}\ ((820 + 2287) + (\,2\ x\ (1224 + 1696 + 1920)) + (\,4\ x\ (978 + 1504 + 1710 + 2005)) =$ **$\underline{62625\ m^3}$**	3		
	Trapezoidal formula/ rule $= \frac{h}{2}\ ((\,First\ area + Last\ area) + (\,2\ x\ \Sigma\ all\ other\ areas))$	1		
	$= \frac{5}{2}\ ((\,820 + 2287) + (\,2\ x\ (978 + 1224 + 1504 + 1696 + 1710 + 1920 + 2005)) =$ **$\underline{62952.5\ m^3}$**	2		
	OR			
VI	**i) Transit Theodolite:** A theodolite is called a transit theodolite when its telescope can be transited. i.e, revolved through a complete revolution about its horizontal axis in the vertical plane.	2		
	Non-Transit theodolite:- Theodolite in which the telescope cannot be revolved through a complete revolution about its horizontal axis in the vertical plane .	1.5		
	ii) Vernier Theodolite: For reading the graduated circle if verniers are used, the theodolite is called as a Vernier Theodolite.	2		
	Micrometer Theodolite:- Whereas, if a micrometer is provided to read the graduated circle the theodolite is called as a Micrometer Theodolite.	1.5		

VII					7	7

Side	Latitude	Departure	Station	Independent coordinates	
				Y	X
			A	**200**	**200**
AB	-116.1	-44.4	B	83.90	155.60
BC	6.8	58.2	C	90.70	213.80
CD	80.5	17.2	D	171.20	231.00
DA	28.8	-31.0	A	200	200

3

$$\text{Area} = \frac{1}{2}((x_2y_1 + x_3y_2+x_4y_3+x_1y_4)-(x_1y_2+x_2y_3+x_3y_4+x_4y_1))$$ 1

$$= \frac{1}{2}((200X155.6+83.9X213.80+90.70X231+171.20X200)-(200X83.9+155.6X90.7+213.8X171.2+231X200))$$ 2

$$= \frac{1}{2}(104249.52-113695.48) = \underline{\underline{\mathbf{4722.98\ m^2}}}$$ 1

VIII

OR

1. **Stadia Method of Tacheometry**

The stadia technique of tacheometry is a popular method adopted for calculating horizontal distance and vertical elevation. The horizontal distance between the staff station and the instrument station and the elevation of the staff station along the instrument's line of sight is computed using this approach with only one observation from the instrument station. This method of surveying can be further classified into the following two types: 3.5

A. Fixed Hair Method:- The device used for taking observations in this form of surveying is a telescope with two extra cross-hairs, one above and one below the center hair. Thus, stadia hairs are ones that are equally spaced from the center hair. When observed via the instrument's telescope, the stadia hairs are seen to intercept a specific length of the staff. This is the most often used tacheometric surveying approach.

	B. Movable Hair Method :- In contrast to the stadia hair technique, the telescope connected to the instrument in the movable hair method comprises moveable cross-hairs. The center hair can also be used to fix the moveable cross-hairs. The stadia interval is customizable in this manner for different staff positions. The horizontal distance is then calculated. The gadget is used with two fixed-distance targets. **2. Tangential Method of Tacheometric Surveying** Tangential tacheometric surveying necessitates two observations between the staff station and the instrument station. The horizontal distance and elevation difference between the collimation line and the staff station is calculated in this manner.The most significant advantage of this procedure is that it may be performed with a standard transit theodolite. Due to the sheer sluggish rate of work, this approach is used less in comparison to the stadia system.	3.5		
IX	The versed sine of the curve $O_o = R - \sqrt{R^2 - (\frac{L}{2})^2}$ $4 = R - \sqrt{R^2 - (40)^2}$ on solving, $R = 202$ m Ordinate length $O_x = \sqrt{R^2 - x^2} - (R - O_o)$ $O_{10} = \sqrt{202^2 - 10^2} - (202 - 4) = 201.75 - 198 = 3.75$ m $O_{20} = \sqrt{202^2 - 20^2} - (202 - 4) = 201.01 - 198 = 3.01$ m $O_{30} = \sqrt{202^2 - 30^2} - (202 - 4) = 199.76 - 198 = 1.76$ m $O_{40} = \sqrt{202^2 - 40^2} - (202 - 4) = 198 - 198 = 0$ m	2 1 1 1 1 1	7	7

X	OR **Traversing by Included Angle** An included angle at a station is either of the two angles formed by two survey lines meeting there and these angles should be measured clockwise. The method consists simply in measuring each angle directly from a back sight on the preceding station. The angles may also be measured by repetition. The angles measured from the back station may be interior or exterior depending on the direction of progress. **Traverse by Deflection Angles** A deflection angle is an angle in which a survey line makes with the prolongation of the preceding line. It is designated as right (R) or left (L) as it is measured clockwise or anti-clockwise from the prolongation of the previous line. This type of traversing is more suitable for the survey of roads, railways, pipe-lines, etc where the survey lines make small deflection angles.	3.5 3.5		
XI	**Parts of a electronic theodolite** 1. A digital theodolite consists of a telescope mounted on a base. 2. A sight on the top of the telescope is used to align the target. The target is made clear by using the focusing knob on the instrument. 3. The eyepiece of the telescope is used to find the target. 4. An objective lens is present on the opposite side of the telescope used to sight and magnify the target as required. 5. The parts of a digital theodolite are mostly similar to a non-digital theodolite, except for the presence of a liquid crystal display (LCD), which shows the reading of the target in focus. 6. The display system also has operating keys for changing the device settings. 7. Similar to the parts of non-digital theodolite, the leveling is performed using optical plummets or plumb bobs and the spirit or bubble level. OR	7 points 7 X 1	7	7

XII	Error Sources in Total Station in Surveying **1.Circle Eccentricity:-** Circle eccentricity exists when the theoretical center of the mechanical axis of the theodolite does not coincide exactly with the center of the measuring circle. Circle eccentricity in the horizontal circle can always be compensated for by measuring in both faces (opposite sides of the circle) and using the mean as a result. Vertical circle eccentricity cannot be compensated for in this manner since the circle moves with the telescope. 2. **Horizontal Collimation Error in Total Station**: Horizontal collimation error exists when the optical axis of the theodolite is not exactly perpendicular to the telescope axis. Horizontal collimation error can always be corrected for by meaning the face one and face two pointings of the instrument. **3.Circle Graduation Error in Total Station:-**. This is accomplished by photo-etching the graduations onto the glass circles and making a precise master circle and photographing it. An emulsion is then applied to the circle and a photo-reduced image of the master is projected onto the circle. The emulsion is removed and the glass circle has been etched with very precise graduations. **4.Vertical Circle Error in Total Station:-** When direct and indirect zenith angles are measured to the same point, the sum of the two angles may diverge from 360° and consequently cause errors in vertical angle measurements. While averaging the direct and indirect zenith angles easily eliminates this error, on many jobs it may not be cost effective to make two readings. **5..Pointing Errors in Total Station:-** Pointing errors are due to both human ability to point the instrument and environmental conditions limiting clear vision of the observed target. The best way to minimize pointing errors is to repeat the observation several times and use the average as the result.	Any 3 error with detail Listin-g 1 mark Expla-ining 3 x2		

	6.Uneven Heating of the Instrument:- Direct sunlight can heat one side of the instrument enough to cause small errors. For the highest accuracy, utilize an umbrella or pick a shaded spot for the instrument. **7.Vibrations:-**Avoid instrument locations that vibrate. Vibrations can cause the compensator to be unstable. **8. Collimation Errors**:- When sighting points a single time (e.g., direct position only) for elevations, check the instrument regularly for collimation errors. **9.Vertical Angles and Elevations:-**. Precise elevations of the points along the baseline should be measured by differential leveling. Set up the total station at one end of the baseline and measure the elevation of each point. Comparing the two sets of elevations provides a check on the accuracy and adjustment of the instrument. Accuracy requirements may dictate that more than one set of angles and distances is measured to each point. **10.Atmospheric Corrections in Total Station**:- Instruments used to measure atmospheric temperature and pressure must be periodically calibrated. This would include psychrometers and barometers. 11.**Optical Plummet Errors:-**The optical plummet or tribrachs must be periodically checked for misalignment. This would include total stations with laser plummets. **12.Adjustment of Prism Poles:-** Using a plumb bob, establish a point under the point on the doorway. If possible, use a center punch to make a dent or hole in both the upper and lower marks. The prism pole can now be placed into the check station and easily adjusted. **13.Recording Errors:-**The two most common errors are reading an angle incorrectly and entering incorrect information into the field book. Another common error is an incorrect instrument or rod height. Although electronic data collection has all but eliminated these errors, it is still possible for the			

	surveyor to identify an object incorrectly, make a shot to the wrong spot, or input a bad target height. **14.Angles** **15.Slope to Grid and Sea Level EDM Corrections:**			
XIII	Application of GPS **1. Road transportation**:- These applications can be for tracking of freight, commercial fleet management, public transport monitoring, services of a taxi, navigation and dispatch, emergency vehicle location and passenger information. The owners of private cars are also widely adopting the in-built GPS system in their cars and most of the manufacturers of the automobiles are into releasing newer vehicles that have an optional fitted GPS. **2. Aviation industry**:-When it comes to commercial aviation, most of the aircraft today make use of the GPS navigation and it is widely being used for a non-precision and initial approach for airfields. **3. Rail and shipping transport**:- These applications include inshore and ocean navigation, approaching ports, dredging, docking and harbor entrance, AIS or Automation Identification System, VTS or Vessel Traffic Services, handling of cargo and hydrography. When it comes to the railways, the applications include information of the passengers, rolling stock management, signaling of cargo tracking, preventing the doors from opening until there is carriage alongside the platform, train integrity and approach for the level crossing. **4. Applications in science**:-. These applications are widespread and include monitoring of atmosphere, several studies related to animal behavior, climate research and meteorology. The GPS signals are also used for the mapping of the land area when it comes to fisheries and agriculture. It is also used for monitoring the yields, harvesting and spraying, precision crop planting, and control of autonomous vehicles and monitoring limits of fishing. **5. Security applications**:-GPS is also used for several security applications and some of them include the tracking of different vehicles, several	Any 3 Listin-g 1 mark Expla-ining 3 x2	7	7

containers, cargoes that are highly valuable and converting the suspect tracking.

6. Guidance for the heavier vehicles:-GPS signals are being used increasingly for guiding and tracking heavier vehicles when it comes to civil engineering applications, such as construction and mining.

7. Mapping, surveying, and geophysics:- These GPS signals are increasingly been used in mappings, such as aerial mapping and several other GIS applications or Geographical Information System. Coming to geophysics, these GPS signals are being used for time-stamping several seismic activities and monitoring the changes in the position f the sensitive physical formations like earthquakes and volcanoes.

8. Financial services:- The time signal which is provided by the atomic clocks which are on the GPS satellites is being used by several financial institutions across the globe to provide time stamps and dates for the electronic fund transfers. In most developed countries about 80% of all the retail transactions make use of debit or credit cards.

9.Telecommunications:-The timing of the GPS signals is very essential for several applications related to telecommunications, especially the ones that include mobile telephone networks. The synchronous technologies are of much more effective than the asynchronous ones, but require a specific time source with correct accuracy, reliability and stability for operating with much effectiveness. The GPS satellites help in providing this effectiveness. The ground-based clocks are much accurate for achieving this, but the synchronization of several such clocks can turn out to be problematic. GPS signals allow this derivation of the synchronized time by resolving signals from several sources of atomic clocks at the locations known.

10. Other activities:-The lower cost and hand-held receivers for the GPS signals are widely available and are used for several social activities. Some of the most prominent applications include navigation in cars, hiking, cycling, skydiving, paragliding, and many such gaming activities.

	OR			
XIV	**Map projection:-** The method of representing the curved surface of a globe or a part of it on a flat surface on a certain scale by making parallels and meridians.	1		
	Conformal – Map projections in which shape is preserved are known as conformal or orthomorphic. A conformal map projection is one in which every angle between two curves that cross each other on Earth is preserved in the image of the projection.	2		
	Equal-Area – Equal-area projection is a map projection It is a map projection that shows regions that are the same size on the Earth the same size on the map but may distort the shape, angle, and/or scale.	2		
	Equidistant – Distance from a single location to all other locations are preserved. A projection that maintains scale along one or more lines, or from one or two points to all other points on the map. Lines along which scale (distance) is correct are the same proportional length as the lines they reference on the globe.	2		

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