NAME_____ Score_____

CEEN 113-5 Engineering Measurements
Dr. Nelson
Exam #2 Spring 1997
Use the space given to answer the questions, you may wish to use scratch paper for calculations.
CLOSED BOOK - CALCULATORS REQUIRED

Section I - Answer the following True/False questions by circling either T or F (10 pts)

T F Widely spaced contours represent relatively steep terrain.
T F A large scale produces a map with less detail.
T F For distance and area computations, latitude-longitude is the most preferable coordinate system.
T F The largest source of errors in GPS data collection result from atmospheric conditions.
T F In GPS, vertical accuracy is generally better than horizontal accuracy.

Section II - Short Answer (10 pts)

1. Describe how you “move up on the curve” when laying out a horizontal curve?

2. Under what assumption will the average end area method for computing volumes between cross sections work? What should you do if the assumption is violated?

3. In GPS, what determines the PDOP, is a low or high PDOP more desirable?

4. Why is a fourth satellite vehicle needed when determining positions with GPS?

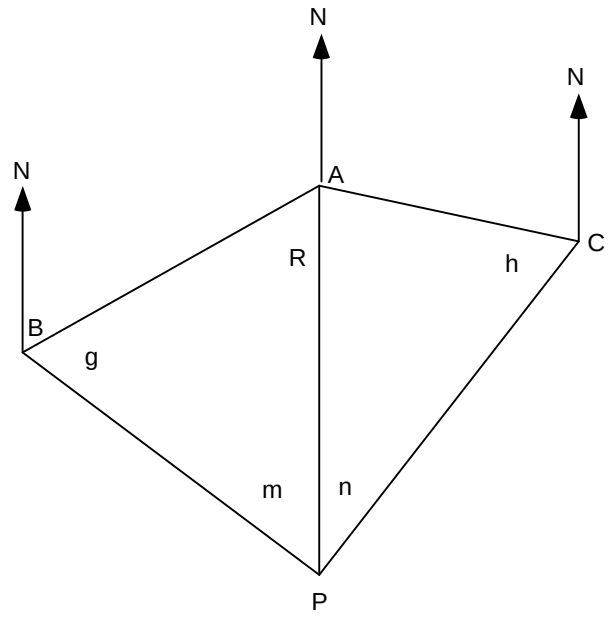
5. When do you need to use a 3-point resection rather than the more simple 2-point resection?

Section II - Problems (80 pts)

1. In the following 3-point resection diagram, m was measured as 48°53'12" and n as 41°20'35". Control points A, B, and C have Coordinates XA=12,963.71, YA=27,002.38, XB = 5721.25, YB=21802.48, XC=20,350.09, and YC=24,861.22 ft.

   Hint: As in class you will want to determine the bearings/azimuths of some combination off AB, AC, BA, and CA to help you solve for R. Then set J = g + h = 360 - m - n - R. Using the law of sines and the trig identity sin(A-B) = sinAcosB - sinBcosA we derivee a relationship for h in terms of J that is $\tan(h) = \frac{\sin(J)}{K + \cos(J)}$ where $K = \frac{\sin(m)}{\sin(n)} \frac{AC}{AB}$ (you do not need to re-derive these equations)

   Using these equations determine the coordinates at P. (20 pts)



2. You are asked to make preliminary measurements at a site prior to design and construction. You need to determine the limits of the boundaries on the site, the total area enclosed and other basic topographic detail, including contours. You and your crew go to the site, occupy each property corner, and make the necessary measurements for your calculations and map. You return to the office and reduce your notes to the following information (in feet) **NOTE**: You do not need to balance angles or adjust coordinates because of the error in closing on the N.W. Corner. Only use the last coordinate in the list to compute parts c and d. (30 pts):

Point	*Northing (Y)*	*Easting (X)*	*Elevation (Z)*	*Feature*
N.W. Corner	1000.00	1000.00	4410.3	
N.E. Corner	880	1320	4400.5	Ditch
#1	924	1184	4403.0	
#2	894	1106	4398.3	Ditch
#3	780	1100	4413.5	Ridge
#4	885	1020	4400.5	
S.E. Corner	540	1340	4409.0	Ridge
#5	804	1200	4409.5	
#6	855	1180	4406.1	
S.W. Corner	580	840	4397.0	Ditch
#7	700	1120	4408.0	
#8	620	1290	4410.0	Ridge
N.W. Corner ‘	1000.12	999.93	4410.3	(use this only for c&d)

Show your answers on this sheet, even if you do your work on another sheet.

a. Calculate the bearings (degrees-minutes-seconds) and distances(feet) of the construction boundaries. (6 pts)

N.W. --> N.E. Bearing_____ Distance_____

N.E. --> S.E. Bearing_____ Distance_____

S.E. --> S.W. Bearing_____ Distance_____

S.W. --> N.W. Bearing_____ Distance_____

b. Calculate the area of the construction site (sq. feet). (6 pts)

Area_____.

c. The bearing and distance of the closing vector (N.W. Corner’ -> N.W. Corner): (4 pts)

Bearing_____ Distance_____

d. What is accuracy ratio of the survey expressed as a fraction with a numerator of 1? (2 pts)

Accuracy Ratio _____

e. Length of fence required to enclose the boundary of the construction site (in feet). (2 pts)

Length_____.

f. Make a pre-design map on the following sheet by plotting the given points in their correct locations and drawing linearly interpolated four-foot contours beginning at 4400. (10 pts)

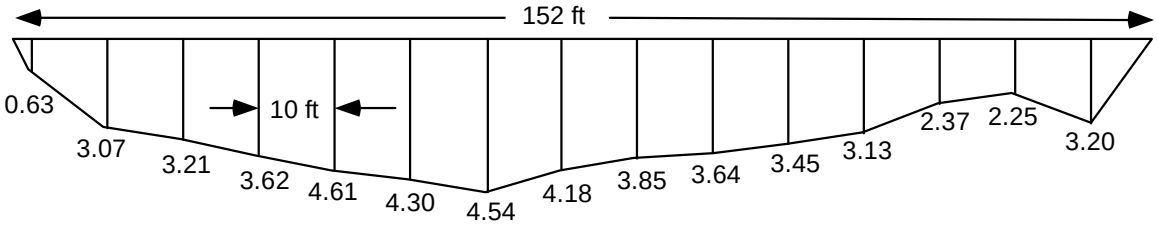
3. Given PI @ 5+862.789, $\Delta=12^{o}47'$, and R=300 M, compute the following:

   a) The stations of the of the BC, and EC (4 pts)

   b) The deflection angles for even 20-m stations (the station must be divisible by 20) (4 pts)

   c) The chord distances from the BC for even 20-m stations (4 pts)

4. The depth of water in a stream was measured every 10 feet (except the left-most section) in order to develop the cross-sectional area of flow. What is the cross-sectional area of flow in the stream? You can use any method you want to compute the area, just be sure and identify which method it is. (8 pts)



5. Fill for ramps to a river bridge abutment were taken from a nearby borrow pit. A grid of this borrow pit is shown below. Values for the undisturbed earth - befor excavation - are shown for each grid point. Values at the same grid points taken after excavation are shown in parenthesis. Assuming a 2:1 side slope, calculate how many cubic yards of earth were excavated from this borrow pit. (10 pts)

   HINT: first plot the perimeter of the excavated region.

Law of Sines and Cosines

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$a^2 = b^2 + c^2 - 2bc(\cos A)$ or $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

$b^2 = a^2 + c^2 - 2ac(\cos B)$ or $\cos B = \frac{a^2 + c^2 - b^2}{2ac}$

$c^2 = a^2 + b^2 - 2ab(\cos C)$ or $\cos C = \frac{a^2 + b^2 - c^2}{2ab}$

Borrow Pit Volumes:

$V_s = A_g * ((h_1 + h_2 + h_3 + h_4) / 4)$ (Use h = 0 if corner is not in the borrow pit)

Horizontal Curves

Tangent: $T = R\tan(\Delta / 2)$

Arc Length: $L = 2\pi R\Delta / 360$

Chord Length: $LC = 2R\sin(\Delta / 2)$

Areas

Trapezoid: Area of triangles + $X(\frac{h_1 + h_n}{2} + h_2 + \ldots + h_{n-1})$

Simpsons 1/3: Area of triangles + $\frac{X}{3}(h_1 + h_n + 2\sum h_{odd} + 4\sum h_{even})$

X - interval between measurements.