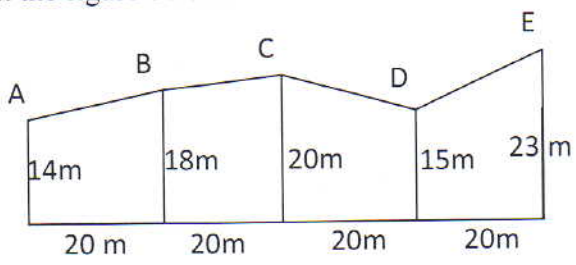
University of Technology
Engineering Department of Building and Construction
Final Exam 2015-2016

Subject: Engineering Surveying (II)
Division: All Divisions
Examiner: Surveying Committee

Year: 2nd year
Time: Three hours
Date: 12 / 6 / 2016

Answer Four Questions Only

Q1) A) For the parcel shown in the figure below:



Compute the area using:
1- Trapezoidal Rule
2- Simpson Rule

(9 marks)

B) Complete the missing values (?) in the traversing table below

Point	Line	Horizontal Distance (m)	Azimuth	ΔX (m)	ΔY (m)	X (m)	Y (m)
A						?	?
	AB	؟	$57^o59'40"$	400	؟		
B						500	350
	BC	217.816	$300^o19'55"$	؟	؟		
C						؟	؟

(16 marks)

Q2) A) The following table represent the angle to the right for traverse ABCDE:

Angle to the right
$ABC = 80^o11'20"$
$BCD = 240^o51'43"$
$CDE = 75^o34'25"$

(10 marks)

Knowing that Azimuth of line $ED = Az_{ED} = 210^o41'33"$
Compute the Azimuth for all the traverse lines.

B) The table below represent the field measurements for the trigonometric leveling using theodolite and leveling rod:

Theodolite Station	Observed station	V.C.R	Distance (m)	Rod reading (m)
B	A	91°32' 45"	50	1.214
	C	85°30' 15"	50	3.125
D	C	271°50' 33"	50	1.102
	E	265°41' 21"	50	2.872

Knowing that the elevation of point A= Z_A =**33.157** m.
Compute the elevation (Z) of point (**E**).

(15 marks)

Q3) The following table represent the field data of details survey by radiation method:

Theodolite station	Observed station	H.C.R	V.C.R	Road reading (m)			horizontal angle subtended by substance bar
				U	M	L	
H	P	$20^0 21' 35''$	$85^O 51' 37''$	3.543	2.942	2.341	
	T	$70^0 19' 55''$					$00^o 30' 00''$
	R	$260^0 25' 41''$	$92^O 42' 39''$		1.273		
	R		$82^O 34' 40''$		3.548		

Knowing that the horizontal coordinates of point H are X_H=500m, Y_H=500m, Azimuth HP= $AZ_{HP}=150^0 27' 49''$.
Compute the horizontal coordinates (X,Y) of points (P,T,R). **(25 marks)**

Q4) A) List the type of meridian **(4 marks)**

B) The following table represent the final cross section for road with bed width = 30 m.

Station	Grade Elev. m	Area Cut m^2	Area fill m^2	Cross-section Left CL Right	Remarks
55+00		0.0	55.78		
55+50	20.3	؟	؟	29.4 27.9 20.3 18.8 14.5 / 42.3 37.8 0.0 18.0 ?	*ground Elev.(m)* / distance *from CL(m)*
56+00		80.47	0.0		

Knowing that the side slope in cut=1:3 and in fill=1:2.

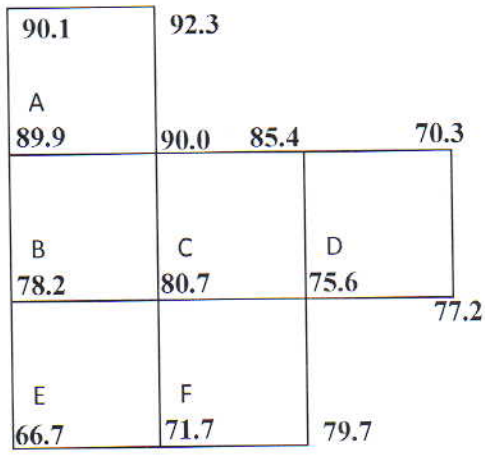
A. Compute the area of cut and/or fill for station 55+50 by coordinates method. **(25 marks)**
B. Compute the volume of earthwork from station 55+00 to 56+00 station using end area method.

Q5) The figure below represent the grid elevation (m) for a parcel with (100 m x 100 m) sub-grid dimensions.

1- Draw the contour line with elevation=70.00 m using a horizontal scale =1/2500. **(10 marks)**

2- Compute the volumes of earthwork (cut, fill) that is required to level sub grid (A) into elevation 85.00 m. **(8 marks)**

3- Compute the final elevation required to level the ground into a horizontal plane at which the volume of cut = volume of fill. **(7 marks)**



Good luck

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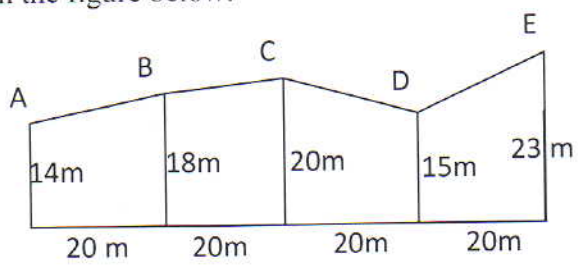
Q1) A) For the parcel shown in the figure below:



Compute the area using:

1- Trapezoidal Rule **(9 marks)**

$$Area = \frac{w}{2}\left[y_1 + y_n + 2\sum_{i=2}^{n-1} y_i \right] \ldots\ldots\ldots\ldots (9-2)$$

$$= \frac{20}{2}[14 + 23 + 2 * (18 + 20 + 15)] = 1430\ m^2$$

2- Simpson Rule

$$Area = \frac{w}{3}\left[y_1 + 2\sum y_{odd} + 4\sum y_{even} + y_n \right]$$

$$= \frac{20}{3}[14 + 2 * (20) + 4 * (18 + 15) + 23] = 1393.333\ m^2$$

B) Complete the missing values (?) in the traversing table below

Point	Line	Horizontal Distance (m)	Azimuth	ΔX (m)	ΔY (m)	X (m)	Y (m)
A						?	?
	AB	؟	57°59′40"	400	؟		
B						500	350
	BC	217.816	300°19′55"	؟	؟		
C						؟	؟

Point	Line	Horizontal Distance (m)	Azimuth	ΔX (m)	ΔY (m)	X (m)	Y (m)
A						**100**	**100**
	AB	**471.7**	57°59′40"	400	**250**		
B						500	350
	BC	217.816	300°19′55"	**-188.00**	**110**		
C						**312**	**460**

(16 marks)

Q2) A) The following table represent the angle to the right for traverse ABCDE:

Angle to the right
$ABC = 80^o11'20"$
$BCD = 240^o51'43"$
$CDE = 75^o34'25"$

(10 marks)

Knowing that Azimuth of line $ED = Az_{ED} = 210^o41'33"$
Compute the Azimuth for all the traverse lines.

Solution:

$$Az_{DE} = 30^o41'33"$$
$$Az_{DC} = Az_{DE} - CDE = 30^o41'33"\text{-}75^o34'25" = 315^o07'08"$$
$$Az_{CD} = 135^o07'08"$$
$$Az_{CB} = Az_{CD} - BCD = 135^o07'08"\text{-}240^o51'43" = 254^o15'25"$$
$$Az_{BC} = 74^o15'25"$$
$$Az_{BA} = Az_{BC} - ABC = 74^o15'25"\text{-}80^o11'20" = 354^o04'05"$$

B) The table below represent the field measurements for the trigonometric leveling using theodolite and leveling rod:

Theodolite Station	Observed station	V.C.R	Distance (m)	Rod reading (m)
B	A	91°32' 45"	50	1.214
	C	85°30' 15"	50	3.125
D	C	271°50' 33"	50	1.102
	E	265°41' 21"	50	2.872

Knowing that the elevation of point A= Z_A =**33.157** m.
Compute the elevation (Z) of point (**E**).

(15 marks)

Solution:

$BS_A = Rm - D_{AB} * \tan\alpha$
$= 1.214 - 50 * \tan(90 - 91^O32'45") = 2.563\ m$
$FS_C = Rm - D_{BC} * \tan\alpha$
$= 3.125 - 50 * \tan(90 - 85^o30'15") = -0.806\ m$
$Z_C = Z_A + BS_A - FS_C = 33.157 + 2.563 + 0.806 = 36.526\ m$
$BS_C = Rm - D_{DC} * \tan\alpha$
$= 1.102 - 50 * \tan(271^o50'33"\text{-}270^o) = -0.506\ m$
$FS_E = Rm - D_{DE} * \tan\alpha$
$= 2.872 - 50 * \tan(265^o41'21"\text{-}270^o) = 6.641\ m$
$Z_E = Z_C + BS_C - FS_E = 36.526 - 0.506 - 6.641 = 29.379\ m$

Q3) The following table represent the field data of details survey by radiation method:

Theodolite station	Observed station	H.C.R	V.C.R	Road reading (m)			horizontal angle subtended by substance bar
				U	M	L	
H	P	$20^0 21' 35''$	$85^O 51' 37''$	3.543	2.942	2.341	
	T	$70^0 19' 55''$					00°30'00"
	R	$260^0 25' 41''$	$92^O 42' 39''$		1.273		
	R		$82^O 34' 40''$		3.548		

Knowing that the horizontal coordinates of point H are X_H=500m, Y_H=500m, Azimuth HP= $AZ_{HP}=150^0 27' 49''$. Compute the horizontal coordinates (X,Y) of points (P,T,R). **(25 marks)**

Solution:

$$D_{HP} = K\,S\,\cos\emptyset^2 = 100 * (3.543 - 2.341) * \cos(90\text{-}85^o 51'37")^2 = 119.573\ m$$

$$X_P = X_H + D_{HP} \sin Az_{HP} = 558.946\ m$$

$$Y_P = Y_H + D_{HP} \cos Az_{HP} = 395.966\ m$$

$$D_{HT} = \frac{1}{2} b\ cot\frac{\theta}{2} = cot\frac{00^o 30'00"}{2} = 229.181\ m$$

Angle to the right PHT=$70^0 19' 55'' - 20^0 21' 35'' = 49^0 58' 20''$

AZ_{HT}= AZ_{HP} + Angle to the right PHT =$150^0 27' 49'' + 49^0 58' 20'' = 200^0 26' 09''$

$$X_T = X_H + D_{HT} \sin Az_{HT} = 419.979\ m$$

$$Y_T = Y_H + D_{HT} \cos Az_{HT} = 285.242\ m$$

$$D_{HR} = \frac{Rm2 - Rm1}{\tan\alpha_2 - \tan\alpha_1}$$

$$\alpha_1 = 90 - 92^o 42'39" = -2^o 42'39"$$

$$\alpha_2 = 90 - 82^o 34'40" = 7^o 25'20"$$

$$= \frac{3.548 - 1.273}{\tan 7^o 25'20" - \tan -2^o 42'39"} = 12.808m$$

Angle to the right PHR=$260^0 25' 41'' - 20^0 21' 35'' = 240^0 04' 06''$

AZ_{HR}= AZ_{HP} + Angle to the right PHR =$150^0 27' 49'' + 240^0 04' 06'' = 390^0 31' 55'' - 360^o = 30^0 31' 55''$

$$X_R = X_H + D_{HR} \sin Az_{HR} = 506.506\ m$$

$$Y_R = Y_H + D_{HR} \cos Az_{HR} = 511.032\ m$$

Q4) A) List the type of meridian **(4 marks)**

B) The following table represent the final cross section for road with bed width = 30 m.

Station	Grade Elev. m	Area Cut m^2	Area fill m^2	Cross-section Left	CL	Right	Remarks
55+00		0.0	55.78				
55+50	20.3	؟	؟	29.4 / 42.3	27.9 / 37.8	20.3 / 0.0 18.8 / 18.0 14.5 / ?	*ground Elev.(m)* / distance *from CL(m)*
56+00		80.47	0.0				

Knowing that the side slope in cut=1:3 and in fill=1:2.

A. Compute the area of cut and/or fill for station 55+50 by coordinates method. **(25 marks)**

Station	Cross _ station Left		cL	Right	
55+50	C9.1 / 42.3	C7.6 / 37.8	0.0 / 0.0	f1.5 / 18	f5.8 / 26.6

$$\therefore A_{cut} = \frac{1}{2}[0.0 + 0.0 + 9.1(-37.8 + 15) + 7.6(0.0 + 42.3)] = 57\ m^2$$

$$A_{fill} = \frac{1}{2}[0.0 + 0.0 - 5.8(18 - 15) - 1.5(0.0 - 26.6)] = 11.25\ m^2$$

B. Compute the volume of earthwork from station 55+00 to 56+00 station using end area method.

$$V_{1\,fill} = \frac{50}{2}[57 + 55.78] = 2819.5 m^3$$

$$V_{2\,fill} = \frac{50}{3} * 57 = 950\ m^3$$

$$V_{fill} = V_{1\,fill} + V_{2\,fill} = 3769.5 m^3$$

$$V_{fill} = 1311.375 + 898.5 = 2209.875\ m^3$$

$$V_{1cut} = \frac{50}{3} * 11.25 = 187.5 m^3$$

$$V_{2cut} = \frac{50}{2}[11.25 + 80.47]$$

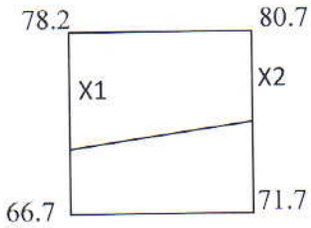
$$V_{2cut} = 2293 m^3$$

$$V_{cut} = V_{1cut} + V_{2cut}$$

$$V_{cut} = 375 + 2293 = 2480.5 m^3$$

Q5) The figure below represent the grid elevation (m) for a parcel with (100 m x 100 m) sub-grid dimensions .

1- Draw the contour line with elevation=70.00 m using a horizontal scale =1/2500. **(10 marks)**



$$\frac{1}{2500} = \frac{X}{10000}$$

$X = 4\ cm$ ابعاد المربع على الخارطة

THE HIGHTEST CONTOR LINE =50 m

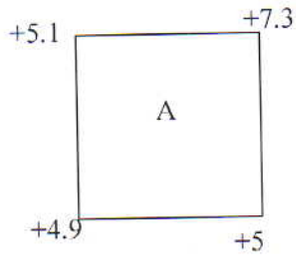
$$\frac{78.2 - 66.7}{4} = \frac{78.2 - 70}{\times 1}$$

$$X_1 = 2.8\ cm$$

$$\frac{80.7 - 71.7}{4} = \frac{80.7 - 70}{\times 2}$$

$X_2 = 4.7\ cm$

2- Compute the volumes of earthwork (cut, fill) that is required to level sub grid (A) into elevation 85.00 m. **(8 marks)**



$$v_{Ci} = \frac{[\sum c_i]^2}{\sum (C+f)_i} * \frac{A_i}{4}$$

$$v_{cut} = \frac{(5.1 + 7.3 + 4.9 + 5)^2}{(5.1 + 7.3 + 4.9 + 5)} * \frac{100 * 100}{4} = 55750\ m^3$$

3- Compute the final elevation required to level the ground into a horizontal plane at which the volume of cut = volume of fill. **(7 marks)**

$$\overline{Z_G} = \frac{(n_1 * z_1) + (n_2 * z_2) + \ldots\ldots\ldots + (n_K * z_K)}{4 * M}$$

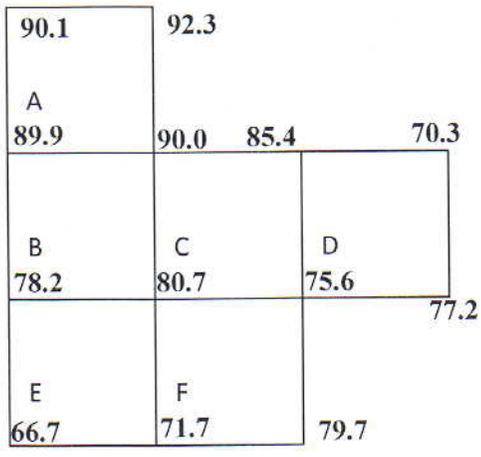
$$\sum (1 * Z_1) = (90.1 + 92.3 + 70.3 + 77.2 + 66.7 + 79.7) = 476.3$$

$$\sum (2 * Z_1) = 2 * (89.9 + 78.2 + 71.7 + 85.4) = 650.4$$

$$\sum (3 * Z_1) = 3 * (90 + 75.6) = 496.8$$

$$\sum (4 * Z_1) = 4 * (80.7) = 322.8$$

$$\bar{Z} = \frac{476.3 + 650.4 + 496.8 + 322.3}{6 * 4} = 81.095\ m$$



Good luck