
Mechanical behavior of materials

Finalità

Models of the mechanical behaviour of materials will be presented and discussed, with emphasis on metals, polymers, and composites. Methodologies for the evaluation of mechanical properties will be also given.

Programma

Introduction. Dimensional scales and models of the mechanical behavior; materials for mechanical engineering; elastic and viscoplastic strain, microstructure and deformation of metals, polymers and composites.

Time-independent behavior. Anisotropic elasticity: lamination theory. Elastoplasticity (monotonic loading): tests and equipment; engineering and true stress and strain; elastoplastic material models; failure micromechanisms. Elastoplasticity (cyclic loading): tests and equipment; Bauschinger effect; hysteresis cycle and strain partitioning; cyclic stress-strain response; comportamento hardening and softening, relaxation of mean stress and ratchetting; cyclic stress-strain at notches, Neuber's rule. Fracture mechanics: crack tip stress distribution, stress intensity factor; Fracture mechanics as a design tool; plasticity effect; tests and equipment. High-cycle fatigue: basic concepts.

Time-dependent behavior. Creep and linear viscoelasticity: tests and equipment; linear and non-linear creep; creep strength and data extrapolation; models, relaxation and recovery characteristics; load sequence effect; multiaxial creep; creep deformation of structures; viscous damping and cyclic dissipation.

Attività d'esercitazione

Room exercises.

Modalità d'esame

Written and oral (not mandatory above a 18/30 grade in written examination).

Propedeuticità

Strength of materials; Machine design; Metallurgy

Testi consigliati

N.E. DOWLING: "Mechanical behaviour of materials", 2nd Ed., Prentice-Hall, 1999.

I.M. DANIEL, O. ISHAI, "Engineering mechanics of composite materials", Oxford University Press, 1994 (lamination theory only).