NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF GEOLOGICAL, MINING AND METALLURGICAL ENGINEERING

MINING ENGINEERING PROGRAM

TM527 – MINING TOPOGRAPHY

I. GENERAL INFORMATION

CODE	**:** TM527 Mining Topography
SEMESTER	**:** 5
CREDITS	**:** 3
HOURS PER WEEK	**:** 4 (Theory – Practice - Laboratory)
PREREQUISITES	**:** TM417 Topography
CONDITION	**:** Compulsory

II. COURSE DESCRIPTION

The course prepares students for the application of surveying and geodesic techniques and instruments used in modern mining industry. Students understand the components of total station and Global Positioning System GPS and use them to complete mining surveying projects using specialized software. The Peruvian Mining Law and the Peruvian Mining Cadaster Law are analyzed as well as the procedures for requesting mining concessions in the country.

III. COURSE OUTCOMES

1. Organize and interpret field data, as well as topographical planes.
2. Understand the differences between underground and surface surveying.
3. Understand the components and setting of a total station and properly use it for mining surveying.
4. Understand the process for azimuth transferring in chimneys and pikes.
5. Understand the components of GPS and properly use it for mining surveying.
6. Transform coordinates in different reference systems.
7. Understand the most relevant points of the Peruvian Mining Law and the Peruvian Mining Cadaster Law.
8. Understand the administrative process for requesting mining concessions.

IV. LEARNING UNITS

1. MINING TOPOGRAPHY
Mining topography: steps / Topographical survey / Differences between underground and surface topographical surveys / Instruments, equipment and materials / Pithead location / Underground polygoning using plumb method / Height control with vertical angles / Distance leveling / Underground surveying / Direction and gradient control for drainage, transport and lifting / Construction of mining gallery and chimneys / Theodolite / Suspended compass / Inclinometer / Transversal sections and profiles / Horizontal and vertical control / Scales.

2. AZIMUTH AND COORDINATES TRANSFERRING
Azimuth transferring in chimneys and pikes / Instruments, equipment and materials / Pikes and slopes depth measurement / Underground communications / Communication between galleries, pikes, chimneys and their control / Communication with diamond drill /

3. TOTAL STATION
Introduction / Elimination of horizontal and vertical eccentricity errors / Optical micrometer / Electronic odometer / Total station: theodolite with computer, coders, decoders and electronic

odometer / Real time / Resident memory for atmospheric correction, Erath curvature prism, deviation, etc. / Surveying software for applied engineering / Geodesics / Earth shape and dimensions / Cartography / Revolution geoid and ellipsoid / Reference systems / Local datum: PSAD 56 Datums, WGS 84, ITRF 1993 / Geocentric reference system 1995.42 (SIRGAS 95.4) / Peruvian geodesic network / Geographic coordinates and UTM.

4. GLOBAL POSITIONING SYSTEM GPS
Basic principles / Satellites / Land control and receptors / Satellite orbits / Components of a GPS receptor / Time system and scale / Methods: differential, static, cinematic, pseudo-cinematic, stop and go / Limitations / Mission planning and programming / Distance measurement / Light speed, atomic clock / Cut angle / PDOP / Satellite height and azimuth / PC data processing / Post processing software / Coordinates computation.

5. COORDINATES TRANSFORMATION
Coordinates transformation: Geodesic, Cartesian, three-dimensional / Application software / Meridian convergence / Scaling factor / Cartography / Cartographic projections: cylindrical, conic / Plane and UTM coordinates / National chart.

6. PERU MINING LEGISLATION
General Mining Law / National Institute of Concessions and Mining Cadaster / National Law of Mining Cadaster / Procedures for requesting mining concessions and their classes / Mining property.

V. LABORATORY AND PRACTICAL EXPERIENCES
Terrain reconnaissance using preliminary works
Use and applications of Total station
Use and application of Global Positioning System
Coordinates transformation
Software for mining topography.

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 (total station, GSP). At the end of the course, students submit and defend a final report with the practical solution to a real mining topography problem. 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, 2012
2. **DOMINGUEZ GARCIA, Francisco**
   General and Applied Topography
   Dossat Editions, 2015
3. **DAVIS, Raymond**
   Treatise on Topography
   Mc. Graw Hill Editorial, 2005