Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem: Odd Sem 2019-20
Course Code: CIV 202
Course Name: SURVEYING
Program & Sem: B.Tech (CIV) & III

Date: 30.09.2019
Time: 11:00AM to 12.00PM
Max Marks: 40
Weightage: 20%

Instructions:

(i) Read the questions carefully
(ii) Answer all the questions
(iii) Draw figures neatly wherever necessary

Part A [Memory Recall Questions]

Answer all the Questions. Each Questions carries four marks. **(3Qx4M=12M)**

1. Write the objectives of Surveying (C.O.NO.1)[knowledge]

2. Differentiate between WCB & QB. (C.O.NO.1)[Knowledge]

3. Define (a) True bearing & Magnetic bearing (b) Magnetic declination & Magnetic Dip (C.O.NO.1)[Knowledge]

Part B [Thought Provoking Question]

Answer both the Questions. Each Question carries eight marks. **(2Qx8M=16M)**

4. A line was measured with a steel tape was exactly 30m at 18^{0}C and found to be 452.343m. The temperature during the measurement was 32^{0}C. What is the true length of the line. Take co-efficient of expansion of the tape per °C= 0.0000117. (C.O.NO.1)[Comprehension]

5. A close traverse is conducted with 5 stations A, B, C, D, E taken in anti – clockwise order in the form of a regular pentagon. If the fore bearing of AB is 30°, find bearings of the other sides. (C.O.NO.1)[Comprehension]

Part C [Problem Solving Questions]

Answer the Questions. The Question carries twelve marks. **(1QX12M=12M)**

6. Following are the observed bearings of the lines of a traverse ABCDEA with a compass at a place where local attraction was suspected. Find the correct bearings of the lines and show in tabulated form along with calculations. (C.O.NO.1)[Application]

Line	Fore bearing	Back bearing
AB	191°45'	13°0'
BC	39°30'	222°30'
CD	22°15'	200°30'
DE	242°45'	62°45'
EA	330°15'	147°45'

SCHOOL OF ENGINEERING

Semester: 3rd

Course Code: CIV202

Course Name: SURVEYING

Date: 30-09-2019

Time: 11:00 – 12:00

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	1	Module 1	4									4
2	1	Module 1	4									4
3	1	Module 1	4									4
1	1	Module 1				8						8
2	1	Module 1				8						8
1									12			12
	Total Marks											40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I here certify that All the questions are set as per the above lines Navneet Singh]

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

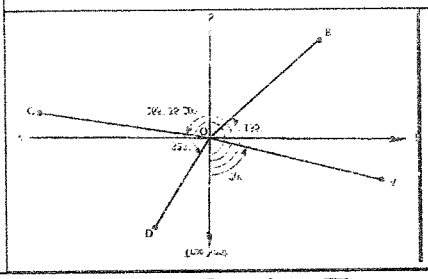
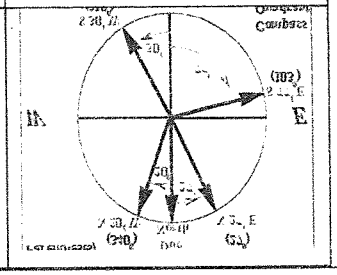
SOLUTION

Semester: 3rd
Course Code: CIV202
Course Name: SURVEYING

Date: 30-09-2019
Time: 11:00-12:00
Max Marks: 40
Weightage: 20%

Part A (3Q x 4M =12 Marks)

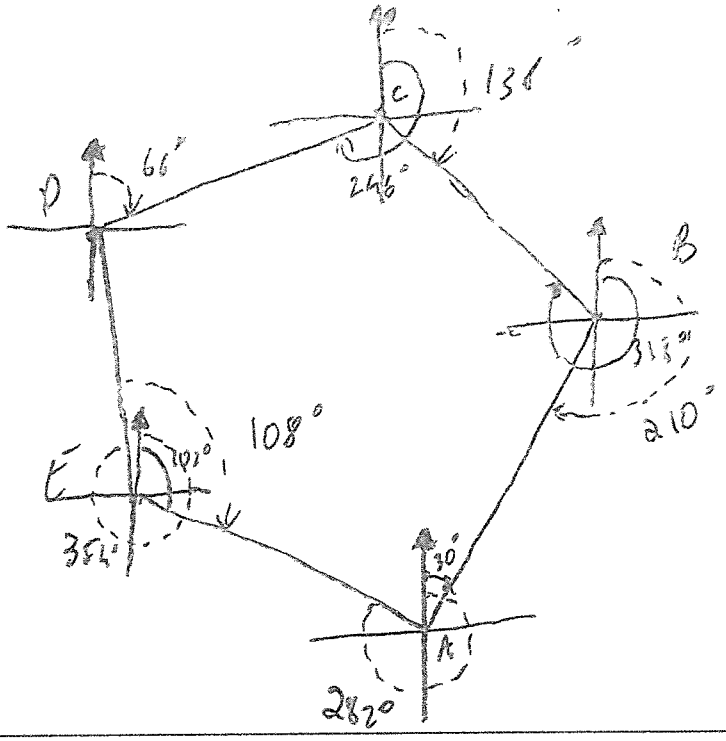
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Objectives of surveying 1. The main object of surveying is to prepare a map or plan to show the relative positions of the objects on the surface of the earth. 2. To determining the boundaries of land. 3. It is very useful for the purpose of designing projects, such as dams, canals, roads, railways etc. 4. The successful completion of any engineering project mainly depends upon the accurate surveying. 5. To determine area and Volume.	**1 mark for each point**	**5 minutes**
2	Whole Circle Bearing: ◉ The bearing of a line measured with respect to magnetic meridian in clockwise direction is called magnetic bearing and its value varies between 0^o to 360^o. ◉ The quadrant start from north an progress in a clockwise direction as the first quadrant is 0^o to 90^o in clockwise direction , 2^{nd} 90^o to 180^o , 3^{rd} 180^o to 270^o, and up to 360^o is 4^{th} one. Quadrantal Bearing: ◉ In this system, the bearing of survey lines are measured wrt to north line or south line which ever is the nearest to the given survey line and either in clockwise direction or in anti clockwise direction.	**1 mark each difference**	**5 minutes**

		◎ Hence the bearings ranges from 0 to 180^0 		
3	**a) <u>True Bearing</u>:** The true bearing of a line is the horizontal angle between the true meridian and the survey line. The true bearing is measured from the true north in the clockwise direction. **<u>Magnetic Bearing</u>:** the magnetic bearing of a line is the horizontal angle which the line makes with the magnetic north. b) **<u>Magnetic Declination</u>**: Horizontal angle between the magnetic meridian and true meridian. **<u>Magnetic Dip</u>**: Inclination of the needle with the horizontal is called magnetic dip		**Each definition carries 4 marks**	**5 minutes**

Part B (2Q x8 M =16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Given: To = 18*C, Tm = 32*C, length of steel tape (L) = 30m, Lm = 452.343m & α = 0.0000117/*C Correction per tape length $= \alpha ((T_m - T_o)L$ = 0.0000117 x (32 -18)X30 = **0.004914 m (+ve)** True length of tape (while measuring) L' = 30+0.004914 **30.004914 m**	2M(formula) + 6M(calculations)	8 minutes

	True length of line = $\frac{L'}{L} X Lm$ True length of line = 30.004914 / 30 x 452.343= **452.417 m**		
2.	**Given :** FB of AB is 30* and it's a regular Pentagon Closed traverse in anti-clockwise direction **Interior angle = (2n-4)*90°/n** where n= number of sides. = (2*5 – 4)*90/5 = **108°** BB of AB = FB+180° = 30°+180° = 210° FB of BC = BB of AB + IA = 210°+108° = 318° BB of BC = 318°- 180° = 138° FB of CD = BB of BC + IA = 138° + 108° = 246° BB of CD = 246° – 180° = 66° FB of DE = BB of CD + IA = 66°+108° = 174° BB of DE = 174° + 180° = 354° FB of EA = BB of DE + IA = 108° + 354° – 360° = 102°	2M(figure)+6M(calculation)	12 minutes

	BB of EA = 102° + 180° = 282°  		

Part C (1Q x12 M =12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	DE is free from Local attraction as the difference Between FB and BB of AB i.e. 242°45' – 62°45' = 180°. Therefore, station D and E are free from Local attractions. FB of EA 330°15' is correct. Actual BB of **EA** = 330°15' - 180° = **150°15'** Correction at A = 150°15' – 147°45' = **+2°30'** Correct **FB of AB** = 191°45' + 2°30' = **194°15'** Actual **BB of AB** = 194°15' – 180° = **14°15'** Correction at B = 14°15' – 13°00' = **1°15'** Correct FB at **BC** = 39°30' + 1°15' = **40°45'** Actual BB of **BC** = 40°45' + 180° = **220°45'**	12 M(Table & calculations)	20 minutes

Correction at C = 220°45' – 222°30' = -1°45'

Correct FB at CD = 22°15'- 1°45' = 20°30'

Actual BB of CD = 20°30' + 180° = 200°30'

Line	Observed		Correction	Correct	
	FB	BB		FB	BB
AB	191°45'	13°0'	+2°30'	194°15'	14°15'
BC	39°30'	222°30'	+1°15'	40°45'	220°45'
CD	22°15'	200°30'	-1°45'	20°30'	200°30'
DE	242°45'	62°45'	0°	242°15'	62°45'
EA	330°15'	147°45'	0°	330°15'	150°15'

Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem. 2019-20
Course Code: CIV 202
Course Name: SURVEYING
Program & Sem: B.Tech (CIV) & III.

Date: 18.11.2019
Time: 11:00 AM to 12:00 PM
Max Marks: 40
Weightage: 20%

Instructions:

(i) Read the questions carefully
(ii) Answer all the questions
(iii) Draw neat figures wherever necessary

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries four marks . **(3Qx4M=12M)**

1. List the different leveling operations (C.O.NO.2) [Knowledge]
2. Write the use of spirit level and Trough compass in Plane Table (C.O.NO.2) [Knowledge]
3. Define (a) Transiting (b) Swinging (c) Face Left (d) Face Right. (C.O.NO.2) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries eight marks. **(2Qx8M=16M)**

4. The following consecutive readings were taken with a dumpy level along a chain line at a common interval of 15 m. The first reading was at a Chainage of 165 m where the RL is 98.085. The instrument was shifted after the fourth and ninth readings.
   3.150, 2.245, 1.125, 0.860, 3.125, 2.760, 1.835, 1.470, 1.965, 1.225, 2.390 and 3.035 m.
   Mark rules on a page of your notebook in the form of a level book page and enter on it the above readings and interpret the RL of all the points. (C.O.NO.2) [Comprehension]
5. Explain Contour and its characteristics. (C.O.NO.2) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. The question carries twelve marks. **(1Qx12M=12M)**

6. In order to find ascertain elevation of top Q of the signal on a hill, observation were made from two instrumental station P and R at horizontal distance 100m apart, the stations P and R being in a line with Q the angle of elevation of a Q at P and R were 28°42' and 18°6' respectively. The staff reading upon the BM elevation 287.25 were respectively 2.870 and 3.750 when the instrument was at P and R the telescope being horizontal. Calculate the elevation of the foot of the signal if the height of the signal above its base is 3m.

(C.O.NO.2) [Application]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: 3rd

Course Code: CIV 202

Course Name: **SURVEYING**

Date: 18th November 2019

Time: 1 hr

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			.
A1	2	Module-2	4									4
A2	2	Module-3	4									4
A3	2	Module-3	4									4
B1	2	Module -2				8						8
B2	2	Module-3				8						8
C1	2	Module-2							12			12
	Total Marks		12			16			12			40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students

must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Semester: 3rd
Course Code: CIV 202
Course Name: **SURVEYING**

Date: 18th November 2019
Time: 1 hr
Max Marks: 40
Weightage: 20%

Part A (3Q x4 M = 12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1)	(a) Simple Levelling (b) Differential Levelling (c) Profile/Longitudinal Levelling (d) Cross-sectional Levelling (e) Check Levelling (f) Fly Levelling (g) Reciprocal Levelling (h) Precise Levelling	**Any 4 types – 4 Marks**	**4mins**
2)	**Trough Compass** • The trough compass is required for drawing the line showing magnetic meridian on the paper. It is used to orient the table to the magnetic meridian. When the freely suspended needle shows 0^0 at each end, a line is drawn on the drawing paper which represents the magnetic north **Spirit Level** • A Spirit Level is used for ascertaining If the table is properly level. The Table is leveled by placing the level on the board in two positions at right angles and getting the bubble central in both positions.	**2 Mark each for Trough compass and Spirit Level** **(2x2 – 4 Marks)**	**4mins**

3)	**Transiting** – The Method of turning telescope about its horizontal axis in a vertical plane throughm180° is termed as Transiting. **Swinging of Telescope** – This indicates the turning of telescope in a horizontal palne. ***Face Right*** When the vertical circle of a theodolite is on the right of the observer, the position is called *face right* and the observation made is called face right observation. ***Face Left*** When the vertical circle of a theodolite is on the left of the observer, the position is called *face left* and the observation made is called face left observation. By taking the mean of both face readings, the collimation error is eliminated.	**Each definition 1 Mark.** **4x1 = 4 Marks**	**4 mins**

Part B (2Q x8 M = 16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1)	**Height of Collimation Method**	Marking rules in the form of level book page=4m HI/Rise and fall=1.5m RLs=2.5m (4+1.5+ 2.5=8m)	20mins

Station point	Chainage	BS	IS	FS	RL of collimation line (HI)	RL	Remark
1	165	3.150			101.235	98.085	
2	180		2.245			98.990	
3	195		1.125			100.110	
4	210	3.125		0.860	103.500	100.375	Changed point
5	225		2.760			100.740	
6	240		1.835			101.665	
7	255		1.470			102.030	
8	270	1.225		1.965	102.760	101.535	Change point
9	285		2.390			100.370	
10	300			3.035		99.725	
Total =		7.500		5.860			

Arithmetical check:

Σ BS – Σ FS = 7.500 – 5.860 = +1.640

Last RL – 1st RL = 99.725 – 99.085 = +1.640

Rise and Fall Method

Station point	Chainage	BS	IS	FS	Rise (+)	Fall (–)	RL	Remark
1	165	3.150					98.085	
2	180		2.245		0.905		98.990	
3	195		1.125		1.120		100.110	
4	210	3.125		0.860	0.265		100.375	Changed point
5	225		2.760		0.365		100.740	
6	240		1.835		0.925		101.665	
7	255		1.470		0.365		102.030	
8	270	1.225		1.965		0.495	101.535	Changed point
9	285		2.390			1.165	100.370	
10	300			3.035		0.645	99.725	
Total =		7.500		5.860	3.945	2.305		

Arithmetical check: Σ BS – Σ FS = 7.500 – 5.860 = +1.640

Σ Rise – Σ fall = 3.945 – 2.305 = +1.640

Last RL – 1st RL = 99.725 – 98.085 = +1.640

2) An imaginary line on the ground surface joining the points of equal elevation is known as contour,

CHARACTERISTICS

i. All points in a contour line have the same elevation.

ii. Flat ground is indicated where the contours are widely separated and steep-slope where they run close together.

iii. A uniform slope is indicated when the contour lines are uniformly spaced and

iv. A plane surface when they are straight, parallel and equally spaced.

v. A series of closed contour lines on the map represent a hill , if the higher values are inside

vi. A series of closed contour lines on the map indicate a depression if the higher values are outside

vii. Contour line cross ridge or valley line at right angles- If the higher values are inside the bend or loop in the contour, it indicates a Ridge and If the higher values are outside the bend, it represents a Valley

viii. Contours cannot end anywhere but close on themselves either within or outside the limits of the map

ix. Contour lines cannot merge or cross one another on map except in the case of an overhanging cliff

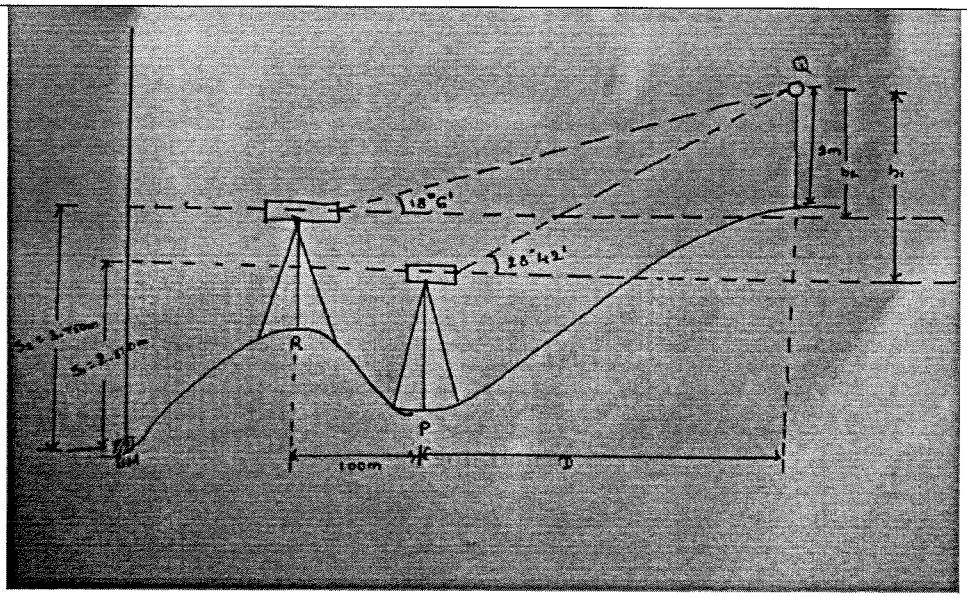
x. Contour lines never run into one another except in the case of a vertical cliff. In this case ,several contours coincide and the horizontal equivalent becomes zero

Definition =2m
Any 4contour Characteri Stics=6m
4x1.5=6m

10mins

	xi. Depressions between summits are called a saddle. It is represented by four sets of contours as shown. It represents a dip in a ridge or the junction of two ridges. And in the case of a mountain range, it takes the form of a pass.		

Part C (1Q x 12M = 12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1)		Fig=4m h and S =2m D=4m RL of Q=1m RL of foot=1m	18mins

RL of Q = RL of BM + S1 + h1

$\text{Tan}28^\circ42' = \frac{h1}{D}$, $\tan 18^\circ 6' = \frac{h2}{(100+D)}$

$h1 = D\tan 28^\circ 42'$ $h2 = (100+D)\tan 18^\circ 6'$

$S = h1 - h2$

$0.880 = D\tan 28^\circ 42' - [(100+D)\tan 18^\circ 6']$

	0.880=0.5474D-32.685-0.3268D 0.5474D-0.3268D=0.880+32.685 0.2206D=33.565 D=152.153M RL of Q=373.45M RL of foot of signal = RL of Q-height of signal 373.451-3 370.451m		

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 2020
Course Code: CIV 202
Course Name: SURVEYING
Program & Sem: B.Tech (CIV) & III

Date: 24 December 2019
Time: 1:00 PM to 4:00 PM
Max Marks: 80
Weightage: 40%

Instructions:
(i) Read the all questions carefully and answer accordingly.
(ii) Draw figures wherever necessary

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 6 marks. **(5Qx6M=30M)**

1. Explain with neat figure the radiation method of plane table survey. (C.O.No.2) [Knowledge]
2. Differentiate between Prismatic and Surveyor's compass. (C.O.No.1) [Knowledge]
3. Define Benchmark and list the types of Benchmark. (C.O.No.2) [Knowledge]
4. Write a short note on: Plane survey and Geodetic survey. (C.O.No.1) [Knowledge]
5. Differentiate between Trapezoidal rule and Simpsons rule. (C.O.No.3) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 10 marks. **(3Qx10M=30M)**

6. Derive the distance equation used in tacheometry when the line of sight is horizontal. (C.O.No.2) [Comprehension]

7. The following perpendicular offsets were taken at 10m intervals on a survey line to an irregular boundary line.

   3.25, 5.60, 4.20, 6.65, 8.75, 6.20, 3.25, 4.20, 5.65

   Calculate the area enclosed by:

   (a) Average ordinate rule
   (b) Trapezoidal rule
   (c) Simpson's rule

(C.O.No.3) [Comprehension]

8. An embankment of width 10m and side slope 1.5:1 is to be made on a ground which is level in a direction transverse to the central line. The central heights at 40m intervals are as follows:

0.90, 1.25, 2.15, 2.50, 1.85, 1.35, and 0.85m

Calculate the volume of earthwork according to: (a) Trapezoidal formula and (b) Prismoidal formula (C.O.No.3) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. This Question carries 20 marks. **(1Qx20M=20M)**

9. Given below is the Fig 1 of block size 20mx15m which is divided into blocks of size 5mx5m. The reduced levels of each corner of the block is shown in the figure. Draw the block to a scale of 1:100. Plot the contours of 99.25, 99 and 98.75m in the given block and calculate at what distance they lie on the ground by interpolation method. (C.O.No.2) [Application]

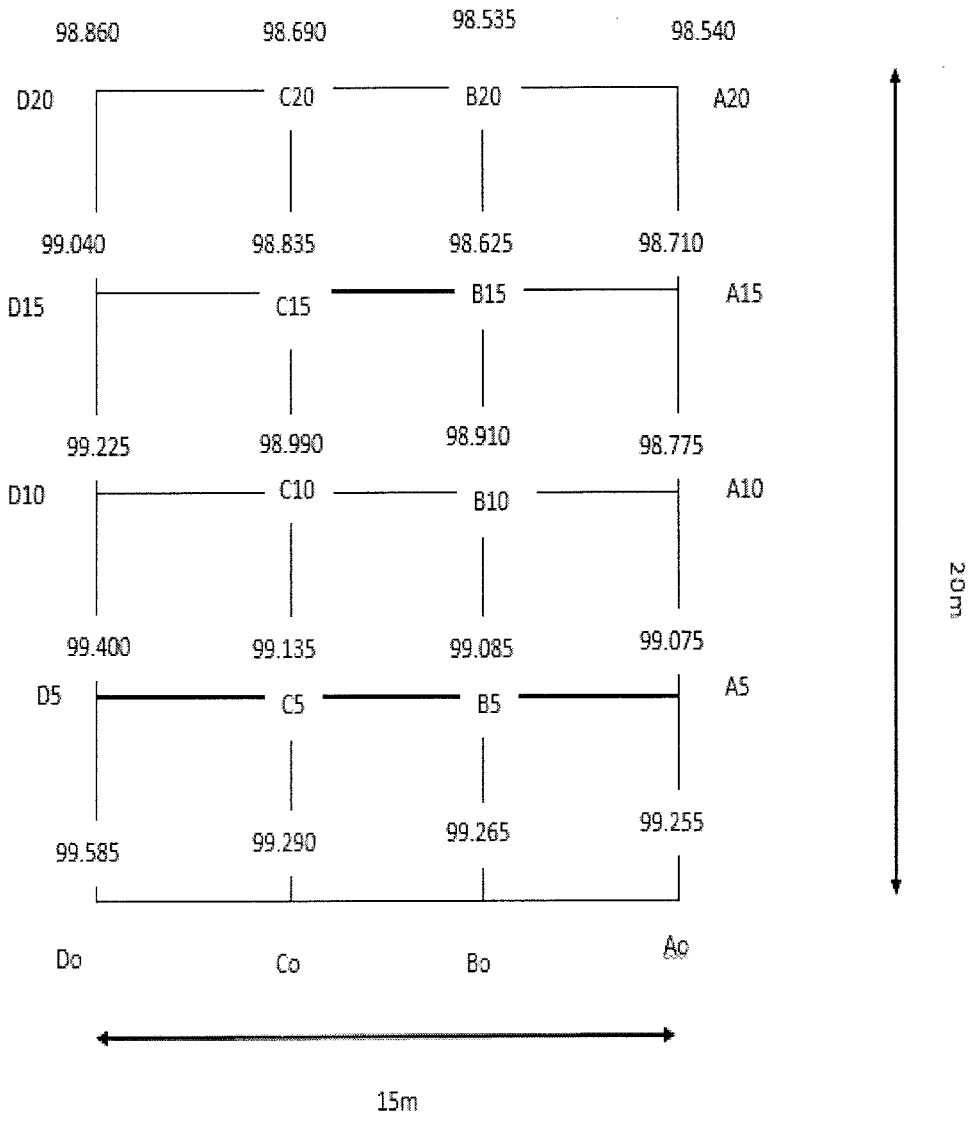


Figure.1

Reviewer Commend:

Format of Answer Scheme

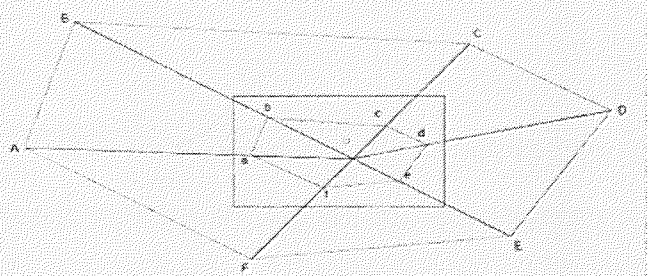
SCHOOL OF ENGINEERING

SOLUTION

Semester: Odd Sem. 2019-20
Course Code: CIV 202
Course Name: SURVEYING
Program & Sem: B.TECH & THIRD

Date: 24.12.2019
Time: 3 HRS
Max Marks: 80
Weightage: 40%

Part A (5Q x 6M =30Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	In this method the objects are located by radiating lines from the point, and measuring the distance with chain or tape with suitable scale. It is chiefly used for locating the details from the station, which have been established previously by other methods triangulation, or traversing. RADIATION METHOD  	**Explaination:3marks** **Diagram:3marks** **3+3=6M**	**12mins**
2	Prismatic Compass: ◉ Graduated ring is attached with needle; ◉ WCB used; ◉ Inverted engraved graduations; ◉ Reading taken with the help of prism Surveyors Compass: ◉ Graduated ring is attached to the box; ◉ QB used; ◉ Erect engraved graduations; ◉ Readings taken directly	**Each difference: 1.5marks** **4x1.5=6M**	**12mins**

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	2	3	6			
2	1	1	6			
3	2	2	6			
4	1	1	6			
5	3	4	6			
6	2	4		10		
7	3	4		10		
8	3	4		10		
9	2	3			20	
	Total Marks		30	30	20	80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

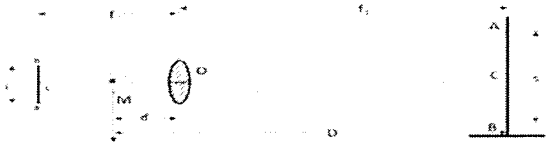
I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

	⊙ Can be hand held ⊙ Needs a tripod		
3	**BENCH –MARKS (BM):** These are fixed points or marks of known RL determined with reference to the datum line. Different Types of Bench Mark are as follows (a)GTS (b)Permanent (c)Temporary (d)Arbitrary	**Defn:2M** **List:4M** **2+4=6M**	**12mins**
4	<table><tr><th>Plane surveying</th><th>Geodetic surveying</th></tr><tr><td>1. The effect of curvature of earth is not considered.</td><td>1. The effect of curvature of earth is considered.</td></tr><tr><td>2. The surface of the earth is taken as plane.</td><td>2. It involves spherical trigonometry. So it is called trigonometrical survey.</td></tr><tr><td>3. The area to be surveyed less than 250 km^2</td><td>3. The area to be surveyed more than 250 km^2</td></tr><tr><td>4. The degree of accuracy is low.</td><td>4. The degree of accuracy is high.</td></tr><tr><td>5. Plane surveying is conducted by state agencies like Irrigation department, Railway department.</td><td>5. Geodetic surveying is conducted by Survey of India (GTS) department.</td></tr><tr><td>6.</td><td>6.</td></tr></table>	**Three major points in each: 3x2=6M**	**12mins**
5	<table><tr><th>Trapezoidal Rule</th><th>Simpson's Rule</th></tr><tr><td>The boundary between the ordinates is considered to be straight.</td><td>The Boundary between the ordinates is considered to be an arc of a parabola.</td></tr><tr><td>There is no limitation. It can be applied for any number of ordinates.</td><td>To apply this rule, the number of ordinates must be odd. That is, the number of divisions must be even.</td></tr><tr><td>It Gives an approximate Result.</td><td>It gives a more accurate result.</td></tr></table>	**Each difference:2M** **3x2=6M**	**12mins**

Part B (3Q x10M =30 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question

6	Horizontal Sights:  Consider the figure, in which *O* is the optical centre of the objective of an *external focusing telescope*. *Let A, C, and B* = the points cut by the three lines of sight corresponding to three wires. *b, c, and a* = top, axial and bottom hairs of the diaphragm. ab = i = interval b/w the stadia hairs (stadia interval) AB = s = staff intercept; f = focal length of the objective f_1 = horizontal distance of the staff from the optical centre of the objective f_2 = horizontal distance of the cross-wires from O. d = distance of the vertical axis of the instrument from O. D = horizontal distance of the staff from the vertical axis of the instruments. M = centre of the instrument, corresponding to the vertical axis. Since the rays *BOb* and *AOa* pass through the optical centre, they are straight so that *AOB* and *aOb* are similar. Hence, $\frac{f_1}{f_2} = \frac{s}{i}$ Again, since f_1 and f_2 are conjugate focal distances, we have from lens formula, $\frac{1}{f} = \frac{1}{f_2} + \frac{1}{f_1}$ Multiplying throughout by ff_1, we get $f_1 = \frac{f_1}{f_2} f + f$ Substituting the values of $\frac{f_1}{f_2} = \frac{s}{i}$ in the above, we get $f_1 = \frac{s}{i} f + f$ Horizontal distance between the axis and the staff is $D = f_1 + d$ $D = \frac{f}{i} s + (f + d) = k \cdot s + C$	1Diagram: 4m Each step of derivation: 1m-i.e 6steps:6M 4+6=10M	20mins
7	**1) By average ordinate rule** Area=[o0+o1+o2+o3+.....on]\(n+1)]*L n=8, n+1=9,d=10m, L=10x8=80m Area[(3.25+5.60+4.20+6.65+8.75+6.20+3.25+4.20+5.65)\9*80 Area =424.4m² **2) by trapezoidal rule** Area=d\2(o0+0n)+2[o1+o2+o3+.....+on-1] Area=10\2(3.25+5.65)+2[5.60+4.20+6.65+8.75+6.20+3.25+4.20] Area=433m² **3) By simpson's rule** Area =d\3[(o0+on)+4(o1+o3+o5+...+on-1)+2(o2+o4+.....+on-2)] 10\3[(3.25+5.65)+4(5.60+6.65+6.20+....+4.20)+2(4.20+8.75+3.25)] Area=439.66m²	Each formula: 1+1+1=3M Each substitution of values:1+1.5+1.5=4M Each answer: 1+1+1=3m 3+4+3=10m	20mins
8		Each C/s area:1M 7x1=7M	20mins

	Solution The cross-sectional areas are calculated by Eq. (1): Area, $\Delta = (b + Sh) \times h$ $\Delta_1 = (10 + 1.5 \times 0.90) \times 0.90 = 10.22\ m^2$ $\Delta_2 = (10 + 1.5 \times 1.25) \times 1.25 = 14.84\ m^2$ $\Delta_3 = (10 + 1.5 \times 2.15) \times 2.15 = 28.43\ m^2$ $\Delta_4 = (10 + 1.5 \times 2.50) \times 2.50 = 34.38\ m^2$ $\Delta_5 = (10 + 1.5 \times 1.85) \times 1.85 = 23.63\ m^2$ $\Delta_6 = (10 + 1.5 \times 1.35) \times 1.35 = 16.23\ m^2$ $\Delta_7 = (10 + 1.5 \times 0.85) \times 0.85 = 9.58\ m^2$ (a) Volume according to trapezoidal formula: $V = \frac{40}{2}\{10.22 + 9.58 + 2(14.84 + 28.43 + 34.38 + 23.63 + 16.23)\}$ $= 20\{19.80 + 235.02\} = 5{,}096.4\ m^3$ (b) Volume calculated in prismoidal formula: $V = \frac{40}{3}\{10.22 + 9.58 + 4(14.84 + 34.38 + 16.23) + 2(28.43 + 23.63)\}$ $= \frac{40}{3}(19.80 + 261.80 + 104.12) = 5{,}142.9\ m^3$	Each formula: 0.5M 2x0.5=1M Each substitution and answer 1m 2x1=2M 7+1+2=10M	

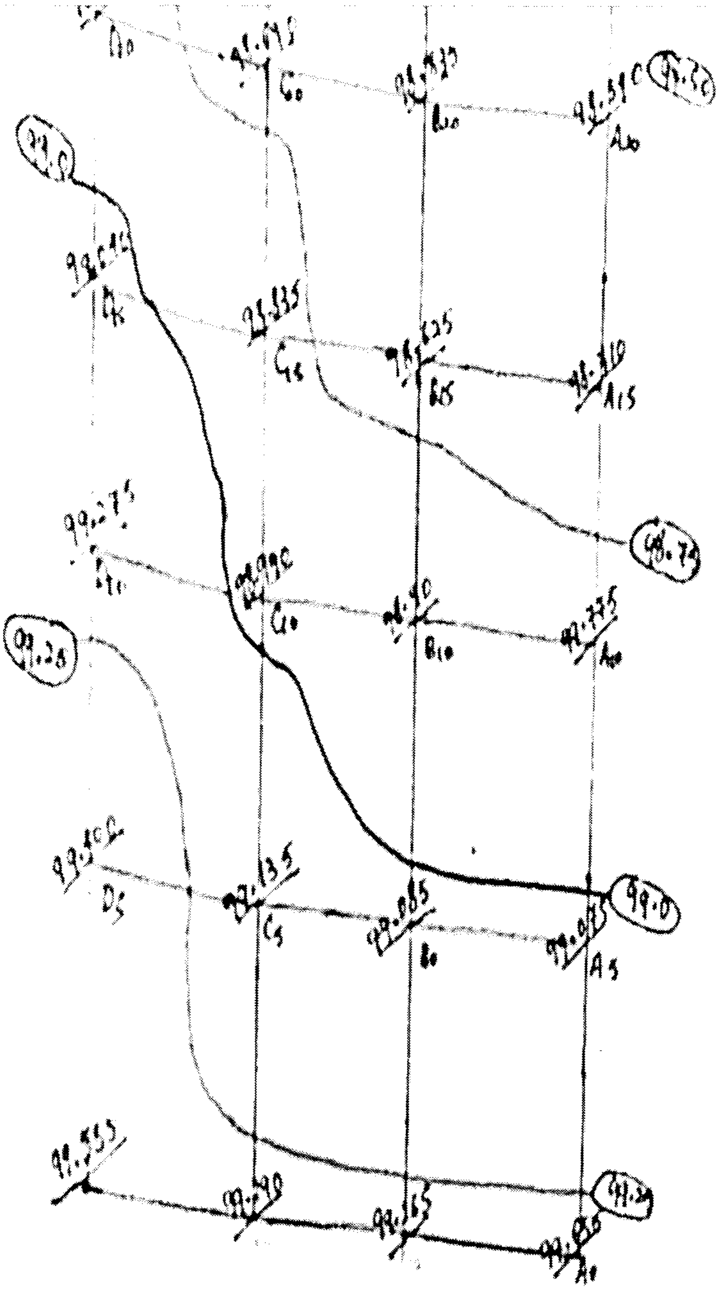
Part C (1Q x 20M =20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
9	Distance to required Reduced Level = $\frac{Required\ RL - Reference\ RL}{Difference\ in\ elevation\ between\ the\ two\ points}$ x Distance between the two points **Sample Calculation** Required RL = 99.25 Distance between two points (to scale) 50mm Between A0 and A5: $\frac{99.25-99.075}{99.255-99.075} \times 50$ = 48.867 mm or 1.39 mm depeending on the Reference RL taken **REQUIRED RL** — **99.25 m** Location: Between Ao and A5 — Distance: 48.867mm or 1.39mm Between Bo and B5 — 45.833mm or 4.167mm	Drawing block to scale:2m, Plotting contours:3m Each Contour calculation: 5M (3x5=15m) 2+3+15=20M	60mins

Between Co and C5	37.0967mm or 12.9032mm
Between C5 and D5	21.698mm or 28.302mm
Between D5 and D10	7.143mm or 42.857mm

REQUIRED RL		**99 m**
Location		Distance
Between A5 and A10		37.5mm or 12.5mm
Between B5 and B10		25.714mm or 24.29mm
Between C5 and C10		3.448mm or 46.5522mm
Between C15 and D15		40.244mm or 9.756mm
Between D15 and D20		38.89mm or 11.11mm

REQUIRED RL		**98.75 m**
Location		Distance
Between A10 and A15		30.769mm or 19.231mm
Between B10 and B15		21.9298mm or 28.0702mm
Between C15 and C20		20.689mm or 29.310mm
Between C20and D20		17.647mm or 32.353mm



Required [illegible]

A_5 to A_{10} = $\frac{5.0}{99.[illegible] - 99.0[illegible]}$ × (99.[illegible] - 99) = [[illegible] mm] = [[illegible] m]

B_5 to B_{10} = $\frac{5.0}{99.[illegible] - 99.[illegible]}$ × (99.40 - 99) = [[illegible] mm] = [[illegible] m]

C_5 to C_{10} = $\frac{5.0}{99.135 - 98.990}$ × (99.135 - 99) = [[illegible] mm] = [[illegible] m]

C_{10} to D_{10} = $\frac{5.0}{99.225 - 98.990}$ × (99.225 - 99) = [[illegible] mm] = [[illegible] m]

D_{15} to C_{15} = $\frac{5.0}{99.225 - 98.[illegible]}$ × (99.0[illegible] - 99) = [[illegible] mm] = [[illegible] m]

D_{15} to D_{20} = $\frac{5.0}{99.0[illegible] - 98.[illegible]}$ × (99.0[illegible] - 99) = [[illegible] mm] = [[illegible] m]