

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Kartik

Exam. Level Programme Year / Part	Back		
	BE	Full Marks	80
	BCE	Pass Marks	32
	II / II	Time	3 hrs.

Subject: - Surveying II (CE 554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- What are the types of traverse? Why traverse balancing is necessary? Explain the methods briefly. [1+1+2]
- In a traverse survey due to some field obstructions, parameters of some lines could not be measured. The remaining observation are given below. Find the missing data. [10]

Line	AB	BC	CD	DA
Length (m)	335.00	?	408.00	828.00
Bearing	181°18'	90°00'	357°36'	?

- Describe the principle of stadia tacheometry. Derive the formula of horizontal distance and vertical distance for the line of sight inclined and staff held vertical. [2+4]
- Compute the gradient and distance of PQ from the following observation having tacheometric constant 100 & 0. Take RL of 'X' = 1350 m. [8]

Inst st ⁿ	HI	Sighted to	Bearing	Zenith Angle	Staff Readings
P	1.4	X	60°	75°	2.01, 1.76, 1.51
Q	1.5	X	340°	96°	1.52, 1.27, 1.02

- Compute RL of a hill station 'P' from two instrument stations A and B at very large different level with same line of sight to that of target from the following information. [6]

Inst.Stn.	Inst. ht.(m)	Target	Zenith angle		Distance, Rod ht. and RL
			FL	FR	Distance between A and B=120 m Rod ht at B=1.9 m, RL of B=1280.00m
A	1.45	P	62°23'	297°36'	
B	1.42	P	64°52'	295°09'	
A	1.45	B	96°20'	263°40'	

- What are the factors affecting contour intervals? Describe the direct and indirect method of contouring. How can you estimate the general topographic map contour interval? [2+3+1]
- Stations A, B and C have the following coordinates (8343.570mN, 5436.120mE), (8853.090mN, 6457.300mE) and (6889.620mN, 5964.870mE) respectively. Station P is resection point and following observations were recorded. Determine the coordinate of P. [8]

Instrument Station	Sighted to	Horizontal Angle
P	A	<APB=109°51'18"
	B	<BPC=145°23'9"
	C	<CPA=104°45'37"

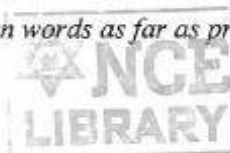
8. What is curve? Describe the procedure of curve setting by linear method; offset from tangent. [4]
9. A road 7 m wide is to deflect through an angle of 60° with the center line radius of 300 m, the chainage of the intersection point being 3600.0 m. A transition curve of such a length that the rate of gain of radial acceleration is 0.5 m/s^3 , when the speed is 50 km/hr. Find out:
Length of the transition curve
Super elevation
Chainage of all junction points
Also calculate setting out data for theodolite of least count $10''$ of the left hand transition curve only by deflection angle method taking peg interval as 5 m. [6]
10. How can you estimate the lowest and highest point position from the BVC of vertical curve? The elevation and chainage of intersection point are 2267 and 3+780 km. A grade of -3.5% meets another grade of 0.5%. Field condition requires that the vertical curve should pass through a point of elevation 2268 m at chainage 3+780 km. Compute a suitable equal tangent vertical curve and full station elevations. Calculate the curve elevation by using general equation of parabolic vertical curve with peg interval 30m. [1+5]
11. Write short notes on: [4×4]
- a) What is remote sensing? And application of remote sensing in civil engineering
 - b) Types and components of GPS
 - c) Height relief displacement in photogrammetry
 - d) Digital data recording fundamentals of total station

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- Why traversing is necessary? What are the types of traverse? Explain Bowditch's rule for balancing the traverse with its assumptions. [1+1+2]
- The following data refers to a traverse ABCDEA. Check the accuracy of work and complete the Gale's table up-to co-ordinate calculation. Coordinate of D is (2500.00 mN, 4500 mE). [10]

Station	Leg	Horizontal Angle	Distance	Bearing
A	-	128°48'	-	
B	AB	102°7'	47.23m	40°
C	BC	108°52'	42.51m	
D	CD	91°0'	67.25m	
E	DE	109°13'	49.36m	
A	EA	-	44.02m	

- Explain the principal of optical distance measurement. Discuss measurement of horizontal distance by tangential method. [2+4]
- A tacheometer fitted with anallatic lens and having multiplying constant of 100 was setup at station 'P'. The following readings were taken with the staff held vertically. Calculate the distance between XY and the gradient between X and Y. [8]

S.N	Staff Station	Bearing	Vertical Angle	Staff Intercept (s)	Central hair reading
1	X	38°15'	-11°30'	2.23	1.980
2	Y	68°25'	+8°15'	2.08	1.503

- The top of a hill station P was sighted from two instrument stations A and B at a very different level and at the same vertical plane with the target. The zenith angle from A to P and B to P were 59°15' and 69°45' respectively. The zenith angle from A to B to a vane 1.75 m above the foot of the vane was 105°30'. If the height of the instrument of A and B were 1.56 m and 1.48 m respectively and distance between A and B was 150 m, RL of B was 1500 m. Find the RL of hill station (The target is 2.5 m above the ground). [6]
- Define the term Contour Interval and Index Contour. Describe the procedure for contour plotting with applying surveying principle. Write uses of contours. [1+1+2+2]
- The coordinates of three known stations P, Q and R are given below and from an instrument point O following observations were taken. Calculate the coordinates of 'O' by Tienstra's method. [8]

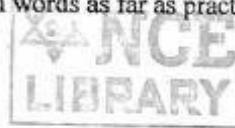
Known station	Observed Angles	Northing (m)	Easting (m)
P	<POQ=142°43'32"	29236.48	24078.31
Q	<ROQ=92°19'52"	31493.20	26266.48
R	<POR=124°56'26"	29661.04	28377.67

8. What is degree of curvature? Derive the relation between the radius and degree of curvature with its finding. [4]
9. The chainage of IP is 2+450 km. Deflection angle is 30° . The curve is 3° with the fixed arc length of 25 m. The peg interval is 30 m. Calculate the setting out table by Rankine's deflection angle method. [6]
10. Why vertical curves are generally used parabolic curve? The elevation and chainage of intersection point are 3267 and 1+780 km. A grade of -3.5% meets another grade of 0.5%. Field condition requires that the vertical curve should pass through a point of elevation 3268 m at chainage 1+780 km. Compute a suitable equal tangent vertical curve and full station elevations. Use parabolic equation. The peg interval is 30 m. [1+5]
11. Write short notes on: [4×4]
- (a) Describe types of remote sensing and application of remote sensing.
 - (b) Working principle of GPS and its components.
 - (c) Define Photogrammetry. Write down the application of GIS in civil engineering and mapping in detail.
 - (d) Principle of Total station and describe the digital data recording fundamentals.

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- Why degree of accuracy in between angular and linear measurements are to be maintained during traversing? By which expression angular versus linear and vice-versa precision are to be computed. State one of each example. [2+2+2]
- The bearings and lengths of the sides of a closed traverse ABCDEA are given below but bearing of EA and length of BC are missed, find those missing figures. Also compute the coordinates of other points if coordinates of C are: [3+3+2+2]

Northing of C = 1000.00 m. Easting of C = 1000.00 m.

Line	AB	BC	CD	DE	EA
Length (m)	282.20	?	324.70	381.60	359.60
Bearings	61°30'	151°24'	201°02'	280°14'	?

- Write down the principle of stadia tacheometry. Discuss measurement of horizontal distance and elevation by tangential method for both angles in depression. [2+4]
- From two unknown instrument stations P and Q tacheometric observations are taken for common point 'R' holding the staff vertical and following observations are noted. [2+2+2]

Inst. sta.	Sighted to	hi. (m)	Zenith angle	Bearing	Staff Reading
P	R	1.380	81°00'	60°30'	1.000, 2.000, 3.000
Q	R	1.420	85°00'	335°45'	1.300, 2.450, 3.600

If RL of 'R' is 1200.00 m, compute the gradient between P and Q. Take K = 100 and C = 0.00.

- A hill station signal was sighted from two instrument stations R and Q in which stations R and Q are in the same vertical plane to that of target 'P'. [2+2+2]

Inst. sta.	Target	hi (m)	Staff Reading to BM	zenith angle	Remarks
Q	P	1.420	1.250	62°30'	Dist. P _{QR} = 125 m Rod ht at Q = 1.75 m
R	P	1.480		70°45'	
R	Q	1.480		98°15'	

Compute the Reduced level of top of hill station.

- Explain the characteristics (important any six) of contours with suitable sketches. RL of two guide points A and B are 1000.25m and 1001.32m. The distance between these guide points in a topo map is 5 cm. Find the distance of all the contours that lies on line AB from guide point A if the contour interval is 0.5m. [4+2]
- The followings are the coordinates of their known stations whose direction are observed from unfixed instrument station P.

Stations	A	B	C
Easting (m)	5000.000	10000.000	15000.000
Northing (m)	1000.000	15000.000	10000.000

If observed horizontal angle APB = 45° 00' 00" and angle BPC = 52° 00' 00", determine the coordinates of resection point P by Tienstra method.

8. Two tangents T_1V and T_2V intersect at chainage of 13+700, km. The bearing of T_2V is $300^\circ 30'$ and T_1V is $80^\circ 30'$. It is proposed to insert 6° circular curve with transition curve 90m at each end. Calculate the first two deflection angle for setting out first transition and circular curve only at peg interval of 10m on transition curve and 30 m at circular curve. [6]
9. Illustrate the methods (including sketch) of setting out of simple circular curve by Rankin's method. [4]
10. A grade of 1.25% meets another grade of 4.75%. The elevation and chainage of intersection point are 1517.60 and 2+030 km. Field condition requires that the vertical curve should pass through a point of elevation 1518.30 m at chainage (2+030) km. Compute a suitable equal tangent vertical curve and full station elevations. Use parabolic equation. Take peg interval 30m. [6]
11. A line PQ measures 20 cm on an aerial photograph taken with an aerial camera having focal length 24 cm. The same line measures 6 cm on a map drawn to a scale of 1:50000. Calculate the flying height of the aircraft if the average altitude of ground is 350 m. [4]
12. Write short notes on: (Any Three) [3×4]
- Briefly explain remote sensing process. What are the application of remote sensing in civil engineering?
 - Explain the basic principle of calculating location by a GPS receiver and explain about the component of GPS.
 - What is GIS? Why is GIS advantageous then other mapping tools? Mention the application of GIS.
 - Write down the key features of total station and its application in civil engineering.

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Year / Part	II / II	Time	3 hrs.

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- What do you mean the term "balancing the traverse"? Explain the types of balancing method you know with proper logic behind their uses. Why there is need of using independent coordinates instead of consecutive coordinates? [1+2+3]
- A link traverse was run between two known station Q and X where Q and X are the ending and starting points for the known traverse legs, PQ and XY respectively. The following observations were taken:

Known stn.	Total coordinates		link stn	Hz. angles to right	line	Length (m)	Bearing
	N (m)	E (m)					
P	-	-		$\angle PQM_1 = 93^\circ 6' 51''$	Qm_1	49.085	$PQ = 61^\circ 06' 56''$ $XY = 288^\circ 07' 21''$
Q	63148.201	7492.189	m_1	$\angle Qm_1m_2 = 155^\circ 45' 25''$	m_1m_2	73.787	
X	63321.618	7439.604	m_2	$\angle m_1m_2X = 247^\circ 09' 37''$	m_2X	85.590	
Y	-	-		$\angle m_2XY = 90^\circ 58' 47''$			

Calculate the independent coordinates of m_1 and m_2 in Gale's table by adjusting the coordinates using Bowditch's method. [10]

- What is tacheometry surveying? You are preparing a topographic map with using method of tacheometry. In the field you missed the staff anywhere now there is no staff. Is this possible to survey by using tacheometry? If so, please mention the procedures completely with neat sketch. [6]
- Find out RL, distance and gradient between P and Q by using below data given in table, the staff held vertical to the line of sight by using anallactic lens. Take RL of instrument station is 1325.750 m. [6]

Instrument St ⁿ	Staff	Line	Bearing	Vertical angle	Hair Reading(m)
A	P	AP	$84^\circ 36'$	$3^\circ 30'$	1.35, 2.10, 2.85
A	Q	AQ	$142^\circ 24'$	$2^\circ 45'$	1.955, 2.875, 3.795

- The top (T) of a radio transmission tower was sighted from two small hill tops A and B which were in the line with T. Calculate the R.L. of the top of the tower and the horizontal distance from A to the tower from the following data. [6]

Instrument Station	Height of Instrument (m)	Sighted to	Vertical Angle	Remarks
A	1.40	T	$26^\circ 21'$	RL of B = 1121.500 m Distance AB = 75 m Target ht at A = 3m
B	1.500	T	$21^\circ 18'$	
B	1.500	Target at A	$14^\circ 56'$	

- What is contour index? Explain the method of fixing the index and minor contour from two uniform slope ground points such as 1240.12 m and 1264.32 m and CI = 3.0 m. Why do contour line never touch or cross? [1+3+2]

7. The following are the three known points. The information regarding the three points and one traverse leg are given below. Compute the coordinates of instrument station and the traverse station A. [8]

Instrument station	Sighted to	CW observed angles	Coordinates		Remarks
			Northing (m)	Easting (m)	
O	P	$\angle POW = 140^\circ 58' 51''$	8760.12	2880.24	
	W	$\angle WOD = 82^\circ 18' 14''$	8000.25	3820.60	
	A	$\angle WOA = 42^\circ 18' 14''$	?	?	Length (OA) = 140.23 m
	D	$\angle DOP = 136^\circ 42' 55''$	7588.80	3010.40	
	P		8760.12	2880.24	

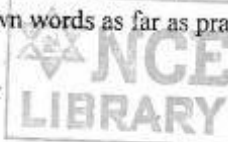
8. Explain the procedure for the setting out of composite curve with neat sketch. [4]
9. A simple circular 8° curve with fixed 30 m arc length is to be set with the 187.62 m long chord. The chainage of intersection point is 2552.00 m. The regular peg interval is 30 m. Compute the necessary data to set out the curve in field by Rankine's method. [6]
10. A grade of $(-)3\%$ meets another grade of $(-)35\%$. The elevation and chainage of IP are 2477.00 m and 4500 m respectively. Field conditions require that the vertical curve should pass through a point of elevation 2474.50 m at chainage 4500.00m. Compute a suitable equal tangent vertical curve including full station elevations. Take peg interval 30 m. [6]
11. Describe the field procedure of aerial photogrammetry and relief displacement of photogrammetry. [2+2]
12. Discuss remote sensing and its types and application in civil engineering. [1+1+2]
13. State the principle components of GPS and mention the application of GIS. [2+2]
14. What is total station? Write some typical features of total station. You are recording the data in the total station mention the three points which are kept in mind. [4]

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- Define closed loop and closed link traverse. Explain the terms angular misclosure and relative closing error briefly. How is angular misclosure balanced in linked traverse? [1+1+3]
- In a four sided anti-clockwise traverse PQRSP the following information are given.

Side	Length (m)	Deflection angle	Bearing	Co-ordinates
PQ	436.80	?	S45°W	?
QR	?	85°00' Left	?	?
RS	499.20	100°00' Left	?	R=2345mE, 6789mN
SP	516.084	?	?	?

- Compute all the missing figures.
 - Compute the co-ordinates of other points with respect to R. [10]
- Describe the working principle of subtense bar and derive subtense bar formula for computing horizontal and vertical distances when line of sight is inclined upward. [2+4]
 - A tachometer fitted with anallactic lens and having multiplying constant of 100 was setup at station 'P'. The following readings were taken with the staff held vertically.

S.N.	Staff Station	Bearing	Vertical Angle	Staff Intercept	Axial hair reading
1	A	345°	+15°10'10"	1.370	1.435
2	B	250°	+09°50'40"	2.425	1.835

Calculate the distance AB and the gradient between AB. Also express the gradient as decimal percentage and angle. [6]

- Compute the RL of top of a hill station P from the following data.

Inst St ⁿ	Target	Zenith Angle	Height of Instrument	Target ht & Distance
A	P	64°30'	1.42	DAB = 58m
B	P	74°15'	1.48	B = 1.75m
A	B	78°00'	1.42	BM = 1.25m
A	BM	90°00'	1.42	

RL of BM is 1280.00m. [6]

- Describe contour interval and index contour. Explain the direct and indirect method of contouring. [2+5]
- The co-ordinates of three stations are known Nagarkot (N), Phulchowki (P) and Nagarjun (G). A resection point "O" is set inside the triangle and the observations taken for horizontal angle to these known stations from "O" are given in the table below along with the co-ordinates of the three known stations. Calculate the co-ordinate of resection point "O". [8]

Known station	Easting (m)	Northing (m)	Horizontal Angle
Nagarkot (N)	352836.105	3066097.505	∠ NOP = 140°04'45"
Phulchowki (P)	342615.318	3050525.416	∠ POG = 99°25'48"
Nagarjun (G)	329189.716	3070164.918	∠ GON = 120°28'57"

8. Two straights AB and BC intersect at chainage 1+234.5 km, the deflection angle being 40° . It is proposed to insert a circular curve of radius 300m. A transition curve is to be inserted at each end of transition curve such that the rate of change of radial acceleration is 40cm/sec^3 , when the design speed is 80 kmph. Calculate the shift, length of transition curve, chainage of tangent points, junction points and data required to set the transition curves (at left end) and circular curve. [6]
9. A grade of 3.5% meets another grade of (-) 2.75%. The elevation and chainage of IP are 1470.00m and 2800.00m respectively. Field condition requires that the vertical curve should pass through a point of elevation 1468.75m at a chainage of 2800.00m. Compute a suitable equal tangent vertical curve of full stations elevation including highest point also. Take page interval = 30m. [6]
10. Explain about the setting out procedures of horizontal sample circular curve by deflection angle method with supporting sketch. [4]
11. Write short notes on: (Any four) [4×4]
- a) GIS & its application in civil engineering
 - b) Working principle of GPS and it's components
 - c) Feature of total station and its application in civil engineering
 - d) Planning and taking aerial photographs
 - e) Application of remote sensing

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- List principle of theodolite traverse. Explain necessary planning that needs to be performed before traversing. [2+2]
- Describe procedure how one can tackle a case of omitted measurement when affected legs are not adjacent. [4]
- The following observations were recorded during link traversing. The independent coordinates of M2 is (1000 mN, 1000mE) and M8 is (1095mN, 1042mE). Compute minor traverse in Gale's Table, indicating balancing of coordinates by Bowditch method. [8]

Station	Horizontal Angle (degrees)	Leg	Length (m)	Bearing (Degrees)
M2	110	M1-M2	-	105
m1	200	M2-m1	35.50	
m2	90	m1-m2	55.00	
M8	250	m2-M8	42.35	
		M8-M9	-	36

- Explain Principal of optical distance measurement. [3]
- A 3m long subtense bar was placed above the station B and angle subtended in the instrument placed at station A was read out to be $0^{\circ}50'20''$ but the bar was deviated 4° from being normal to the line joining the instrument and bar station. By using a tachometer with constant 100 and 0 at station R following observations were produced with staff held vertical. Calculate the level difference and gradient between A and B. [6]

Station	Sighted to	Bearing	Zenithal Angle	Staff Readings
R	A	315°	$98^{\circ}45'$	-1.100-
	B	210°	$83^{\circ}45'$	0.65, 1.25, 1.85

- The top of the hill station 'P' was sighted from two instrument stations A and B located at very different level and in the same vertical plane to that of target and following observations were noted.

Inst. Stn	HI (m)	Target	Zenithal angle		Distance	Target height
			FL	FR		
A	1.47	P	$59^{\circ}18'$	$300^{\circ}36'$	A to B = 112.00m	-
B	1.42	P	$69^{\circ}52'$	$290^{\circ}09'$		-
B	1.42	A	$85^{\circ}32'$	$274^{\circ}26'$		1.75m

If RL of B was 1290.00m, find the RL of the top of hill station.

- Define terms contour interval, Horizontal equivalent and index contour. Explain methods of contour interpolation.

[3+4]

8. The coordinates of three known stations (S), (D) and (C) are given in Table below. A theodolite is setup over the unknown point X, which is set outside of this known triangle and horizontal angle observation are made. Calculate coordinates of station X using any one method.

Known Points	Horizontal angle	Easting (m)	Northing (m)
(S)	LSXD = 41°20'21"	7464.718	6928.474
(D)	LDXC = 97°56'41"	9602.0054	5363.275
(C)	LCXS = 220°42'48"	7611.753	1479.468

9. It is necessary to design a circular curve by tangential angle method by selecting radius 'R' in such a way that the tangent length should be provided within the length of 35m, having deflection angle 48°30' and chainage of corresponding IP is 1+945.55 km. Take normal chord = 20m. Prepare a setting out table.
10. Prove the deflection angle of transition curve is $\alpha = \frac{573I^2}{RL}$ mins where symbols have their usual meaning.
11. A grade of (-)3.5% meets with another grade of 0.5%. The elevation and chainage of point of intersection are 1300m and 2600m respectively. Compute the suitable equal tangent vertical curve for full stations elevation assuming that vertical curve should pass through a point of elevation 2601m at a chainage 1300m. Take peg interval = 30m.
12. Describe relief displacement and derive its expression in case of vertical photogrammetry.
13. Discuss application of Remote Sensing in civil engineering.
14. Explain working principle and component of GPS.
15. Describe Features of Total Station and its uses.
16. Explain importance of GIS in civil engineering giving suitable example.

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2076 Baisakh

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- What are the points to be considered while establishing theodolite traverse in fields? [4]
- Explain with the help of sketch about the method for finding the missing quantities when two affected legs in a close traverse are not in adjacent. [4]
- In a four legged closed traverse ABCDA, the following data were taken. [8]

Leg	Length (m)	Deflection angle	Bearing	Co-ordinate
AB	280.00	?	S 50°00'00" W	?
BC	360.00	85°00'00" left	?	?
CD	320.00	135°00'00" left	?	C(1200mN, 2000mE)
DA	?	?	?	?

Find out the missing data and independent coordinates of all remaining station.

- Describe the principle of optical distance measurement (ODM). Explain the field procedure of tacheometric survey by theodolite for preparing topographic map. [4]
- Compute the gradient between two instrument stations A and B from the following observation having tacheometric constant 100 & 0. [6]

Inst st ⁿ	Hi	Sighted to	Bearing	Zenith Angle	Staff Readings	Remarks
A	1.42	P	60°00'	75°35'25"	1.025, 1.525, 2.025	RL of
B	1.48	P	345°00'	96°52'45"	0.925, 1.525, 2.125	P=1234.560m

- The top of the hill station Q was sighted from two instrument station P and R located at very different level and in the same vertical plane to the target and following observations were noted. [6]

Inst st ⁿ	HI (m)	Target	Zenith Angle		Distance	Target ht.
			FL	FR		
P	1.47	Q	59°18'	300°36'	PR=112.00m	
R	1.42	Q	69°52'	290°09'		
R	1.42	P	85°32'	274°26'		1.75m (vane)

If RL of station R was 1280.00m, find the RL of top of hill.

- What is mean by interpolation of contour? Briefly describe about interpolation of contour. List out the uses of contour maps. [1+3+2]
- Two points A and B have coordinates (7928.474mN, 8464.418mE) and (6363.275mN, 10602.054mE). From two points C and D located south and west of AB angles observation are $\angle ACB = 70^\circ 35' 50''$, $\angle DCA = 52^\circ 25' 40''$, $\angle ADB = 65^\circ 27' 35''$ & $\angle BDC = 32^\circ 16' 40''$. Determine the coordinates of resection point C. [6]

9. Two tangents PQ & QR of a highway curve meet at an angle to right of 140° . The circular curve which will pass through a point M 16m away from IP(Q) with an angle PQM being 70° . Compute the suitable radius of curve then compute the first three deflection angles on the curve if chainage of IP is 2250.00m. Take normal chord=30m. [6]
10. Describes the setting out procedures of combined curves including clear sketch. [4]
11. A grade of -3.5% meets another grade of -0.5%. The elevation of intersection is 1267m & chainage is (1+780)km. Field coordinates require that the vertical curve should pass through a point of elevation 1268m at chainage (1+780) km. Compute a suitable equal tangent vertical curve full station elevations including lowest point elevation. Use parabolic method. [6]
12. What are the consideration of flight planning and explain merits and limitation of photogrammetry. [4]
13. Describe about working principle and component of GPS. [4]
14. Describe about the features and use of Total Station. [4]
15. What are the components and sub system of GIS? Describes its application in the field of civil engineering. [4]
16. What are the Application of remote sensing in the sense of civil engineering and mapping? [4]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE 554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- Define closed loop and closed link traverse. Explain the plotting method of traverse by grid coordinates. [3+3]
- The following traverse notes were taken during a field survey in which the bearing of lines BC and DE could not be taken due to some reasons. Compute the missing data. [8]

Line	AB	BC	CD	DE	EF	FA
Length (m)	872	322	770	406	1079	1480
Q.B	N41°35'W	??	N 63°12' W	??	S 26°39' E	N 53°30' E

- The top of the building was sighted from two instrument stations A and B at very different level. The stations A and B lie on the same line with the building. The angle of elevation from A and B to the top of building was 35°21' and 19°28' respectively. The angle of elevation from B to a rod of 2m height held at A was 14°11' respectively. The height of instrument at A and B were 1.540m and 1.410m respectively. The horizontal distance between A and B was 130.570m and RL of B was 1234.250m. Find the RL of top of the building. [6]
- A 2m long subtense bar was placed above station B and the angle subtended at station C was 2°40'20". Intermediate level information was later recorded using a theodolite having constant 100 and 0 at station C and staff held vertical to the line of sight. The following data was recorded on two stations A and B. What is the difference in RL between A and B, gradient between A and B and bearing of AB. [6]

Sighting	Horizontal angle	Vertical Reading	Staff Reading (m)
C-A	0°0'0"	95°10'	1.459, 1.649, 1.839
C-B	80°24'20"	70°23'	, 1.235,

- Derive an expression for horizontal distance and RL for the tangential system of tacheometry when both sighting are angle of elevation. [4]
- Explain the factors that affect contour interval. Explain characteristics of contour with neat sketches. [6]
- In a three point analytical resection P, W and D are three known coordinated points and from resection point O, angles observation are taken. Compute the average coordinates of instrument point O from the following data. [8]

Instrument pointing to	HCR observation	Station	Coordinates	
			Easting (m)	Northing (m)
P	90° 00' 00"	P	2876.240	8754.110
W	230° 58' 51"	W	3810.800	7997.250
D	313° 17' 05"	D	2959.390	7487.090
P	90° 00' 30"			

8. Two tangents T_1V and T_2V intersect at chainage of (13+7) Chains. The bearing of forward tangent T_2V is $300^\circ 30'$ and backward tangent T_1V is $80^\circ 30'$. It is proposed to insert 6° Circular Curve with transition curve 90m at each end. Make all the calculations necessary for setting out the curve at peg interval of 15m on the transition curve and 30m at the circular curve. [6]
9. Derive the formula for deflection angle (α) in a transition curve, $\alpha = 573 l^2/RL$ minute and explain the laying out procedure. [4]
10. A grade of 1.25% meets another grade of 4.75%. The elevation and chainage of intersection point are 1267m and 1+780km. Field condition requires that the vertical curve should pass through a point of elevation 1267.70m at chainage (1+780)km. Compute a suitable equal tangent vertical curve and full station elevations. Use parabolic equation. [6]
11. Describe briefly about relief displacement and its expression. [4]
12. Describe briefly about application of remote sensing in civil engineering. [4]
13. Describe briefly about field procedure of GPS and components of GPS. [4]
14. Describe briefly about features of total station and its importance. [4]
15. Describe briefly about components and subsystem of GIS and uses. [4]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain about the relationship between precision of angle and distance measurement in a precise traverse. [6]
2. A link traverse Qm_1m_2X was run between two known stations Q and X where Q and X are starting point for the legs QP and XY respectively and following observations were taken. [10]

Known st ⁿ	Easting (m)	Northing (m)	Unknown st ⁿ	Mean Hz. Angle	Length (m)
P	7432.293	63115.158		$\angle PQM_1 = 93^\circ 06' 51''$	
Q	4792.189	63148.201	m_1	$\angle Qm_1m_2 = 155^\circ 45' 25''$	$Qm_1 = 49.085$
X	7439.604	63321.618	m_2	$\angle m_1m_2X = 247^\circ 09' 37''$	$m_1m_2 = 73.787$
Y	7358.014	63348.321		$\angle m_2XY = 90^\circ 58' 47''$	$m_2X = 85.590$

Calculate the coordinates in Gale's Table of m_1 and m_2 adjust them by Bowditch's rule and compute easting and northing coordinates.

3. Mention different methods of tachometric surveying. Discuss measurement of horizontal distance by tangential method. [2+4]
4. Calculate the elevation difference and gradient between station P and Q from the data given below, which are observed by a theodolite from station A with tachometric constant 100 and 0. The staff was held at station Q and subtense bar at station P. The subtended angle between the instrument and 3 m long bar was $00^\circ 17' 40''$. [6]

Inst. St ⁿ	Target St ⁿ	Azimuth	Vertical angle	Staff reading (m)	Subtends bar height	Remarks
A	P	$37^\circ 45'$	$(-) 10^\circ 31'$	x	1.75 m	
	Q	$112^\circ 15'$	$(+) 7^\circ 15'$	0.56, 1.61, 2.66	x	Staff vertical

5. Compute RL of a hill station 'P' from two instrument stations A and B at very different level with same line of sight to that of target from the following information. [6]

Inst st ⁿ	Inst ht (m)	Target	Zenith angle		Distance, Rod ht and RL
			FL	FR	Distance between A and B = 125 m
A	1.47	P	$62^\circ 18'$	$297^\circ 36'$	Rod ht at B = 2.0m, RL of B = 1280.50 m
B	1.42	P	$64^\circ 52'$	$239^\circ 00'$	
A	1.47	B	$96^\circ 10'$	$263^\circ 40'$	

6. What are the methods of contouring? Describe about field procedures of direct method of contouring. [6]
7. What is two point resection? Describe the two point resection method for finding the coordinates of unknown resection point. [6]
8. Two straight intersecting at a point B have the following bearings. AB 90° , CB 290° . They are to be joined by a circular curve which must pass through a point D which is 5 m from B and the bearing of BD is 190° . Find the required radius, tangent lengths, length of curve and setting-out angle or a 20-m chord. [6]
9. With the help of neat sketch, describe about the laying out procedures of composite curve left transition and central circular by using single theodolite and tape. [4]
10. A grade of 5% meets another grade of 3%. The elevation and chainage of IP are 1475.0 m and 3500 respectively. Field condition require that the vertical curve should pass through a point of elevation 1474.50 m at chainage 3500.00 m compute a suitable equal tangent vertical curve including full station elevations take peg interval 30 m. [6]
11. Describe the field procedure of aerial photogrammetric and relief displacement of photogrammetric. [6]
12. Discuss remote sensing and its types and application in civil engineering. [4]
13. State the principle of GPS and mention the application of GIS. [4]
14. Describe the features of total station and also describe the importance of total station. [4]

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain significance of traversing and describe about the accuracy parameters of horizontal and vertical control of traverse. [4]
2. Explain about the method of plotting of traverse in a standard grid sheet. [4]
3. Prepare the Gale's Table and find the co-ordinates of all the points if the co-ordinate of C is (1000N, 1500E) from the following data. [8]

S.No	Line	Length (m)	Bearing (WCB)
1	AB	66.60	30° 30'
2	BC	135.70	102° 48'
3	CD	66.30	95° 40'
4	DE	76.60	198° 8'
5	EA	214.30	284° 1'

4. Explain the principle of Tacheometric survey and also derive the formula to determine the horizontal distance and RL of the object with respect to instrument station when the staff is held in vertical. [8]
5. A tacheometer fitted with an anallatic lens and having multiplying constant of 100 was setup at station 'P'. The following readings were taken with the staff held vertically.

S.N	Staff Station	Bearing	Vertical Angle	Staff intercept	Axial hair reading
1	X	40° 35'	- 10° 20'	2.25	1.987
2	Y	70° 10'	+ 7° 30'	2.05	1.500

- Calculate the distance XY and the gradient between X and Y. [8]
6. What are the important characteristics of contour? Explain with sketches. [5]
 7. Explain about the reciprocal trigonometrical levelling and express the formula for computing elevation difference. [4]
 8. Stations A, B and C have the following respective coordinates (2876.24 mE, 8754.11 mN), (3810.80 mE, 7997.25 mN) and (2959.39 mE, 7487.09 mN) respectively. Station 'O' was established and following observations were recorded by a theodolite.

Pointing towards	Horizontal Circle Readings
A	90° 00' 00"
B	230° 58' 51"
C	313° 17' 05"
A	90° 00' 30"

Determine the coordinates of resection point 'O'. [7]

9. It is required to join two straights having a total deflection angle $18^{\circ} 36'$ by a central circular curve of radius 450 m with two ends cubic spiral transition curves. The design velocity is 70 kmph and rate of change of radial acceleration is 30 cm/sec^3 . Chainage of IP = 2524.20 m. Take Peg interval for circular and transition curve = 20 m for both. [8]

10. A grade of -0.7% is followed by another grade of + 0.5%. The two ends of these portions are connected by a parabolic vertical curve. The chainage and RL of intersection point are 1000 and 650 m respectively. Calculate RLs of all the points on the curve. Take peg interval of 20 m and rate of change of grade is 0.1% per 20 m. [8]

11. Write short notes on: (Any Four)

[4×4]

- a) Importance of GPS and GIS
- b) Scale of vertical photograph and uses of photo grammetry
- c) Features of total station and its uses
- d) Types of remote sensing and its application
- e) Setting out of circular curve by Rankine's method

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) How a linked traverse is balanced? How total misclosure is balanced by Transit Rule? [6]
b) Calculate the omitted quantities in the closed traverse ABCDE given below. [10]

Line	Length	Bearing
AB	282.20	61°30'
BC	?	151°24'
CD	324.70	201°02'
DE	381.60	280°14'
EA	359.60	?

2. a) Compute RL of a hill station 'P' from two instrument stations A and B at very different level with same line of sight to that of target from the following informations. [5]

Inst St ⁿ	Inst ht	Target	Zenith angle		Distance & Target ht and RL
			FL	FR	
A	1.42	P	65°18'	304°36'	Distance between A and B = 120.00 m RL of B = 1280.00 m Target ht at B = 1.50 m
B	1.47	P	69°52'	290°00'	
A	1.42	B	102°52'	257°16'	

- b) What is stadia interval factor and additive constant? How these constants are determined? [3]
c) Following observations were made in a Tacheometric survey a station A of RL 1086.550, the height of instrument being 1.385 m. [8]

Inst. Station	H.I.	Staff Station	Bearing	Zenithal Angle	Staff Reading
A	1.385	B	18°00'	71°30'	1.295, 1.820, 2.345
		C	127°00'	96°00'	1.010, 1.790, 2.570

The instrument is fitted with an anallactic lens and the multiplying constants is 100. Determine the R.L of B and C and the gradient of line BC, and bearing of BC.

3. a) How do you define contour interval, contour gradient and index contour? Explain the main characteristics of Contours with neat sketch. [6]
b) What is the different between Intersection and Resection? Explain three point Resection Method to determine the unknown co-ordinate of a point. [4]

- c) The co-ordinates of three known stations Swoyambhu (S), Harisiddhi (D) and Chovar Temple (C) are given below. A traverse point "O" is set outside of this triangle and observations are taken for horizontal angle to these known co-ordinate points. Calculate the co-ordinate of station point "O".

[6]

Known Station	Horizontal Angle	Easting, m	Northing, m
Swoyambhu (S)	<SOD = 40°20'21"	627465.718	3066929.474
Harisiddhi (D)	<DOC = 98°56'41"	629603.054	6065364.275
Chovar Temple (C)	<COS = 220°42'58"	627612.753	3061479.468

4. a) Two roads BA and AC intersect at an angle of 150°. They are to be connected by a 4° circular curve. The chainage of point of intersection A is (138+20.3) chains. Compute all data necessary (i.e deflection angle, tangent length, apex distance, mod ordinate, length of curve, long chord for laying out the curve if only 30 m chain is used.

[6]

- b) State the function of transition curves. Derive the expression for deflection angle in transition curve that $\alpha = \frac{573\ell^2}{RL} \text{ min}$

where, ℓ = chord length

R = Radius

L = Length of transition curve

[5]

- c) A grade of 3.5% meets another grade of -0.5%. The elevation and chainage of intersection pt are 1267.00 m and 780.00 m respectively. Field condition requires that vertical curve should pass through a point of elevation 1266.00 m at chainage 780.00 m. Compute a suitable equal tangent vertical curve and full station elevation including highest point. Take peg interval = 30m.

[5]

5. Write short notes on: (Any four)

[4×4]

- Planning and taking of photographs and interpretation of aerial photograph
- Application of Remote sensing in surveying and mapping
- Working principle and Components of GPS
- Application of GIS in Civil Engineering
- Features and precautions taken in Total Station

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Explain different cases of omitted measurements in theodolite traversing. Explain plotting of traverse in grid sheet by co-ordinates method. [6]
- b) A link traverse was run between stations A and X. The co-ordinates of the controlling stations at the ends of the traverse are as follows: [10]

Stn.	E(m)	N(m)	Clockwise Angle	Length (m)
A	1769.15	2094.72	115°37'00"	A-1=208.26
B	1057.28	2492.39		
X	2334.85	1747.32	173°31'00"	4-X=224.79
Y	2995.85	1616.18		
1			168°19'10"	
2			281°12'40"	1-2=193.47
3			242°53'40"	2-3=326.71
4			80°26'20"	3-4=309.15

Calculate coordinates of stations 1, 2, 3 and 4. Adjust any mis-closure by transit method.

2. a) Find the gradient from P to Q using data below, [6]

Instru ment at	Staff at	Line	Bearing	Vertical Angle	Staff readings (m)
A	P	AP	84°36'	3°30'	1.35, 2.10, 2.85
A	Q	AQ	142°24'	2°45'	1.955, 2.860, 3.765

The staff was held vertical to the line of sight in both cases.

- b) Describe contour interval and horizontal equivalent. Explain characteristics of contour with neat sketches. [6]
- c) Describe tangential tachometry. Explain the field procedure of tachometric survey by total station for preparing topo map. [4]

3. a) Define intersection and resection. Derive the equation for any one method of resection for finding the coordinates of that unknown point. [2+6]

- b) The top of the hill station 'P' was sighted from two instrument stations A and B located at very different level and in the same vertical plane to that of target and following observations were noted. [8]

Inst st ⁿ	HI (m)	Target	Zenith Angle		Distance	Target nt.
			FL	FR		
A	1.47	P	59°18'	300°36'	A to B = 112.00 m	-
B	1.42	P	69°52'	290°09'		-
C	1.42	A	85°32'	274°26'		1.75 m

If RL of "B" was 1280.00 m, find the RL of top of hill station.

4. a) Derive the formula for deflection angle (α) in transition curve, $\alpha = 573 l^2 / RL$ minute. [4]

- b) In a road alignment a grade of (-)1% is followed by another grade of 0.5%. The chainage and RL of intersection pt are 1500 m and 1250 m respectively. The rate of change of grade is 0.1% /20 m. calculate the necessary data required for setting out of vertical curve by parabolic equation method take peg interval = 30 m. [6]

- c) Compute and tabulate the data required for setting out a simple circular curve by Rankine's Method from the following information: [6]

Angle of intersection = 150°00'

Chainage of point of intersection = 1585.00 m

Degree of curve = 3°

Peg interval = 20 m, Normal chord = 20 m

5. Write short notes on: (any four) [4×4]

- Field procedure of aerial photogrammetry
- Principle of GPS and its components
- Features of total station and importance of total station
- Components and sub system of GIS and its application
- Application of remote sensing

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	H / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What is omitted measurement? Explain the case when two affected sides are not adjacent. [4]
- b) A link traverse was run between main traverse stations "B" and "M". Clockwise angles of link traverse taken were: $ABX = 135^{\circ}00'30''$, $BXY = 98^{\circ}07'55''$, $XYM = 209^{\circ}45'02''$ and $YMN = 64^{\circ}39'33''$ respectively. Lengths of link traverse are: $BX = 31.612$, $XY = 22.260$ m and $YM = 36.153$ m respectively. The coordinates of main traverse stations given are: A (42.360 mN, 18.820mE), B (20.000mN, 30.000mE) and M (50.000mN, 100.000mE), N (70.600mN, 65.6670mE) respectively. Calculate the final coordinates of stations X and Y. Adjust any misclosure by Bowditch method. [12]

2. a) What is tacheometry? Explain the booking and plotting details in techeometric surveying. Calculate the gradient between station A and station B from the following observations taken from tacheometer fitted with anallactic lens. The RL and HI of instrument station P are 1275m and 1.55m respectively. [4+6]

Inst. Station	Target Station	Bearing	Vertical angle	Staff readings (m)
P	A	$30^{\circ}30'$	$6^{\circ}30'$	1.115, 1.735, 2.355
	B	$75^{\circ}30'$	$9^{\circ}15'$	1.250, 2.000, 2.750

- b) Calculate the RL of top of tower P, base of which was not accessible from the two instrumentation stations X and Y. The top of the tower and the instrument stations were not in the same vertical plane. The observed zenithal angles from X to P and Y to P were $30^{\circ}30'$ and $29^{\circ}20'$ respectively. H.I. of instruments at X and Y were 1.57m and 1.50 m respectively and distance between them was 200 m. The horizontal angles observed were: $PXY = 45^{\circ}45'$ $XYP = 60^{\circ}30'$ respectively. The back sights taken to BM with RL of 1000.00m were 1.8m and 0.8m from X and Y respectively. [6]
3. a) What is contour index? What are the different methods of interpolating contours? Explain them with appropriate examples and sketches. [8]
- b) What is resection? Explain the two point problem. What is intersection? The coordinates of known stations A (7492 mN, 3932mE) and station B (7487mN, 2960mE). Calculate the coordinate of unknown point P, where the observed horizontal angles taken to P from A is $44^{\circ}52'36''$ and to P from B is $75^{\circ}33'22''$ respectively. [4+4]

4. a) Explain the setting out of simple circular curve by offsets from long chord. [4]
- b) It is proposed to insert a circular curve of 300m radius with a transition curve of length 60 m long each end of the circular curve. Prepare necessary data for setting out the combined curve in tabular form. Deflection angle between two alignments of road is 45° and chainage of intersection point is 2000m. Peg interval for transition and circular curve are 20 m and 30 m respectively. Take chainage at multiple of peg interval. [6]
- c) A grade of -3.5% meets another grade of +0.5%. The elevation and chainage of IP are 1267.00m and 780 m respectively. Field condition requires that the vertical curve should pass through a point of elevation 1268m at chainage 780m. Compute a suitable equal tangent vertical curve and full stations elevations when normal chord = 30 m. [6]
5. Explain the following: (any four) [4×4]
- i) Principle of stereoscopy, importance of aerial mapping
 - ii) Application of remote sensing
 - iii) Working principle and components of GPS
 - iv) GIS and its components and subsystem
 - v) Features of total station and its importance.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Explain the procedure of computation of omitted measurement, when two affected sides of traverse are not adjacent. [6]

- b) The following observations are made in a traverse ABCDA. [10]

Traverse Leg	Horizontal Distance (m)	Traverse Station	Horizontal Angle		
			°	'	"
AB	71.5	A	78	41	25
BC	42.0	B	101	18	38
CD	70.0	C	89	59	41
DA	56.0	D	90	00	21

Bearing of CD = $314^{\circ}58'04''$ Coordinate of C (500 m N, 500 m E)

Complete the Gale's Table with final adjusted length and bearing of each line.

2. a) Describe about the working principle of subtense bar tacheometry and derive subtense bar formula for computing horizontal and vertical distances when line of sight is inclined upward. [2+4]

- b) It is required to determine the height (clear) of a Flood light tower in an arena by using a transit theodolite and for this zenith angles observation taken at 5 m and 2 m height on a target vane held on the plinth level of tower were $87^{\circ}45'$ and $88^{\circ}30'$ respectively. From the same instrument, zenith angle observed at top of the tower was found as $67^{\circ}45'$. If the RL of the instrument axis was 1200.00 m, Calculate the clear height (plinth to top) of the tower. [10]

3. a) Explain contour, contour interval, horizontal equivalent, index contour and the characteristics of contour with appropriate neat sketches. [8]

- b) The following are the co-ordinates of three known station points whose directions are observed from the unknown instrument station P. [8]

	A	B	C
Easting (m)	5,000	10,000	15,000
Northing (m)	10,000	15,000	10,000

If observed horizontal angle $APB = 45^{\circ}$ and $BPC = 52^{\circ}$

Determine (i) Length and Bearings of AP, BP and CP (ii) Co-ordinates of P.

4. a) Derive the expression that in a parabolic shaped vertical curve, RL of any curve point

'P' is equal to $y_p = \frac{(g_2 - g_1)x^2}{200L} + \frac{g_1x}{100} + \text{RL of BVC}$

Where, g_1 and g_2 are percentage of grade of two tangents, L is the total length of curve and x is the chord distance taken from BVC. Also find the formula to determine lowest and highest point of the curve. [6]

- b) A road 8 m wide is to deflect through an angle of 60° with the center line radius of 300 m, the chainage of intersection point being (3+605) Km. A transition curve is to be used at each end of the circular curve of such a length that the rate of change of radial acceleration is 50 cm/sec^3 , when the speed of design vehicle is 70 Kmph, find out: [10]

- i) Length of transition curve
- ii) Super elevation
- iii) Chainage of tangent points and junction points
- iv) Deflection angles for first two points of transition curves and circular curve.

Take peg interval for transition curve = 10 m and circular curve = 20 m.

5. Attempt any four:

[4×4]

- a) Feature of total station and its importance
- b) Working principle and components of GPS
- c) Field procedure of aerial photogrammetry
- d) Application of remote sensing in engineering and mapping
- e) Components of GIS and its application

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Describe consecutive and independent coordinates. Explain the plotting method of traverse by grid coordinates. [3+3]
- b) In a four sided closed traverse ABCDA the following informations are given. [10]

Side	Length (m)	Deflection angle	Bearing	Coordinates
AB	280.00	?	S50°W	?
BC	360.00	85°00' Left	?	?
CD	320.00	135°00' Left	?	C=2500mE, 2500mN
DA	?	?	?	?

- i) Compute all missing figures.
- ii) Compute the coordinates of other points with respect to C.
2. a) Develop expression for H, V, and R.L for the tangential system of tachometry when the both sightings are angles of depression. [4]
- b) Determine gradient and bearing of PQ. The staff was held vertical. $K = 100$, $C = 0$. [6]

Inst. St.	Staff St.	Bearing	Zenithal Angle	Staff Readings (m)		
				T	M	B
R	P	S60°E	79°28'	2.36	1.81	1.25
	Q	S30°W	95°06'	2.94	2.12	1.30

- c) The top (Q) of a tower was sighted from two stations at very different level and in same vertical plane with Q. Find R.L of the top of tower from the following observed data: [6]

Inst. St.	H.I	R.L	Target	Zenithal angle
P	1.87 m	-	Q	51°39'
R	1.64 m	112.78 m	Q	68°42'

The distance between instrument stations P and R is 120 m.

The angle of elevation from R to 2 m. above the foot of the staff held at P was 15°11'

3. a) Explain the factors that affect the contour interval. [4]
- b) In a trigonometrical levellings a hill station "P" was sighted from two instrument station A and B which were at very different level but with same line of sight to that of target and following information were noted. [6]

Inst. st ⁿ	HI (m)	Target	Zenith	Angle	Distance
			FL	FR	
A	1.42	P	65°18'	304°36'	120.00m (st ⁿ A to St ⁿ B)
B	1.47	P	69°52'	290°00'	
A	1.42	B	102°52'	257°16'	

Determine the RL of P, if RL of ground point B was 1280.00 m and vane height while sighting from A to B was 2.50 m above the foot of the vane.

- c) In two point resection problem, if two known points A and B having coordinates (6928.474 mN, 7464.418 mE) and (5363.275 mN, 9602.054 mE) are given. From two points C and D located south and west of AB, angles observations are: $\angle ACB = 70^\circ 35' 48''$, $\angle DCA = 52^\circ 25' 35''$, $\angle ADB = 65^\circ 27' 35''$ and $\angle BDC = 32^\circ 16' 42''$. Determine the coordinates of resection point "C" [6]
4. a) Derive the formula for deflection angle (α) in transition curve, $\alpha = 573 \frac{l^2}{RL}$ minute. [4]
- b) Calculate the R.L.s of pegs on a vertical curve connecting two grades of -0.5% and +0.7% at the intersection point which has chainage = 1000 m and R.L = 500 m. The rate of change of grade is 0.1% per 30 m. Take peg interval = 20. [6]
- c) Compute the data for setting out a simple circular curve by Rankines deflection angle method from the following informations: [6]
- Angle of intersection = $145^\circ 0'$
 Chainage of point of intersection = 1580 m
 Degree of curve = 5°
 Least count of the theodolite = $10''$
 Peg interval = 30 m
5. Write short note on: (any four) [4×4]
- Field procedure of aerial photogrammetric
 - Application of remote sensing in engineering and mapping
 - Working principle and components of GPS
 - Components of GIS and its application
 - Features of total station and its importance

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Define closed loop and closed link traverse. Also explain angular misclosure balancing process in linked traverse. [6]
- b) A traverse ABCDA was conducted and the following data were obtained. It was required to connect the midpoint E of CD to the midpoint F of AB. Find the length and bearing of EF. [10]

Line	Length	Bearing
AB	610.00	N 80°10' E
BC	510.00	N 13°00' E
CD	1130.00	S 80°10' W
DA	450.00	S 15°30' E

2. a) State the principle of stadia tacheometry and describe the field procedure of tacheometry survey for preparing topographic map. [8]
- b) A tachometric survey was done to find the gradient between X and Y. Tacheometer consist of an anallatic lens was used and following observations were made from section R on vertical staff. [8]

Inst. Stn.	Staff point	Stadia hair readings	Vertical angle	Bearing
R	X	0.915, 1.750, 2.585	+15°	345°
	Y	0.760, 2.240, 3.715	+10°	75°

3. a) How can you measure the horizontal distance and elevation of an inaccessible object when the instrument positions are at very different levels; instrument stations and the elevated object are in the same vertical plane. [8]
- b) The co-ordinates of three known stations Swayambhu, Dharara and Chovar temple is given below. [8]

Known station	Horizontal angle	Easting	Northing
Swayambhu (S)	$\angle S \times D = 41^\circ 20' 21''$	627464.718	3066928.474
Dharara (D)	$\angle D \times C = 97^\circ 56' 41''$	629602.054	3065363.275
Chovar Temple (C)	$\angle C \times S = 220^\circ 42' 58''$	627611.753	3061479.468

A theodolite is set up over an unknown point X. Calculate the co-ordinates of station X using the Tienstra method.

4. a) Describe index contour and explain indirect method of contouring for field control. [1+5]
- b) A road 8m wide is to deflect through an angle of 60° with the center line radius of 300m, the chainage of intersection point being 3605m. A transition curve is to be used at each end of circular curve of such a length that the rate of gain of radial acceleration is 0.5 m/s^3 , when the speed is 50 km/h. Find out: [10]
- i) length of transition curve
 - ii) superelevation
 - iii) chainage of all tangent points and junction points
 - iv) Calculate the first two deflection angles for transition curve, and first two deflection angles for circular curve. Take peg interval = 10m for transition curve and 20m for circular curve.
5. Write short notes on: (any four) [4×4]
- a) Working principle and components of GPS
 - b) Relief displacement and its expression
 - c) Application of remote sensing in civil engineering
 - d) Features of total station and its importance
 - e) Component of GIS and its application

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) When would you suggest a theodolite traversing by the method of deflection angles? Explain with neat sketches. [6]

- b) The following data refers to a traverse ABCDE. Determine the bearings of the sides DE and EA. [10]

Line	AB	BC	CD	DE	EA
Length (m)	230.50	250.20	210.80	240.30	265.40
Bearing	N 36°45' E	S 82°48' E	S 10°15' E	?	?

2. a) The co-ordinates of stations S and A are (1309.12 m E, 1170.50 m N) and (1525.43 m E and 956.87 m N) respectively. Calculate the co-ordinates of point B which has been located by intersection from stations S and A observing the following angles. $\angle BSA = 85^\circ 38' 49''$ and $\angle SAB = 55^\circ 50' 33''$. [8]

- b) Calculate the elevation difference and gradient between stations A and B from the given data which are observed by a tacheometer from station R. Staff was vertically held at A and subtense bar at B. The subtended angle between the instrument and 2m long subtense bar was $00^\circ 42' 15''$ [8]

Instrument Station	Sighted to	Bearing	Zenith angle	Staff readings (m)	Subtense bar height
R	A	345°00'	96°30'	0.650, 1.250, 1.850	X
R	B	225°00'	85°00'	X	1.180 (m)

3. a) Explain the direct method of contouring and write the uses of contour map. [6]

- b) In a road alignment a falling grade of 1% is followed by rising grade of 0.5%. The chainage and RL of the intersection point are 500 and 350 m respectively. The rate of change of grade is 0.1% per 20 m. Calculate the necessary data required for setting out the vertical curve, take peg interval of 30 m. [10]

4. a) Explain degree of curve with neat sketch. Derive the formula of Tangential angle, $\alpha = \frac{90^\circ C}{\pi R}$ and deflection angle $\Delta_n = \delta_1 + \delta_2 + \delta_3 + \dots + \delta_n$. [8]

- b) The top of temple was sighted from two stations A and B at very different level. The observed vertical angle from A and B to top of temple 'P' were $30^\circ 36'$ and $20^\circ 12'$ respectively. The vertical angle B to A to a vane at 1.5 m above the foot of the vane was $4^\circ 15'$. The height of instrument at A and B were 1.47 m and 1.42 m. The distance between two instrument station was 112 m. RL of B was 1280.00 m. Find the RL of the top of the temple. Also apply the correction for refraction and curveturate. [8]

5. Write short notes on: (any four) [4×4]

- a) Working principle and components of GPS
- b) Importance and uses of photogrammetry
- c) Application of remote sensing in Civil Engineering
- d) Features, importance and uses of Total Station
- e) Component and subsystem of GIS and its application

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Write the field measurements required in theodolite traversing and explain closed and open traverses. [4+4]

- b) Balance the following coordinates and compute the total coordinates for a link traverse XABCY using Bowditch's rule. The given coordinates of X and Y are (1877.51 mN, 1290.20 mE) and (1626.50 mN, 1578.87 mE) respectively. If permissible closing error is 1:500, justify your assessment. Other observed data are as follows: [8]

Lines	XA	AB	BC	CY
Length (m)	120.00	111.50	132.40	97.60
Bearing	135°00'	119°30'	175°00'	77°30'

2. a) The following observation were made with a tacheometer. The staff was held vertical (constants are 100 and 0). [8]

Inst. St	Staff St	Bearing	Vertical angle	Staff	Readings	
R	P	100°	+8°20'	2.60	1.85	1.10
	Q	200°	-2°30'	2.50	1.91	1.32

Find the gradient between P and Q.

- b) Explain the method of trigonometrical levelling to determine the elevation of inaccessible object when the instrument stations and the object are in different vertical plane. [8]
3. a) Explain about the characteristics of contour lines with clear supporting sketches. [8]
- b) Explain any one method of analytical resection. [8]
4. a) Prepare a table giving all necessary data for setting out a vertical curve. [10]
- In a road alignment a grade of -4.5% followed by +3.5%, R.L. of I.P. = 1000 m chainage of IP = 1500 m connect the two grade by a parabolic curve 200 m long. Take peg interval = 20 m.
- b) Determine the expression for the scale of vertical photograph. [6]
5. Write short notes on: (any two)
- a) Write the working principle of GPS, its components and uses. [8]
- b) Working principle of total station, its importance and uses in surveying and mapping. [8]
- c) Write the components of GIS. [8]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE557)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Explain in brief field procedure of traverse survey between two known stations. [6]
- b) Below given table lists measured angles to the right for the traverse. The bearings A-X and E-Y have known value of $139^{\circ}05'45''$ and $86^{\circ}20'47''$ respectively. Adjust this traverse for departure and latitude misclosure. [10]

Status	Length	Measured angle
A	-	$283^{\circ}50'10''$
	1045.50	
B	-	$25617'18''$
	1007.38	
C	-	$98^{\circ}12'41''$
	897.81	
D	-	$103^{\circ}30'34''$

2. a) In what situation reciprocal trigonometrically levelling is conducted? Derive a relation for determining the reduced level of a hill top when two instrument stations and target point are at different vertical plane. [6]
- b) A 2 m long subtense bar was placed above station B and the angle subtended at station A was read as $02^{\circ}40'20''$. Intermediate level information was later recorded using a theodolite with tachometric constants 100 and 0 at station C and the staff was held vertical. The following data were recorded on to stations A and B. [10]

Inst st ⁿ	Sighted to	Horizontal circle	vertical angle	Staff readings (m)
C	A	$00^{\circ}00'00''$	$-05^{\circ}10'00''$	1.459, 1.649, 1.839
hi = 1.55 m	B	$80^{\circ}24'20''$	$+10^{\circ}23'30''$	-, 1.235, -

Find the difference in elevation and distance between A and B, the horizontal angle ACB was $60^{\circ}0'00''$

3. a) What is mean by contour interpolation? Which method do you suggest for contour interpolation in large volume of work and how would you applied it? [6]
- b) A, B and C are three visible stations in a location survey. The computed sides of the triangle ABC are AB = 1200 m, BC = 1442 m and CA = 1960 m. A station 'O' is established outside the triangle and its position is to be determined by resection on A, B and C. The angles AOB and BOC being $45^{\circ}30'$ and $52^{\circ}15'$ respectively. Determine the distances of OA and OC. [10]
4. a) Describe elements of transition curve. [6]
- b) A road curve of 180 m radius is to be set out to connect two tangents. The maximum speed of this part of the road will be 13.2m/sec. Transition curves are to be introduced at each end of the curve. Find a suitable length of transition curve and circular curve including the value of first two deflection angles of each curve. [10]
- a) With the help of neat sketch describe relief displacement on a vertical photograph. [6]
- b) Explain in brief GPS field procedure. [5]
- c) Discuss the uses and advantages of satellite imagery. [5]

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) For a closed traverse ABCDA, compute the missing data. [8]

Line	Length(m)	Bearing
AB	100.00	N 45° 30' W
BC	605.00	N 5° 30' E
CD	95.00	N 88° 20' E
DA	?	?

- b) What are closed and open traverse? Explain consecutive and independent co-ordinates with examples. [8]

2. a) The following readings were taken by a tacheometer with the staff held vertical. The tacheometer is fitted with an anallactic lens and the multiplying constant is 100. find out the horizontal distance from A to B and gradient of AB. [10]

Instrument station	Staff Station	Vertical angle	Staff readings	Remarks
A	BM	-6°30'	1.100, 1.153, 2.060	RL of BM =970.00m
	B	+10°0'	0.982, 1.105, 1.188	

- b) Derive an expression to find the RL of an inaccessible object when the instrument and the object are not in the same vertical plane. [6]
3. a) What are the methods of contouring? Explain briefly. Write the uses of contour maps. [8]
- b) What is analytical resection? Derive an expression to find the co-ordinates of unknown points by observations to three known points. [8]
4. a) Calculate the RLs of pegs on a vertical curve connecting two grades of +0.5% and -0.7% at the point of intersection. The chainage and RL of intersection point are 500m and 350.750m respectively. The rate of change of grade is 0.1% per 30m. [8]
- b) Find the elements of simple circular curve. [4]
- c) Define: (i) Tilted photograph (ii) Side overlap (iii) Principal point (iv) Flying height [4]
5. a) What is GPS? Write the components and working principle of GPS. [8]
- b) Explain the working principle of total station. Write its importance and uses in surveying and mapping. [8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What are closed and open traverses? Explain transit rule for balancing the traverse. [7]
- b) Balance the coordinates of a link traverse XABCY using Bowditch's rule. The coordinates of stations X and Y are (1162.510N, 775.250E) and (1043.610N, 1043.610E) respectively and permissible closing error is 1:500. Other observed data are given below: [9]

Lines	XA	AB	BC	CY
Length (m)	120.00	111.50	132.40	97.60
Bearings	135°00'	119°30'	175°00'	77°30'

2. a) What is contour gradient? Write characteristics of contours with suitable sketches. [7]
- b) The following observations were taken from the traverse station A and B. The staff was held vertical. The tachometer is fitted with anallactic lens. Multiplicative constant = 100. [9]

Traverse station	H.I. (m)	Staff Station	Bearing	Vertical angle	Staff reading
A	1.50	C	15°14'	+8°9'	2.60 1.85 1.10
B	1.53	D	340°18'	+2°3'	2.50 1.91 1.32

Independent coordinates of A is (800, 1800)
Independent coordinates of B is (950, 2500)
Compute the length and bearing of CD.

3. a) What is degree of curve? Describe the elements of simple circular curve. [7]
- b) Design a composite curve with the following data: Deflection angle = 60°, Maximum speed of vehicle = 40km/hr, centrifugal ratio = 1/8, rate of change of radial acceleration = 0.30m/sec³, chainage of IP = 1150m. Also calculate the setting out data of circular curve by Rankine's method. Take peg interval = 20m. [9]
4. a) What is GPS? Write about the principles of GPS and its components and applications. [9]
- b) Explain any one method of analytical resection to calculate the position of instrument station. [7]
5. Write short notes on: (any two) [8×2]
- a) Components of GIS and applications of GIS in Civil engineering
- b) Features of total station and its operations
- c) Remote sensing and its applications

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- i. a) What are the field measurements necessary in theodolite traversing? Explain Bowditch's rule for balancing the traverse. [6]
- b) In a four sided closed traverse ABCDA, the following informations are given: [10]

Side	Length (m)	Deflection angle	Bearing	Coordinates		Remarks
				Northing	Easting	
AB	160	?	S 40°00' W	?	?	Coordinates of B.
BC	340	116°00' (L)	?	26500	22400	
CD	210	60°00' (L)	?	?	?	
DA	?	?	?	?	?	

Find the missing data.

2. a) Describe the working principle of subtense bar. Derive an expression to find the horizontal distance and height difference between the instrument station and staff point in the case of fixed hair method, line of sight is inclined and staff held vertical. [7]
- b) A tachometer is placed at a station A and readings on a staff held upon a B.M. of R.L. = 1000.00 and station B are 0.640, 2.200, 3.760 and 0.010, 2.120, 4.230 respectively. The angle of depression of the telescope in the first case is $-6^{\circ}19'$ and in the second case $-7^{\circ}42'$. Find the horizontal distance from A to B and R.L. of the station B. (Constants are 100 and 0.3) [9]
3. a) Describe the principle characteristics of contour lines with supporting sketches and uses of contour map. [8]
- b) The top of a hill station P was sighted from two stations A and B at a different level and at the same vertical plane with the target. The zenith angle from A to P and B to P were $59^{\circ}15'$ and $69^{\circ}45'$ respectively. The zenith angle from A to B to a vane 1.5m above the foot of the vane was $105^{\circ}30'$. If the height of instrument of A and B were 1.45m and 1.35m respectively and distance between A and B was 150m, and RL of B was 120.00m. Find the RL of hill station (if target is 3.5m above the ground). [8]
4. a) Derive the expression of the three point analytical resection. [8]
- b) Two tangents which deflect at an angle of $37^{\circ}46'$ are to be connected by a circular curve of 2000m radius with a transition curve at either end. The chainage of the point of intersection is (3436+26) chains. Find the chainages of the beginning and end of the three curves and draw a table of the deflection angles for chords of 15m for each transition curve. Assume velocity = 160 km/hr, rate of change of radial acceleration = 0.3m/sec^3 , chain used was 30m length. [8]
5. a) Define vertical and horizontal control. Describe the process of measurement of velocity and flow of stream. [8]
- b) A down grade of 3.5% is followed by an upgrade of 4.5%. The reduced level and chainage of IP are 900.00m and 2450.00m respectively. A vertical parabolic curve 180m long is to be introduced to connect the two grades. The pegs are to be fixed at 20m intervals. Calculate the RLS of curve points including lowest point [8]
6. Write short notes on: (any two) [8x2]
 - a) Global Positioning System
 - b) Photogrammetry its limitation and uses
 - c) Location of sounding point in hydrographic survey
 - d) Setting out vertical curve

Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What is traverse? Explain in brief about traverse computation process. [6]
- b) Given the following latitudes and departures of traverse ABCDEA, the bearings of AB and EA having been omitted. [10]

Line	Latitude (m)	Departure (m)	Length (m)
AB	---	---	1970
BC	+841.11	+336.71	
CD	+877.18	-311.74	
DE	-700.60	-727.88	
EA	---	---	1181

Determine the bearings of AB and EA.

2. a) What is the use of subtense bar? Write the working principles of subtense bar. [6]
- b) Discuss importance of trigonometrical levelling. Derive an expression to find the R.L. of an inaccessible object when the instrument stations are in the different vertical plane. [10]
3. a) Discuss about the principal characteristics of contour lines with supporting neat sketches. [6]
- b) The following observations were made on a vertically held staff with a tacheometer fitted anallactic lens having multiplying constant of 100. [10]

Instrument Station	Height of Instrument	Staff Station	Bearing	Zenith Angle	Hair Reading	Remarks
O	1.55	A	30°30'	85°30'	1.155, 1.755, 2.355	RL of O = 450.80m
		B	75°30'	101°15'	1.250, 2.000, 2.750	

Calculate the distance AB and RL_s of A and B. Find the gradient of the line AB.

4. a) Derive the expression for three point resection problem. [8]
- b) A down grade of 4.5% is followed by an upgrade of 3.5%. The reduced level and chainage of the point of intersection level and chainage of the point of intersection are 900.00m and 450.00m respectively. A vertical parabolic curve 180m long is to be introduced to connect the two grades. The pegs are to be fixed at 20m intervals. Calculate including lowest point also. [8]
5. a) Describe about the setting out techniques of right hand side composite curve. [6]
- b) Two straights AB and BC intersect at the chainage (1+400) kilometer, the deflection angle being 40°00'. It is proposed to layout a circular curve of 400m radius with a cubic parabola of 90m length at each end. Peg intervals for circular and transition curve re 20m and 30m respectively. Calculate tangential angles for first two points on transition curve, deflection angles for two points on the circular curve and chainage at the beginning and at the end of this composite curve. [10]
6. Write short notes on any two: [8×2]
 - a) Global positioning system (GPS)
 - b) Location of sounding points
 - c) Remote sensing and its application

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying



- ✓ Candidates are required to give their answers in the words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) What are closed and open traverses? Explain Bowditch's rule for balancing the traverse. [7]
- b) The following data refers to a traverse ABCDE. Determine the bearings of the sides BC and CD. [9]

Line	Length in (m)	Bearing
AB	306.00	164°00'
BC	432.00	?
CD	324.00	?
DE	302.40	328°00'
EA	629.43	269°06'

2. a) Write working principle of a subtense bar. How precision can be increased by using subtense bar for computed distance. [7]
- b) The following observations were taken in a tacheometric survey from a station A of R.L. 1086.550, the height of instrument being 1.385m. [9]

Instrument Station	Height of Instrument	Staff Station	Bearing	Zenithol	Stadia Reading
A	1.385	B	18°00'	71°30'	1.295, 1.820, 2.345
		C	127°0'	96°00'	1.010, 1.790, 2.570

The instrument is fitted with an anallactic lens and the multiplying constant is 100. Determine the R.L. of B and C and the gradient of the line BC.

3. a) Write characteristics of contours and illustrate with suitable sketches. [9]
- b) Explain the method of determining the R.L. of an inaccessible object when the instrument stations and object are in different vertical plane. [7]
4. a) What is degree of curve? Find the elements of a composite curve including sketch. [7]
- b) Two tangents intersect at chainages 1190m, the deflection angle being 36°. Calculate all the necessary data for setting out a curve with a radius of 300m, by deflection angle method. Take peg interval of 30m. Also provide check to support the calculation during setting out. [9]
5. a) Derive the expression that the tangential angle for points on the circular curve is equal to $1718.87 \times C/R$ and also express about the deflection angles for laying out of circular curve. [6]
- b) A 2% down gradient meets a 3% up gradient at a chainage of 2600m, the RL of the point of intersection being 1200.00m. A vertical parabolic curve is to be set out to connect two grades with pegs at 20m interval. The rate of change of grade is 0.5% per 20m chain. Tabulate the chainages and RLS of the station pegs including lowest point on the curve. [10]

6. Write short notes on (any two): [8×2]

a) Analytical resection b) Under water mapping c) Global Positioning System (GPS)