Course description

1 General information

Course name	Strength of materials
Course code	M1-SM
Level of study (B.Sc, M.Sc., Ph.D.)	B.Sc
ECTS	5
Course manager	prof. dr hab. inż. Halina Egner, Institute of Applied Mechanics (M-01)
Course length	One (1) semester
Coordinator for international programs	erasmus@mech.pk.edu.pl

2 Prerequisites

- Completed courses in “Mathematics” and “General mechanics”

2 Program

Type	Lectures	Classes	Labs	Computer labs	Project	Seminar
Hours	15	15	15	-	15	-

3 Contents

Lectures		
No.		Hours
1	Introduction to engineering design: basic assumptions and design procedure; problem formulation and solution; significant digits; computational tools; system of units. Review of static equilibrium. Internal force resultants.	2
2	Internal force diagrams: internal axial forces; internal torque; shear and moment in beams; load, shear, and moment relationships; internal forces in frames and arches.	2
3	Concept of stress: normal stress in axially loaded members; bearing and shearing stresses in connections; allowable stress and factor of safety.	1
4	Strain and material properties: deformation; components of strain; stress-strain diagram; elastic versus plastic behavior; Hooke’s law; Poisson’s ratio; strain energy.	1
5	Transformation of stress and strain: plane stress; principal stresses; maximum shear stresses; Mohr’s circle for plane stress; Mohr’s circle for plane strain.	2
6	Design of statically determinate axially loaded members.	1
7	Torsion: deformation of a circular shaft; torsion formula; angle of twist; design of circular shafts.	2
8	Stresses in beams: beam deformation in pure bending; assumptions of beam theory; normal strains in beams; normal stresses in beams; shear stresses in beams; design of prismatic beams; deflection of beams (method of integration).	2
9	Energy methods.	1
10	Statically indeterminate structures.	1

Classes		
No.		Hours
1	Internal forces in bar elements.	4
2	Stresses and deformation of axially loaded members, circular shafts subjected to torsion, beams, frames.	6
3	Energy methods.	2
4	Analysis of internal forces in statically indeterminate structures.	3

Labs		
No.		Hours
1	Static tensile and compression tests of metals. Mechanical properties of metallic materials in elastic and plastic range. Determination of modulus of elasticity, Poisson's ratio, yield stress, tensile strength.	2
2	Properties of materials under dynamic loads. Deformation rate, temperature and notch influence. Determination of the dynamic load factor for impact bending.	2
3	Contact problems and hardness of materials. Contact stresses and hardness measurements of metals and non-metallic materials using various methods.	2
4	Rheological properties of polymeric materials and composites. Creep and relaxation phenomena. Basic rheological models of solids.	2
5	Electrofusion tensometry. Fundamentals of the method. Factors influencing measurement results.	2
6	Fatigue of materials. Fatigue as one of the basic modes of failure. Fatigue hypotheses. Wöhler's test. Lehr's method.	2
7	Static bending and twisting test. Experimental verification of bending theory with the use of superposition method. Determination of beam deflection. Static test of twisting bars with axisymmetric cross-section. Determination of shear modulus.	3

Project		
No.		Hours
1	Internal forces in bar elements	2
2	Design of axially loaded members (bars, trusses) and bars subjected to torsion (transmission shafts).	2
3	Design of beams.	3
4	Design of statically indeterminate structural elements.	3
5	Calculating displacements by the use of energy methods.	2
6	Design of statically indeterminate structural elements.	3

3 Learning Outcomes (skills and knowledge):

Upon successful completion of this course students should be able to:

- calculate and represent the internal force diagrams in bars and simple structures
- understand the fundamental concepts of stress and strain, and the relationship between both to solve simple problems of applied elasticity
- solve problems related to axial loading, torsion, and bending of simple structural elements
- analyze and design structural members subjected to tension, compression, torsion, bending using the fundamental concepts of stress, strain, and elastic behavior of materials.

4 Assessment policy (examination):

- Attendance and assignment (5%)
- Midterm exam (written) (35%)
- Test (written) (10%)
- Final Exam (written) (50%)

5 Literature

1. Ansel C. Ugural — Mechanics of Materials, USA, 2007, John Wiley & Sons
2. R. C. Hibbeler — Mechanics of Materials, Singapore, 2005, Pearson
3. A. Pytel, J. Kiusalaas — Mechanics of Materials, Cengage Learning, 2012
4. V. D. da Silva, — Mechanics and Strength of Materials, Springer 2010