INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Solid Mechanics			Field of study	Solid Mechanics and Structures		
Bachelor in	Mechanical Engineering			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	2	Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9123-759-2202-00-22		

Workload (hours)	162	Contact hours	T -	TP 60	PL -	TC -	S -	E -	OT -	O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Luís Manuel Ribeiro Mesquita

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Use the equilibrium, compatibility and constitutive relations applied to engineering problems.
2. Apply various theories of elastic failure to the design components.
3. Analyse all stresses in two and three dimensional elasticity problems.
4. Analyse and interpret the elastic-plastic mechanical behaviour of solid materials due different loading conditions.
5. Analyse a wide range of problems in Solids Mechanics.
6. Understand the mechanisms involved in fracture mechanics and its importance in design of mechanical parts.
7. Design simple structural parts subjected to fatigue loads.
8. Study independently, use library resources and manage working time.

Prerequisites

Before the course unit the learner is expected to be able to:
Understand the fundamental principles of Calculus, Physics and mechanics of materials.

Course contents

Analysis of Stress and Graphical Representation.Analysis of strain and Graphical Representation. Constitute Models and Criteria Failure Material. Theory of Elasticity. Linear Elastic Fracture Mechanics. Design for Fatigue Strength.

Course contents (extended version)

1. Analysis of Stress and Graphical Representation
   - Components of Stress. Equilibrium equations. Stresses transformation.
   - Principal stresses. Maximum shear stress.
   - Mohr's circle for two dimensional stresses.
   - Principal stresses and directions in three dimensions.
2. Analysis of Deformation and Graphical Representation
   - Components of strain. Equilibrium equations.
   - Strains transformation. Principal strains and maximum shear deformation.
   - Mohr's circle for two dimensional deformations.
   - Principal strains and directions in three dimensions.
3. Constitute Models and Criteria Failure Material
   - Constitute models of isotropic material.
   - Failure by yielding: Tresca, von-Mises, Mohr and Hill theory.
   - Measurement of Strain using strain gauge rosettes.
4. Theory of Elasticity
   - General formulation of theory elasticity problems.
   - Plane strain and stress problems. Airy function and biharmonic equation. Polynomial functions.
5. Linear Elastic Fracture Mechanics
   - Development of fracture mechanics. Design for static strength.
   - Cracks. Fracture modes. Crack propagation
6. Design for Fatigue Strength
   - Fatigue: time-varying loads, definition, failure process.
   - Fatigue tests: S-N (Wöhler) curves. Fatigue strength.

Recommended reading

1. Gomes J. F. S. , Mecânica dos Sólidos e Resistência dos Materiais, Edições INEGI, 2004.
2. Ugural A. C. , Fenster S. K. , Advanced Strength and Applied Elasticity, Prentice-Hall, 2003.
3. Timoshenko, S. P. , Goodier, J. N. , Theory of Elasticity, McGrawHill, 1970.
4. C. M. Branco. Mecânica dos Materiais, 4ª Edição, Fundação Gulbenkian, Lisboa, 2006.
5. A. P. Boresi, R. J. Schmidt, O. M. Sidebottom. Advanced Mechanics of Materials, John Wiley, 1993.

Teaching and learning methods

Methodologies: theoretical lessons with different methodologies presentation. Application of theoretical concepts in practical lectures through problems resolution, given in class and homework. Resources: Software and testing with gauges rosettes.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary)
   - Practical Work - 30%
   - Final Written Exam - 70%
2. Alternative 2 - (Regular, Student Worker) (Special)
   - Final Written Exam - 100%
3. Alternative 3 - (Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100%

Language of instruction

Portuguese

Electronic validation

Luís Manuel Ribeiro Mesquita	Debora Rodrigues de Sousa Macanjo Ferreira	João da Rocha e Silva	José Carlos Rufino Amaro
22-02-2023	23-02-2023	23-02-2023	04-03-2023