NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

TV561 – SATELLITE GEODESICS

I. GENERAL INFORMATION

CODE	**:**	TV561 – Satellite Geodesics
SEMESTER	**:**	5
CREDITS	**:**	04
HOURS PER WEEK	**:**	06 (Theory – Workshop)
PREREQUISITES	**:**	TV114 – Topography II
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

It is a course that describes the shape and dimensions of the earth, determining a reference ellipsoid to be able to calculate our measurements. It relates the different reference systems making the transformations of these. Determination of the time and the wave transmissions in the electromagnetic spectrum, orbits principles of the satellites and determination of the ephemeris to be able to make measurements taking advantage of the GPS, navigators and double frequency receivers. Location of points on the surface of the earth for applications in engineering works such as: roads, tunnel control bridges, dams.

III. COURSE OUTCOMES

At the end of the course the student will:

- Analyze the earth shape and dimensions.
- Deduce and distinguish the different reference systems in topographic and / or geodetic measurements.
- Solve and calculate the different transformations between the measurement systems.
- Handle and manipulate GPS instruments both browsers and dual frequency.
- Distinguish and recognize accuracy in measurements with browsers and dual frequency equipment.
- Investigate and analyze the data collected from the satellites, and then process and interpret them.
- Check the results, to be able to apply them in engineering works designs, such as: canals, roads, dams, among others.

IV. LEARNING UNITS

1. GENERALITIES

Introduction. - Satellite Geodesy, basic problems, relationship with other sciences, basic classification, Geodesy concepts, fundamental concepts.

2. **INTRODUCTION - POSITION ASTRONOMY**
   The celestial sphere; Introduction to position astronomy, astronomical coordinates

3. **REFERENCE SYSTEM**
   Reference system, local geodesic system, PSAD56.
   Global astronomical system, ellipsoidal system, movement of the earth rotation axis, International Terrestrial Reference Framework ITRF, Global Geodetic Reference System WGS84, SIRGAS.

4. **CARTOGRAPHIC PROJECTIONS**
   Cartographic projections, properties of cartographic projections, types of cartographic projection, Mercator projection, Mercator transverse projection, Mercator UTM universal transverse projection.

5. **TRANSFORMATION OF COORDINATES BETWEEN SYSTEMS**
   Coordinate transformation between systems, determination of transformation parameters.

6. **TRANSFORMATION OF UTM COORDENDAS TO TOPOGRAPHICS**
   Scale factor, one-point scale factor, grid distance, geodetic distance, elevation factor, topographic distance. Direction measurement, geographic meridian of a point, grid meridian of a point, convergence of meridians, flat grid azimuth, projected geodetic azimuth, correction by curvature, true geographical azimuth, calculation of topographic coordinates. Workshop class: transformation of UTM coordinates to topographic.

7. **GPS GLOBAL POSITIONING SYSTEM**
   Global Positioning System (GPS), satellite constellations for georeferencing purposes, Georeferencing of a point using GPS technology. Components of the global navigation satellite system (GNSS), control segment, space segment, user segment, almanacs and ephemeris DOP precision dilution, influence of the receiver's instrumental height on GPS measurements. Classification of geodetic points.

8. **METHODS IN SATELLITE OBSERVATIONS**
   Postprocess method, autonomous method, static differential method, minimum viewing time for baseline, kinematic differential method, dynamic differential method.

9. **TRANSFORMATION OF UTM COORDENDAS TO TOPOGRAPHICS**
   Workshop class: Satellite viewing static differential method; configuration, viewing, information transfer and postprocessing.

10. **SATELLITE VIEW IN REAL TIME**
    Real-time methods, differential method RTK, NTRIP, SBAS, satellite signal, types of receivers.

11. **THE TIME AND COURSE APPLICATIONS**
    Time: basic considerations; sidereal time, universal time; LAST, GAST, LM ST, GMST, dynamic time, atomic time, GPS time. GPS applications; in Transportation: Air, Maritime Land; bathymetry, road applications, mines; Tunnels, etc.

V. METHODOLOGY

In the course an active method is used in the teaching-learning process, in which students have participation in all classes either individually or in work groups. The teacher uses expositions and exemplification to complement the activity of the students using the available audiovisual aids. The explanation in the classroom is complemented by application field work, presentation of research topics, etc.

VI. EVALUATION FORMULA

The learning will be evaluated through the "G" system.

- Average of Practices: AP
- Qualified Practices: QP
- Staggered Work: W1
- Research Work: W2

$$AP = \frac{3 * QP1 + 3 * QP2 + 2 * W1 + 2 * W2}{10}$$

- Final Average: FA
- Mid-Term Exam: PE
- Final Exam: FE

$$FA = \frac{PE + FE + AP}{3}$$

VII. BIBLIOGRAPHY

- TOPOGRAPHY - GEODESIA, Jorge Mendoza Dueñas - Lima, Peru, 2019.
- SATELLITE GEODESY, Gunter Seeber Walter de Gruyter - Berlin, New York 1993
- GLOBAL POSITIONIG SYSTEM, B. Hofmann - Wellenhof, H. Lichtenesgger and J. Collins Sprinnger - Verlag Wien, New York.
- GPS SATELLITE SURVEYING, Alfred Leick, Department of surveying, University of Maine Orono -maine
- Internet link, given by the teacher.