



**Faculty of Engineering  
Prince of Songkla University**

Final Examination  
December 19<sup>th</sup>, 2015  
220- 361 Surveying II

1<sup>st</sup> Semester 2015  
Room R201  
Time: 9:00 - 12:00 (3 hours)

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***This is a closed book exam.*** Books, lecture notes, needed materials, and all other documents are definitely ***not*** allowed. However, dictionary, scientific calculator and needed stationery are exempted.

**Instructions**

1. There are 5 problems in this exam. ( 100 points)
2. Attempt all problems.
3. Books and lecture notes are not allowed.
4. Students can use a calculator and a dictionary.
5. Students can use pencils to write the answers.

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นาย รจ ศุภวิไล ผุ้ออกข้อสอบ

- 1) Explain the effects of parallax and refraction on astronomical observations. Sketch a diagram that clearly shows the relations among parallax, refraction and altitude of the Sun during an observation from the earth. Also explain why parallax has no effect on the observation of a star. (15 points)
  
  - 2) On December 19<sup>th</sup> 1984, the observed altitude of the sun at station A was  $25^{\circ} 20' 35''$  at  $14^{\text{h}} 41^{\text{m}} 35^{\text{s}}$  local time. The latitude of the station A is  $37^{\circ} 52' 20''$  N. The temperature and barometric pressure during the observation was  $80^{\circ}\text{F}$  and 28.7 inch Hg respectively. The mean horizontal angle (measured clockwise) from the reference station B to the sun was  $60^{\circ} 01' 57''$ . What are the azimuth of the sun (measured from the north) and the azimuth of the reference line AB? (25 points) **Hint:** GMT = Local time + 8<sup>h</sup>.
  
  - 3) Prepare the table required for staking out at every **50** m. full station of a horizontal curve by chord-deflection angle method. Given the required radius of the curve  $R = 220$  m., the deflection angle  $\theta = 105^{\circ}$  and the stationing at PI = 8 km. +859.543 m. Also calculate the stationing of the stations PC and PT. (20 points)
  
  - 4) An entering grade of  $-3\%$  meets a departing grade of  $+2\%$  at station 8+735.00 km. The two grades intersect at an elevation of 347.00 m. above mean sea level. If these two grades are connected by a 600-m equal-tangent curve, computing the elevation of the points BVC, EVC and all full stations POC for every 50m. Also determine the location and elevation of the lowest point on this vertical curve. (25 points)
  
  - 5) What is "**Singularity**"? Explain the situation and problems of the singularity in resection problems. Also describe the advantages of the method of resection over the method of intersection. (15 points)
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**TABLE 1**  
**SOLAR EPHEMERIS DECEMBER 1984**  
 For 0<sup>h</sup> Universal Time or Greenwich Civil Time

Day of Month & Week	The Sun's Apparent Declination	Diff. in Declin. for 1 hour	Equation of Time		GHA of Polaris
			True Sol. Time = LCT + Eq. of Time	Differ. for 1 hour	
1 SA S21 47.9 0.38 +11 02.5 0.94 035 46.7					
2 SU S21 57.1 0.36 +10 39.8 0.97 036 46.1					
3 M S22 05.8 0.35 +10 16.5 0.99 037 45.4					
4 TU S22 14.1 0.33 +09 52.7 1.02 038 44.7					
5 W S22 21.9 0.31 +09 28.2 1.04 039 44.1					
6 TH S22 29.4 0.29 +09 03.3 1.06 040 43.4					
7 FR S22 36.4 0.27 +08 37.8 1.08 041 42.7					
8 SA S22 42.9 0.25 +08 11.8 1.10 042 41.9					
9 SU S22 49.0 0.24 +07 45.3 1.12 043 41.2					
10 M S22 54.6 0.22 +07 18.4 1.14 044 40.6					
11 TU S22 59.8 0.20 +06 51.1 1.15 045 39.9					
12 W S23 04.6 0.18 +06 23.4 1.17 046 39.3					
13 TH S23 08.9 0.16 +05 55.3 1.18 047 38.7					
14 FR S23 12.7 0.14 +05 26.9 1.20 048 38.1					
15 SA S23 16.1 0.12 +04 58.1 1.21 049 37.6					
16 SU S23 19.0 0.10 +04 29.1 1.22 050 37.0					
17 M S23 21.4 0.08 +03 59.8 1.23 051 36.4					
18 TU S23 23.4 0.06 +03 30.3 1.24 052 35.8					
19 W S23 24.9 0.04 +03 00.7 1.24 053 35.2					
20 TH S23 25.9 0.02 +02 30.8 1.25 054 34.5					
21 FR S23 26.4 0.00 +02 00.9 1.25 055 33.9					
22 SA S23 26.5 0.02 +01 30.9 1.25 056 33.3					
23 SU S23 26.2 0.04 +01 00.9 1.25 057 32.6					
24 M S23 25.3 0.06 +00 30.9 1.25 058 32.1					
25 TU S23 24.0 0.07 +00 01.0 1.24 059 31.5					
26 W S23 22.2 0.09 -00 28.9 1.24 060 31.0					
27 TH S23 19.9 0.11 -00 58.6 1.23 061 30.5					
28 FR S23 17.2 0.13 -01 28.2 1.22 062 30.0					
29 SA S23 14.0 0.15 -01 57.5 1.21 063 29.5					
30 SU S23 10.3 0.17 -02 26.7 1.20 064 29.0					
31 M S23 06.2 0.19 -02 55.6 1.19 065 28.5					
32 TU S23 01.6 -03 24.1 066 27.9					

Hourly differences in declination and equation of time are for the 24-hours following 0-hours of date in left column.

**TABLE 2**  
 REFRACTION AND SUN'S PARALLAX  
 (To be applied to observed altitudes. See page 16)  
 Bar. = 29.6 in. Temp. = 50° F

Measured Altitude	Refraction	Sun's Par.	Measured Altitude	Refraction	Sun's Par.
7 30	6.88	0.15	17 30	3.02	0.14
7 40	6.75	0.15	18 00	2.93	0.14
7 50	6.62	0.15	18 30	2.85	0.14
8 00	6.50	0.15	19 00	2.77	0.14
8 10	6.37	0.15	19 30	2.70	0.14
8 20	6.25	0.15	20 00	2.62	0.14
8 30	6.13	0.15	21 00	2.48	0.14
8 40	6.02	0.15	22 00	2.36	0.14
8 50	5.92	0.15	23 00	2.25	0.14
9 00	5.82	0.15	24 00	2.15	0.14
9 10	5.72	0.15	25 00	2.05	0.14
9 20	5.63	0.15	26 00	1.96	0.13
9 30	5.53	0.15	27 00	1.88	0.13
9 40	5.43	0.15	28 00	1.80	0.13
9 50	5.34	0.15	29 00	1.73	0.13
10 00	5.26	0.15	30 00	1.66	0.13
10 20	5.10	0.15	32 00	1.53	0.13
10 40	4.95	0.14	34 00	1.42	0.12
11 00	4.81	0.14	36 00	1.32	0.12
11 20	4.67	0.14	38 00	1.23	0.12
11 40	4.54	0.14	40 00	1.15	0.11
12 00	4.42	0.14	42 00	1.07	0.11
12 30	4.25	0.14	44 00	1.00	0.11
13 00	4.09	0.14	46 00	0.93	0.10
13 30	3.93	0.14	48 00	0.86	0.10
14 00	3.78	0.14	50 00	0.80	0.09
14 30	3.65	0.14	55 00	0.67	0.08
15 00	3.53	0.14	60 00	0.55	0.07
15 30	3.42	0.14	65 00	0.45	0.06
16 00	3.32	0.14	70 00	0.35	0.05
16 30	3.22	0.14	80 00	0.17	0.03
17 00	3.12	0.14	90 00	0.00	0.00

The refraction values in Table 2 are corrected by multiplying them by the multipliers in Table 2a when the barometric pressure and the temperature differ from those on which Table 2 is based, i. e. 29.6 inches and 50° F.

If the barometric pressure is not known, it may be estimated from the elevation of the locality in accordance with the values given in Table 2a. Otherwise the elevations are disregarded.

**TABLE 2a**

To correct Table 2. See Examples below.  
**MULTIPLIERS FOR OBSERVED BAROMETRIC PRESSURE OR ELEVATION**

Bar. (Inches)	Elev. (Feet)	Multi-plier	Bar. (Inches)	Elev. (Feet)	Multi-plier
30.5	- 451	1.03	23.9	+ 6194	0.81
30.2	- 181	1.02	23.6	6538	0.80
30.0	00	1.01	23.3	6887	0.79
			23.0	7239	0.78
29.9	+ 91	1.01			
29.6	366	1.00	22.7	7597	0.77
29.3	643	0.99	22.4	7960	0.76
29.0	924	0.98	22.1	8327	0.75
28.7	1207	0.97	21.8	8700	0.74
28.4	1493	0.96	21.5	9077	0.73
28.1	1783	0.95	21.2	9460	0.72
27.8	2075	0.94	20.9	9848	0.71
27.5	2371	0.93	20.6	10242	0.70
27.2	2670	0.92	20.3	10642	0.69
			20.0	11047	0.68
26.9	2972	0.91			
26.6	3277	0.90	19.7	11458	0.67
26.3	3586	0.89	19.4	11875	0.66
26.0	3899	0.88	19.1	12299	0.65
25.7	4215	0.87	18.8	12729	0.64
25.4	4535	0.86	18.5	13165	0.63
25.1	4859	0.85	18.2	13608	0.62
24.8	5186	0.84	17.9	14058	0.61
24.5	5518	0.83			
24.2	5854	0.82			

**MULTIPLIERS FOR TEMPERATURE**

Temp. Deg. F	Multi-plier	Temp. Deg. F	Multi-plier	Temp. Deg. F	Multi-plier
- 20	1.16	+ 30	1.04	+ 80	0.94
- 10	1.13	+ 40	1.02	+ 90	0.93
0	1.11	+ 50	1.00	+ 100	0.91
+ 10	1.08	+ 60	0.98	+ 110	0.90
+ 20	1.06	+ 70	0.96	+ 120	0.88

Example. Sun: Meas. Alt. = 30°; Bar. = 26 in. or Elev. 3900 ft.; Temp. 70° F.

Refraction = 1.66' (0.88) (0.96) = 1.40'. Parallax = 0.13'.  
 True Alt. = 30° 00.00' - 1.40' + 0.13' = 29° 58.73'.

Example. Star: Meas. Alt. = 25°; Bar. = 24.5 or Elev. 5518 ft.; Temp. 10° F.

Refraction = 2.05' (0.83) (1.08) = 1.84'.  
 True Alt. = 25° 00.00' - 1.84' = 24° 58.16'.

**TABLE 3**

**POLAR DISTANCE OF POLARIS 1984**  
 For 0<sup>h</sup> Universal Time or Greenwich Civil Time

Polar Distance			Polar Distance		
1984	Angle	Cotan	1984	Angle	Cotan
Jan. 1	0 48.24	71.26	July 9	0 48.71	70.57
11	0 48.21	71.30	19	0 48.70	70.59
21	0 48.19	71.33	29	0 48.69	70.60
31	0 48.19	71.33			
Feb. 10	0 48.19	71.33	Aug. 8	0 48.67	70.63
20	0 48.20	71.32	18	0 48.64	70.67
			28	0 48.61	70.72
Mar. 1	0 48.23	71.27	Sep. 7	0 48.56	70.78
11	0 48.26	71.23	17	0 48.52	70.85
21	0 48.30	71.17	27	0 48.46	70.94
31	0 48.35	71.10			
Apr. 10	0 48.40	71.02	Oct. 7	0 48.40	71.02
20	0 48.45	70.95	17	0 48.34	71.11
30	0 48.50	70.88	27	0 48.28	71.20
May 10	0 48.54	70.82	Nov. 6	0 48.21	71.30
20	0 48.59	70.75	16	0 48.15	71.39
30	0 48.63	70.69	26	0 48.09	71.48
June 9	0 48.66	70.64	Dec. 6	0 48.04	71.56
19	0 48.68	70.61	16	0 47.98	71.64
29	0 48.70	70.59	26	0 47.94	71.70

Declination = 90° - Polar Distance

**TABLE 4**

**THE SUN'S SEMI-DIAMETER 1984**  
 For 0<sup>h</sup> Universal Time or Greenwich Civil Time

Date	Semi-Diam.	Date	Semi-Diam.	Date	Semi-Diam.
1984		1984		1984	
Jan. 1	16.29	May 10	15.86	Sep. 7	15.90
11	16.29	20	15.83	14	15.93
21	16.28	30	15.80	27	15.98
31	16.26				
Feb. 10	16.24	June 9	15.78	Oct. 7	16.03
20	16.20	19	15.76	17	16.08
		29	15.76	27	16.12
Mar. 1	16.17	July 9	15.76	Nov. 6	16.16
11	16.12	19	15.76	16	16.20
21	16.08	29	15.78	26	16.23
31	16.03				
Apr. 10	15.99	Aug. 8	15.80	Dec. 6	16.26
20	15.94	18	15.83	16	16.28
30	15.90	28	15.86	26	16.29