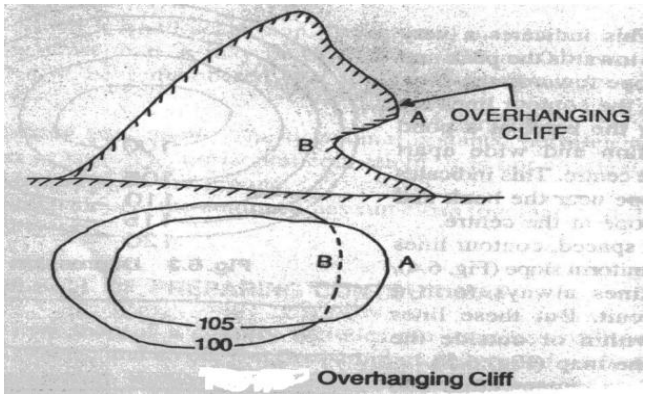
Important Instructions to examiners:

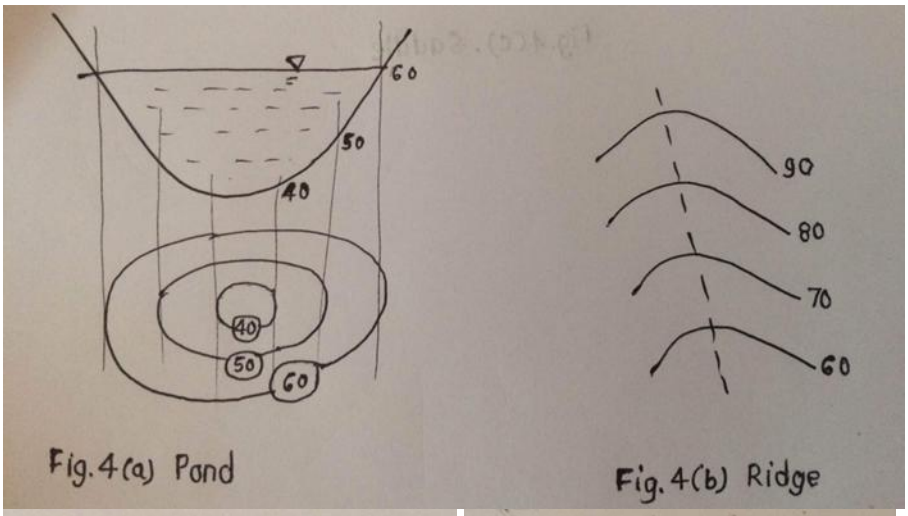
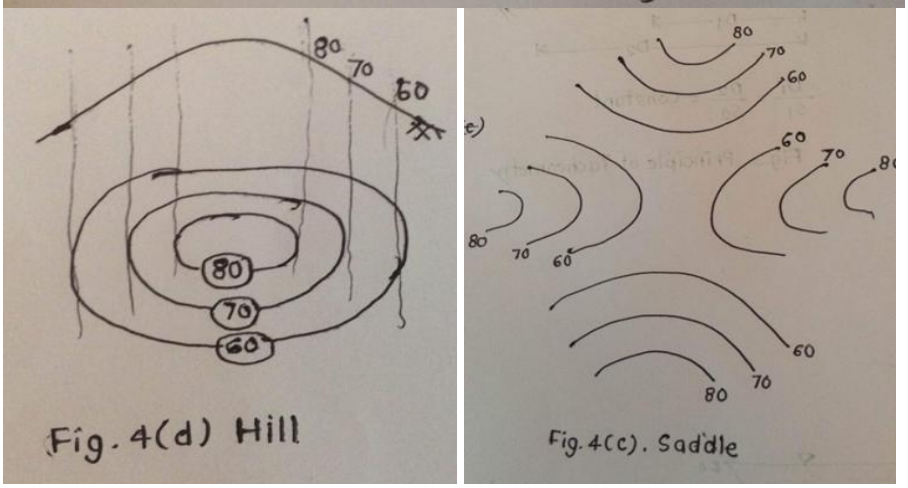
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling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

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**a)**	**Attempt any SIX of the following:**		**12**
	(i)	**In a contour map, if contours are crossing each other, what will be nature of topography? Draw the sketch to support your answer.** **Ans.** If contours are crossing or intersecting each other, then there is **overhanging cliff** as shown in figure 1 below.  	**1** **1** **2**	
	(ii)	**What is a contour map? Write any two objects of preparing contour map.** **Ans :** **Contour map :** It the map showing nature of topography of any particular field with the help of contour lines indicating reduced levels of ground.	**1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**a) (ii)**	**Objects of preparing contour map :** Contour map is prepared for the following 1. To know the nature of ground (i.e. elevation, depression, slope etc.) of the field under consideration. 2. To decide the feasible site of dam construction by knowing maximum probable reservoir storage capacity. 3. To finalise the best suitable alignment of roadway or railway by knowing earthwork calculations. 4. To excavate the canal and contour cut trenches along hillside under watershed management works.	**½ mark each**	**2**
	(iii)	**Give the simplest method of finding the area of zero of a zero circle from manufacturers table.** **Ans.** The area of zero circle can be find out simply by using following formula. **A = M x C** Where, A = Area of zero circle M = Multiplier or multiplying constant provided in manufacturers table C = Constant of planimeter provide in manufacturers table	**1** **1**	**2**
	(iv)	**Write the use of Gale's table.** **Ans.** Gale's traverse table is useful to find out independent co-ordinates of theodolite traverse by applying necessary corrections to consecutive co-ordinates of the same traverse. Further these independent co-ordinates are useful to draw the accurate traverse without linear and angular errors.	**2**	**2**
	(v)	**State any four uses of transit theodolite.** **Ans.** Transit theodolite is useful for the following. 1. To measure the horizontal and vertical angles between survey stations. 2. To measure deflection angles between survey lines. 3. To measure horizontal distances when used as tacheometer. 4. To measure vertical distances, heights of ground points. 5. To measure magnetic bearing of survey lines by attaching tubular compass to it. 6. To prolong or extend the survey line up to required destination.	**½ mark each (Any four)**	**2**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**(vi)**	**State any two situations under which tacheometry is preferred.** **Ans.** Tacheometry is preferred in following situations. 1. When horizontal distances can't be measured by chaining on highly uneven ground. 2. When vertical distances or reduced levels can't be measured due to more elevated or depressed ground using ordinary level. 3. When it is necessary to fill the details in topographic map and contour map with low degree of precision.	**1 mark each (Any two)**	**2**
	(vii)	**List any four modern survey instruments.** **Ans.** Following are the modern survey instruments. 1. Digital Level 2. Electronic Distance Meter (EDM) 3. Micro-optic Theodolite 4. Total Station 5. Global Positioning System (GPS) Device 6. Aerial Camera 7. Remote Sensors	**½ mark each (Any four)**	**2**
	(viii)	**Define degree of curve.** **Ans.** **Degree of curve :** The angle subtended at the centre by a standard chord of 30 m length, is known as degree of curve.	**2**	**2**

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>Q.1</td><td>(b)</td><td>Attempt any <u>TWO</u> of the following:</td><td></td><td>8</td></tr>
<tr><td></td><td>(i)</td><td>Differentiate between active system and passive system of remote sensing
Ans.
<table>
<tr><th>Sr. No.</th><th>Active system</th><th>Passive system</th></tr>
<tr><td>1</td><td>The system in which manmade resources of energy are used is known as active system of remote sensing.</td><td>The system in which natural sources of energy are used is known as passive system of remote sensing.</td></tr>
<tr><td>2</td><td>The electromagnetic waves are transmitted and reflected back from ground to record the data.</td><td>The natural sunrays are allowed to impact on ground objects and received back from earth surface to collect data.</td></tr>
<tr><td>3</td><td>The active remote sensors like satellite or airborne sensors, microwave sensors, RADAR etc. Are useful.</td><td>The passive remote sensors like film photography, infrared and radiometers are useful.</td></tr>
<tr><td>4</td><td>It gives more accurate details of ground objects even from higher elevation.</td><td>This system may give less accurate outputs because of variation in sunlight.</td></tr>
<tr><td>5</td><td>It is widely applicable in flood, earthquake disaster management and subsoil exploration</td><td>This system is limitedly useful in land use and land cover analysis and small scale mapping.</td></tr>
</table></td><td>1 mark each (any four)</td><td>4</td></tr>
<tr><td></td><td>(ii)</td><td>What are the checks applied in case of
1. Closed traverse 2. Open traverse
Ans.
1. Checks applied in closed traverse :
a. The sum of all measured included angles should be equal to (2N-4)x90^0; where N=Number of sides of closed traverse.
b. The sum of all calculated exterior angles should be equal to (2N+4)x90^0; N=Number of sides of closed traverse.
c. The sum of all deflection angles should be equal to 360^0.
d. The fore bearing of last line of closed traverse should be equal to back bearing + or – 180^0; measured at first station.</td><td>1 mark each (any two)</td><td></td></tr>
</table>

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**b) (ii)**	**2. Checks applied in open traverse :** a. For long and precise open traverse, an angular error is determined by astronomical observations at suitable intervals. b. The suitable cut-off lines are taken on accessible stations to make temporary closed traverse. Then the difference of fore and back bearings of these cut-off lines should be 180^0. c. The lines joining from any specific station are plotted on sheet. Then the bearings of these lines are checked ensuring that all are passing through that specific station.	**1 mark each (any two)**	**4**
	(iii)	**Draw neat sketch of contour for the following. Assume suitable contour values and show the same.** **1.Pond 2. Ridge 3. Saddle 4. Hill** **Ans.**  	**1 mark each**	**4**

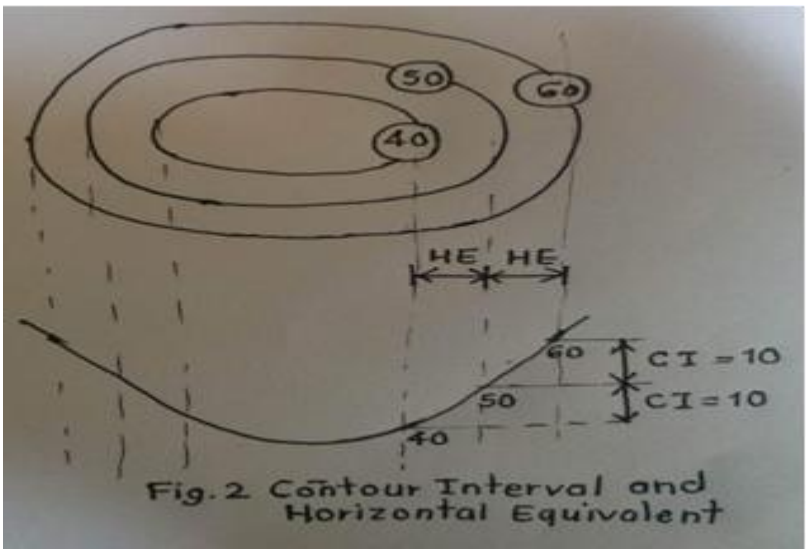
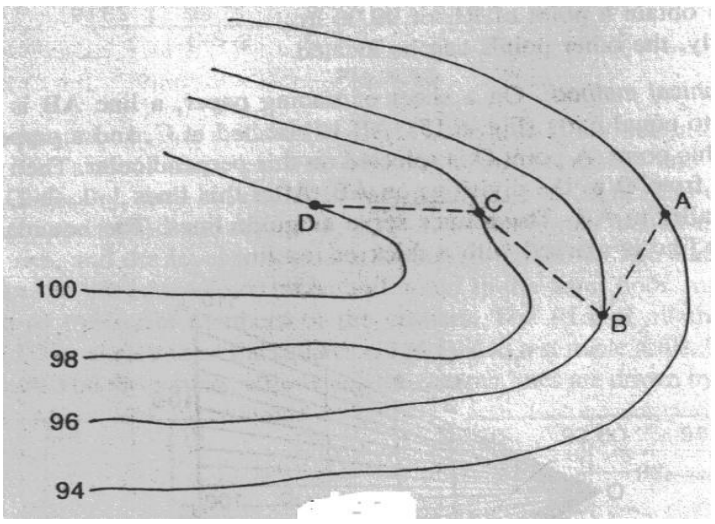
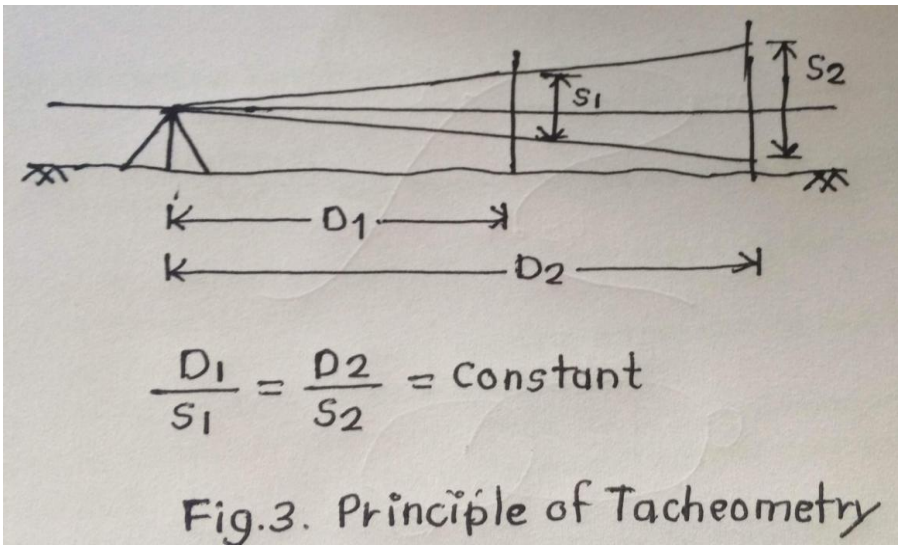
<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>Q.2</td><td></td><td>Attempt any <u>FOUR</u> of the following:</td><td></td><td>16</td></tr>
<tr><td></td><td>a)</td><td>Differentiate between contour interval and horizontal equivalent. (Minimum two points) Draw plan and section view to support your answer.
Ans.
<table>
<tr><th>Sr. No.</th><th>Contour Interval</th><th>Horizontal Equivalent</th></tr>
<tr><td>1</td><td>It is the vertical distance between two successive contours.</td><td>It is the horizontal distance between two successive contours.</td></tr>
<tr><td>2</td><td>It remains constant irrespective of nature of ground</td><td>It varies with respective slope of ground</td></tr>
</table>


Fig. 2 Contour Interval and Horizontal Equivalent</td><td>1 mark each

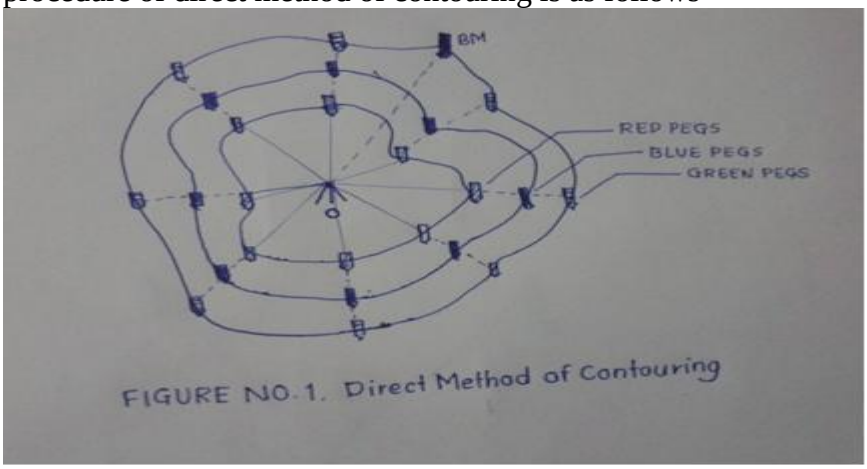
1 mark for plan

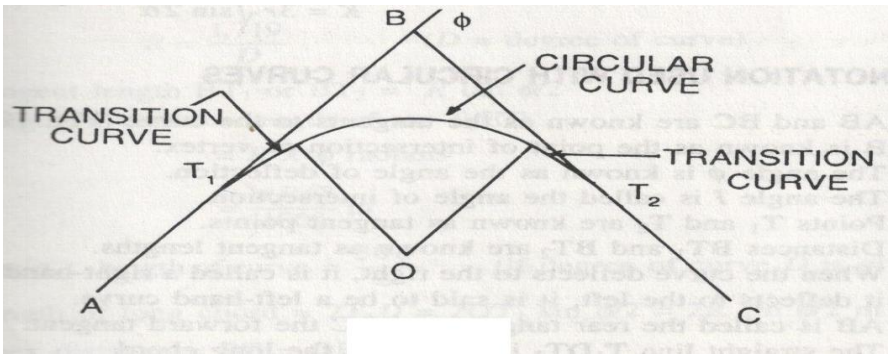
1 mark for section</td><td>4</td></tr>
<tr><td></td><td>b)</td><td>Define grade contour. Give the procedure to locate grade contour on contour map with suitable sketch.
Ans.
Grade Contour - It is the contour established on a specific grade or gradient along the hill side.
OR
The line joining the points of equal grade or gradient is termed as grade contour.</td><td>1</td><td></td></tr>
</table>

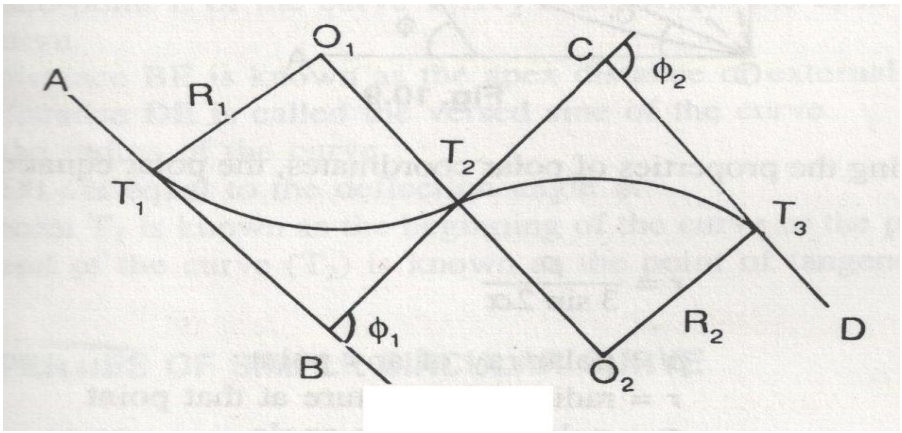
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**b)**	**Procedure for establishing grade contour on ground :** The grade contour along hill side can be established by following procedure. **1.** Suppose a grade contour of 1 in 30 is to be established on ground. The points of grade contour can 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.  	**2** **1**	**4**

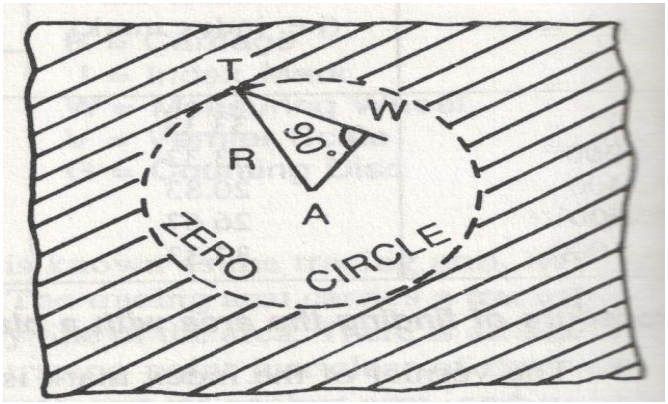
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**c)**	**Calculate the area of figure in hectares, drawn to scale of 1 cm = 120 m, from the following data – I.R. = 2.695, F.R. = 9.148. Zero of dial passed the fixed index mark twice in clockwise direction. Area corresponding to one revolution of the roller is 100 sq.cm. Anchor point was outside the figure.** **Ans.** **Given :** I.R. = 2.695, F.R. = 9.148, N = +2, M = 100 sq.cm., C = 0 (anchor outside) Scale of Map 1cm=120m. **Find :** Area of figure in Ha = ? **Solution :** By formula, A = M (F.R. – I.R. ±10N + C) A = 100 (9.148 – 2.695 + 10 x 2 + 0) A = 100 (26.453) A = 2645.3 sq.cm. 1 cm = 120 m A = 2645.3 x 120x 120 sq.m. A = 38092320 sq.m. To calculate area in Ha, use 1 Ha = 10000 sq.m. A = 38092320/ 10000 A = 3809.232Hectares.	**1** **1** **1** **1**	**4**
	d)	**Define tacheometry. State the principle of tacheometry with sketch.** **Ans.** **Tacheometry :** It is the branch of angular surveying in which horizontal and vertical distances are determined from instrumental observations only, is known as tacheometry. **Principle of tacheometry :** As the distance between instrument station and staff station increases, the staff intercept also increases; so that the ratio of horizontal distance to corresponding staff intercept remains constant as shown below in figure 3  Fig.3. Principle of Tacheometry	**1** **2** **1**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**e)**	**State any four uses of digital theodolite.** **Ans.** The uses of digital theodolite are as follows. 1. To measure horizontal angle vey precisely up to one second. 2. To measure vertical angle accurately up to one second. 3. To set out control points of the particular field. 4. To take reduced levels of ridge and valley lines accurately. **5.** To determine horizontal distance more precisely	**1 mark each (Any four)**	**4**
	f)	**Find the length and bearing of line AB, if the co-ordinates of A and B are as follows.** **Station / Northing / Easting** **A / 1282.5 / 939.8** **B / 900.2 / 766.4** **Ans.** **Given –** $L_A = 1282.5$, $D_A = 939.8$ $L_B = 900.2$, $D_B = 766.4$ **Find –** l (AB) = ? ɵ (AB) = ? **Solution –** Latitude of line AB i.e. $L_{AB} = L_B - L_A$ $= 900.2 - 1282.5 = -382.3$ Departure of line AB i.e. $D_{AB} = D_B - D_A$ $= 766.4 - 939.8 = -173.4$ Length of line AB i.e. $l(AB) = \sqrt{((L_{AB})^2 + (D_{AB})^2)}$ $l(AB) = \sqrt{((382.3)^2 + (173.4)^2)}$ **l (AB) = 419.786 m** Reduced Bearing of line AB i.e. $\theta(AB) = \tan^{-1}(D_{AB} / L_{AB})$ $\theta(AB) = \tan^{-1}(173.4 / 382.3)$ **θ (AB) = 24.39^0** (S-W quadrant) Whole Circle Bearing of line AB i.e. WCB (AB) = $180^0 + 24.39^0$ **WCB (AB) = 204.39^0**	½ ½ **1** **1** **1**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3		**Attempt any FOUR of the following:**		**16**
	a)	**What are the different methods of contouring? Describe any one method along with sketch . Also write the situation where it is suitable** **Ans.** There are two methods of contouring:- 1. Direct Method 2. Indirect Method – a. By squares b. By cross section c. By tacheometric **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. 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 300 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. **(Note:- any other method from above should be considered)**	**1** **2 mark for explanation** **1 mark for situation**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**b)**	**State the component parts of micro optic theodolite . How it is superior to a transit theodolite. Also write the situation where it is suitable.** **Ans.** **Component parts of micro optic theodolite** 1) Telescope 2) Magnification with standard eyepiece. 3) Level tube 4) Foot screws. 5) Tribatch & Trivet 6) Optical micrometer 7) Changing nob 8) Horizontal circle 9) Verticle circle. **Superior to Transit theodolite :** 1) It is a recent development in surveying instrument which gives the 1" accuracy in measuring the angle. 2) This instrument is most suitable 3) This instrument is durable for harsh environments. 4) It is simple in use.	**½ mark each (Any four)** **1 mark each (Any two)**	**4**
	c)	**Give the classification of curve and Define** **1.Transition curve 2. Reverse curve** **Ans.** Classification of curve is as follows- 1) **Horizontal curve** a) Simple curve b) Compound curve c) Reverse curve d) Transition curve e) Lemniscate curve 2) **Vertical curve** a) Summit curve b) vally curve **Transition curve:-** A curve of variable radius is known as a transition curve .In railways ,such a curve is provided on both sides of a circular curve to minimize super elevation  	**1** **1** **1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**c)**	**Reverse curve:-** A reverse curve consist of two arc bending in opposite directions ,their centers lie on opposites sides of the curve . They have one common tangent.  	**1**	**4**
	d)	**State any four applications of remote sensing in civil engineering.** **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 each (Any four)**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**e)**	**What is meant by zero circle? State the advantages of digital planimeter over polar planimeter.** **Ans.** **Zero circle:-** When the tracing point is moved along a circle without rotation of the wheel i.e. when the wheel slides without any change in reading ,the circle is known as the zero circle or circle of correction.	**1**	
			**1**	
		Advantages of digital planimeter - 1) It does not required to take the reading. 2) No calculations are required for area. 3) It gives more accurate reading 4) Less time required for measurement	**½ mark each**	**4**
	f)	**Enlist the advantages and disadvantages of total station** **Ans:-** **Advantages of Total station -** 1) Great speed of the work 2) Better accuracy in the measurements 3) Low power consumptions 4) Less time required for work. 5) Less man power required	**½ mark each (any four)**	
		Disadvantages of Total station - **1)** Its high initial cost **2)** There are no effective checks over its measurements.	**1 mark each**	**4**
Q.4		**Attempt any <u>FOUR</u> of the following:**		**16**
	a)	**Calculate the ordinates at 7.5 m intervals for a circular curve, given that the length of long chord is 80m and radius of curve is 130m . use exact formula.** **Ans:-** Given data :- Length of long chord L=80m Radius=130m, Ordinates=7.5m,		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4		Take half length of long chord=80/2=40m **Mid ordinate**	**1**	
		$Oo = R-\sqrt{(R)^2-(L/2)^2}$ $= 130-\sqrt{(130)^2-(80/2)^2}$ $= 6.31m$	½	
		$O_x = \sqrt{(R)^2-(X)^2} - (R-Oo)$	½	
		$O_{7.5} = 6.10m$	½	
		$O_{15} = 5.44m$	½	
		$O_{22.5} = 4.35m$	½	
		$O_{30} = 2.80m$	½	**4**
		$O_{37.5} = 0.78m$		
		$O_{40} = 0m$		
	b)	**Define following terms and give any two components of each :** **1. GIS 2. GPS**		
		Ans.		
		GIS:- A geographic information system is a computer based tool that allows you to create, manipulate, analyze ,store & display information based on its location.	**1**	
		Components:- 1) hardware 2) Software	**1**	
		GPS:- A global positioning system is a satellite navigation system used to determine ground position &location speed and direction.	**1**	**4**
		Components:- 1) Antenna 2) Radio frequency	**1**	
	c)	**Explain temporary adjustments of digital level.**		
		Ans.		
		Temporary adjustment of digital level:- 1) Setup stability:- Set tripod legs wide apart to increase the stability of the setup. 2) Centering:- Setup the tripod roughly above the station point .The tripod head plate should be approximately horizontal. Hook the plumb line into the retaining screw and set up the tripod roughly centered above the ground mark. 3) Levelling and fine centering:-a)Align the control unit parallel the imaginary connecting line between two tribracth screws. 4) Level the instrument in the telescope axis and rectangularly to it by means of the tribratch screws. 5) Shift the tribrach on the tripod head plate until the plumb line is hanging centrally above the ground mark repeat the leveling various time if required. 6) Telescope focusing the cross hairs	**1 mark for each step**	**4**

Q.4 d) **The areas enclosed by contours in lake are as follows :**

Contour (m)	250	255	260	265	270
Area (m^2)	2080	8500	16500	25200	33700

Calculate the volume of water between the contours 250m and 270 m by

1. Trapezoidal formula 2. Prismoidal formula

Ans.

Given data :-

D=5m,

A1=2080M^2, A2=8500M^2, A3=16500M^2, A4=25200M^2, A5=33700M^2. **1**

Volume by Trapezoidal formula= D/2(A1+A5+2(A2+A3+A4)) ½

= 5/2(2080+33700+2(8500+16500+25200)) ½

=340450M^3 ½

Volume by Prismoidal formula= D/3(A1+A5+4(A2+A4)+2(A3)) ½

= 5/3(2080+33700+4(8500+25200)+ 2 x 16500) ½

=339300M^3 ½

4

e) **What is the difference between a theodolite and a tacheometer. Give any two characteristics of tacheometer**

Ans.

Sr.No	Theodolite	Tacheometer
1	It is most accurate instrument used for measurement of horizontal and vertical angle.	Tacheometer is usually a transit theodolite having a stadia diaphargm
2	In case of theodolite , the distance is measured on the field by chain or tape	In case of tacheometer distance is calculated by direct formula
3	Suitable for plane and hilly areas with less obstacles.	Suitable in case of obstruction like steep and broken ground.
4	More stations are required to take reading on field.	Less stations are required to take reading on field

1 mark each (any two)

characteristics of tacheometer –

1. The value of constant f/i = 100
2. The telescope should be powerful, the magnification should be 20 to 30 times the diameter
3. The telescope should be fitted with anallatic lens to have the value of f +c = 0
4. The vision through the telescope should give a clear and bright image at a long distance.

1 mark each (any two)

4

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**f)**	**Give the main features of total station** **Ans.** 1. Easy access to any desired programme and mode of selection 2. Automatic atmospheric correction 3. Guide message arrangement 4. Higher distance resolution 5. Two speed tangent resolution 6. Tri axis compensation 7. East to read arrangement 8. Detachable tribranch facility	**1 mark each (any four)**	**4**
Q.5		**Attempt any <u>TWO</u> of the following:**		**16**
	a)	**Calculate the corrected consecutive co-ordinates for the following observations of traverse.**		

Line	Length (m)	Point	Consecutive Coordinates	
			Latitude	Departure
AB	**705**	**A**	**+ 655.19**	**- 260.29**
BC	**952.5**	**B**	**+127.07**	**+943.99**
CD	**645**	**C**	**- 628.47**	**+145.54**
DA	**844.5**	**D**	**- 151.48**	**- 830.80**

Ans.

Line	Length (m)	Point	Consecutive coordinates	
			Latitude	Departure
AB	705	A	+ 655.19	- 260.29
BC	952.5	B	+127.07	+ 943.99
CD	645	C	- 628.47	+ 145.54
DA	844.5	D	- 151.48	- 830.80
			$\sum L = +2.31$	$\sum D = -1.56$

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 = 2.31 x (705/3147) = 0.517 ½

Correction in latitude in line BC = 2.31 x (952.5/3147) = 0.699 ½

Correction in latitude in line CD = 2.31 x (645/3147) = 0.47 ½

Correction in latitude in line DA= 2.31 x (844.5/3147) = 0.62 ½

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**a)**	**Corrected Latitudes**- Corrected Latitudes = Observed Latitude ± correction in latitude Corrected Latitude of Line AB = 655.19 - 0.3495= 654.673 Corrected Latitude of Line BC = 127.07 - 0.699 = 126.371 Corrected Latitude of Line CD = 628.47 + 0.47 = 628.94 Corrected Latitude of Line DA = 151.48 + 0.62 = 152.1 **Correction In Departures**- Correction In Departure = Total error in Departure x (Departure of that line/ Arithmetical sum of all Departure) Correction in Departure in line AB = 1.56 x (705/3147) = 0.3495 Correction in Departure in line BC = 1.56 x(952.5/3147) = 0.4721 Correction in Departure in line CD = 1.56 x(645/3147) = 0.3197 Correction in Departure in line DA = 1.56 x (844.5/3147) = 0.4186 **Corrected Departures**- Corrected Departures = Observed Departure ± correction in Departure Corrected Departure of Line AB = - 260.29+0.3495 = -259.94 Corrected Departure of Line BC = + 943.99+ 0.4721= +944.462 Corrected Departure of Line CD = +145.54 + 0.3197 = +145.8597 Corrected Departure of Line DA = - 830.80 + 0.4186= -830.3814	½ ½ ½ ½ ½ ½ ½ ½ ½ ½ ½ ½	**8**

Line	Consecutive Co-ordinate				Correction	
	Lattitudes		Departures			
	N	S	E	W	L	D
AB	655.19			260.29	-0.517	+0.3495
BC	127.07		943.99		-0.699	+0.4721
CD		628.47	145.54		+0.47	+0.3197
DA		151.48		830.80	+0.62	+0.4186

Line	Corrected Consecutive Co-ordinate			
	Lattitudes		Departures	
	N	S	E	W
AB	654.673			259.94
BC	126.371		944.462	
CD		628.94	145.859	
DA		152.1		830.381
	781.04	781.04	1090.32	1090.32

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**b)**	**A tacheometer was set up at station A and following readings were obtained on a staff held vertically.**		

Station	Staff Station	Vertical Angle	Hair Reading
A	B.M.	$+7^0 30'$	0.900,1.175,1.530
B	B	$-2^0 20'$	1.125,1.330,1.445

The constants of instrument were 100 and 0.10.Find the horizontal distance AB and R.L. of B, if R.L. of B.M. is 500.00m.
Ans.
Given:
Anallatic lens, (f+c) = 0.1,
f/i = 100, RL of BM. = 500m

Part (I) RL of instrument station
$\theta = +7^o 30'$ (Elevation),
S_1 = staff intercept = 1.53 – 0.9 = 0.63
V_1 = Vertical distance between horizontal collimation and axial reading at BM — **1**

$V_1 = f/i\ (S) \sin 2\theta /2 + (f+c) \sin \theta$,
h_1= axial reading at BM = 1.175
$\theta = +7^o 30'$ (Elevation)
V_1= 100 (0.63)sin (2 x $7^o 30'$)/ 2 + 0.1sin$7^o 30'$ — **1**
V_1= 8.166 m
RL of instrument station = RL of BM + $h_1 – V_1$
= 500+1.175-8.166 — **1**
= 493.00m

V_2 = Vertical distance between horizontal collimation and axial reading at B
$V_2 = f/i\ (S_2) \sin 2\theta /2 + (f+c) \sin \theta$,
h_2 = axial reading at B — **1**
$\theta = -2^o 20'$ (depression),
S_2 =1.445 -1.125 = 0.32

V_2= 100 (0.32) Sin (2 x2 $^o 20'$) / 2 + 0.1sin$2^o 20'$ — **1**
= 1.3058

RL of station B = RL of A – h_2 - V_2 — **1**
= 493 – 1.3058 -1.33
= 490.364 m
Horizontal distance AB = f/i (S) $\cos^2\theta$ + (f+c) $\cos\theta$ — **2**
= 100 (0.32) $\cos^2 2^o 20'$ +(0.1)cos $2^o 20'$
= 32.05m — **8**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**c)**	**Enlist any eight components of transit theodolite and write their functions.** **Ans.** A transit theodolite consists of the following essential parts: **1) Levelling head:** It supports the main working parts of the instrument and screws on to a tripod. Head comprises two parts: a) A leveling base and trivet fitted with leveling foot screws –for leveling the instrument it is used. b) A movable head – It is used for centering the vertical axis accurately over the station point **2) A lower circular horizontal metal plate** – It carries a graduated circular arc which is used for taking readings **3) The upper plate –** a) It carries an index and vernier to read fine reading on graduated horizontal circle. b) Standards – The upper plate also carries standards used for supporting the telescope c) A spirit level – It is used for leveling the instrument. **4) Telescope** – It is used for observation and bisection of the object. **5) A vertical circle –** It is provided with circular graduated arc which is generally divided into four quadrants and is used for measurement of vertical angle. **6) A lower clamp and lower tangent screw** – A lower clamp clamps the lower plate and its outer axis to the leveling head The lower tangent screw enables finely controlled circular motion of it. **7) An upper clamp and upper tangent screw -** An upper clamp clamps the upper to lower one, and the upper tangent screw finely controlled circular motion about vertical axis. **8) A diaphragm –** It is provided with cross hairs in telescope to give a definite line of sight. **9) A vertical circle clamp and tangent screw -** A vertical circle clamps the vertical circle and tangent screw enables finely controlled circular motion of it.	**1 mark for each component and function (any eight)**	**8**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**a)**	**Attempt ant <u>TWO</u> of the following** **Two tangents intersect at a chainage of 1250m. The angle of intersection is 145^0.Calculate all the necessary data for setting out a curve of radius 250m by deflection angle method. Take peg interval as 20m and prepare setting out table**. **Ans.** Given : Angle of intersection I = 145^0 Chainage of intersection point = 1250 m Radius of curve = 250m Peg interval = 20m Solution- 1. **Deflection angle** = $Ø = 180^0$ – Angle I $= 180^0 - 145^0$ $= 35^0$ 2. **Tangent length** = $BT_1 = BT_2 = R. \tan Ø/2$ $= 250. \tan(35/2)$ $= 78.82$ m 3. **Chainage of first tangent point T_1**= Chainage of intersection point – Tangent length = 1250-78.82 = 1171.18 m 4. **Length of curve** = $(\pi R Ø)/ 180$ $= (\pi \times 250 \times 35)/ 180$ = 152.72 m 5. **Chainage of tangent point T_2** = Chainage of Tangent point T_1 + length of curve = 1171.18 + 152.72 = 1323.9 m 6. **Chainage of peg P_1 on the curve** = 1190 m (Next to T_1) 7. **Length of first sub chord** = 1190- 1171.18 = 18.82 m 8. Since the peg interval is 20 m , next pegs will have chainage as follows: P_2 = 1210 m P_3 = 1230 m P_4 = 1250 m P_5 = 1270 m P_6 = 1290 m P_7 = 1310 m T_2 = 1323.9 m	½ ½ ½ ½ ½ **1**	**16**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**a)**	9. **The of last sub chord=** 1323.9 – 1310 =13.9 m **10. Calculation of deflection angle** $\delta_1 = 1718.9 \times (l_1/ R)$ $\delta_1 = 1718.9 \times (18.82/ 250)$ $\delta_1 = 129' = 2^0 9'$ δ_2 to $\delta_7 = 1718.9 \times (20/ 250)$ $= 137' = 2^0 17'$ $\delta_8 = 1718.9 \times (l_1/ R)$ $\delta_8 = 1718.9 \times (13.9/ 250)$ $\delta_8 = 96' = 1^0 36'$ **11. Calculation of total deflection angles =** a. $\Delta_1 = \delta_1 = 2^0 9'$ b. $\Delta_2 = \Delta_1 + \delta_2 = 2^0 9' + 2^0 17' = 4^0 26'$ c. $\Delta_3 = \Delta_2 + \delta_3 = 4^0 26' + 2^0 17' = 6^0 43'$ d. $\Delta_4 = \Delta_3 + \delta_4 = 6^0 43' + 2^0 17' = 9^0 00'$ e. $\Delta_5 = \Delta_4 + \delta_5 = 9^0 00' + 2^0 17' = 11^0 17'$ f. $\Delta_6 = \Delta_5 + \delta_6 = 11^0 17' + 2^0 17' = 13^0 34'$ g. $\Delta_7 = \Delta_6 + \delta_7 = 13^0 34' + 2^0 17' = 15^0 51'$ h. $\Delta_8 = \Delta_7 + \delta_8 = 15^0 51' + 2^0 17' = 17^0 27'$ Check = Ǿ / 2 = 35^0 / 2 = $17^0 30'$ Above results are tabulated as below-	**1 ½** **1 ½** **1**	**8**

Peg or point on curve	Chainage (m)	Chord length (m)	Deflection angle (δ_n)	Total deflection angle (Δ_n)	Remark
T_1	1171.18	-	-	-	First tange t point
P_1	1190	18.82	$2^0 9'$	$2^0 9'$	-
P_2	1210	20	$2^0 17'$	$4^0 26'$	-
P_3	1230	20	$2^0 17'$	$6^0 43'$	-
P_4	1250	20	$2^0 17'$	$9^0 00'$	-
P_5	1270	20	$2^0 17'$	$11^0 17'$	-
P_6	1290	20	$2^0 17'$	$13^0 34'$	-
P_7	1310	20	$2^0 17'$	$15^0 51'$	-
T_2	1323.9	13.9	$1^0 36'$	$17^0 27'$	Second tangent point

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**b)**	**Describe layout of a small building by using total station.** **Ans.** Layout of a small building by using total station : 1. On the plan supplied by an architect, number the column serially from left to right and top to bottom starting from top left corner. 2. Work out coordinates of column centre with respect to one plot corner or well defined point, assuming line parallel to any one face of building as meridian. 3. Create an excel document with 4 independent columns one for column number and rest three for N, E & H coordinates. Upload this file to total station by using transfer software provided with instrument. 4. Set the total station at site at a point with respect which the coordinates of column centre are work out. Initiate the total station by proving with the coordinates of station and by orienting the telescope along the reference meridian. 5. Now, activate the setting out programme of the total station. Open the uploaded file & bring in the coordinates of any column to be set out. Hold prism pole at tentative position of that column on ground, bisect it & get measured its coordinates. 6. In next reading machine will display the discrepancies in the coordinates of the point & point to be set out. Direct the reflector man accordingly to occupy the new position, bisect him again & get measured its coordinates to know the discrepancy. 7. Repeat the process till you get no discrepancy in the coordinates of point occupied & point to be set out. In this way Get marked centres of rest of the columns. 8. Check the accuracy of the process of setting out by comparing the diagonal distance between the extreme column centres to their calculated values.	**1 mark for Each point**	**8**

Q.6 c) Following are the lengths and bearings of a closed traverse ABCDA.

Line	**AB**	**BC**	**CD**	**DA**
Length (m)	**260**	**240**	**250**	**?**
Bearing	**341^0**	**295^0**	**147^0**	**?**

Determine length and bearing of line DA

Ans.

Line	Length (m)	Bearing	Reduced bearing
AB	260	341^0	N 19^0 W
BC	240	295^0	N 65^0 W
CD	250	147^0	S 33^0 E
DA	?	?	?

1

Consecutive Latitude (L cos Θ)	Consecutive Departure (L sin Θ)
+ 245.835	- 84.647
+ 101.428	-217.514
- 209.667	+ 136.159
$\sum$ L = 137.596	$\sum$ D = - 166.00

3

For a closed traverse $\sum L = 0, \sum D = 0$ **1**

Length of line DA $= \sqrt{(L^2) + (D^2)}$

$= \sqrt{(137.596^2) + (166.00^2)}$ **1**

$= 215.61$m

$\text{Tan } \Theta = D/L$ **1**

$= 166.00/137.596$

$\Theta = 50.34^0$ **1**

Bearing of line DA = N $50^0$20’41” W

8