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**NATR 142**  
**Plane Surveying**  
**Fall 2023**

**Third Examination Study Guide**  
**Prepared By: Dr. Walid H. Shayya**

- Understand how to work with map (plan) scale in its different forms and how to use scale in both location and layout surveys.
- Understand what is unique about topographic maps and how to interpret them.
- Know what contour lines correspond to and how these provide an idea of topography.
- Understand how to read contour lines.
- Use trigonometric functions whenever needed.
- Define trigonometric leveling and when it is used.
- Understand the steps involved in trigonometric leveling.
- Understand stadia principles and how to make distance measurements using stadia lines, both with a level or inclined telescope.
- Know the terms  $h_i$ ,  $HI$ ,  $RR$ , and  $RI$  ( $RI = TW - BW$ ) as well as how these are used in calculating distances and elevations based on stadia measurements.
- Know how to solve problems involving stadia measurements and trigonometric leveling.
- Define GPS and know what does it stand for.
- Know the three segments of GPS and how these function.
- Know how a GPS receiver determines its position.
- Know the key to measuring distances from satellites using GPS.
- Understand how can GPS be applied in surveying.
- Discuss the use of EDM and total stations.
- Understand the difference among electronic theodolites and total stations.
- Understand the use of EDM instruments with reflectorless technology.
- Find horizontal angles when given a list of data from a repeating theodolite.
- Know how to work with vertical angles and how these are referenced in transits, theodolites, and total stations (horizontal, zenith, and nadir).
- Know how to work with closed and open traverses.
- Discuss the methods for measuring angles or directions in traverse surveys.
- Know why, when, and how deflection angles are measured.
- Know and be able to use formulas for the sum of interior angles [i.e.,  $(n-2) \times 180^\circ$ ].
- Define the difference between true and magnetic north.
- Understand magnetic declination and how it changes.
- Establish a direction of a line if given a bearing.
- Establish a direction of a line if given an azimuth.
- Convert among bearings, reverse bearings, azimuths, and reverse azimuths.
- Compute the bearings and/or azimuths for all lines in a traverse (open or closed) given pertinent angles and distances of the lines and the direction of one of the lines.
- Understand how to adjust interior angles for a closed traverse.
- Calculate latitudes and departures of lines.
- Calculate rectangular coordinates of the vertices of a traverse given latitudes and departures.

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Third Examination  
Equations Sheet

1 ch = 100 links = 66 ft = 4 rods  
 $1^\circ = 60'$ ;  $1' = 60''$ ;  $1^\circ = 3600''$   
 1 yd = 3 ft  
 1 m = 3.2808 ft

1 mi = 5280 ft = 1.609 km  
 1 ac = 43,560 ft<sup>2</sup>  
 1 ft = 12 in

$$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\text{hypotenuse}^2 = \text{opposite}^2 + \text{adjacent}^2$$

$$\text{Grade} = \tan \theta = \frac{\text{rise}}{\text{run}} = \frac{\text{opposite}}{\text{adjacent}}$$

$$\Sigma \text{ of angles} = (n - 2) \cdot 180^\circ$$

$$S = (TW - BW) \cdot 100 \cdot \cos \theta$$

$$H = S \cdot \cos \theta$$

$$V = S \cdot \sin \theta$$

$$\text{Elev.}_B = HI \pm V - RR_B$$

$$\text{Lat.}_{AB} = AB \cdot \cos (\text{Brg.}_{AB})$$

$$\text{Dep.}_{AB} = AB \cdot \sin (\text{Brg.}_{AB})$$

$$Y_B = Y_A + \text{Lat.}_{AB}$$

$$X_B = X_A + \text{Dep.}_{AB}$$