NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF GEOLOGICAL, MINING AND METALLURGICAL ENGINEERING

GEOLOGICAL ENGINEERING PROGRAM

GE112 – GEOMORPHOLOGY AND PHOTOGEOLOGY

I. GENERAL INFORMATION

CODE	**:**	GE112 Geomorphology and Photogeology
SEMESTER	**:**	5
CREDITS	**:**	4
HOURS PER WEEK	**:**	6 (Theory–Practice–Field)
PREREQUISITES	**:**	GE001 Geology
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Geological Engineering

II. COURSE DESCRIPTION

Geomorphology studies the origin and evolution of topographic and bathymetric features created by physical, chemical or biological processes operating at or near the Earth's surface, in order to describe the land relief, understanding its genesis and current behavior, which varies with time due to terrestrial dynamics by action of constructive and destructive processes. Its analysis integrates the knowledge of other sciences of the Earth. The photogeology studies geological features of an area or region, based on the analysis of stereoscopic pairs of photographic images mostly satellite imagery. From this outlook, the photogeology is a useful and practical support tool for the geological study of large areas in a short time, for the location of areas of hydrothermal alteration and consistent location of natural resources such as mineral deposits, etc.

III. COURSE OUTCOMES

At the end of the course, students:

1. Organize the geological information obtained through the use of satellite images and aerial photography to interpret the sequence of the different types of geological events in the various regions of the Peruvian territory and the world.
2. Observe and understand the different types of reliefs to explain the causes that originated them, by making analysis in the field and in the interpretation of aerial photographs.
3. Describe the different geological features, recognized in field and satellite images, to discriminate areas according to lithological units and structural features.
4. Identifies areas of natural resources as well as the location with minimum vulnerability for Civil Engineering works.
5. Analyze agents and geological processes that modify the morphology.
6. Analyze the morphology and provides the possible occurrence of corresponding previous processes.
7. Interpret the evolution of the land relief and identify geological processes that originated it.
8. Elaborate geomorphological maps based on field work and the interpretation of aerial photographs.
9. Compare and relate the different geological features of field with the corresponding areas in aerial photos or satellite images, to identify regional geological patterns and make geo-chronological interpretation easier.

IV. LEARNING UNITS

1. GEOMORPHOLOGY: FUNDAMENTAL CONCEPTS

Geomorphology fundamentals. Influence of climate and geology in the geomorphological evolution. Glacial and periglacial morphology. Morphology in the regions of climates: temperate,

desert and tropics. Current water as one of the main agents of the geomorphic evolution, its rules: regressive erosion, slope and equilibrium profile. Fluvial terraces.

2. GEOMORPHOLOGY DYNAMICS

Origin of internal and external forces acting on Earth. Analysis of geomorphological processes: gradation, degradation and aggradation. Granite weathering: development of "Tafoni" type of erosion, the formation of kaolin. Geomorphic landscapes in failed areas: escarpments associated to faults and fractures. Failure of horizontal and vertical scrolling. Tectonic pillars and tectonic trenches. Limestone morphology: carstic forms: caves, dolines, uvals, lenars, Terra Rosa. The carst geomorphic cycle. Forms of relief due to volcanism: forms of volcanoes and types of eruptions. Deposits of volcanic ash. Fields of lava and their features. Plateaus and volcanic plains. The forms of drainage in volcanic deposits.

3. MAIN MORPHOLOGICAL UNITS AT SEA BOTTOM

Active margins and stable margins. Continental platform and slope. Ocean pits and basins. Subduction. Plates borders. Origin of ocean bottom. Sediments of ocean bottoms. Application of geomorphology to hydrology. Hydrology in limestone lands. Geomorphology oriented to hydrogeological research, case of the tectonic basin of Tacna Valley. Application of geomorphology in civil engineering works: roads, dams, diversion channels. The Poechos dam case.

4. AERIAL PHOTOGRAPHS

Vertical and oblique types of photography. Photographic techniques: black and white, color, infrared. Factors affecting the quality of photographic images. Use of aerial photographs. Vertical aerial photographs: conical projections, terminology and geometric elements of vertical photographs, scale of the photographs. Orthoscopic projections. Restitution of aerial photographs, maps. Stereoscopy and stereoscopic vision. Stereoscopes and their models. Vertical exaggeration of relief: conditions and its usefulness.

5. PHOTOGRAMMETRIC MEASUREMENTS

Parallax. Instruments for the measurement of parallax. The parallax difference between two points. Measures of elevation. Errors in the measurement of parallaxes. Determination of the orthogonal projection of a point with the stereoscopic pair. Determination of the course. Dipping faults and flat stratification. determining the power of the strata and stratigraphic columns. Photogeologic Laboratory: choice of the stereoscope and aerial photographs, preparation of photographs, annotations on photographs, use of transparent paper, annotation of the work, the drawing material. Employment of the photography aerial in the field.

6. PREPARATION OF THE PHOTOGEOLOGICAL MAP BASED ON EXISTING TOPOGRAPHIC MAP

Elaboration of a planimetric map from aerial photographs: method of templates. Control points: central, transferred, geodesic and side points. Transparency of control points of photogeological work. Preparation of mosaics. Photogeological interpretation. Object of photogeology, advantages, and limitations. Photogeological routine: identification of human works, hydrography, geological study. Factors for photogeological interpretation. Elements of recognition: tone, color, texture, shapes, sizes, technical, climatic and human factors, vegetation. Geomorphological analysis: drainage, lithological, topographic and structural controls. River, lacustrine and fluvial deposits and glaciers. Photogeological study of rocks: lithological characteristics of sedimentary, igneous and metamorphic rocks. Aerial photographic interpretation in the search of mineral deposits, in hydrogeological studies and in geological engineering.

V. PRACTICAL WORK

1. **"Drag Hills" (UNI):** The geomorphology “Drag Hills” at UNI campus depending on geological outcrops and structural geology. The dioritic intrusion and sedimentary rocks of "La Herradura" formation. The halos of contact and the metamorphic rocks. Cieneguilla-Valley of the Lurin river. Morphology in relation to the outcrop of intrusive rock (granodiorite) and its structural geology. Quaternary deposits accumulated by waters of Lurin river and streams of their flanks. Fluvial terraces.
2. **The Casuarinas - Outcrop of "Pamplona Formation".** The morphology formed in the area of contact between the intrusive and sedimentary rocks from the Cretaceous. “The Pedregal" Valley, Km.32 of the Peruvian Central Road, phenomena of external geodynamics: erosion,

transport and deposition of materials by action of torrential waters torrential (landslides) of the valley of the same name.

3. **Valley of Chillon Riveer.** The morphology of the dejective cone of Chillon river from the “Hda. Punchauca", as consequence of the nature of their rocks, of its structural geology and of the action of waters. Morphology of the cliffs of the "Costa Verde"-Genesis of the cliffs and causes of the progressive decrease of their power from Chorrillos, the work of sea waves between San Lorenzo island and the tip. Origin of "Tip" and "The Camotal".
4. **Exercise of Stereoscopic Vision:** Use of the stereoscope. Observation of photographs (stereoscopic pairs) areas. Observation of various types of erosion in aerial photographs and geomorphic processes. Geomorphology of the valleys. Studies of forms of valleys and its drainage. Observation and study of glacier landscapes (circuses glaciers, plains of till, of moraines, etc.) from the aerial picturesl.
5. **Recognition of the "Peneplanicies" and of the "Plains of Motion":** Geomorphological folded structures: anticlines, synclines, domes, etc. Observation of geomorphic landscapes in aerial photographs. Recognition, from aerial photographs, of faults, fractures, joints, escarpments, tectonic pillars and tectonic trenches.
6. **Observation on Aerial Photographs of Carstic Landscapes:** Caves, sinkholes, carst window, abandoned runways, etc. Recognition in aerial photographs of coastal geomorphic features of the seabed. Determination from the aerial photographs, of the forms of the relief due to volcanism. Deposits of volcanic ash, lava fields, plateaus and volcanic plains. Form of drainage in volcanic deposits. Observation and study of the geomorphic traits from aerial photographs with the aim of determining areas of mining interest, hydrogeological and other economic resources.

VI. METHODOLOGY

The subject is taught under the following mode:

- A weekly session of 03 hours of theory with the teacher using audiovisual material.
- A weekly session of 03 hours of practical work. In all the activities carried out, the student participates actively so that there is permanent feedback.
- Three field trips to geological areas in Lima region.

VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

PF = (EP + EF + PP) / 3

EP: Mid-term Exam EF: Final Exam
PP: Average of Practical Works.

VIII. BIBLIOGRAPHY

1. William D. Thurnbury.
   Principles of Geomorphology, Ed. Kapeluz, Buenos Aires, Argentina, 2010.
2. M. Derruau
   Compendium of Geomorphology, Ed. Ariel, Barcelona, Spain, 2012
3. Lopez Vergara, M. L.
   Photogeology Manual, Mexico, 2009.