NAME_____ Score_____

CEEN 113 Sections 1-6 Engineering Measurements Dr. Nelson Exam #2 Fall 2002
November 15-19 (Late fee on November 19th)
CLOSED BOOK - CALCULATORS REQUIRED – EQUATION SHEET PROVIDED AT END
Any answer requiring an angle should be given in Degrees-Minutes-Seconds format.
Clearly identify your answer and be careful. Show your work because I will try to give partial credit where appropriate.

1. (9.1.1) Short Answer Questions (10 pts)

Why is the fourth satellite needed by a GPS receiver to calculate an accurate position?

What are the three primary GIS data types that GPS receivers collect?

PDOP is a measure of the accuracy of your GPS receiver. What is PDOP primarily based on?

Why is it no longer necessary to <u>always</u> perform differential correction after collecting data with a GPS?

What does multi-path error mean for GPS data collection?

Why might you need to review an almanac to decide when to collect your GPS data for a particular location?

What role does a base station play in GPS data collection?

Satellites have _____ clocks while a GPS receiver only needs to be _____.

2. (2.1.2) Determine the deflection angle (I) for a proposed horizontal curve if the bearing from the PC to the PI is N29°43'W and the bearing from the PI to the PT is S68°18'W (5 pts).

I = 81°59'

3. (9.1.3) For the given information in the table below point A is the most western point and point D is the most southern point. Compute the Meridian and Parallel Distances for segments BC and DE (You do not have to compute areas by the DMD or DPD methods which would require you to compute all meridian or parallel distances, I only want you to calculate the Meridian and Parallel distances of these two segments). It will probably help you a lot if you first roughly plot these data so that you can see what you have. (10 pts)

Course	Distance (ft)	Bearing	Latitude	Departure
AB	164.95	N71°11'E	53.16	156.16
BC	88.41	S31°00'E	-75.80	45.55
CD	121.69	S44°18'W	-87.12	-84.97
DE	115.89	N68°47'W	41.91	-108.01
EA	68.42	N7°21'W	67.84	-8.74

M BC = 178.94 ft
M DE = 62.75 ft
P BC = 125.02 ft
P DE = 20.96 ft

4. (9.1.4) The coordinates of a roadway cross section are given in the table below, where X = 0 corresponds to the centerline of 30 foot wide roadway and Y = 4303.8 is the design roadway elevation. Calculate the area of this cross section using the coordinate area method and tell me whether it represents cut or fill? Once again it will probably help you if you roughly plot this cross section. (10 pts)

X	Elevation (Y)
0.0	4310.5
20.0	4307.6
42.3	4314.6
15.0	4303.8
-15.0	4303.8
-38.7	4311.2
-20.0	4309.8

Area = 285 ft^2

5. (9.1.4) Calculate the slope intercepts (the x position and elevation) at the left and right of a 30 foot roadway at elevation 108.0 with 4:1 side slopes for the existing ground elevation data shown in the table below. Plotting these data will be a good help. (12 pts).

Distance from Center line	Ground Elevation (ft)
50 feet left	100.9
25 feet left	103.1
Centerline	103.8
25 feet right	103.2
50 feet right	102.5

Left Side	Right Side
XL = -39.81	XR = 35.36
Elev. = 101.80	Elev. = 102.91

6. (9.1.4) The following table shows cross sectional areas at several stations along a proposed highway. Compute the total volume of cut and the total volume of fill in **cubic yards** using the average end area equation. Use the volume of a prism (1/3*base*height) for the transition sections and remember that each full station is 100 feet. (10 pts)

Station	Cut (ft^2)	Fill (ft^2)
10+00	0	992
11+00	0	421
11+21	0	68
11+40	34	31
11+64	144	0
12+00	686	0
13+00	918	0

Fill = 2851 yd^3
Cut = 3611 yd^3

7. (5.9) For a horizontal circular curve, the P.I. is at station 14+87.33, I is $11^{o}21'35''$, and the degree of curve D is $6^{o}00'$ (arc definition). Compute the following curve information: (12 pts)

a) R 954.93.

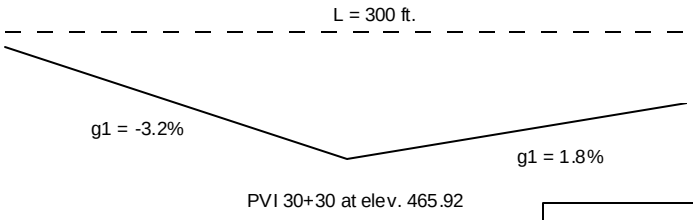
b) PC 13+92.35.

c) PT 15+81.68.

d) Deflection angles for each half station between the PC and PT (i.e. at full stations like 14+00 and 14+50 not just every 50 feet from the PC).

Deflections
13'46"
$1^{o}43'46"$
$3^{o}13'46"$
$4^{o}43'46"$
$5^{o}40'47"$

8. (5.9) For the vertical curve shown below determine the required elevation and or station information listed. g_1=-3.2%, g_2=1.8%, the PVI is at station 30+30 at an elevation of 465.92, and the length of the curve is 300 feet (15 pts).



a) Station and elevation of the PVC = 28+80 470.72.

b) Station and elevation of the PVT = 31+80 468.62.

c) The tangent and curve elevations at station 29+45 tangent 468.64.

curve 468.99.

d) Station and Elevation of the low point on the curve 30+72 at elev 467.65.

9. (9.1.3) The following information with respect to the diagram shown below is known (The diagram is not to scale and is only an approximation) (16 pts).

Angle x is $36^{o}15'52''$, and angle y is $19^{o}38'34''$

X_A=200.0, Y_A=605.0, X_B=810.0, Y_B=195.0, X_C=1185.0, Y_C=375.0 (coordinates are ft.)

Using the 3-point resection method compute the coordinates at point P.

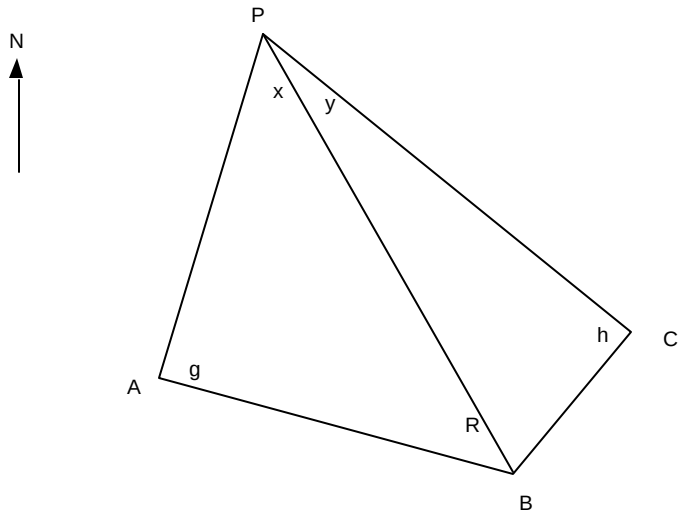
Some important equations that will be helpful include:

J = g + h = 360 - x - y - R

$$\tan(h) = \frac{\sin(J)}{K + \cos(J)}$$

$$K = \frac{\sin(x)}{\sin(y)} \frac{\overline{BC}}{\overline{AB}}$$

Xp = 640.0
Yp = 1420.0



Equations:

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

Law of Cosines $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

Compass Rule $\frac{Correction\,in\ Latitude AB}{Total\ Error\ in\ Latitude} = \frac{Length AB}{Perimeter}$

Horizontal Curves

$$R = \frac{5729.58}{D}$$

$$T = R\tan\left(\frac{I}{2}\right)$$

$$LC = 2R\sin\left(\frac{I}{2}\right)$$

$$L = \frac{RIp}{180}$$

Vertical Curves

$TO = d\left(\frac{x}{L/2}\right)^2$ (where TO is the tangent offset)

Parabolic equation:

$$y = \frac{1}{2}rx^2 + g_1x + elevPVC$$

Average End Area for Volumes

$$Area = \left(\frac{A1 + A2}{2}\right) * L$$

Conversions:

1mile = 5280 feet
1 acre = 43,560 sq. feet
1 ft = 12 inches
1 chain = 66 feet
1 yard = 3 feet