PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
COLLEGE OF ENGINEERING
DEPARTMENT OF MECHANICAL AND METALLURGICAL ENGINEERING
ABET COURSE SYLLABI

ICM 2413 MECHANICAL BEHAVIOR OF MATERIALS

Credits and contact hours:	10 UC credits / 10 hours (3 hours in lectures and 7 individual work hours per week)
Instructor's name:	Jorge Ramos Grez
Course coordinator's name	To be defined
Textbook:	Courtney Thomas, Mechanical Behavior of Materials, 2° Ed, McGraw Hill, 2000
Course Catalog Description:	This course offers students a theoretical and practical foundation for understanding and estimating mechanical properties of solids. The student will be able to analyze the most frequent failures in mechanical components in service.
Prerequisite Courses:	ICM2403 Materials Science
Co-requisite Courses:	None
Status in the Curriculum:	Required
Course Learning Outcomes:	1. To recall the foundations of physical-mechanical behavior of metals, ceramics and polymers. 2. To understand and estimate the elastic, visoelastic and plastic behavior; creep, fatigue and fracture behavior of diverse engineering materials. 3. To characterize diverse engineering materials through laboratory tests: uniaxial stress-strain, hardness and impact tests and metallographic observation. 4. To analyze mechanical component failure. 5. To work in teams, to present and defend and hypothesis about a mechanical component failure, both orally and in writing, using finite element analysis and border elements.

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 e. Identify, formulate, and solve engineering problems f. Professional and ethical responsibility g. Effective communication j. Knowledge of contemporary issues k. Techniques, skills, and modern tools for engineering practice.
Topics covered:	Elasticity: stiffness of a solid related to its bonds, estimation of elastic constants. Isotropic and anisotropic linear elasticity. Generalized Hooke's law. Lamé constants. Stress tensors and deformations. Viscoelasticity: molecular model of elastomers and the effect of entropy in the stiffness of solids. Maxwell and Voigt models and their combinations. Resolution of the resulting differential equations. Obtaining the elastic modulus in function of time. Linear superposition theory. Correspondence theory. Plastic behavior: theory of dislocations, yield stress in monocrystals and polycrystals, estimation of critical resolved stress in monocrystals, plastic deformation ratio. Hollomon equation. Plastic deformation energy. High temperature behavior: creep and its relation to atomic diffusion, assisted by grain boundary and dislocations and grain boundary glide. Analytic models and power-laws. Fracture: Griffith theory, surface energy and critical crack size, fracture modes, state of strain and deformation. Plane stress and plane strain. Characteristics and morphology of brittle (linear elastic) and ductile (plastic) fracture. Irwin theory and determination of stress intensity factor. Fracture toughness of materials. Failure criteria. Fatigue: characteristics and morphology of fatigue fracture. Evaluation of fatigue resistance: local deformation criteria. Fatigue-crack growth rate, Paris Law. Cyclic stress-strain behavior. Failure analysis: procedure to analyses failure in mechanical components.

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