NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF PETROLEUM AND PETROCHEMICAL ENGINEERING

PETROLEUM ENGINEERING PROGRAM

EC310 – MECHANICS AND STRENGTH OF MATERIALS

I. GENERAL INFORMATION

CODE	**:**	EC310 Mechanics and Strength of Materials
SEMESTER	**:**	5
CREDITS	**:**	4
HOURS PER WEEK	**:**	5 (Theory, Practice)
PREREQUISITES	**:**	PF211 Physics III, PM122 Analytic Vector Geometry
CONDITION	**:**	Elective

II. COURSE DESCRIPTION

This course provides students with basic concepts of the elastic body behavior. Concepts of stress, strain and displacement as response to several types of solicitation (isolated or combined), and the application of these provide the foundations for the development of the structure area courses. This course is made up of topics such as axial solicitation, shear stress bending, bending moment, torsional moment and responses in terms of stress and strain. In all the theory exposed, application problems are solved.

III. COURSE OUTCOMES

1. Identify the characteristics of deformable elastic bodies and interpret their properties.
2. Apply knowledge and skills in science and mathematics to solve problems.
3. Understand the behavior of an elastic body subject to external solicitations: Axial, shear, bending and torsional.
4. Understand the proper use of materials, taking into consideration their characteristics of strength and deformability.
5. Interpret the rigor and the objectivity of the theories exposed in the course and their applications.
6. Apply the knowledge given in class to the solution of related problems.

IV. LEARNING UNITS

1. AXIAL SOLICITATIONS / 18 HOURS

Elasticity / Traction and compression axial solicitations / Compression and tensile axial strain / Axial strain / Normal stress / Hooke's law / Stress-strain curve / Allowable stress / Transverse strain: Poisson's ratio / Nodes Displacement in structures / Isostatics / Stress and strain due to the own weight and to temperature variations / Stresses and strains due to inertial forces / Analysis of statically indeterminate structures subject to axial solicitation / Connections: Shear stress and shear strain unit / Stress in inclined planes.

2. STRESSES IN AN ELASTIC BODY POINT / 9 HOURS

Components of the stress in an elastic body point: / Stress tensor / Components of the strain in an elastic body point: strain tensor / Generalized Hooke's Law / The state of pure shear: Relationship between shear stress and shear strain unit / Volumetric variation: Compressibility or expansion module.

3. STRESS AND STRAIN PLANE STATE / 9 HOURS
Plane stress state / Plane strain state / Stress calculation in a point of stress or strain plane state: Main planes and stresses / Mohr's stress circle / Strain calculation in a strain plane state point: Planes of main unit strain / Mohr's circle for strains.

4. TRIAXIAL STATE OF STRESS / 6 HOURS
Stress variation in an elastic body point / Normal stress variation / Stress ellipsoid / Determination of the main stresses / Determination of the maximum and minimum shear stress planes / Strains in a elastic body point / Main unit strains.

5. TORSION / 6 HOURS
Circular shafts torsion: fundamental hypotheses / Stresses and strains / Design of circular section / Power transmission / Coupling of shafts subject to torsion by bolted flanges / Hyperstatic problems.

6. BENDING / 12 HOURS
Simple bending of prismatic bars / Fundamental hypotheses / Normal and shear stress / Stress and strain distribution in the cross section / Design and testing of beams for bending and shear.

7. STRAIN IN BEAMS / 8 HOURS
Elastic shaft equation / Angular and linear displacement of a section / Strains and displacements in isostatic beams / Double integration method.

8. REDUCED MOMENT-AREA METHOD / 8 HOURS
First and second theorem / Sign convention / Bending moment diagram by parts.

9. CONJUGATE BEAM METHOD / 8 HOURS
First and second proposition / Displacements in isostatic beams.

V. METHODOLOGY

This course is carried out in theory and practical sessions. In theory sessions, the instructor introduces concepts of the theory in the teaching-learning process, in which students participate either individually or in work groups. The instructor exposes and gives examples to complement students' activities. Classroom work is complemented with homework. The instructor provides students with theory and problem offprints.

VI. EVALUATION FORMULA

The average grade PF is calculated as follows:

$$PF = 0.25\,EP + 0.50\,EF + 0.25\,PP$$

EP: Mid-Term Exam EF: Final Exam
PP: Average of six quizzes

VII. BIBLIOGRAPHY

1. **GERE, J.M. AND TIMOSHENKO, S.P.**
   Mechanics of Materials
   Thomson Ed., 2006

2. **BEER & JOHNSTON**
   Mechanics of Materials
   Editorial McGrawHill, 2010