module title: **MECHANICS OF MATERIALS & STRENGTH ANALYSIS OF CONSTRUCTION ELEMENTS**		
field of study: **Mechanical Engineering**	type of study: **full-time**	course code: **S6_2-7**
course: **Modelling & Simulation in Mechanics**	degree: **Master (MSc)**	year: **I** semester: **II**
type of classes: **lecture, classes, laboratory**	hours per week: **2L, 1C, 3Lab**	No of ECTS credits: **5**

MODULE DESCRIPTION

TARGETS

- **T1.** Provide theory of complex strength of materials.
- **T2.** Provide theory of mechanics materials .
- **T3.** To acquire capabilities to perform strength analysis of construction elements.
- **T4.** To acquire capabilities to perform laboratory test of thermomechanical properties of materials.

PREREQUISITES & ADDITIONAL REQUIREMENTS

- **R1.** Fundamentals of mechanics and strength of materials.
- **R2.** Statistics and error estimation.
- **R3.** Safety rules during the use of laboratory equipment.
- **R4.** Capability of using source literature.
- **R5.** Capability of individual work and collaboration in a group.
- **R6.** Data analysis and presentation of results.

LEARNING OUTCOMES

- **LO1.** Knowledge on complex strength of materials analysis.
- **LO2.** Knowledge on basics of mechanics of materials.
- **LO3.** Knowledge on the composition of materials structures.
- **LO4.** Knowledge on methods of determination of mechanical properties of materials.
- **LO5.** Knowledge on elastic, plastic and viscoelastic models of materials.
- **LO6.** Knowledge on models of the formation of micro-cracks fatigue.
- **LO7.** Ability to predict stress in loaded construction elements.
- **LO8.** Ability to test of materials properties.

MODULE CONTENT

LECTURE	hours
L1-4 - Internal forces, stress and strain tensor, constitutive relations	**4**
L5-8 – Tension, bending, shear and torsion	**4**
L9-12 - Strength of materials in compound stress. Strength hypotheses	**4**
L13-14 - Combined stresses	**2**
L15-16 - Deformation of beams due to bending	**2**
L17-18 - Mechanical properties of materials, material isotropy and anisotropy	**2**
L19 -20 The structure of materials, material polycrystalline	**2**
L21-24 - Thermomechanical properties, methods of determination of stress and strain	**4**
L25-27 - Linear and non-linear materials in elastic and plastic range	**3**
L28-29 – Creep - the theory of viscoelastic	**2**
L30 – Fatigue - models of the formation of micro-cracks fatigue	**1**

TUTORIALS	hours
C 1-2 - Internal forces in prismatic bars	**2**
C 3-4 – Properties of a plane area	**2**
C 5-6 – Tension, compression and bending	**2**
C 7 – Eccentric tension and compression	**1**
C 8 - Shear and torsion	**1**
C 9-10 - Combined stresses – strength hypotheses	**2**
C 11-12 - Deformation of beams. Statically indeterminate systems – 1D and 2D problem	**2**
C 13-14 - Castigliano-Menabrei energetic methods	**2**
C 15 – Buckling of beams	**1**

LABORATORY	hours
Lab 1-4 - Hardness testing, (Brinell, Poldi, Rockwell, Vickers)	**4**
Lab 5-8 - Tension test	**4**
Lab 9-10 - Compression test	**2**
Lab 11-12 – Bending test	**2**
Lab 13 – Impact test - Charpy	**1**
Lab 14-17 – Deflection test on beam	**4**
Lab 18-19 – Dilatometric test	**2**
Lab 20-23 - Measurement of stresses with bond wire strain gauges	**4**
Lab 24-25 - Photoelastic method for stress state analysis	**2**
Lab 26-28 - Determination of fatigue strength	**2**
Lab 27-33 –Numerical modelling of displacement in mechanically loaded bars	**6**
Lab 34-39 – Numerical simulations of stress and strain in element subjected to thermal load	**6**
Lab 40-45 –Numerical modelling of loaded systems in elastic – plastic range using stress-strain curves	**6**

TEACHING TOOLS

1 - lecture with the use of multimedia presentations
2 - experimental stands equipped with measuring instrumentation
3 - computer laboratory, software for FEM simulation of construction
4 - instructions to laboratory exercises

SOURCE LITERATURE

1. Blake A.: Handbook of Mechanics, Materials, and Structures, 1985
2. Silva V. D.: Mechanics and Strength of Materials, 2006
3. Ross Carl T.F., Case J., Chilver A., Strength of materials and Structures, Elsevier, 1999
4. Patnaik S., Hopkins D., Strength of Materials, A New Unified Theory for the 21 Century, Elsevier, 2004
5. Timoshenko S.: Strength of materials, part I, part II, Van Nostrand Company, Inc. 1956
6. Shigley J.: Applied Mechanics of Materials, 1976

TEACHERS

module coordinator: dr Marcin Kubiak - kubiak@imipkm.pcz.pl
academic teachers:
- dr Marcin Kubiak - kubiak@imipkm.pcz.pl
- dr Tomasz Domański - domanski@imipkm.pcz.pl