
SUMMER – 2015 EXAMINATION

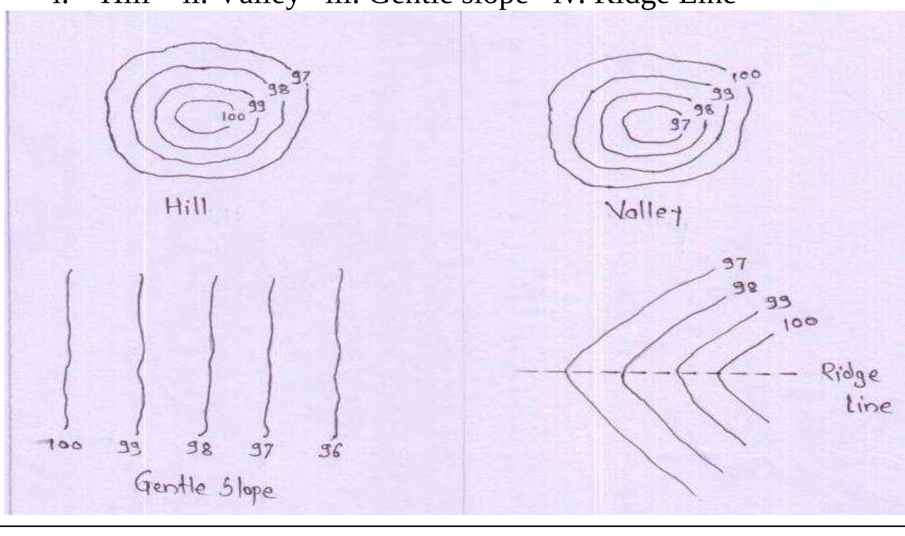
MODEL ANSWER

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills.)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by the candidate and those in the model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and the model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Model Answer

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**a)** **Ans.**	**i) Define contour and contour line.** **Contour: -** It is an imaginary line on the ground joining the points of same elevation or same R.L's. **Contour line: -** It is a line passing through points of equal elevation or equal R.L's.	**1** **1**	**2**
		ii) Define the terms: 1) Transiting and 2) Swinging in relation with theodolite surveying. **Transiting :-**The method of turning the telescope about its horizontal axis in vertical plane through 180^0 is termed as transiting **Swinging: -** It can be the process of turning the telescope in horizontal plane about vertical axis. Swinging of telescope may be left sway or right sway.	**1** **1**	**2**
		iii) State the four uses of transit theodolite. The uses of transit theodolite are as follows. 1. Measuring horizontal angles 2. Measuring vertical angles 3. Measuring deflection angles 4. Measuring magnetic bearing 5. Measuring horizontal distance between two points 6. Finding vertical height of an object 7. Finding the difference of elevation between various points 8. Ranging a line	**1/2 mark each (any four)**	**2**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**a)**	**iv) Define the terms – Latitude and Departure.**		
		Latitude :- The projection of survey line parallel to the meridian or North- South line.	**1**	
		Departure :- The projection of survey line perpendicular to the meridian / North- South line Or parallel to East-West line.	**1**	**2**
		v) State the essential characteristics of tacheometer. Essential characteristics of tacheometer. 1. The value of multiplying const (f/i) = 100 Where, f = focal length i = length of image. 2. The telescope when fitted with anallatic lens, the value of (f+c)= 0 3. One should get clear and bright image even of long distance object. 4. The telescope should be powerful, the magnification should be 20 to 30 times the diameter.	**1/2 mark each (any four)**	**2**
		vi) Enlist the types of curves used in road or railway alignment The types of curve used in road or railway alignment.		
		1. Horizontal curve - Simple curve, compound curve, reverse curve, Transition curve.	**1**	
		2. Vertical curve – Summit curve, valley curve.	**1**	**2**
		vii) What is meant by the term Remote sensing? **viii) Remote sensing:** The method of collecting and interpreting information about terrain and other objects from a distance without being in physical contact with the object.	**2**	**2**
Q.1	**b) Ans.**	**i) State the two application of GPS.** Application of GPS. 1. To prepare contour maps. 2. To prepare longitudinal section of roads. 3. To prepare alignment of roads & bridges.	**1 mark each (any two)**	**2**
		Draw a neat sketch of contour for a following. i. Hill ii. Valley iii. Gentle slope iv. Ridge Line  	**1 mark each**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q1.	**b)**	**ii) How is the layout done using total station?**		
	Ans.	Layout using total station. 1. On the site plan supplied by an architect , number the columns serially and workout the co- ordinates of the column centres with respect to any one plot corner assuming any one side of building as meridian. 2. Create an excel document with four independent columns for column no. and upload this file to total station by making use of communication/ transfer software. 3. Carry this total station to proposed site. Set the total station at site at a point with respect the co ordinates of column centres which are worked out. 4. Get done all the temporary adjustments of total station. Initiate the total station providing it with the co- ordinates of the station occupied and by orienting the telescope along the meridian taken at the time of reduction of co-ordinates of column centres. 5. Activate setting out the programme on total station & open the uploaded file and bring the co-ordinates of any column to be set out. 6. Hold the prism pole at tentative position of that column at ground , bisect it and get measured its co-ordinates. 7. Repeat the process till you get no discrepancy in the co-ordinates of points occupied and point to be set out. This way, you will get marked the centres of rest of columns.	½ **marks (each step upto 6)** **1**	**4**
		iii) Explain the method of measuring vertical angle with theodolite. Also draw the typical format of observation table for the same.		
	Ans.	Procedure of measuring vertical angle using theodolite. 1. To measure the vertical angle of an object at a section O. 2. Set up the instrument over station O and level it carefully with respect to altitude bubble. 3. Set zero of vertical vernier exactly to zero of vertical circle using vertical circle clamp and tangent screw. 4. Bring the bubble of altitude level to the centre by means of foot screws. (i.e. Line of collimation is horizontal) 5. Loosen the vertical circle clamp P and bisect exactly using vertical circle tangent screw. 6. Read both the verniers C and D. The mean of the two readings gives the valves of of required angle for the face. 7. Change the face of instrument and repeat the process. The mean of the two vernier readings observations gives the valves of required angle. 8. The average values of two angles obtained from left observation and right observations give exact values of the required angle.	**2**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**b)**	**iii) Observation table.**	**2**	**4**

Inst. station	Object	Reading on window												Mean angle (4+6)/2	Remark
		Window C (3)			Diff (4)			Window D (5)			Diff (6)				
		0	'	"	0	'	"	0	'	"	0	'	"		

Q.2 a) State the methods of contour interpolation and explain any one.

Ans.

Methods of interpolation. **(1)**

i) By Arithmetic calculations
ii) By Estimation
iii) By Graphical method

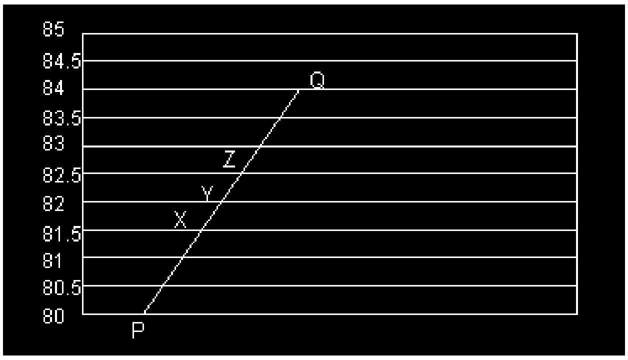
i. By Arithmetic Calculation: This is very tedious but accurate method and is used for small areas where accurate results are necessary. The contours are interpolated as under: Suppose A and B are two points at a distance of 30 m and the reduced level of A and B are 25.45m and 27.54m respectively .Taking the contour interval as 1m, 26 and 27 m contours may be interpolated in between A and B. The difference of level between A and B is 2.09m.the difference of level between A and 26m, and A and 27m is 0.55m and 1.55 m respectively. Therefore the horizontal distance between A and 26 m contour =0.55/2.09 x 30m and Between A and 27 m contour =1.55/2.09 x 30m. These distances are then plotted to scale on the map .

ii. By Estimation Method

1. Contour points are estimated by judgment and marked .The contour lines are then drawn through these points.
2. This method is rough and is suitable for small scale works
3. This points located by judgment is not accurate as located by arithmetic calculations

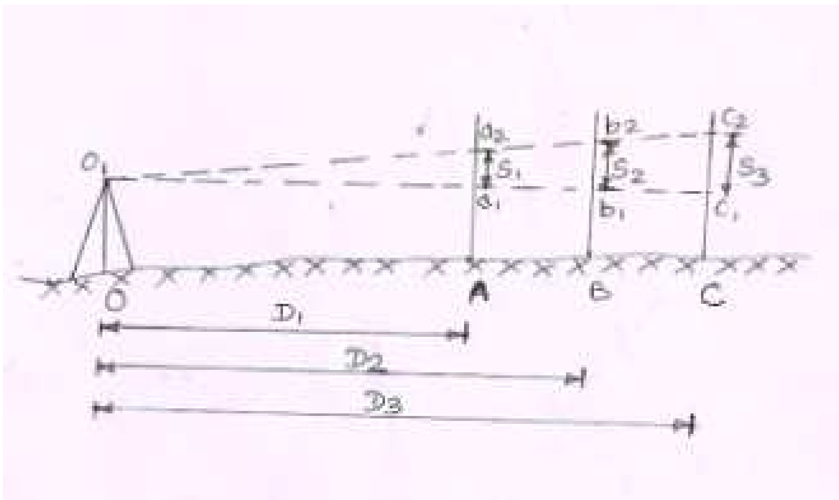
iii. By Graphical Method

Several lines are drawn parallel to each other on a tracing paper say at an interval of 0.5 m. in fig the bottom most line represent an elevation of 80.00m and if it is required to interpolate contour of 81.5,82 and 82.5 between a line PQ of an elevation of 80.00mand 84.00 m then keep the tracing paper on the line in such a way that point P may lie on a parallel representing an elevation of 80.00 m. Now, rotate the tracing paper on drawing in such a way that point Q may lie parallel representing an elevation of 84.00m. The points at which the parallel representing 81.5, 82.0 and 82.5m (shown by X, Y, Z in fig.)May now be pricked through the position of the contour points on line PQ. **(3)** **(4)**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**a)**	 ***Note: Any one method.***		
	b) **Ans.**	**What are the uses of contour map?** 1. The nature of the ground surface of a country can be understood by studying a contour map. To mark possible routes of communication between two different places. 2. A suitable site or an economical alignment can be selected for any engineering projects. 3. The capacity of a reservoir or the area of catchment can be determined approximately. 4. The indivisibility or otherwise of different points can be established. 5. A suitable route for a given gradient can be marked on the map. 6. A section of the ground surface can be drawn any direction from the contour map. Quantities of earthwork can be determined approximately.	**1 mark each (any four)**	**4**
	c) **Ans.**	**What is contour interval? State and explain in brief the factors affecting contour interval.** It is vertical distance between two successive contours. It remains constant for given map. The factors affecting contour interval. 1. **Nature of ground –** for flat ground , contour interval is small For undulating / sloping ground , contour interval is large. 2. **Scale of map**- If scale of map is small, contour interval should be large. 3. **Purpose and extent of survey**- For detailed and accurate work calculation, small contour interval is used. If time available is less, greater contour interval should be used.	**1** **1** **1** **1**	**4**
	d) **Ans.**	**What is meant by grade contour? How to locate grade contour?** It is the line joining the points of different RL's having constant gradient. In Establishing grade contour, it is necessary to measure the distance	**1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**d)**	from the starting point or the last point fixed to the next point to be fixed the required staff reading is calculated from i) Distance ii) Given gradient iii) The RL of plane of collimation of the level (HI).	**1**	
		e.g. Suppose a down gradient of 1 in 25 is to be traced on the ground. Let RL of the starting point = 750.00 m .,The distance = 30m, the height of instrument = 75.75 then R.L. of the next point = 750.00 – 30/25 = 750.00 – 1.2 = 748.80 m	**1**	
		H.I. = 750.75 m. Therefore, the staff reading required at the next point. =750.75 – 748.80 = 1.95 m	**1**	**4**
		Note- If assumed other data in problem could be considered.		
	e)	**Find the area of an irregular area which was measured with planimeter, keeping the anchor point inside the figure. The following readings were noted.** **IR= 8.395, FR= 3.425; The zero marked crossed the fixed index once in clockwise direction. If M=100 sq.cm and C= 24.20**		
	Ans.	Given data, IR= 8.395	**1**	
		FR= 3.425 M=100 sq.cm C= 24.20 N= +1	**1**	
		Formula-- A = M (FR – IR ± 10N + C)	**1**	
		= 100 (3.425 - 8.395 + 10X 1 + 24.20) =2923.00 sq.cm	**1**	**4**
	f)	**State the trapezoidal and prismoidal formula for volume computation, stating each term used in the formula.**		
	Ans.	Prismoidal formula : V =D/3 [A1 + 4(A2 + A4 +….) + 2(A3+A5+….) + An]	**1 ½**	
		Trapezoidal formula V =D/2 [A1 + 2(A2 + A3+ A4 + A5+…………..An]	**1 ½**	
		Where, A1,A2,A3…………..An = Area of cross sections D = Distance between cross section V = Volume of cutting or an embankment	**1**	**4**
Q.3	**a)**	**List all the components of a polar planimeter.**		
	Ans.	1)Tracing Arm 7)Wheel 2)Tracing Point 8)Graduated Drum 3)Weight 9)Vernier 4)Anchor Arm 10)Adjusting screw for tracing arm 5)Anchor Point 11)Index 6)Hinge 12)Magnifier	**½ mark each (any eight)**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	b)	**Define zero circle. How it is found out?** Zero circle or circle of correction is defined as circle round the circumference of which if tracing point is moved, wheel will simply slide(without rotation) on the paper without any change in reading. There are three methods of find zero circle area **Method-I** To find area of zero circle by using formula. Area of zero circle = $\pi(L^2 \pm 2LL_1 + R^2)$ Where, L= length of tracing arm from hinge to tracing point. L_1=distance from hinge to wheel. R= length of anchor arm from hinge to anchor point. +ve sign:- When wheel is placed beyond hinge away from tracing point -ve sign:- When wheel is placed between hinge and tracing point. **Method-II** To find area of zero circle by using planimeter. i) Measure area of figure with anchor point outside of the figure. ii) Measure area of figure with anchor point inside of the figure. iii) Equate two results to find area of zero circle. **Method-III** When constants M and C are known. Area of zero circle = M × C Where M= multiplying constant. C= additive constant. ***Note: Any one method could be considered.***	**2** **2**	 **4**
	c) **Ans.**	**Explain temporary adjustments that are carried out in a transit theodolite.** Following are temporary adjustments. i)Setting up theodolite over a station. ii)Levelling. iii)Focusing of eye piece. iv)Focusing of object glass. **Setting up-** i. Place instrument over station by spreading tripod legs at convenient height. ii. Suspend plumb bob from hook about 2 cm above the station point. iii. Bring plumb bob exactly over the station by moving legs of tripod. Place legs firmly into ground. Also keep in mind approximate leveling of the stand. **Leveling up-** Accurate leveling is done with reference to plate level and foot screws. i. Turn theodolite until plate level is parallel to any pair of foot screws. ii. Bring the bubble to centre by turning both foot screws inward or outward at a time. iii. Turn instrument, make plate level at 90^0 to previous position.	 **1** **1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**c)**	iv. Repeat the procedure until plate bubble is exactly centered in any position. v. Rotate theodolite about vertical axis through 360^0 , the bubble will remain in the central position. **Focusing of eye piece**: - It is done to make cross hairs on diaphragm distinct and clear. To do this place white paper in front of the object glass, move eye piece circumferentially until cross-hairs are seen sharp and black. **Focusing of object glass:** - It is done to make image of object clear & exactly in plane of cross hairs, if not done accurately parallax will occur. Parallax can be removed by sharp focusing until image appears sharp and clear.	1 1	4
	d)	**State and explain the principle of tacheometry with neat sketch.**		
	Ans.	Principle of tacheometry is based on principle of similar triangle corresponding sides & altitudes are proportional. The ratio of distance of base from apex and length of base is always constant.	1	
		 **Fig.**	1	
		In fig. $\Delta O_1a_1a_2$, $\Delta O_1b_1b_2$, $\Delta O_1c_1c_2$ are all isosceles triangles where D_1 , D_2, D_3 are the distances of bases from the apices and S_1, S_2, S_3 are the lengths of the bases. According to stated principle. $D_1/ S_1 = D_2/ S_2 = D_3 / S_3 = \text{Constant}$ f/i= Multiplying constant. f= Focal length of objective. i= Stadia Intercept.	2	4

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	e)	**What is meant by permanent adjustment of a theodolite? Enlist any two such adjustments.**		
	Ans.	After setting up an instrument over a station point and all temporary adjustments are done but still if the desired relations between fundamental axis are not satisfied. To satisfy that some adjustments should be done permanently in instrument that in known are permanent adjustment	**2**	
		List of permanent adjustment 1. Adjustment of horizontal plate levels i.e., to make axis of plate level perpendicular to vertical axis 2. Collimation adjustment: To make the line of sight perpendicular to the horizontal axis 3. Horizantal axis adjustment: To make horizontal axis perpendicular to the vertical axis 4. Adjustment of telescope level: -To adjust the level on the vernier frame to that it is parallel to line of sight Vertical circle index adjustment: To adjust the index on the vernier frame so that circle reads zero when the line of collimation is horizontal	**1 mark each (any two)**	**4**
	f)	**How is the accuracy of field work checked in the following cases** **i) Closed traverse by measurement of included angles and** **ii) Closed traverse by deflection angles.**		
	Ans.	i) Closed traverse by measurement of included angles i) Sum of measured included angles should be equal to $(2n-4)\times 90^0$	**1**	
		ii) Sum of measured exterior angles should be equal to $(2n+4)\times 90^0$ n = no. of sides of traverse	**1**	
		ii) Closed traverse by deflection angles The algebraic sum of deflection angles should be equal to 360^0 considering right hand deflection angles as +ve & left hand deflection angles as –ve.	**2**	**4**
Q.4	a)	**The co-ordinates of two points x and y are as under.**		

Point	**Co-ordinates**	
	N	**E**
x	**980.50**	**800.00**
y	**1200.00**	**500.00**

Find the length and bearing of x y.

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
	Ans.	Latitude of xy (L) = 1200-980.50 = 219.50 Departure of xy(D) = 500-800 = - 300	**1**	
		tan θ = Departure / Latitude = 300 / 219.50 = 1.3667 Therefore θ = 53.808 = 53^0 48’ 30”	**1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**a)**	Since latitude is +ve and departure is –ve xy lies in N-W quadrant RB = N 53^0 48’ 30” W	**1**	
		WCB = 360^0 - 53^0 48’ 30” = 306^0 11’ 30” Length of xy = $\sqrt{(L^2 + D^2)} = \sqrt{(219.5^2 + 300^2)}$ = 317.73 m	**1**	**4**
	b)	**State the errors that are eliminated by method of repetition in measurement of horizontal angle by a transit theodolite.**		
	Ans.	i) Errors due to eccentricity of verniers and centers are eliminated by taking the both readings ii) Errors due to in adjustments of line of collimation and trunnion axis are eliminated by taking both face readings. iii) Errors due to inaccurate graduations are eliminated by taking the readings at different parts of circle. iv) Errors due to inaccurate bisection of object, eccentric centering ect, may be some extent counter-balanced in different observations.	**1mark each**	**4**
	c)	**What are the sources of errors in stadia surveying. Briefly explain.**		
	Ans.	I) Instrumental Errors: Errors due to following. i. Imperfect adjustment of tacheometer. ii. Erroneous graduations on stadia rod. iii. Incorrect value of multiplying constant (f/i).	**1½**	
		II) Personal Errors: Errors due to following. i. Inaccurate centering and leveling of instrument. ii. Inaccurate estimation of stadia intercept. iii. Inaccurate focusing.	**1½**	
		III) Natural Errors: Errors due to following. i. High wind. ii. Unequal refraction of atmospheric air. iii. Unequal expansion of parts of instruments. iv. Bad visibility due to strong light.	**1**	**4**
	d)	**Following are the length and bearings of a theodolite traversing:**		

Line	Length	Bearing
AB	**258.00m**	**30^0**
BC	**321.00m**	**140^0**
CD	**180.00m**	**210^0**
DA	**?**	**?**

Find the missing data.

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**d) Ans.**	(table below) For closed traverse $\Sigma L = 0$, $\Sigma D = 0$. Therefore, $L - 178.35 = 0$ $L = 178.35$ $\Sigma D = D + 245.33 = 0$ $D = -245.33$ $\tan\theta = l.\sin\theta / l.\cos\theta$ $= +2245.33 / -178.35$ $\theta = 53^0\ 59'$ Bearing of DA = N 53^0 59'W Departure of DA = $l.\sin 53^0\ 59' = 245.33$ Length of DA = 303.31m.	1 ½ ½ 1 1	4
	e)	**State the component parts of micro-optic theodolite. How is it superior to a transit theodolite?**		
	Ans.	i) Telescope. ii) Magnification with standard eyepiece. iii) Level tube. iv) Automatic vertical and horizontal reading circles. v) Foot screws. vi) Tribrach and trivet. vii) Tripod top Its telescope gives bright, high contrast erect image than transit theodolite. Digital reading is quick and error free. Automatic index improves accuracy and simplifies vertical angle measurement.	2 2	4
	f)	**State uses of digital theodolite.**		
	Ans.	i. To measure horizontal and vertical angles. ii. It can be combined with EDM to measure horizontal and vertical distances. iii. It can be connected to computer with R232 interface. iv. To measure horizontal and vertical distances using principle of tacheometry. v. To mark out line completed and large building. vi. To mark alignment of road, railway, canal and electric transmission line tower.	**1mark each (any four)**	4

Table for Q.4 d):

Line	Length (l)	Bearing	Reduced Bearing (θ)	Latitude $=l.\cos\theta$	Departure $= l.\sin\theta$
AB	258.00m	30^0	N 30 E	+223.43	+129.00
BC	321.00m	140^0	S 40 E	-245.33	+206.33
CD	180.00m	210^0	S 30 W	-155.88	-90.00
DA	?	?	?	L $\Sigma L = -178.35$	D $\Sigma D = +245.33$

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**a)**	**Mention any four built-in programmes in a total station.**		
	Ans.	**Programmes in a total station.** i. Horizontal circle orientation. ii. Co-ordinate measurement. iii. Traverse measurement. iv. Resection. v. Missing line measurement. vi. Remote elevation measurement. vii. Find out area. viii. Setting out layout. ix. Automatic target recognition. x. Reflector less distance measurement. xi. Data management system.	**1 mark each (any four)**	**4**
	b)	**State the practical application of remote sensing in civil engineering project.**		
	Ans.	**1) Applications of Remote sensing with respect to natural hazard.** e. g In case of flood ,earthquake ,volcano eruption and related hazards land slides, Tsunami, cyclone, etc. **2) Environmental application**: - INSAT series of satellite used for weather forecast i.e. cyclone, cloud, wind velocity, sea states, pollution global warming, and ozone layer depletion. ii) Mineral exploration: - Detailed exploration of non –renewable resou like minerals and fossil fuels, geological data, location of minerals, mapping of mineral zones. **3) Land use and land cover Analysis**: - Land use for Urban purpose agricultural sea forest etc. particular cropping pattern, spread area. **4) Archaeology**:-To recognize archaeological patterns of prehistoric land use, buried archaeologically important sites. **5) Revision of topo sheets**:-Rapid revision and updating of existing topo sheets (maps) with help of aerial photography and satellite imagery survey of India department undertake such work. **6) Alignment of (new) highways and rail-lines**: - By using aerial photographs and satellite imagery location of most economical alternative sites of such works may be carried out easily. **7) Location of gravity dam sites** :- Geological investigation of dam site can be carried at using aerial photographs and satellite imagery (Geological features such as folds, faults, dykes, fractures, rock type) **8) Tunneling**: - Geological information (i.e. Faults & fractures) along alignment of tunnel is furnished by aerial photographs and satellite. imagery to ensure safety during construction and maintenance of funnel. **9) Silting of storage reservoir, harbors etc**.:- Satellite gives imagery idea about silting of reservoir (reduces reservoir capacity) qualitatively and quantitatively and silting of harbor (reduces navigational depth).	**1mark each (any four)**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**b)**	**10) Location of percolation tanks**: To locate exact location of percolation tank from geological investigation of permeable foundation to increase ground water table by using satellite imagery. **11) Seepage losses in canal**: By careful study of aerial photograph and satellite imagery, soil moisture in and around the canal system can be monitor and identify the seepage through the canal **12) Location of bridge site:** Careful study of aerial photograph and satellite imagery used to analyze existing foundation conditions along the proposed bridge construction site. To find economic and safe alignment of bridge. **13) Study of catchment and command area of dam site**: Aerial photographs and satellite imagery used to ascertain the catchment area and command area of dam site.		
	c)	**State the advantages and disadvantages of GPS.**		
	Ans.	**Advantages of GPS are as follows.** 1) It is widely used to navigation worldwide. 2) It is used to observe transportation system for aviation, marine etc. 3) Accurate timing obtained by GPS. 4) It is used for disaster relief and emergency services knowing location and timing capabilities. 5) Surveying of any project is completed in less time and with high accuracy.	**1 mark each (any two)**	
		Disadvantages of GPS are as follows. 1) Initial cost of GPS is high. 2) GPS signal unable to pass through solid structure, so it is unable to work indoors and underground. 3) GPS accuracy is depends on the quality of signal reception. 4) GPS can be affected by large building. 5) Atmospheric factor affect the accuracy of GPS receivers.	**1 mark each (any two)**	**4**
	d)	**What is GIS? State the components of GIS.**		
	Ans.	**GIS –** A Geographical Information system is a special purpose information system used to acquire, store, manage, retrieve, manipulate, analyze and display the data for the purpose of planning and management of the land water and other natural resources and give the information of object**.**	***2***	
		Components of GIS 1) **Hardware -** Hardware is the computer on which a GIS operates. 2) **Software -** GIS software provide functions and tools needed to input and store geographical Information. 3) **Data –** Geographic data which is comprised of geographic features and their corresponding is entered into a GIS. 4) **User -** These are the people for whom GIS is developed there are different user looking for different kind of information and analysis and output in desired formats.	**½ mark each**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks

Q.5 e) **The following are the observations made with a tacheometer. Determine the constants of tacheometer**

Inst. station	Staff reading	Distance(m)	Stadia reading	
			Top	Lower
O	A	100	2.500	1.490
O	B	150	2.000	0.600

Ans.

Note Assume $\theta = 0^o$

$D = (f/i)\,(S)\cos^2\theta + (f+c)\cos\theta$ **01**

$D = (f/i)\,(S) + (f+c)$ (Cos 0 = 1, S = Staff intercept) **½**

$100 = (f/i)\,(1.010) + (f+c)$ …………… Eq_n 1 (S = 2.500- 1.490=1.010) **½**

$150 = (f/i)\,(1.400) + (f+c)$ ………… Eq_n 2 (S= 2.000- 0.600=1.400)

Solving equation 1 and 2 simultaneously, **01**

Subtracting eqn 1 from 2

$150 = (f/i)\,(1.400) + (f+c)$

$-100 = (f/i)\,(1.010) + (f+c)$

$50 = 0.39\,(f/i)$ **½**

Therefore $(f/i) = 128.20$ **½** **4**

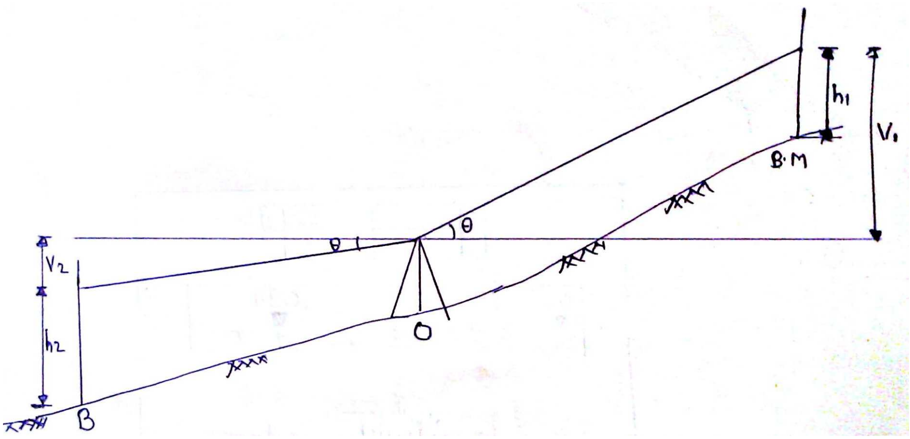
Putting the value of (f/i) in eq_n 1, (f+c) = -29.48

f) **A tacheometer fitted with anallatic lens was set up at station O and the following readings were taken on a staff held vertical.**

Inst. station	Staff station	Vertical angle	Stadia reading
O	BM	+7 º 30´	0.900, 1.200, 1.500
O	B	-2 º 30´	1.100, 1.350, 1.600

Find the horizontal distance 'OB' and RL of 'B' if RL of BM is50.000 m. Take the constant of tacheometer as 100

Ans.



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	f) Ans.	Given: Anallatic lens are provided, (f+c) = 0, f/i = 100, B.M. RL. = 50.000m **Part I) Distance OB** θ = **-2 º 30′** (depression), S = staff intercept = 1.600 – 1.100 = 0.500 Horizontal distance OB = f/i (S) $\cos^2\theta$ + (f+c) $\cos\theta$ = 100 (0.500) $\cos^2$ 2 º 30 ′ + 0 Horizontal distance OB = **49.90 m**	02	
		Part II) RL of station B V_1= Vertical distance between horizontal collimation and axial reading at BM V_1 = f/i (S) $\sin 2\theta/2$ + (f+c) $\sin\theta$, θ = **+7 º 30′** (Elevation) V_1 = 100 (0.600) Sin (2 x **7 º 30′**)/ 2 + 0 (S = 1.500- 0.900 = 0.600) **V_1= 7.76 m**	½	
		V_2 = Vertical distance between horizontal collimation and axial reading at B V_2 = f/i (S) $\sin 2\theta/2$ + (f+c) $\sin\theta$ θ = **-2 º 30′** (depression), V_2= 100 (0.500) Sin (2 x **2 º 30′**) / 2 + 0 (S = 1.600- 1.100 = 0.500m) **V_2=2.18 m**	½	
		RL of station B = RL of BM – V_1 + h_1 – V_2 –h_2 = 50.000 – 7.760 + 1.200 – 2.18 – 1.350 **RL of station B = 39.91 m**	01	4
Q.6	a)	**The WCB of a straight portion AB and BC of a railway line are 120˚ and 150˚ respectively. The chainage of intersection point B is 1000 m. These two are to be connected by a circular curve of radius 300 m. calculate all the necessary data for setting out curve by tangential angle method. Peg interval may be taken as 30 m.**		
	Ans.	WCB of AB = 120˚, FB of AB =120˚ BB of AB =300˚ WCB of BC =150˚, FB of BC =150˚ Therefore Intersection angle ABC= BB of AB - FB of BC = 300˚- 150˚ = 150˚		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks

Deflection angle = 180˚ - Intersection angle
= 180˚-150˚
Deflection angle = 30˚ — **01**

Tangent length = R tanΦ/2
=300 tan 30˚/2
= **80.38 m** — **01**

Length of curve =R x Φ x (π/180)
=300 x 30x (π/180)
=**157.07 m** — **01**

Chain age of starting point,
T1 =Chainage of intersection point - Tangent length
= 1000 – 80.38
= 919.62 m — ½

Chain age of last point(T2) = Chin age of T1 + length of curve
= 919.62 + 157.07
T2 =**1076.69m** — ½

The Peg Interval is 30 m
Therefore Length of unit chord = 30 m
Therefor no of unit chord = 05
Length of sub chord = 7.07 m (Providing at end)
No of Chords = 05 unit chords and 01 sub chords — **01**

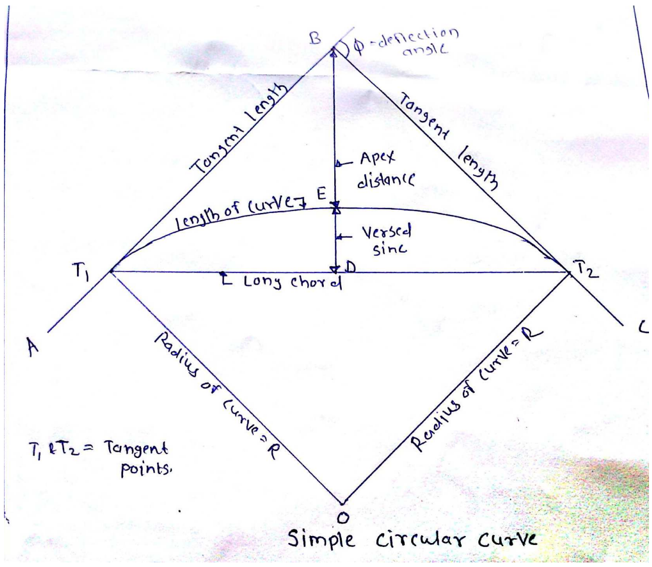
Rankine's deflection angle formula. δ = 1718.9 C/R

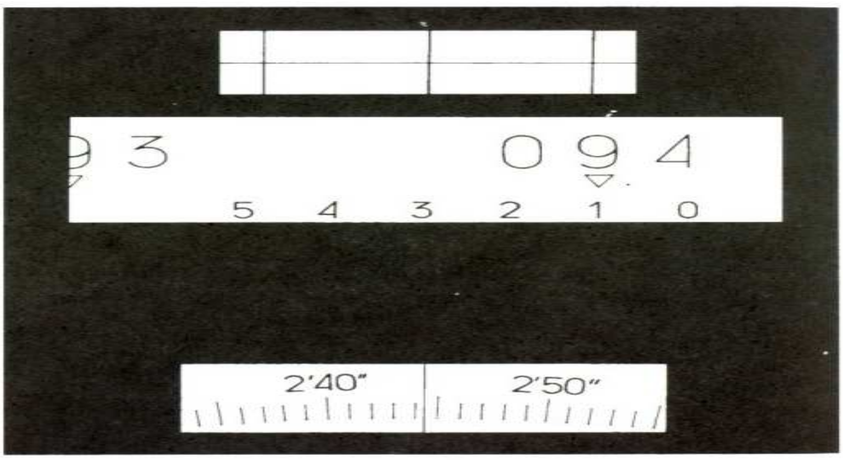
Sr.no.	Peg Interval Point	Length of chord(m)	Deflection angle	Total Deflection angle
1	**T1**	**-**	**-**	**-**
2	**P1**	**30**	**2˚ 51′ 54″**	**2˚ 51′ 54″**
3	**P2**	**30**	**2˚ 51′ 54″**	**5˚ 43′ 48″**
4	**P3**	**30**	**2˚ 51′ 54″**	**8˚ 35′ 42″**
5	**P4**	**30**	**2˚ 51′ 54″**	**11˚ 27′ 36″**
6	**P5**	**30**	**2˚ 51′ 54″**	**14˚ 19′ 30″**
7	**T2**	**7.07**	**0˚ 40′ 30″**	**15˚ 00′ 00″**

03 — Total Marks **8**

b) **i) What is simple curve? Describe with neat sketch denoting all important features.**

Ans. **Simple Curve:** A Curve consists of a single arc connecting two tangents with a same radius. — **01**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**b)**	**i)** 	3	4
		ii) Calculate the ordinates at 25 m interval to set out a circular curve having long chord of 300 m and versed sine of 10 m.		
	Ans.	A Versed sine is the offset of the middle of the long chord**.**		
		$\mathbf{O_o = R - \sqrt{(R^2-(L/2)^2})}$	½	
		Where, R = Radius of curve L = Length of long chord Oo = Versed sine = 10 m Therefore $10 = R - \sqrt{R^2-150^2}$		
		R = 1130 m	½	
		The ordinate at distance x from the mid point may be calculated using $\mathbf{O_x = \sqrt{(R^2-x^2)} - (R-O_o)}$		
		O25= $\sqrt{(1130^2-25^2)}$ - (1130 -10) **= 9.7 m**	½	
		O50= $\sqrt{(1130^2-50^2)}$ - (1130 -10) **= 8.89 m**	½	
		O75= $\sqrt{(1130^2-75^2)}$ - (1130 -10) **= 7.51 m**	½	
		O100= $\sqrt{(1130^2-100^2)}$ - (1130 -10) **= 5.56 m**	½	
		O125= $\sqrt{(1130^2-125^2)}$ - (1130 -10) **= 3.06 m**	½ ½	
		O150= $\sqrt{(1130^2-150^2)}$ - (1130 -10) **= 0 m**		4

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**c) i) Ans.**	**Uses of digital level.** 1) Digital level can be used to draw maps using interface with computer 2) It is also used for day night work of survey. 3) It can be used for determined the quantity of earth work with interfacing of software. 4) It is used to prepare a layout map for water supply sanitary or drainage scheme. 5) To prepare a L section and cross section of a project (Roads, Irrigation canal etc.) in order to determine the volume of earth work. 6) To determine altitude of different important points. 7) To prepare a counter map for fixing sights for a different structure	**1 mark each (any four)**	**4**
	ii) Ans.	**Salient features of Total Station.** 1 High accuracy. 2 Long measuring range. 3 Large internal memory. 4 It is water resistance and dust proof. 5 Easy access to any desired programme and mode of selection. 6 Try axis compensation. 7 Easy to read arrangement. 8 Automatic atmospheric correction. 9 Guide message arrangement. 10 Higher distance resolution. 11 Two speed tangent movement. 12 Detachable tribrach facility. 13 Eighteen different programmes (modes of measurements).	**1 mark each (any four)**	**4**
	iii) Ans.	**Use of micro-optic theodolite for measurement of vertical angle.**  Horizontal or vertical circle reading 94°12'44" **Fig.**	**01**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q. 6)		**Procedure** 1) Take out micro optic theodolite from the box and fix it on the tripod over the required station. 2) Carry out the approximate leveling by leg adjustment and centering by judgment. 3) Accurate centering is done with the help of optical plummet. 4) Do levelling with help of foot screws and plate level. 5) Focusing and sighting by using dioptric ring on the eye piece to get clear image of cross hair and focusing sleeve on telescope to get clear image of the object. 6) Open the illumination mirror and turn it towards the light to get the circle evenly illuminated. 7) Setting initial angle zero-zero by using vertical circle drive 8) Bisect the object whose vertical angle is to be found out. 9) Measure and take the reading of micrometer and record it. ***Note: Procedure could be considered.***	**3**	**4**