PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
COLLEGE OF ENGINEERING
ABET COURSE SYLABBI

ING1024 PROPERTIES AND STRENGTH OF MATERIALS

Credits and contact hours: 10 UC credits /10 hours (3 h. Lectures ; 1.5 h. Assistantship and 5.5 h. Independent learning experiences)

Instructor's name: Section 1: Magdalena Walczak/ Section 2: Claudia Stuckrath
Section 3: Ricardo Serpell

Course coordinator's name Magdalena Walczak

Textbook: "Materials science and engineering: an introduction", W. Callister, 2010 (or Spanish translation, 1997)

Course Catalog Description: In this introductory course to the science and engineering of materials, the concepts of mechanical and physical properties of materials are presented from both continuous and atomistic perspectives. The origin and variation of properties is explained in relation with microstructure for the three main classes of materials as well as combination of these.

Prerequisite Courses: FIS1513 Estática y Dinámica, QIM100A General Chemistry

Co-requisite Courses: None

Status in the Curriculum: Required

Course Learning Outcomes:

1. Apply the concepts of stress and strain to the problems of solid mechanics
2. Apply the concepts of differential equilibrium and kinematics of deformation the problems of solids mechanics
3. Apply to concepts of constitutive relation and failure criteria to the problems of solid mechanics
4. Define the principal physical and mechanical properties of metals, ceramics, polymers and composites
5. Explain the relationship between the type of chemical bond and properties of metals, ceramics and polymers
6. Explain the relationship between microstructure and properties for metals, ceramics and polymers.
7. Communicate effectively the concepts, ideas and specific information in various contexts and formats (written and orally).
8. Work and collaborate effectively in a team.

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Relation of Course to ABET Criteria:

a. Knowledge of mathematics, science and engineering
b. Design and conduct experiments: analyze and interpret data
c. Design a system, component, or process
d. Multidisciplinary teams
g. Effective communication
h. Broad education necessary for global, economic, environmental and societal context
i. Recognition of the need for, and an ability to engage in life-long learning
k. Techniques, skills, and modern tools for engineering practice.

Topics covered:

1. Introduction to the study of materials
   - Motivation and overview of the discipline
   - Definition of mechanical properties (phenomenological)
2. Introduction to the theory of elasticity
   - Analysis of stresses: the concept of tension, stress and differential equilibrium, transformation of coordinates, the state of plane stress, principal stresses and directions, Mohr's circle of stresses, internal stresses
   - Analysis of deformation: the concept of strain, transformation of coordinates, the state of plane strain, principal strains, Mohr's cirle of strain
   - Constitutive relation in solid mechanics: elastic modulus, bulk modulus, Poisson ratio, general Hooke's law, mathematical formulation of elasticity
3. Atomic structure of matter
   - Elements of microstructure
   - Atomic bonding: primary and secondary
   - Crystalline and amorphous structures (crystallographic systems, lattices of Bravais, Miller indices, BCC, FCC and HCP lattices)
   - Microstructural defects
4. Physical properties and their relationship with microstructure
   - Selected physical properties: density, porosity, coefficient of thermal expansion, specific heat capacity, thermal conductivity, melting point, electric conductivity.
5. Mechanical properties and their relationship with microstructure
   - Elasticity, anelasticity and pseudelasticity
   - Plasticity
   - Criteria of failure: Tresca, von Mises
   - Fracture and fatigue
   - Viscoelasticity
6. Classes of materials

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