NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING

PETROLEUM ENGINEERING PROGRAM

PG311 – STRUCTURAL GEOLOGY

I. GENERAL INFORMATION

CODE	**:**	PG311 Structural Geology
SEMESTER	**:**	5
CREDITS	**:**	4
HOURS PER WEEK	**:**	5 (Theory–Practice–Field visits)
PREREQUISITES	**:**	PG221 Sedimentology and Stratigraphy PH121 Descriptive Geometry
CONDITION	**:**	Compulsory

II. COURSE DESCRIPTION

The course prepares students for analyzing the three-dimensional distribution of rock units with respect to their deformational histories. Students use measurements of present-day rock geometry to uncover information about the history of deformation-strain in the rocks, to understand the stress field resulting from the observed strain and geometry. Students characterize deformation structures (geometry), characterize flow paths followed by particles during deformation (kinematics) and to infer the direction and relative magnitude of the forces involved in driving deformation (dynamics).

III. COURSE OUTCOMES

At the end of the course, the student:

1. Explain and identify intact rocks, rock mass, and characteristics of discontinuities.
2. Explain the relationship between morphogenesis and the structural conditions of a zone, as well as reliefs and drainages controlled by structural conditions.
3. Understand the statistical analysis of discontinuities, projections, instability planes, stress orientation and types.
4. Characterize the deformation geometry, deformation paths, and the direction of the forces driving deformation

IV. LEARINING UNITS

1. PRIMARY STRUCTURES

Concepts / Sedimentary structures, identification, formation processes, types, crossed stratifications, rhythmic stratification, gradual stratification, stratum floor and ceiling characteristics / Non-diastrophic structures, concepts, formation processes, types and identification, elastic expansion, underwater and surface motion, filling structures of irregular surfaces / Deformation physics / Application of deformation ellipsoidal method, criteria, stress-strain relationship along time. Effects of temperature and pressure. Deformation theory.

2. FRACTURING

Concepts, intact rocks, rock mass, types and characteristics of discontinuities, orientation, spacing, openings, persistence, rugosity, undulation, alterations (discontinuities and fillings), humidity, unitary blocks / Formats for measurement of discontinuities.

3. FAULTING

Concepts, causes, types, classification according to vertical, horizontal and rotational displacement / Minor structures associated to faults, fault filling, fault zones, active and inactive faults / Folding, concept, causes, fold components, fold classification according to symmetry, axial plane inclination, ridge inclination, opening between folds, monoclonal folds, homoclinal folds, similar folds, parallel folds, disharmonic folds, dome structures.

4. STEREOGRAPHIC PROJECTIONS

Statistical analysis of discontinuities, projections, instability planes stress orientation, stress types, determination of structural traps / Igneous rocks, concepts, intrusives, classification of volcanic, fluidal structures, faulting associated to intrusive and extrusive rocks, pad-type structures, contact structures, levees (radial and cone beams), seams / Tectonics, concepts, dystrophic and static-type movements, orogeny, epirogeny, tafrogeny, plate tectonics, global tectonics, transformants, faults, craton shields, geosynclinals. Tectonic units, evolution of sedimentary basins.

5. GEOMORPHOLOGY

Geologic processes, relation between morphogenesis and structural conditions of a zone, relief and drainages controlled by structural conditions (folds and faults) / Structural cartography, symbology: stratums, fractures, faults, folds, igneous rocks, structural, zoning, structural planes, isocontours, isochoric curves, determination of faults, structural profile, stereographic projections, applications of structural cartography.

V. LABORATORIES AND PRACTICAL EXPERIENCES

Field visits to identify primary and non-dystrophic structures / Identification of dystrophic structures / Measurement of discontinuities / Stereographic projections and rosettes / Interpretation of stereographic projections / Description and identification of planes and profiles with structural information / Three-points problem / Formation and faults runarounding knowing one outcrop point, the course and dip on surface and in surface excavation / Determination of fault orientation knowing dislocated planes and lithology deformations / Projection of structures in tunnels and galleries / Identification of intrusive rocks.

VI. METODOLOGÍA

The course takes place in theory and practice sessions, as well as field visits. Active learning methodology is applied with intense participation of students in class. In this perspective, the student is the main protagonist of the learning process and the instructor is the facilitator. The course is based on: problem-based learning, constant feedback to students, individual and team work. At the end of the course, students should present a group work based on a field visit.

VII. FÓRMULA DE EVALUACIÓN

The Final Grade PF is calculated as follow:

PF = (EP + EF + PP) / 3

EP: Mid-term Exam EF: Final Exam
PP: Average of 5 practical works

VIII. BIBLIOGRAPHY

1. E. SHERBONHILLSS.
   Elements of Structural Geology.
2. DONALD M. P.
   Structural Geology – An Introduction to Geometrical Techniques.