WINTER – 2015 EXAMINATION

Subject: Advanced Surveying **Subject Code: 17419**

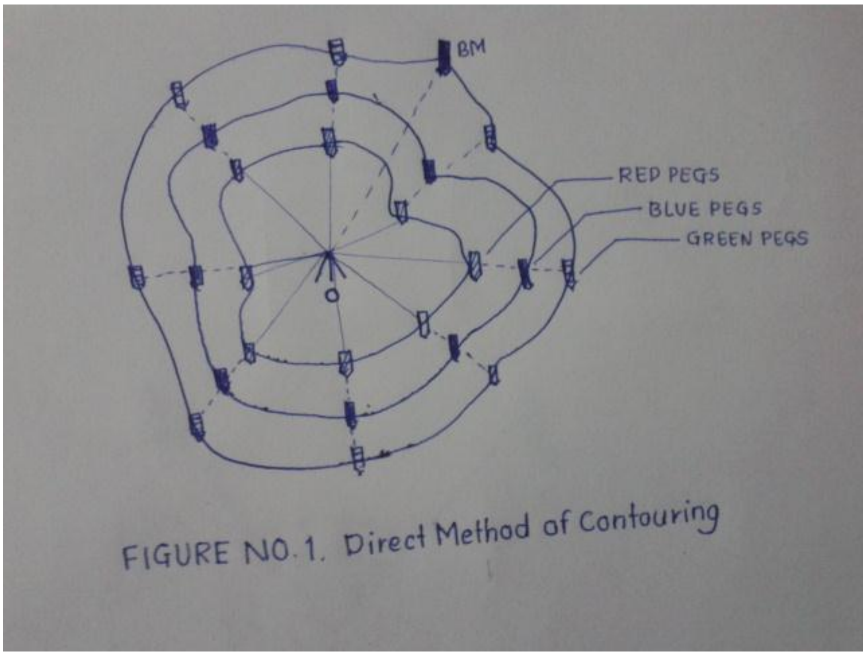
Important Instructions to examiners:

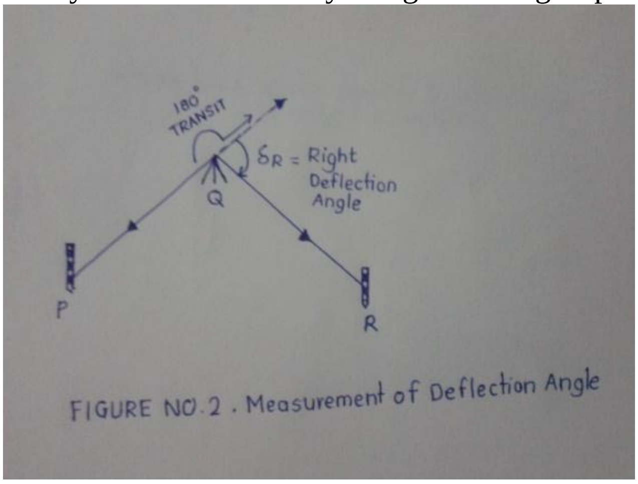
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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

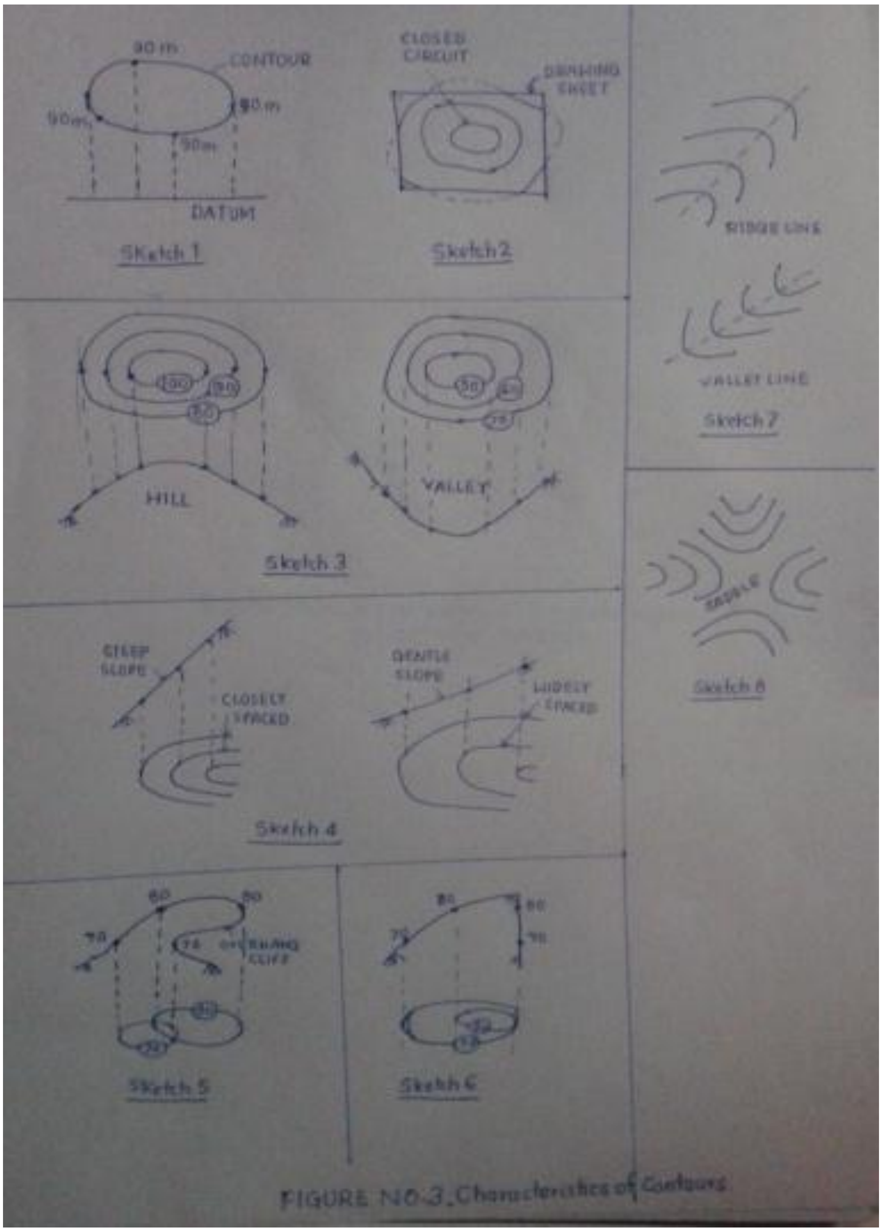
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**a)**	**Attempt any SIX of the following:**		**12**
		i) Define contour interval and horizontal equivalent.		
		Ans: Contour Interval - The vertical distance between two successive contours or contour lines, is known as Contour Interval.	**1 mark**	**2**
		Horizontal Equivalent - The horizontal distance between two successive contours or contour lines, is known as Horizontal Equivalent.	**1 mark**	
		ii) What do you mean by zero circle in area measurement?		
		Ans: Zero Circle - It is the circle formed due to sliding of wheel of mechanical planimeter without changing the reading of circular measuring disc.	**1 mark**	**2**
		It is unmeasured circular area on drawing sheet due to non-rotation of counter disc.	**1 mark**	
		iii) Define grade contour.		
		Ans: Grade Contour - It is the contour established on a specific grade or gradient along the hill side. **OR** The line joining the points of equal grade or gradient is termed as grade contour.	**2 marks**	**2**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**a)**	**iv) Define transiting and swinging of theodolite.**		
		Ans: Transiting of theodolite – The vertical movement of telescope about its horizontal axis through 360 degree is known as Transiting of telescope of theodolite.	**1 mark**	**2**
		Swinging of theodolite - The lateral or horizontal movement of theodolite about its vertical axis through 360 degree is known as Swinging of theodolite.	**1 mark**	
		v) Define latitude and departure.		
		Ans: Latitude – The projective distance of survey line parallel to meridian (i.e. N-S direction) is known as Latitude of a line.	**1 mark**	**2**
		Departure - The projective distance of survey line perpendicular to meridian (i.e. N-S direction) is known as Departure of a line.(01 mark)	**1 mark**	
		vi) State any four component parts of micro-optic theodolite.		
		Ans: The component parts of micro-optic theodolite are as follows. 1. Telescope with eyepiece screw 2. Microscope with focussing knob 3. Optical Plummet 4. Tri-batch with foot screws 5. Plate level 6. Circular bubble tube 7. Collimation slow motion screw 8. Horizontal clamp	**½ mark each (Any four)**	**2**
		vii) Give classification of curve and explain any one in detail.		
		Ans : Types of curve : The curve is classified broadly in two categories **1.** Horizontal curve – When the points of curve are joined in horizontal plane then it is known as horizontal curve. **2.** Vertical curve - When the points of curve are joined in vertical plane then it is known as horizontal curve.	**1 mark**	**2**
		Explanation : **1.** Horizontal curve – These curves are provided at turn or corner points of roadway or railway tracks. Horizontal curves are of four types. a) Simple circular curve b) Compound curve c) Reverse curve d) Transitition curve **2.** Vertical curve – These curves are provided at rise or fall points of roadway or railway tracks. Vertical curves are of four types. a) Summit curve b) Valley curve	**1 mark (Any one)**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**b)**	**Attempt any TWO of the following:** **i. Explain direct method of contouring.** **Ans:** Direct method of contouring – In this method of contouring, the contours of required reduced level are plotted on ground itself. The procedure of direct method of contouring is as follows.  Figure No. 1: Direct Method of Contouring	**1 mark**	**8**
		1. Set the level instrument at the center O as shown in figure 1 and do all temporary adjustments like levelling and focusing. 2. Take the first reading on bench mark (Reduced Level i.e. R.L. 100 m) as back sight reading (Say 1.200 m), so that R.L. of instrument axis will become 101.200 m. 3. If the contour of 100 m is required to plot, then reading on staff should be 101.200 – 100 = 1.200 m. 4. This reading of 1.200 m is searched in radial directions (say 30^0 around instrument station O) by looking through telescope of level instrument. Once these points are found out, then they are marked with red coloured pegs. 5. Similarly, to set 99, 98, and 97 m contour, the reading on staff should be 2.2, 3.2 and 4.2 m respectively. These all contours can be searched in same radial directions and then marked with blue, green and yellow coloured pegs respectively. 6. By joining these identical coloured pegs, we get the required contours on ground by this direct method of contouring.	**3 marks**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**b)**	**ii. State any four applications of remote sensing.** **Ans:** Applications of remote sensing – Remote sensing is widely applicable in the following areas. 1. Resource exploration – The underground resources like fossil fuels, mineral and oil deposits can be explored using remote sensing. The geological features like faults, fractures, dykes etc can be determined using this. 2. Environmental prediction – The prediction of probable precipitation and related environmental changes can be made base of remote sensing techniques. 3. Land use and land cover analysis – By using remote sensing principles, one can analyse land use and land cover of any locality. 4. Flood or feminine relief - Remote sensing is very effective in case of flood and drought prone areas. 5. Navigation routes – The navigational routes of road, railway and airways can be controlled using remote sensing. 6. Determination of Topography – The various ground features like hill, valley, trees, houses etc. can be determined in highly steep slopes.	**1 mark (Any four)**	**4**
		iii. Explain the procedure of measurement of deflection angle. **Ans:** Procedure of measurement of deflection angle – The deflection angle of a survey line is measured by using following steps.  Figure No. 2: Measurement of Deflection angle.	**1 mark**	**4**
		1. Set the theodolite instrument at station Q as shown in figure 2 and do all temporary adjustments like centering, levelling and focussing. 2. Set the $0^0 0' 0''$ and $180^0 0' 0''$ reading in window A and B of horizontal circle of theodolite with face left condition and then clamp upper clamp screw (UCS). 3. Now by releasing lower clamp screw (LCS), turn the telescope and bisect the ranging rod at station P. Clamp LCS after exact bisection.	**3 marks**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**b)**	4. Transit the telescope through 180^0 so that line of sight become opposite to original position 5. Now release UCS and turn the telescope to right or left (here towards right refer figure) to bisect the ranging rod at station R. Clamp UCS after exact bisection and take the reading in both windows A and B as right defection angle. 6. Repeat the above steps with face right condition to calculate average right or left defection angle.		
Q.2		**Attempt any <u>FOUR</u> of the following:**		**16**
	(a)	**State any four characteristics of contours with sketches.** **Ans:** Characteristics of contours – The characteristics of contours are described in following statements with the help of necessary sketches. 1. All the points on contour line represent same reduced level or equal elevation from reference level as shown in sketch 1. 2. Two contour lines always forms closed circuit within the boundary of drawing sheet as shown in sketch 2. 3. When the reduced levels goes on increasing at center of contour, then it represent hill whereas when the R.L's goes on decreasing at center, then it represent valley as shown in sketch 3. 4. The contour lines for steep slope in closely spaced while for gentle sloped ground it is widely spaced as shown in sketch 4. 5. The contour lines may intersect each other for overhanging cliff as shown in sketch 5. 6. The contour lines may overlap each other at a point for vertical cliff as shown in sketch 6. 7. The continuous increase and decrease in reduced level represents ridge and valley lines as shown in sketch 7. 8. The summit of four ridge lines represents saddle as shown in sketch 8. ***Note: ½ mark – Explanation and ½ mark – Sketch.***	**1 mark (Any four)**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2		 Figure No. 3 : Characteristics of Contours		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**(b)**	**Define interpolation of contour. Explain in brief the method of arithmetical calculation for interpolation of contour.** **Ans: Interpolation of contour** – The method of locating the required contour proportionally in between two points of different reduced levels, is known as interpolation of contour. Method of arithmetical calculation for interpolation of contour – In this method, the interpolation of contour is done on the basis of arithmetical calculations based of law of proportionality. Suppose the two ground points A and B has reduced level as 98.200 m and 101.800 m with horizontal equivalent 10 m. Now the distance X1 of 99m contour from point A and to locate the contour of 99m the following calculation should be done. $$\text{Distance X1} = \frac{99.000 - 98.200}{101.800 - 98.200} \times 10 = 2.22 \text{ m}$$ Similarly distances X2 and X3 of 100 m and 101 m contours from point A can be calculated as follows. $$\text{Distance X2} = \frac{100.000 - 98.200}{101.800 - 98.200} \times 10 = 5.00 \text{ m}$$ $$\text{Distance X3} = \frac{101.000 - 98.200}{101.800 - 98.200} \times 10 = 7.77 \text{ m}$$ In this way the distances X1, X2 and X3 are calculated using method of arithmetical calculations. The same distances are then converted as per scale of drawing sheet to mark points of required contour. ***Note: 1 mark for 3 illustrations each.***	**1 mark** **3 marks**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**(c)**	**Explain the procedure for establishing grade contour on ground.** **Ans:** Procedure for establishing grade contour on ground: The grade contour along hill side can be established by following procedure. 1. Suppose a grade contour of 1 in 30 is to be established on ground. The points of grade contour can be marked approximately using Abney level. 2. By setting the instrument of tripod do all temporary adjustments. Take the reading on bench mark of R.L. say 100 m as B.S. reading 0.400 m; so that H.I. will be 100.400 m. 3. Therefore R.L. of first point (40 m away in straight line) will be 100.000 – (40/30) = 98.67 m. And therefore to get this R.L. on ground, the staff reading should be 100.400 – 98.67 = 1.73 m 4. Now, the staff is held 40 m away from bench mark and up and down movement is done to get 1.73 m reading and then point is marked on ground with peg. 5. The above procedure is continued in the same straight line and corresponding points are marked on ground. 6. Finally the line joining all the marked points will give us the required grade contour of 1 in 30 accurately.	**4 marks**	**4**
	(d)	**Explain the method of repetition to measure horizontal angle using transit theodolite** **Ans:** Method of repetition to measure horizontal angle – The horizontal angle is measured very precisely using method of repetition as follows (Refer figure 4). 1. Set the instrument at station O with face left condition and do all temporary adjustments. Set the $0^0$0'0" and $180^0$0'0" reading in window A and B of horizontal circle of theodolite with face left condition and then clamp upper clamp screw (UCS). 2. By releasing lower clamp screw (LCS), turn the telescope and bisect the ranging rod at station A. Clamp LCS after exact bisection. 3. Now, release UCS and bisect the ranging rod at station B. Clamp UCS after exact bisection and take the changed reading in both windows as say the $30^0$0'0" and $210^0$0'0". 4. Now with same reading, release LCS and turn the telescope clockwise to bisect rod at A again. Clamp LCS after exact bisection. 5. Repeat above steps for two more times to get doubled and tripled to that of original.	**3 marks**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2		6. Repeat above procedure with face right condition. The average of both face reading can be taken as accurate horizontal angle AOB.	**1 mark**	**4**

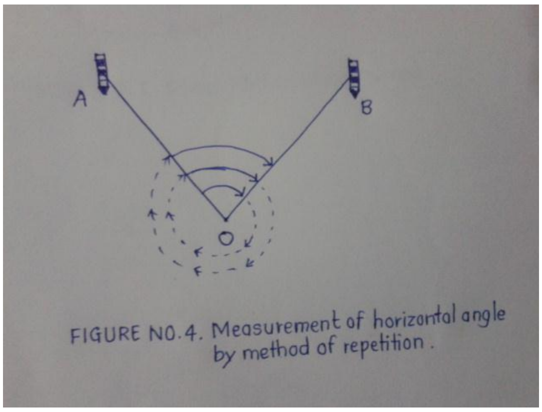


Figure No. 4 : Measurement of horizontal angle by method of repetition

(e) **The co-ordinates of two points C and D are as follows**

Point	**Co-ordinates**	
C	**982.5**	**825.2**
D	**1198.6**	**576.4**

Find the length and bearing of line CD.

Ans : Given: L_C=982.5, D_C=825.2
L_D=1198.6, D_D=576.4

Find: l (CD) =?
ɵ (CD) = ?

Solution:
Latitude of line CD i.e. $L_{CD}= L_D - L_c$ = 1198.6 – 982.5 = 216.5
Departure of line CD i.e. $D_{CD}= D_D - D_c$ = 576.4 – 825.2 = - 248.8 (01 mark) — **1 mark**

Length of line CD i.e. l (CD) = $\sqrt{(L_{CD})^2 + (D_{CD})^2}$
l (CD) = $\sqrt{(216.5)^2 + (248.8)^2}$
l (CD) = 329.808 m — **1 mark**

Reduced Bearing of line CD i.e. ɵ (CD) = $\tan^{-1}(DCD / LCD)$
ɵ (CD) = $\tan^{-1}(248.8 / 216.5)$
ɵ (CD) = 48.96 $\cong$ ***49 degree*** (S-E quadrant) — **1 mark**

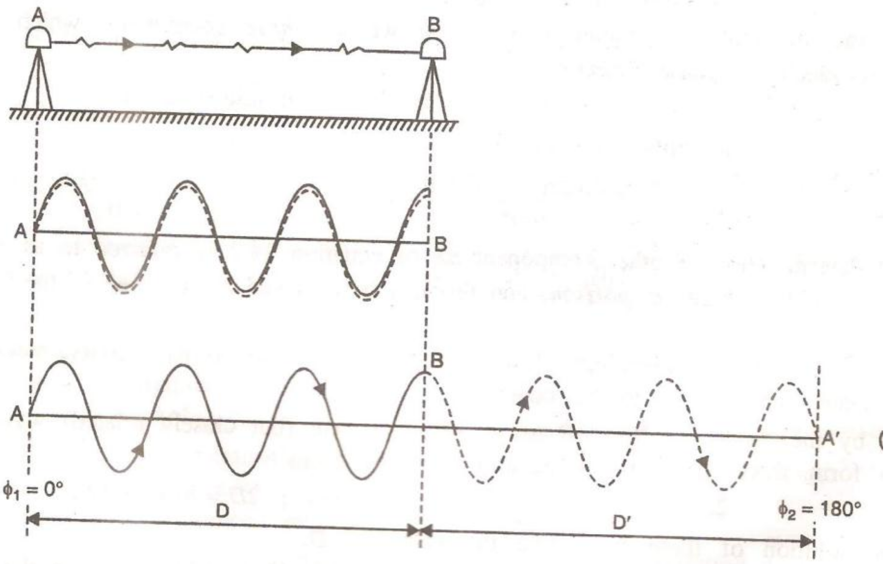
Whole Circle Bearing of line CD i.e. WCB (CD) = $180^0 - 49^0$
WCB (CD) = 131^0 — **1 mark**

Total Marks: **4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**(f)**	**State and explain temporary adjustments of theodolite.** **Ans:** Temporary adjustments of theodolite – The following operations should be done as temporary adjustments before taking readings on any theodolite. 1. Setting of theodolite on tripod stand – The theodolite should be fixed by rotating its screw head on top of tripod stand. The legs of tripod stand should be fixed on ground very firmly to ensure safety of theodolite and easiness in taking observations. 2. Centring of theodolite over prefixed survey station – The centring of theodolite can be done by either dropping stone or suspending plumb bob from bottom of tri-batch plate. Then it made to match over nail point of station peg by adjusting one of the leg. In some theodolite, optical plummet is provided for this centring. 3. Levelling of theodolite in horizontal plane – By keeping horizontal plate bubble tube (HPBT) parallel to any two foot screws, both are rotated inward or outward simultaneously to bring the bubble at center. Then by keeping HPBT perpendicular to original position, the third foot screw is rotated inward or outward to bring the bubble at center. These should be continued till in both positions, bubble of HPBT remains at center. Once bubble remains at center, levelling of theodolite is said to be completed. 4. Focussing of telescope – The focusing of telescope is done to remove parallax. First eyepiece screw is rotated to see clear image of cross-hairs. Then focussing screw is rotated to see clear image of object. Once both images (i.e. cross hairs and object) simultaneously focussing of telescope is said to be completed.	**1 mark each**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3		**Attempt any <u>FOUR</u> of the following:**		**16**
	(a)	**Enlist the component parts of digital level. State the functions of each.** **Ans:** Following are the component parts of Digital Level**:** 1. Display screen: To show the program is going on. It has high resolution. 2.Key Pad- For operating the instrument 3.Telescope- For bisecting the object at longer distance with high precision 4.Foot screws- For leveling purpose 5. Focusing screw- Internal focusing is provided, so to observe the object clearly, it is focused with focusing screw.	**1 mark each (Any four)**	**4**
	(b)	**Explain the procedure for measurement of vertical angle using digital theodolite.** **Ans:** The procedure of measurement of vertical angle using digital theodolite is as follws: 1. Mount the digital theodolite on tripod and fix it. While fixing it, tripod should be nearly leveled. 2. Set out the theodolite with its all temporary adjustments. i) Levelling – It is done by using three foot screws. ii) Focusing of telescope – done with focusing screw 3. Start the theodolite using power on button on key board. 4. Set the mode of angle as vertical angle and set the vertical angle at 0^0 0’0” by moving the telescope and clamp it. 5. Now bisect the Point may b in elevation or depression by moving the telescope up or down and clamp it. 6. The angle is displayed on display screen.	**4 marks**	**4**
	(c)	**State any four advantages of total station over other Advanced Surveying instruments.** **Ans:** Advantages of total station over other Advanced Surveying instruments are as follows: 1.Easy access to any desired program and mode of selection 2.Tri-axis compensation 3.Easy to read arrangement – The desired information is displayed 4.Automatic atmospheric correction 5.Guide message arrangement – By just pressing HELP key if guidance is required 6.Higher distance resolution 7.Two speed tangent movement 8.Detachable tri-branch facility 9. Eighteen different programmes i.e. mode of measurements.	**1 mark each (Any four)**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**d)**	**Explain the classification of EDM instruments.** **Ans.** (A) Classification based on the type of carrier wave used: (i)Instruments using visible light waves, (ii) Instruments using invisible infra-red waves, (iii) Instruments using micro-waves and (iv) Instruments using long ratio-waves. (B) Classification based on the range of instruments: (i)Short range instruments (up to 10km) for example, various infra-red distances, (ii) Medium range instruments (up to 60km) for example, Geodimeters using visible light waves, (iii) Long range instruments (up to 150km) for example, Tellurometer using micro-waves. (C) Classification based on (external) appearance of instrument (i)Mount Type instruments for example EDM is mounted on the One Second Theodolite, (ii) Built in Type for example Total Station with built in vertical sensor. (D) Classification based upon reflected or transmitted wave: (i)Reflecting Type of instrument for example Geodimeters and Infra-red distancers, (ii) Transmitting type of instrument for example Tellurometer, Total station.	**1 mark each**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**(e)**	**Explain the working principle of EDM with neat sketch.** **Ans.** The fig shows a survey line AB, the length D of which is to be measured using EDM equipment placed at ends A and B. Let a transmitter be placed at A to propagate electromagnetic waves towards B, and let a receiver B placed at B, along with a timer. If the timer at B starts at instant of transmission of wave from A, and stops at the instant of reception of incoming wave at B, the transit time foe the wave from A and B in known.	**1 mark**	
			**2 marks**	**4**
		From this transit time, and from the known velocity of propagation of the wave, the distance D between A and B can be easily computed. However this transit time is of the order of 1×10^{-6} which requires varying advanced electronics. Also it is extremely difficult to start the timer at B when the wave is transmitted at A. Hence a reflector is placed at B instead of a receiver. This reflector reflects the waves back towards A, where they are received as shown in the fig. Thus the equipment at A acts both as a transmitter as well as receiver. The double transit time can be easily measured at A. This will require EDM timing devices with an accuracy of $\pm 1 \times 10^{-9}$s.	**1 mark**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**(f)**	**Calculate the ordinates at 25m interval to set a circular curve having a long chord of 300m and versed sine of 10m.**		
		Ans.		
		A versed sine is the offset at the middle of long chord.		
		$O_0 = R - \sqrt{R^2 - (L/2)^2}$	**1 mark**	
		Where R = radius of curve.		
		L = Length of Long chord = 300m.		
		Therefore $10 = R - \sqrt{R^2 - (150)^2}$		
		R = 1130m.	**1 mark**	
		The ordinates at distance x from the midpoint may be calculated from the formula		**4**
		$O_x = \sqrt{R^2 - x^2} - (R - O_0)$		
		$O_{25} = \sqrt{(1130^2 - 25^2)} - (1130 - 10) = 9.70$m		
		$O_{50} = \sqrt{(1130^2 - 50^2)} - (1130 - 10) = 8.89$m	**2 marks**	
		$O_{75} = \sqrt{(1130^2 - 75^2)} - (1130 - 10) = 7.51$m		
		$O_{100} = \sqrt{(1130^2 - 100^2)} - (1130 - 10) = 5.56$m		
		$O_{125} = \sqrt{(1130^2 - 125^2)} - (1130 - 10) = 3.06$m		
		$O_{150} = \sqrt{(1130^2 - 150^2)} - (1130 - 10) = 0.00$m		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4		**Attempt any FOUR of the following:**		**16**
	(a)	**Write the stepwise procedure to measure area of irregular figure using digital planimeter.** **Ans:** The procedure of measurement of an irregular figure using digital planimeter is as follows: 1. Take the irregular map on the plane surface of table and fix it with clips so that while measurement it does not move. 2. Mark one starting point on boundary of that area and place the point of magnifier of tracing arm of digital planimeter. 3. Start the planimeter by pressing on button on key pad of it. Screen will be displayed. 4. Set the scale by pressing scale button on key pad. 5. Press the Start button and move tracing arm on boundary of area and end it again at its starting point. Press the end button. 6. On the screen the area of irregular figure is displayed.	**4 marks**	**4**
	(b)	**State the two applications each of GIS in land information and land environmental field.** **Ans.** Applications of GIS as follows; 1.In land information: i)Map making ii)Site selection iii)Mineral Exploration iv)Land use planning and management 2.In land environmental field: i)Environmental Impact studies ii)Natural Hazard mapping iii)Water Resources availability.	**2 marks** **2 marks**	**4**
	(c)	**Define G.I.S. Enlist the key components of G.I.S.** **Ans.** Definition: A Geographic Information System (GIS) is a computer based tool that allows you to create, manipulate, analyze, store and display information based on its location. Components of GIS: 1.Hardware- It is the computer on which GIS operates 2. Software- It provides the functions and tools needed to store, analyse, and display geographic information. Key components are a database management system (DBMS), tools for input and manipulation of geographic information, graphical user interface (GUI) for easy access to tools. 3. Data- Geographic data and related tabular data can be collected or brought from a commercial provider. 4. People- GIS users range from technical specialist who design and maintain system to those who use it to help them do their everyday work. 5. Methods- A successful GIS operates according to a well-designed plan and business rules, which are the models and **operating** practices unique to each organization.	**1 mark** **3 marks (Any three)**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**(d)**	**State any four essential characteristics of tacheometer.** **Ans.** Following are some characteristics of tacheometer: 1.The value of constant (f/i) = 100 2.The telescope should be fitted with analytic lens to have the value of (f + c) = 0 3.The telescope should be powerful, the magnification should be 20 to 30 times the diameters 4. The vision through the telescope should give a clear and bright image at a long distance.	**1 mark each**	**4**
	(e)	**How would you determine the constants of given tacheometer on field.** **Ans.** The values of tacheometric constants, i.e. additive constant (f + c), multiplying constant (f/i) for given instrument may be determined on field as follows: (A)In this method value of (f + c) is obtained by direct measurement and the value of (f/i) is computed. Steps: 1. Sight any distance object and focus it carefully. 2. Measure the distance between object glass and plane of cross hairs along the top of telescope with scale, let it be (f) focal length of objective. 3. Measure the distance (c) from object glass to the vertical axis of the instrument. 4. Measure the distance D1, D2, D3 etc. From instrument and let the corresponding staff intercepts be S1, S2, S3 etc. 5. In the formula D = (f/i).S + (f + c), Knowing (f + c) as directly measured distance in step 2 and 3 and measured distances D1, D2, D3 etc., obtain several values of (f/i) by computation and get the mean of it as the value of constant (f/i).	**4 marks**	**4**
		OR (B) An alternative method to determine the constants is to the definite distances D1 and D2 and find the corresponding staff intercepts S1 and S2 on the staff held at these positions. By substituting the values in the equation D = (f/i).S + (f + c), two simultaneous equations are obtained. D1 = (f/i).S1 + (f + c) D2 = (f/i).S2 + (f + c) These are solved to find out the two unknown quantities of (f/i) and (f + c).	**4 marks**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**(f)**	**Determine reduced level of horizontal line of sight from given data. Assume multiplying constant with analytic lens.**		

Instr. Station	Staff Station	Vertical Angle	Staff Reading	RL of B
A	**B**	**$+8^0 20'$**	**0.990, 1.555, 2.120**	**100.00m**

Constants – f/i = 100 and (f + c) = 0 As anallatic lens are used. — **1 mark**

RL of B = 100.00m

From given readings,

h = 1.555m

S = 2.12 – 0.99 = 1.13 — **1 mark**

$V = (f/i)\times S\times(\sin 2\theta)/2$

$= 100 \times 1.13 \times (\sin 2 \times 8^0 20') / 2$ — **1 mark**

$= 16.22$ m.

RL of horizontal line of sight = RL of B + h – V

= 100 + 1.555 – 16.22

RL of horizontal line of sight = 85.33 m — **1 mark**

Total Marks: 4

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5		**Attempt any <u>TWO</u> of the following:**		**16**
	(a)	**Define Closed traverse. Calculate length & bearing of line DA From following data.**		

Line	AB	BC	CD	DA
Length (m)	**258**	**321**	**180**	**?**
Bearing	**30^0**	**140^0**	**210^0**	**?**

Ans.

Closed traverse: When the lines form a traverse which ends at the starting point, it is known as closed traverse. — **1 mark**

For closed traverse ΣL = 0, ΣD = 0.

Line	Length	Be ring	Reduced Bearing(θ)	Latitude =l.cos θ	Departure = l.sin θ
AB	258	30^0	$N30^0E$	**+223.43**	**+129**
BC	321	140^0	$S40^0E$	**-245.90**	**+206.33**
CD	80	210^0	$S30^0W$	**-155.88**	**-90**
DA	?	?	θ	**l.cos θ**	**l.sin θ**

3 marks — **8**

ΣL = 0

Therefore, 223.43 - 245.90 - 155.88 + l cos θ = 0

l cos θ = 178.35 ……. Equation (I) — **1 mark**

ΣD = 0

Therefore, 129 + 206.33- 90 + l sin θ = 0

l sin θ = -245.33 ….. Equation (II) — **1 mark**

Equation (II)/ Equation (I)

Tan θ = l.sin θ / l.cos θ

= -245.33 / 178.35= 53^0 59'2"

Since Latitude is + and Departure is - , hence line DA lies in IV Quadrant

Bearing of DA = N 53^0 59'2"W = 306^0 0'58" — **1 mark**

Length of Line DA = √ **((ΣL)² + (ΣD)²)**

= √**((178.35)² + (245.33)²)**

Length of Line DA = 303.30 m

Check Departure of DA l sin θ = -245.33

l sin 53^0 59'2"= -245.33

l = 303.3 m OK. — **1 mark**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	(b)	**Define Independent Co-Ordinates. Calculate Independent Cordinates from following data showing calculations**		

Line	**Latitudes**		**Departures**	
	N	**S**	**E**	**W**
AB		**182.63**	**313.12**	
BC	**244.72**		**470.12**	
CD	**495.17**			**318.34**
DE		**268.7**		**388.46**
EA		**288.27**		**113.44**

Ans-

Independent Co-Ordinates-

The coordinates of any point when measured with respect to common origin are called as Independent Co ordinates — **1 mark**

Line	Latitudes		Departures	
	N	S	E	W
AB		182.63	313.12	
BC	244.72		470.12	
CD	495.17			318.34
DE		268.7		388.46
EA		288.27		113.44
	ΣN= 739.89	ΣS=739.6	ΣE=783.24	ΣW=820.24
	Error = ΣN- ΣS = 0.29		Error = ΣE - ΣW =37	

1 mark

8

There are error in latitude & Departure Hence apply Transit Rule

Correction In Latitudes-

Correction In latitudes = Total error in latitude x (latitude of that line/ Arithmetical sum of all latitudes)

Correction in latitude in line AB = 0.29 x (182.63/1479.49) = 0.035 — **1 mark**

Correction in latitude in line BC = 0.29 x (244.72/1479.49) = 0.048

Correction in latitude in line CD = 0.29 x (495.17/1479.49) = 0.097

Correction in latitude in line DE = 0.29 x (268.70/1479.49) = 0.053

Correction in latitude in line EA = 0.29 x (288.27/1479.49) = 0.057

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5		**Corrected Latitudes-** Corrected Latitudes = Observed Latitude ± correction in latitude		
		Corrected Latitude of Line AB = 182.63 + 0.035 = 182.665	**1 mark**	
		Corrected Latitude of Line BC = 244.72 - 0.048 = 244.672		
		Corrected Latitude of Line CD = 495.17 - 0.097 = 495.073		
		Corrected Latitude of Line DE = 268.70 + 0.053 = 268.753		
		Corrected Latitude of Line EA = 288.27 + 0.057 = 288.327		
		Correction In Departures-		
		Correction In Departure = Total error in Departure x (Departure of that line/ Arithm. sum of all Departure)		
		Correction in Departure in line **AB** = 37 x (313.12/1603.48) = **7.225**		
		Correction in Departure in line **BC** = 37 x (470.12/1603.48) = **10.848**	**1 mark**	
		Correction in Departure in line **CD** = 37 x (318.34/1603.48) = **7.346**		
		Correction in Departure in line **DE** = 37 x (388.46/1603.48) = **8.964**		
		Correction in Departure in line **EA** = 37 x (113.44/1603.48) = 2**.617**		
		Corrected Departures-		
		Corrected Departure s = Observed Departure ± correction in Departure		
		Corrected Departure of Line AB = 313.12 + 7.225 = 320.345		
		Corrected Departure of Line BC = 470.12 + 10.848 = 480.968	**1 mark**	
		Corrected Departure of Line CD = 318.34- 7.346 = 310.994		
		Corrected Departure of Line DE = 388.46 – 8.964 = 379.496		
		Corrected Departure of Line EA = 113.44 – 2.617 = 110.823		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5				

Line	Consecutive Co-ordinate				Correction	
	Lattitudes		Departures			
	N	S	E	W	L	D
AB		182.63	313.12		0.035	7.225
BC	244.72		470.12		-0.048	10.848
CD	495.17			318.34	-0.097	-7.346
DE		268.7		388.46	0.053	-8.964
EA		288.27		113.44	0.057	-2.617

Line	Corrected Consecutive Co-ordinate				Independent Co-ordinate	
	Lattitudes		Departures			
	N	S	E	W	L	D
AB		182.665	320.345		1000	1000
BC	244.672		480.968		1244.672	1480.968
CD	495.073			310.994	1739.745	1169.974
DE		268.753		379.496	1470.992	790.478
EA		288.327		110.823	1182.665	679.655
AB					1000	1000
	739.745	739.745	801.313	801.313		

2 marks

Note- Independent coordinate of First Line is assumed & coordinate may be varied.

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**(c)**			**8**

A tacheometer was fixed with anallatic lens and having multiplying constant 100 was used and the following observations were made on a staff held vertical.

Inst. Station	**HI (m)**	**Vertical angle**	**Staff at**	**Stadia reading**
P	**1.5**	**$+2^0$ 30´**	**M**	**1.20, 1.83, 2.46**
P	**1.5**	**-4^0 40´**	**Q**	**1.35, 1.85, 2.29**

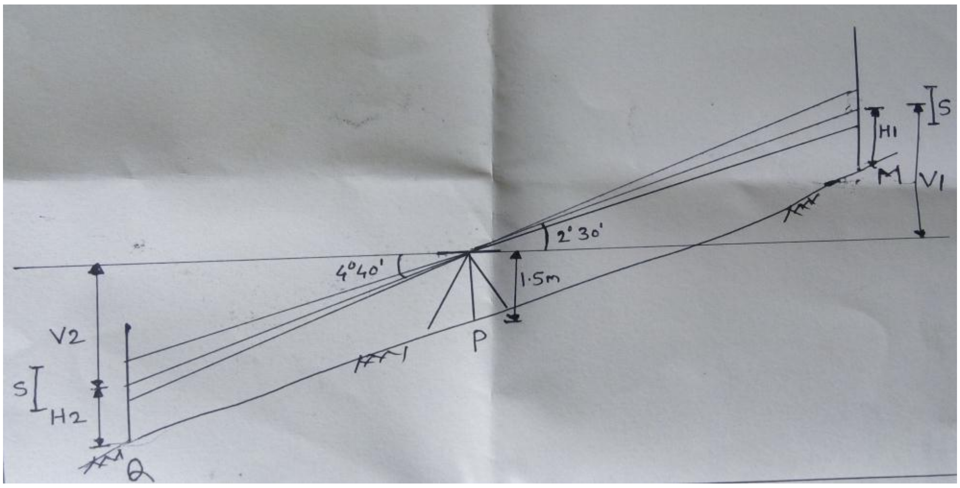
RL of Station M is 50 m. Calculate RL of P & Q and Horizontal distance PQ.

Ans-

Given:

Anallatic lens, (f+c) = 0,

f/i = 100, RL of M. = 50 m



Part (I) Distance PQ ,

θ = -4 º 40´ (depression),

S = staff intercept = 2.29 – 1.1.35 = 0.94

Horizontal distance PQ = f/i (S) cos²θ + (f+c) cosθ

= 100 (0.94) cos² 4 º 40´ + 0

Horizontal distance PQ = 93.378 m

3 marks

Part (II) RL of station P and Q

V1= Vertical distance between horizontal collimation and axial reading at M

V1 = f/i (S) sin2 θ /2 + (f+c) sin θ ,

H1= axial reading at M

θ = +2 º 30´ (Elevation)

V1 = 100 (1.26) Sin (2 x 2 º 30´)/ 2 + 0 (S = 2.46- 1.20 = 1.26)

V1= 5.49 m

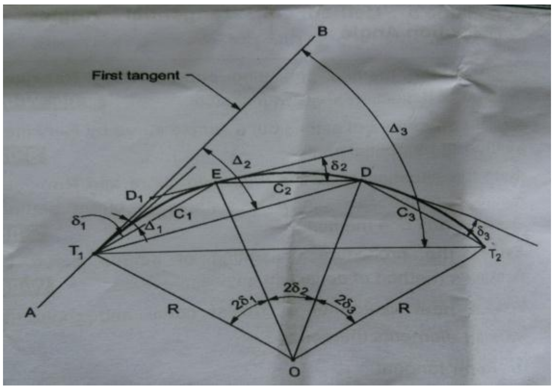
2 marks

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5		V2 = Vertical distance between horizontal collimation and axial reading at Q V2 = $f/i\ (S) \sin 2\theta /2 + (f+c) \sin\theta$, H2= axial reading at Q $\theta = -4^{o}\ 40'$ (depression), V2= 100 (0.94) Sin (2 x 4 º 40´) / 2 + 0 (S = 2.29- 1.35 = 0.94) **V2= 7.62 m**	**1 mark**	
		RL of station P = RL of M + H1 – V1 – HI = 50 +1.83 – 5.49-1.5 **RL of station P = 44.84 m**	**1 mark**	
		RL of station Q = RL of P + HI – V2 –H2 = 44.84 + 1.5 – 7.62 – 1.85 **RL of station Q = 36.87 m**	**1 mark**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6		**Attempt any TWO of the following:**		**16**

(a) **Explain the procedure to set out circular curve using Rankine's method of deflection angle using necessary sketch.**

Ans:



2 marks

1. Locate the tangent points T_1 and T_2 on the straight line AB and BC.
2.Set the theodolite at the beginning of the curve T_1
3. With the vernier A of the horizontal circle set to zero, direct the telescope towards the ranging rod at the point of intersection B and bisect it.
4. Unclamp the upper clamp screw and the vernier A to the first tangential angle (Δ_1) and the telescope being directed along T_1P.
5. T1P the length equal to the first sub chord (C1) thus fixing point P on the curve.
6. Set vernier A is equal to zero and direct the telescope toward the ranging rod fixed at the point of intersection B and bisects it.
7. Unclamp the upper clamp screw and the vernier A to the second tangential angle (Δ_2) and the telescope being directed along PQ.
8. With the zero end of chain or tape at P and with a arrow held at distance of PQ =C2 (second chord or normal chord) swing the chin about P until the line sight bisect the arrow thus fixing the second point Q on the curve.
9.Repeat the process until the last point T2 is reached

5 marks **8**

Table.

Sr.no.	Peg Interval Point	Length of chord	Deflection angle	Total Deflection angle

1 mark

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**(b)**	**Enlist Components parts of mechanical planimeter. Calculate area of figure from following data.** **i) Initial reading = 1.586** **ii) Final reading = 0.392** **iii) Multiplying constant = 100** **iv) Additive constant = 20** **v) Rotation of disc = once in reverse direction.** **Ans-** **Components parts of mechanical planimeter-** 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 four)**	**8**
		Given data, IR= 1.586 FR= 0.392 M=100 sq.cm C=20 N= -1 Formula-- **A = M (FR – IR ± 10N + C)** = 100 (0.392 – 1.586 - 10X 1 + 20) **= 880.60 sq.cm**	**4 marks**	
	(c)	**Describe layout of small building by using Total station.** **Ans-** **Layout of small building using total station**. 1. On the site plan supplied by an architect, number the columns serially and workout the co- ordinates of the column centers 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 centers 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 centers. 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 coordinates of points occupied and point to be set out. 8. This way, you will get marked the centers of rest of columns.	**1 mark each step**	**8**