COURSE OUTLINE
CONS 101 – ELEMENTARY SURVEYING

Prepared By:  Joseph Reilly
A. **TITLE:** Elementary Surveying

B. **COURSE NUMBER:** CONS 101
   **SHORT TITLE:** Elementary Surveying

C. **CREDIT HOURS:** 4

D. **WRITING INTENSIVE COURSE (OPTIONAL):** N/A

E. **COURSE LENGTH:** 15 Weeks

F. **SEMESTER(S) OFFERED:** Fall

G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY:**
   - Lecture: 3 – 50 minute lectures
   - Laboratory: 1 – 2 hr 50 minute laboratory

H. **CATALOGUE DESCRIPTION:**

   Course consists of both lecture and laboratory periods. Lectures include the developmental history of the surveying profession, along with the underlying principles of basic theory and practice. Realistic exercises involving linear and angular measurements, leveling, field-book recording, construction layout, and traversing are performed in the outside laboratory. Computation of errors, adjustments for instrument misalignment and weather are included in the laboratory exercises. Conversion of measurements and use of the Metric (S.I.) system is also included. Students have ample opportunity for hands-on training with the extensive variety of equipment utilized in the course. Field parties of limited size offer “one on one” instruction opportunity.

I. **PRE-REQUISITES/CO-COURSES**

   Pre-requisite: Technical Math (MATH 135), OR
   Co-requisite pre-Calculus (MATH 123) or higher, OR permission from instructor.

J. **GOALS (STUDENT LEARNING OUTCOMES):**

   By the end of this course, the student will be able to:
<table>
<thead>
<tr>
<th>Course objective</th>
<th>Institutional SLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. measure the elevation difference between two points using an engineer’s level</td>
<td>3: Professional Competence</td>
</tr>
<tr>
<td>and rod. This will include computation of closure error, error adjustments and</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>determination of order of accuracy.</td>
<td></td>
</tr>
<tr>
<td>b. record a set of neat and legible field notes for a given set of surveying</td>
<td>3: Professional Competence</td>
</tr>
<tr>
<td>data in accordance with provided format specifications.</td>
<td>1: Communication</td>
</tr>
<tr>
<td>c. use a surveyor’s tape, plumb bob, taping pins and hand level to measure the</td>
<td>3: Professional Competence</td>
</tr>
<tr>
<td>horizontal distance between two points on a slope.</td>
<td></td>
</tr>
<tr>
<td>d. calculate equivalent measurements in different surveying unit systems.</td>
<td>3: Professional Competence</td>
</tr>
<tr>
<td>e. calculate corrections to tape measurements for temperature, pull, tape length</td>
<td>3: Professional Competence</td>
</tr>
<tr>
<td>and sag.</td>
<td>2. Critical Thinking</td>
</tr>
<tr>
<td>f. demonstrate the ability to measure and lay out horizontal and vertical angles</td>
<td>3: Professional Competence</td>
</tr>
<tr>
<td>with a total station. This will include the ability to set up the instrument</td>
<td></td>
</tr>
<tr>
<td>over a point and level it.</td>
<td></td>
</tr>
<tr>
<td>g. Calculate the true direction of a line using a magnetic compass direction</td>
<td>3: Professional Competence</td>
</tr>
<tr>
<td>measurement and current declination</td>
<td></td>
</tr>
<tr>
<td>h. calculate the area of a parcel of land in acres given the length of the sides</td>
<td>3: Professional Competence</td>
</tr>
<tr>
<td>(straight or curved) in a variety of units.</td>
<td></td>
</tr>
<tr>
<td>i. calculate the coordinates of the points of a closed polygon traverse. As part</td>
<td>3: Professional Competence</td>
</tr>
<tr>
<td>of this the student will compute and/or convert bearings and azimuths;</td>
<td></td>
</tr>
<tr>
<td>determine relative precision and accuracy; and adjust angles and distances to</td>
<td></td>
</tr>
<tr>
<td>provide proper closure of the traverse.</td>
<td></td>
</tr>
<tr>
<td>j. function successfully as a member of a field party, both subordinate and</td>
<td>4. Inter/Intra personal skills</td>
</tr>
<tr>
<td>leader</td>
<td>3. Professional competence</td>
</tr>
</tbody>
</table>

K. **TEXTS:**


L. **REFERENCES:** None

M. **EQUIPMENT:** Automatic Level, Total Station, Prism Pole, Metal Detector, Steel Tape, Range Pole, Engineering Rod (Leveling), Miscellaneous Hand Equipment are provided by the department.
The student is expected to provide the following:

- A calculator capable of performing addition, subtraction, multiplication, division, trigonometric functions, inverses, exponentiation and roots.
- Quadrille ruled Engineering Computation paper for assignments.
- A Student Field Book.
- A sharp pencil(s) with H or HB lead for computations.
- A sharp pencil(s) with 3H or 4H lead for field notes.
- Drafting equipment: Engineer’s scale, protractor, triangle

N. **GRADING METHOD:** (P/F, A-F, etc.) A-F

O. **MEASUREMENT CRITERIA METHODS:**
   - Exams
   - Homework Assignments
   - Lab Participation
   - Field Book preparation and maintenance
   - Lab Calculation and mapping projects

P. **DETAILED TOPICAL OUTLINE:**

I. Introduction

II. Theory of Measurement & Errors
   - Types of Measurements Used in Surveying
   - Units
   - Significant Figures
   - Rounding Off Numbers
   - Errors and Error Propagation
   - Precision and Accuracy

III. Surveying Notes
   - Requirements
   - Sample Arrangements

IV. Legal Implications

V. **Distance Measurement by Taping**
   - *Measuring Horizontal Distances*
   - Pacing
   - Level Taping
   - Slope Taping
   - Stationing
   - Corrections
VI. Theory, Methods and Equipment - Leveling
   A. Leveling Methods
   B. Equipment
   C. Field Procedures
   D. Differential Leveling
   E. Reciprocal Leveling
   F. Profile Leveling
   G. Cross Sectioning
   H. Precision
   I. Adjustment of Leveling Loop
   J. Errors and Mistakes
      1. Curvature and Refraction

VII. Angles, Bearings and Azimuths
   A. Units
   B. Horizontal Angles
   C. Bearings
   D. Azimuths
   E. Comparison and conversion of Bearing and Azimuths
   F. Computing Bearings and Azimuths

VIII. Magnetic Compass
    A. Introduction
    B. Magnetic Declination
    C. Variations in Magnetic Declinations
    D. Types of Compasses
    E. Compass Problems

IX. Total Station
    A. Basic Parts
    B. Scales and Verniers
    C. Reading Angles
    D. Field Operations
    E. Setup and adjustments
    F. Bearings and Angles
    G. Closing the Horizon
    H. Deflection Angles
    I. Errors, Mistakes and Corrective Measures

X. Traverse
    A. Traverse Angles
    B. Traverse Distances
    C. Traverse Stations
    D. Note Keeping
    E. Angle Misclosure
XI. Traverse Computations
   A. Balancing Angles
   B. Computation of Bearings, Azimuths, Latitudes and Departures
   C. Closure Conditions
   D. Adjustments
   E. Coordinates
   F. State Plane Coordinates
   G. Sources of Error

XII. Area
    A. Methods of Area Measurements
    B. Offset method
    C. Area of a circular segment
    D. Error in area computation

Q. LABORATORY OUTLINE:

1. Introduction, Pace Length and Prolonging a Line
2. Level Loop I
3. Level Loop II
4. Reciprocal Leveling Project
5. Horizontal and Slope Taping
6. Profile and Cross Section Leveling
7. Angles of Triangle by Taping and Calculations
8. Introduction to Total Station
9. Closing the Horizon
10. Building Layout
11. Total Station Dexterity Test
12. Closed Traverse - Field Problem
13. Closed Traverse – Computations
14. Measuring the Height of an Inaccessible Object