NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ENVIRONMENTAL ENGINEERING
SANITARY ENGINEERING PROGRAM

AA235 - TOPOGRAPHY

I. GENERAL INFORMATION

CODE	**:**	AA235 Topography
SEMESTER	**:**	3
CREDITS	**:**	4
HOURS PER WEEK	**:**	6 (Theory – Practice)
PREREQUISITES	**:**	AA227 Technical Drawing, AA215 Geology
CONDITION	**:**	Compulsory

II. COURSE DESCRIPTION

This course prepares students for the understanding and application of topography methods for the study, representation and analysis of the shape and features of the surface of the Earth. The course deals with subjects such as: Horizontal control using triangulation and trilateration methods. Determination of the relative and total error. Figure compensation methodologies, figure resistance theory, coordinates calculation, off-center station, supplementary horizontal control using direct and inverse intersection (Pothenot problem), volume calculation: methods and considerations, introduction to road theory, applications to mining engineering.

III. COURSE OUTCOMES

1. Carry out topographical surveys of large and medium expanse controlled with triangulation and apply them to engineering works.
2. Propose several work systems that allow them to represent a stretch of land and take decisions.
3. Students will have the possibility to fit in with criteria and requirements of a certain and specific civil work, so their work meet the needs required.
4. The mastery and practice of this conceptual subject matter will allow students to perform in the technical-professional field of topography, and will also provide students with conceptual basis for their later courses.

IV. LEARNING UNITS

1. CONCEPTS AND PRELIMINARY WORKS / 8 HOURS

Topogrphical triangulation / Planimetric control / Clasification / Common figures / Stages / Work planning / propagation of error / geodesic triangulation / Spherical excess. Terrain reconnaissance / Hub location / Monumentation and hub signaling / Daytime and evening observation / Base measurement / Classification and precisions.

2. ANGULAR MEASUREMENTS / 15 HOURS

Base measurements with steel tape and invar bar / electronic instruments / Base orientation with sight and gyro / GPS. Precision theodolites / Measurement of horizontal angles / for reiteration / Precautions / measurement of vertical angles / trigonometric leveling / Off-center station.

3. ANGULAR MEASUREMENTS II / 12 HOURS

Figure compensation / Method used / Equations of condition. Error theory method / Successive-approximations method / Least squares method. Figure resistance / Side calculation / UTM coordinates calculation / Dimension lines calculation.

4. TACHOMETRY WITH TOTAL STATION AND THEODOLITE / 8 HOURS
Tachymetry / Horizontal and inclined sights / Formulas / Optical and electrical instruments / Total station / Curve diagram tachymeter / Errors and precautions. Elaboration of contour lines / Field and lab research methods / Interpolation / Methods / Verifications / Errors and precautions.

5. SUPPLEMENTARY HORIZONTAL CONTROL / 16 HOURS
Applications for contour lines / Gradient stroke / Construction of sections / Volume calculation / Supplementary horizontal control / Simple intersection / inverse intersection (Pothenot) / Analytical development / Common cases / trilateration with electric instruments. Triangulation application for bridges and tunnels / Triangulation networks for basic and cadastral plans / Supplementary control in photogrammetry. Calculation of areas / Surveying / Planimeter / Coordinates / Decomposition into simple figures / Precisions / calculation of volumes / Topographic laser scanner.

6. USE OF TOPOGRAPHICAL TECHNIQUES / 4 HOURS
Boundary rectification / Gradient line / Circular curves / Bathymetric survey / Budges / test of topographic instruments.

V. LABORATORY AND PRACTICAL EXPERIENCES

Terrain reconnaissance using preliminary works.
Measurement with theodolites.
Equations of condition.
Topographical survey.
Measurement with total station.
Stroke of contour lines.
Triangulation scope and uses.
Calculation of areas.

VI. METHODOLOGY

The course is carried out in theory and practice sessions. In theory sessions, the instructor introduces concepts, theorems and applications. In practice sessions, several problems are solved, and their solutions are analyzed using topographic equipment (topographical level, theodolite, total station, GSP). At the end of the course, students must hand in and expose a paper. In all sessions student's active participation is encouraged.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

$$PF = \frac{EP + 2EF + PP}{4} \qquad PP = \frac{PC1 + PC2}{2}$$

EP: Mid-Term Exam EF: Final Exam
PC1, PC2: Quizzes

VIII. BIBLIOGRAPHY

1. **BANNISTER A., RAYMOND S., BAKER R.**
   Modern Techniques in Topography
   Alfa Omega Editions, 2011
2. **DOMINGUEZ GARCIA, Francisco**
   General and Applied Topography
   Dossat Editions, 2009
3. **DAVIS, Raymond**
   Treatise on Topography
   Mc. Graw Hill Editorial, 2012