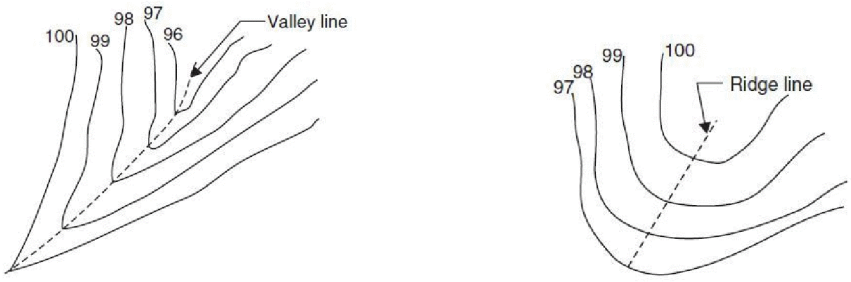
MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)

WINTER– 18 EXAMINATION

Subject Name: Advanced Surveying **Model Answer** 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 candidate and 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 model answer.
6) In case of some questions credit may be given by judgement 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.

Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1	a)	***Attempt any SIX of the following***	**(12)**
	(i) Ans.	***Define contour interval and horizontal equivalent.*** **Contour interval** The vertical distance between two successive contours is called "Contour Interval". **Horizontal Equivalent** The horizontal distance between any two successive contours is called "Horizontal Equivalent".	01 M 01 M
	(ii) Ans.	***Draw contour of Valley and Ridge line.*** 	01 M for each
	(iii) Ans.	***State any four uses of transit theodolite.*** Following are the uses of transit theodolite. i) To measure horizontal angle. ii) To measure vertical angle. iii) To measure magnetic bearing of survey line. iv) To prolong a straight line.	1/2 M for each

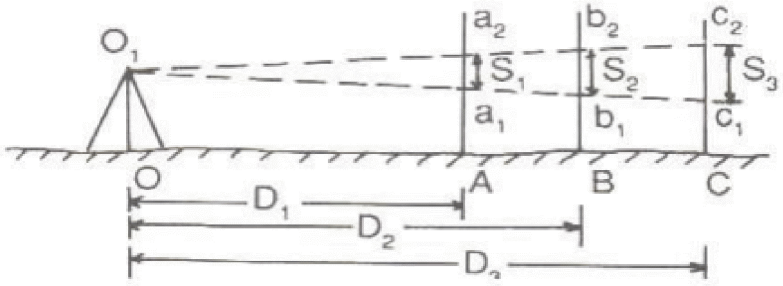
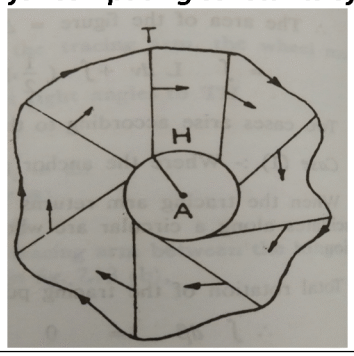
	(iv) **Ans.**	***Define the terms – Latitude and Departure.*** **Latitude :** Projection of survey line parallel to meridian is called as "Latitude". **Departure:** Projection of survey line perpendicular to meridian is called as "Departure".	01 M for each
	(v) **Ans.**	***What is anallatic lens.*** Additional lens provided in the telescope between the object glass and eye piece is known as " Annalatic lens". It eliminate constant (f+c) as the value of (f+c) when annalitic lens is provided is zero.	02 M
	(vi) **Ans.**	***List any four modern surveying instruments.*** Following are the modern surveying instruments 1) Total Station 2) One Second Micro Optic Theodolite 3) Electronic Digital Theodolite 4) Digital level 5) Remote Sensing 6) GPS 7) Aerial camera	Any four 1/2 M for each
	(vii) **Ans.**	***Define compound curve and reverse curve.*** **Compound Curve:** A compound curve consists of two arc of different radius curving in the same direction. The centers of the two arc situated on the same side of the curve. **Reverse Curve:** A reverse curve consists of two arcs of equal or different radius curving in opposite direction with a common tangent. The two centers are on the opposite sides of a common tangent.	01 M for each
	(viii) **Ans.**	***Enlist type of curves used in road and railway alignment.*** Following are the curve used in road and railway alignment. **1. Horizontal Curve** i) Simple Curve ii) Compound Curve iii) Reverse Curve iv) Transition Curve v) Lemniscates Curve **2. Vertical Curve** i) Summit Curve ii) Valley Curve	01 M 01 M
Q.1	b)	**Attempt any <u>TWO</u> of the following**	**(08)**
	(i) **Ans.**	***State the methods of locating contours with merits and demerits of each.*** Following are the methods of locating contours **1) Direct Method** **2) Indirect Method** i) By cross section ii) By Squares(Block Contouring) iii) Tachometric Method **Merits of Direct method :-** 1) It gives accurate contour lines. 2) This method can be controlled from single Station. **Demerits of Direct method :-** 1) This Method is Very Slow and tedious. 2) This method is applicable for small areas only. **Merits of Indirect method :-** 1) This method is quicker and less tedious. 2) This method is applicable for large areas. **Demerits of Indirect method :-**	02 M 1/2 M 1/2 M 1/2 M

		1) It gives less accurate contour lines	1/2 M
	(ii) Ans.	***Describe layout of building using total station.*** The procedure is as follows. **A) CENTERING THE TOTAL STATION:** The instrument must be vertically above the survey station to ensure that horizontal angle observations are correct. The steps are as follows: i) Start with a instrument to get it approximately right above the survey station. ii) Move the foot of tripod so that the optical plummet cross hairs are on to the survey station. iii) Roughly level the instrument using the legs of the tripod the total station should stay almost on target. **B) LEVELLING THE TOTAL STATION** i) Turn bubble parallel to two foot screws, to bring the horizontal bubble to the centre of its run by moving the foot screws in opposite directions (the bubble moves in the direction of your left thumb). ii) Turn the instrument through 90º and bring the bubble to the centre of its run by adjusting the third foot screw only. iii)Turn the instrument through a further 90º to check the adjustment of the plate bubble. iv) If the bubble remains in centre, then it is in adjusted position . v) If not, move it back one-half of the movement from the centre and re-adjust for a further 90º turn. vi) Repeat the whole procedure; assuming this is the correct, the bubble will stay in a stationary position. vii) The bubble must remain in the same place in the tube during a 360º rotation of the instrument. viii) If the stationary position of the bubble is still off the centre, then a permanent adjustment should be made. **B) MARKING OF POINTS ON GROUND** With distance stake out measurement of difference between the desired distance and measurement distance to the point where prism is held displayed by the total station making easier to locate exact points of layout of building. (Note: Students may write the procedure using different command of total station)	01 M 01 M 02 M
	(iii) Ans.	***Differentiate between active system and passive system.***	01 M for each

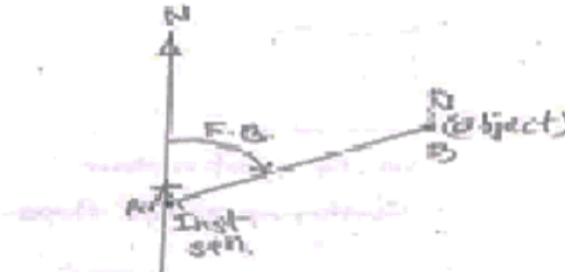
Active System	Passive System
Artificial energy is used as a source	Naturally emitted energy is used as a source
In active system sensors are able to obtain measurement anytime (day & night)	In passive system sensors can obtain measurement in day time only
Active system used their own source for illumination.	In passive system sensors can detect energy when the naturally occurring energy is available
It is costlier	It is economical

Q.2.		***Attempt any <u>FOUR</u> of the following***	**(16)**
	a) Ans.	***Points 'P' and 'Q' are two ground points at a distance of 20 m with their reduced level are 75.380 and 78.260m respectively , interpolate the contours of 76, 77 and 78.*** Difference of level between P and Q = 78.260 -75.380 = 2.88 m in 20 m distance To interpolate contours 76, 77 and 78 m.	01 M

		Difference of level between P and 76 m contour point is 76 -75.380 = 0.62 m Horizontal distance of 76 m contour from P = 0.62 x 20 /2.88 = **4.31 m** Difference of level between P and 77 m contour point is 77 -75.380 = 1.62 m Horizontal distance of 77 m contour from P = 1.62 x 20 /2.88 = **11.25 m** Difference of level between P and 78 m contour point is 78 -75.380 = 2.62 m Horizontal distance of 78 m contour from P = 2.62 x 20 /2.88 = **18.19 m** (Note :Students may write interpolation by estimation or graphical method appropriate marks should be given for the above method also)	01 M 01 M 01 M
Q.2	**b)** **Ans.**	***Enlist uses of contour maps.*** Following are the applications of Contour map. 1. With the help of contour lines on contour map one can know the nature of ground. 2. For determination of most economical site for dams and reservoirs, maximum flood line, submerged area. 3. For estimating volume of water to be impounded in a reservoir. 4. For location of highways, railways, canals, pipelines etc. 5. For determination of volume of cutting and embankment in given gradient. 6. For determining the indivisibility of two given points	Any four 01 M for each
Q.2	**c)** **Ans:**	**Calculate the area of figure in hectares, drawn to scale of 1 cm = 120 m, from 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 roller is 100 sq. cm. Anchor point was outside the figure.** Given Data scale of 1 cm = 120 m I.R. = 2.695 F.R. = 9.148 Zero of dial passed the fixed index mark twice in clockwise direction M = 100 sq. cm. C = 0 (As Anchor point was outside the figure) Solution: Area A = M (F.R. – I.R. +10N + C) = 100 (9.148 – 2.695 + 10x2 + 0) = 2645.30 Sq. cm Scale of area 1 cm = 120 m 1 cm^2 = 120*120 Area of the field = 2645.30 x 120 x 120 = 38092.32 x 10^3 Sq. m Area of the field in hectares = 38092.32 x 10^3/10000 = 3809.23 hectares	01 M 01 M 01 M 01 M
Q.2	**d)** **Ans.**	***State any four uses of total station.*** Following are the uses of total station 1) Measurement of sloping distance. 2) Measurement of horizontal distance. 3) Measurement of vertical distance. 4) Measurement of horizontal angle. 5) Measurement of vertical angle. 6) Measurement of volume and area.	Any four 01 M for each

Q.2	**e) Ans.**	***Define tacheometry. State the principle of tacheometry with sketch.*** **Tacheometry:** It is the branch of angular surveying in which horizontal distances from the instrument station to the staff station and the elevation of staff station are determined from the instrumental observation only. Principle of tachometry is based on principle of similar triangle in which corresponding sides & altitudes are proportional. The ratio of distance of base from apex and length of base is always Constant.  In fig. $O_1a_1a_2$, $O_1b_1b_2$, $O_1c_1c_2$ are all isosceles triangles where D1 , D2, D3 are the distances of bases from the apices and S1, S2, S3 are the Lengths of the bases. According to stated principle. D1/ S1 = D2/ S2 = D3 / S3 = Constant f/i= Multiplying constant. f= Focal length of objective. i= Stadia Intercept.	01 M 01 M 01 M 01 M
Q.2	**f) Ans.**	***Enlist the checks applied in case of closed traverse.*** Following are the checks applied in case of closed traverse a) Sum of measured included angles should be equal to (2N-4)x90 b) Sum of measured exterior angles should be equal to (2N+4)x90 c) Algebric sum of deflection angle should be equal to 360° considering right hand deflection angle as positive and left hand deflection angle as negative. d) Summation of latitude and departure should be equal to zero.	01 M for each
Q.3.		***Attempt any <u>FOUR</u> of the following.***	**(16)**
	a) Ans.	***State with sketch procedure for computing constants of planimeter.***  	01 M

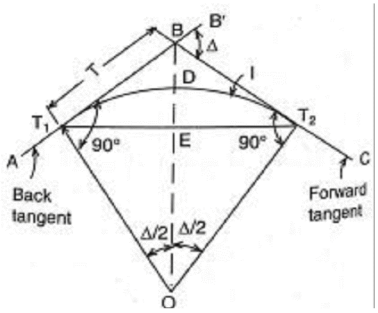
		Two cases are arise for computing constants of planimeter according to the position of the anchor point. Case (1): Where the anchor point is outside the figure. When the tracing arm the tracing arm returns to its original position, the pivot H oscillates along a circular arc whose centre is A and returns to its position. Total rotation of the tracing point about the pivot point is zero. $\int d\theta = 0$ **hence $\Delta = L_V$** Now total rotation of the wheel = algebraic sum of the arcs applied to the paper by the wheel =nc Whrere n = the number of revolutions made by the wheel c= the circumference of the wheel = $\pi.d$ Therefore , Area of the figure= L_V $= L_{cn} = L \times \pi.d \times n$ $= M.n$ The multiplier (M) = length of tracing arm x circumference of the wheel $= L_c = L \times \pi.d$ Therefore, Area of the figure = M(F.R- I.R ± 10N) Case (2) When the anchor point is inside the figure. In this case when tracing point is moved round the periphery of the figure, the tracing arm HT, and also the pivot point H make a complete revolution when they return to their position. Therefore $\int d\theta = 2\pi$. And the area (ΠR^2) of the circle. Hence The area of the figure = $L_{nc} + \pi(L^2 + LL_1 + R^2)$ The quantity $\pi(L^2 + LL_1 + R^2)$ is known as the area of zero circle. Then the area of the figure = M(F.R – I.R ± 10N + C) C is called the additive constant. **OR** Draw the square or any regular area figure whose area A can be calculated by formula. Keep anchor point outside and move the tracing arm clockwise. Take readings for IR, FR and N, put values in the formula and find the value of M, as C = 0. Now repeat the procedure keeping anchor point inside and putting values of IR, FR, N and M find the value of C. **(Note: For this procedure there is no need of sketch)**	03 M OR 04 M
Q.3	**b)** **Ans.**	***State the component parts of micro optic theodolite. How it is superior to a transit theodolite.*** **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	Any four 1/2 M for each Any two 01 M for each

		3) This instrument is durable for harsh environments. 4) It is simple in use.	
Q.3	**c) Ans.**	***Explain the procedure of measurement of magnetic bearing in theodolite.*** Let the magnetic bearing of line AB is to be measured.  1) Set up the theodolite at A .Carry at all temporary adjustment centering and leveling properly. 2) Set the vernier A at 000'00" and vernier 18000'00" using lower plate clamp, upper plate clamp and upper plate tangent screws. 3) Fix the tabular circular or trough compass at its position on the theodolite (A standard of frame or on circular plate between the standards) and release the needle of the compass. 4) Loosen the lower clamp, the telescope until its points to the north (i.e. magnetic needle coincides with the 0'-0' mark) which shows correct orientation of telescope along magnetic meridian. 5) Fix the lower clamp and loosen the upper clamp, turn the telescope clockwise and bisect the ranging rod at B roughly. Fix the upper clamp; bisect the ranging rod at B correctly using upper tangent screw. 6) Read both the vernier, the mean of these two vernier readings is the magnetic bearing of AB. 7) Change the face of the instrument repeat the above the procedure and measure the magnetic bearing of AB more precise.	01 M 03 M
Q.3	**d) Ans.**	***Differentiate between theodolite and tacheometer. Give any two characteristics of tacheometer.***	Any two 01 M for each

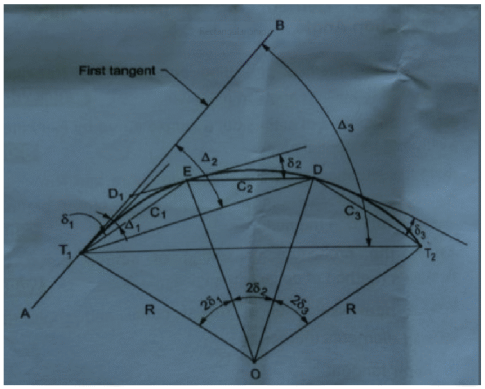
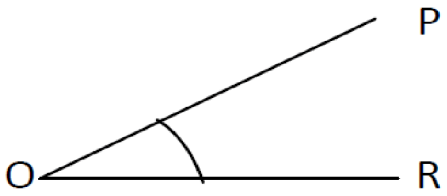
Sr.No.	Theodolite	Tacheometer
1	It is most accurate instrument use for measurement of horizontal and vertical angle.	Tacheometer is usually a transit theodolite having a stadia diaphragm.
2	In case of theodolite, the distance is measured on the field by chain or tape.	In case of tacheometer distance 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.

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 analytic 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.

Any two 01 M for each

Q.3	**e)** **Ans.**	***Draw net sketch of simple circular curve showing all elements.***  Where: AB = Back tangent or rear tangent BC = Forward tangent T1 and T2 = Tangent points B= Vertex or point of intersection. Δ = Deflection angle BD = External distance T1T2 = Long chord T1DT2 = Length of curve	02 M for sketch and 02 M for labeling)
Q.3	**f)** **Ans:**	***The interior angles of closed traverse ABCDE are as follows:*** ***<A = 78⁰ 40' 15" <B = 104⁰ 45' 20" <C = 85⁰ 35' 40"*** ***<D = 150⁰ 40' 30" <E = 120⁰ 18' 15"*** ***The bearing of line AB is 220⁰ 25' 30", calculate bearing of remaining sides.*** The FB of AB = 2200 25' 30" Add < B = 104⁰ 45' 20" 325⁰ 10' 50" Deduct 180⁰ 0' 00" **The FB of BC = 145⁰ 10' 50"** Add < C = 85⁰ 35' 40" 230⁰ 46' 30" Deduct 180⁰ 0' 00" **The FB of CD = 50⁰ 46' 30"** Add < D = 150⁰ 40' 30" 201⁰ 27' 00" Deduct 180⁰ 0' 00" **The FB of DE = 21⁰ 27' 00"** Add < E = 120⁰ 18' 15" Bearing Of EA = 141⁰ 45' 15" Check, Add < A = 78⁰ 40' 15" **FB of AB = 220⁰ 25' 30"**	01 M 01 M 01 M 01 M

4.		***Attempt any <u>FOUR</u> of the following.***	**(16)**
	a) **Ans.**	***Explain with example, establishing grade contours.*** In Establishing grade contour it is necessary to measure the distance from the starting point or the last point fixed to the next point to be fixed. The required staff reading is the calculated from i) the Distance ii) Given gradient iii) The R.L of plane of collimation of the level (HI). **Example**: 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 H.I. = 750.75 m. There for the staff reading required at the next point = 750.75 – 748.80 = 1.95 m.	02 M 02 M
Q.4	**b)** **Ans.**	***State the errors that are eliminated by the method of repetition in the measurement of horizontal angle by transit theodolite.*** 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 etc, may be some extent counter-balanced in different observations.	01 M for each
Q.4	**c)** **Ans:**	***Explain temporary adjustments of digital level.*** The following are the temporary adjustments: i) Setting up Tripod. ii) Centering. iii) Levelling iv) Focusing of object glass to remove the parallax. v) Initial setting procedure 1. Setting up Tripod: • Open the tripod legs sufficiently enough for the instrument to be stable. • Assure that the station point is located directly beneath the center hole in the tripod below. • Firmly press tripod shoes into the ground. • Level the top surface of tripod head. 2. Centering: • The centering can be performed either by plumb bob or optical plummet. • Suspend the plumb bob from the hook provided at tripod mounting screw. • Slightly loose the screw and carefully slide the instrument about tripod head, such that plumb bob is exactly over station point. 3. Levelling: • Loosen the upper plate clamp, rotate the instrument and keep plate level parallel with any two levelling screws. • Bring the plate bubble in the center by moving levelling screws. • Turn instrument through 90^0 in horizontal plane and move the bubble to the	04 M

		• center by third screw. • Repeat the steps so that bubble remains in center for all positions. 4. Removing /eliminating parallax: • Focusing eye piece and object glass eliminate the parallax. 5. Initial setting procedure: • Turn on the power switch • Set minimum angle unit (5" or 10"); vertical 0^0 orientation with horizontal or zenith or compass angle unit. • Automatic vertical compensation. • Automatic power switch.	
Q.4	**d) Ans.**	***Explain the setting of curve by Rankin's deflection angle method.***  1. Locate the tangent points T1 and T2 on the straight line AB and BC. 2.Set the theodolite at the beginning of the curve T1 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 (Δ1) and the telescope being directed along T1P. 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 (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.	01 M for fig. 03 M for procedure
Q.4	**e) Ans.**	***Explain the procedure for measuring vertical angle by using electronic theodolite.*** Suppose it is required to measure the vertical angle of an object 'P'  	01 M

Procedure:

- Set up the instrument over station 'O' and carry out all temporary adjustments.
- Loosen the vertical clamping screw and direct the telescope in vertical plane and bisect 'P' exactly.

Now read the reading on displayed window. — 03 M

Q.4 f) Ans. ***State the sources of error in theodolite.***

i. Non adjustment of plate bubble:
When the plate levels are centered the vertical axis may not be truly vertical.
This would cause an error in angle measurement.
ii. Line of collimation not being perpendicular to horizontal axis.
iii. Horizontal axis not being perpendicular to vertical axis.
iv. Line of collimation not being parallel to axis of telescope.
v. Eccentricity of inner and outer axes.
vi. Gradation not being uniform.
vii. Vernier being eccentric.
viii. The clamp screws may slip.

Any four 01 M for each

Q.5 ***Attempt any TWO of the following:*** **(16)**

a) ***Following are the length of traverse and bearing of traverse.***

Line	*Length in Meters*	*Bearing*
AB	***260 m***	***30^0***
BC	***325 m***	***140^0***
CD	***185 m***	***210^0***

Find the length and bearing of line DA

Ans

Line	Bearing	Length in Meters	Latitude l*cosθ	Departure l*sinθ
AB	30^0	260	+225.16	+130.00
BC	140^0	325	-248.96	+208.90
CD	210^0	185	-160.21	-92.50
DA	θ **(306^0 50' 34")**	? **(306.88)**	l*cosθ **(+184.01)**	l*sinθ **(-245.59)**

04 M

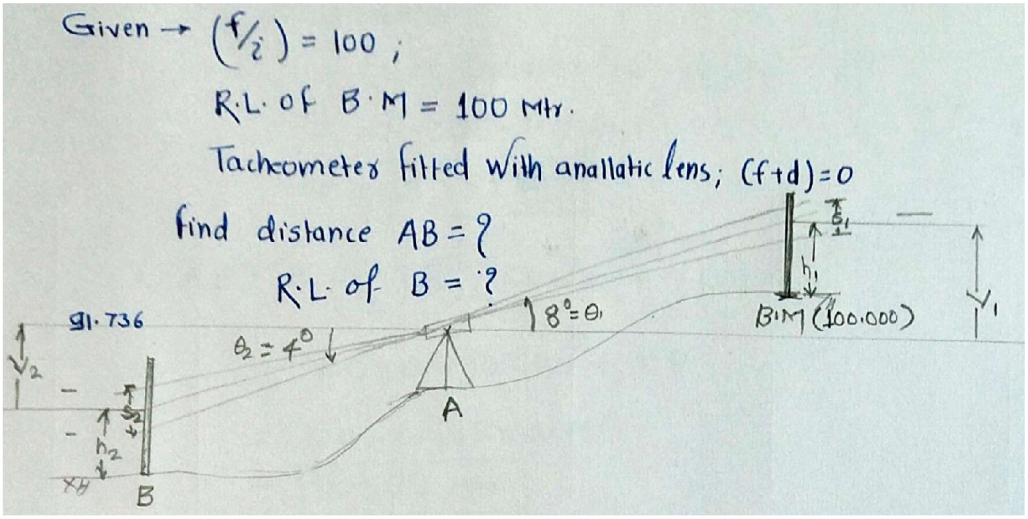
Since ABCDA is a closed traverse, ΣL = 0 and ΣD = 0
ΣL = 0
225.16 – 248.96 – 160.21 + lcosθ = 0
-184.01 + lcosθ = 0
lcosθ = +184.01 — 01 M
ΣD = 0
130 + 208.09 – 92.50 + lsinθ = 0
+245.59 + lsinθ = 0
lsinθ = -245.59 — 01 M
tanθ = lsinθ/ lcosθ = 245.59/184.01 = 1.335
θ = tan-1 1.335
= 53.157^0 = 53^0 9' 26"
Latitude is +ve and Departure is –ve, hence line lies in IV quadrant.
WCB = 306^0 50' 34" — 01 M
Examinee should give calculation of latitude & departure of each line.

		Length of line DA = $\sqrt{L^2 + D^2}$ $= \sqrt{184.01^2 + 245.59^2}$ **= 306.88 m.**	01 M
Q.5	b)	***A tacheometer fitted with anallatic lens was set up at station A and the following readings were obtained on vertically held staff.***	

Inst. Station	*Staff station*	*Vertical Angle*	*Stadia reading*
A	***BM***	***+8^0***	***0.800, 1.120, 1.480***
A	***B***	***-4^0***	***1.140, 1.235, 1.330***

The constant (f/i) is 100, find distance AB and RL of station B as RL of BM is 100.000 m.

Ans



$S_1 = (1.480 - 0.800) = 0.680$
$\theta_1 = +8^0$ — 1/2 M
$h_1 = 1.120$
V1 = (f/i)S1 (sin2 θ_1)
(f+d)=0
=100 X 0.68 X sin16/2 + 0
= 18.768/2 — 01 M
= 9.384 m
R.L. of instrument axis
=R.L. of B.M. + $h_1 - V_1$
= 100 + 1.120 - 9.384 — 01 M
= 91.736 m
$S_2 = (1.330 - 1.140)$
= 0.190 — 1/2 M
$\Theta_2 = 4^0$
$h_2 = 1.235$
$V_2 = (f/i)\ S_2 X\ (\sin 2\theta_2 / 2) + (f + d)\ \sin\theta_2$
= 100 X 0.190 X (sin 8 /2) + 0 — 01 M
V_2 = 1.320 m
RL of station B
= R.L. of instrument axis – V_2 – h_2

		= 91.736 – 1.320 – 1.235 **= 89.181 m** $L(AB) = (f/i)S_2 X \cos^2\theta_2 + (f+d)\cos\theta_2$ = 100 X 0.190 X 0.995 **= 18.905 m** **R.L. of station point B = 89.181 m** **L(AB) = 18.905 m**	02 M 02 M
Q.5	c)i) Ans	***Differentiate between Prismoidal formula and trapezoidal formula for computation of volume.***	Any four 01 M for each

SR.NO.	TRAPEZOIDAL	PRISMOIDAL
1	Volume is calculated as – V=common distance/2 X (area of first section + area of last section) + 2(sum of area of other section)	Volume is calculated as - V= common distance/3 X (area of first section + area of last section) + 4(sum of areas of even section + 2(sum of areas of odd section)
2	This gives approximate volume.	It gives accurate volume.
3	There is no limitations. It can be applied for any number of areas (even or odd)	Prismoidal formula is applicable when there are odd number of section
4	The boundaries between the ends of ordinates are assumed to be straight.	The boundaries between ends of ordinates are assumed tobe arc of parabola.
5	No need of separation of areas.	If number of areas are even the end strip is treated separately & area is calculated according to trapezoidal rule. The volume of remaining strip is calculated by prismoidal formula & both volumes are added to get final volume.

Q.5	c)ii) Ans	***State the advantages and disadvantages of GPS.*** **Advantages.** 1) It helps to survey with many times greater precision. 2) It helps to complete survey in lesser time & thus help in reducing completion period. 3) It helps reduces the difficulty of taking manual measurement to great extent. 4) Chances of errors are less. Error may occur due to instrument malfunction. 5) GPS works in all weather conditions. 6) GPS can be used for catography, forestry, mineral exploration, wild life habitation etc. 7) It helps in search & rescue operation. 8) It gives latitude & longitude of a point. 9) It keeps record of tracking. 10) With GPS one do not require an elaborated design of placement. One can select the optimum measurement points. 11) It improves mapping as well as tracking skill. 12) GPS is extremely easy to navigate. **Disadvantages.**	Any four 1/2 M for each

1) It requires high initial investment.
2) It requires much skilled person to operate.
3) GPS may fail due to certain reason & therefore need to carry a backup maps & directions.
4) GPS works only where satellite signals & reception is possible.
5) It completely relies on receiving signals.
6) GPS signals are not accurate due to obstacles.

Any four 1/2 M for each

Q.6 a) ***Calculate the corrected consecutive co-ordinates for the following observations of traverse.***

Line	*Length (m)*	*Point*	*Consecutive co-ordinates*	
			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 CO-ORDINATES**		**CORRECTION**		**CORRECTED CONSECUTIVE CO-ORDINATES**	
			L	**D**	**L**	**D**	**L**	**D**
AB	705	A	+655.19	-260.29	-0.517	+0.349	654.67	-259.94
BC	952.5	B	+127.07	+943.99	-0.699	+0.472	126.37	+944.462
CD	645	C	-628.47	+145.54	-0.473	+0.319	-628.94	+145.859
DA	844.5	D	-151.48	**-830.80**	-0.620	+0.418	-152.10	-830.382
	3147.0		**∑ L = + 2.31**	**∑ D = - 1.56**	**∑ L = - 2.31**	**∑ D = + 1.56**	**∑ L =00**	**∑ D = 00**

04 M

BOWDITCH RULE

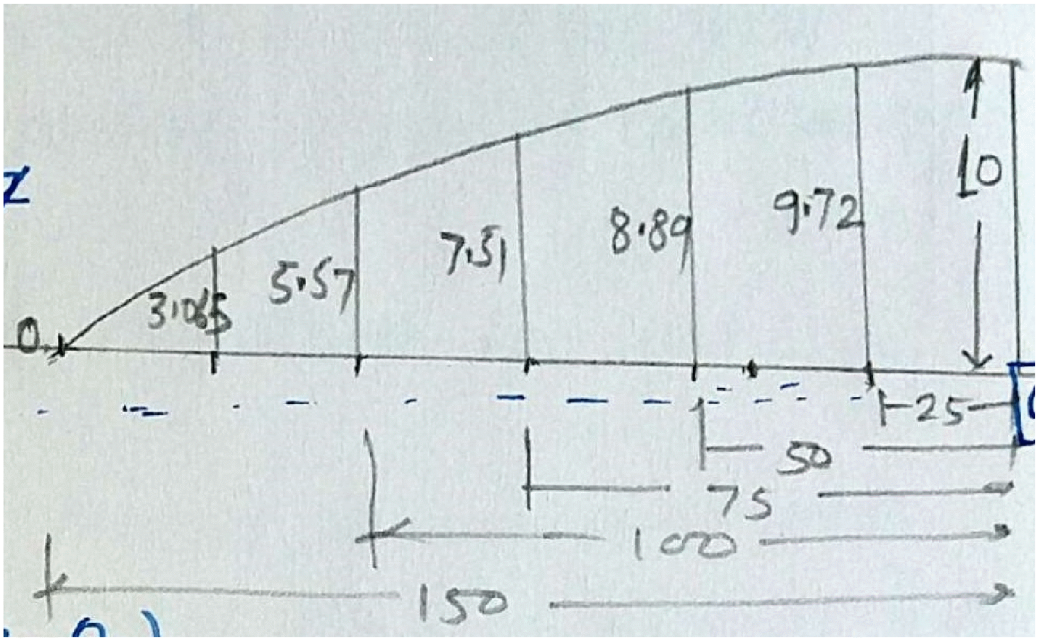
1) Correction to latitude of any side.
=(length of that side / perimeter of traverse) X total error in latitude.
2) Correction in departure of any side.
=(length of that side / perimeter of traverse) X total error in departure.

02 M

Correction to latitude

1) Correction to latitude of line AB
= (705/3147) X 2.31
= - 0.517
2) Correction to latitude of line BC
= (952.5/3147) X 2.31
= - 0.699
3) Correction to latitude of line CD
= (645/3147) X 2.31
= - 0.473
4) Correction to latitude of line DA

		= (844.5/3147) X 2.31 = - 0.620 { error is +ve, correction will be –ve} **Correction to departure** **1) Correction to departure of line AB** **= 705/3147 X 1.56 = +0.349** **2) Correction to departure of line BC** **=952.5/3147 X 1.56 = +0.472** **3) Correction to departure of line CD** **=645/3147 X 1.56 = +0.319** **4) Correction to departure of line DA** **=844.5/3147 X 1.56 = +0.418** **[error is –ve, correction will be +ve]**	02 M
Q.6	b) Ans	***Calculate the ordinates of 25m interval to set out a circular curve having a long chord 300m and versed sine of 10m.*** Given- 1) Peg interval – 25m 2) Length of long chord – 300 m 3) Versed sine – 10 m Versed sine = $O_0 = R - \sqrt{R^2-(L/2)^2}$ R = ? L/2 = 300/2 = 150 m O_0 = 10 m $10 = R - \sqrt{R^2-(L/2)^2}$ $(10-R) = -\sqrt{R^2-(L/2)^2}$ .....(1) Squaring equation (1) on both sides. $(10-R)^2 = R^2-(L/2)^2$ $(10-R)^2 = R^2-(150)^2$ $100 - 20R + R^2 = -22500 + R^2$ $20R = 22600$ $R = 1130$ m O_0 = 10 m $O_{25} = \sqrt{R^2-(25)^2} - (R - O_0)$ $= \sqrt{(1130)^2-625} - (1130-10)$ =9.72 m $O_{50} = \sqrt{(1130)^2-2500} - 1120$ =8.89 m $O_{75} = \sqrt{(1130)^2-(75)^2} - 1120$ =7.51 m	01 M 01 M 01 M 01 M

		$O_{100} = \sqrt{(1130)^2 - (100)^2} - 1120$ =5.57 m	01 M
		$O_{125} = \sqrt{(1130)^2 - (125)^2} - 1120$ =3.065 m	01 M
		$O_{150} = \sqrt{(1130)^2 - (150)^2} - 1120$ = 0.00 m	01 M
			01 M
Q.6	c) Ans	***State the procedure of traversing by using total station.*** Procedure of traversing using total station. 1) Set up total station over station point, the co-ordinates of which are known or fixed arbitrarily. 2) Carry out proper centering & leveling. 3) Create a file in T.S. where particular traverse survey data will be saved. 4) Now go to 'meas' & input co-ordinate details of station point(point no.,N,E,Z,PC,ZH) 5) Then input 'BSP'(basic sight point) details in the first station only. 'Azimuth' or initial bearing ($0^0 0' 0''$) & entered. 6) New point in the telescope of T.S. towards B.S.P., bisect the target & press enter. Then go to 'rectangular co-ordinate' & measure the BSP. 7) It displays the co-ordinate of BSP generated in accordance station point. This form the orientation or basis of entire traverse survey. 8) Now save the BSP. Point telescope towards the foresight bisect the same properly. 9) Measure the third point in similar manner, measured co-ordinates(P.no,N,E,Z) is now displayed. Edit & input 'PC' & "PH" details & save data. 10) Now remove instrument from the initial station & set up like earlier over the foresight point, whose co-ordinates are just measured by T.S. 11) Carry out temporary adjustment. Input co-ordinate data or select from the list. Aim at	08 M for correct steps

BSP & take measurement. The screen displays measured co-ordinates of BSP. If it is within tolerance + / - less tha 5" it is ascertained as good reference.

12) Now point telescope towards next point. Bisect it & then measure. Edit & input "PC" & then save the data.
13) In closed traverse after measuring the initial or starting point if closing error is found it is processed by software