Course description

1 General information

Course name	**Introduction to engineering application of the FEM**
Course code	M1-IE
Level of study (B.Sc, M.Sc., Ph.D.)	B.Sc.
ECTS	5
Course manager	PhD, Katarzyna Tajs-Zielińska, Institute of Applied Mechanics
Course length	One (1) semester
Coordinator for international programs	erasmus@mech.pk.edu.pl

2 Prerequisites

- basics of strength of materials

2 Program

Type	Lectures	Classes	Labs	Computer labs	Project	Seminar
Hours	30	-	15	15	-	-

3 Contents

Lectures		
No.		Hours
1	Motivation to use of modern computational methods. Introduction to structural design and analysis of structures using modern software.	2
2	Introduction to Finite Element Methods: example of plane truss.	3
3	Introduction to Finite Element Methods: finite element: degrees of freedom, geometric stress-stiffness matrix, internal force matrix; structure: transformation from a local to a global coordinate system, assembling, global stiffness matrix, fundamental FEM set of equations; beam element shape function; basic concepts of plane stress and plane strain - example of triangular plane element; error estimators for discrete solutions.	20
4	General rules for FEM modeling: designer tasks - computer tasks, preprocessing - solution - postprocessing.	2
5	Engineering analysis with ANSYS software: static, stability, linear, introduction to nonlinear problems and optimal design.	3

Labs		
No.		Hours
1	Individual work - example of plane truss.	3
2	Basic introduction to Ansys Parametric Design Language (APDL).	4
3	Individual work - analysis using APDL.	4
4	Introduction to optimal design of beams nad frames.	4

Computer labs		
No.		Hours
1	Initial overview of the system ANSYS - a simple beam model.	4
2	Frames and plane stress examples - Model generation: creating solid model from the bottom up: keypoints, lines, areas, volumes; creating solid model from top down - primitives and Boolean operations; Mesh generation: element type, real constants, material properties, meshing controls; Loading: DOF constraints, concentrated loads, surface loads; Solution and postprocessing.	5
3	Introduction to eigenvalue buckling analysis.	2
4	Individual work - analysis of frames and plane structures.	2

5	Final project.	2

3 Learning Outcomes (skills and knowledge):

- understanding of basic FEM theory and ability of derivation of the FEM formulations for 1-D and 2-D problems
- ability of application of the FEM for computational modeling and simulations
- mastering of use of the FEM software ANSYS
- experience in interpretation of the results of finite element analysis
- ability of using modern analysis techniques in engineering practice

4 Assessment policy (examination):

- final test
- final individual project

5 Literature

1. https://www.colorado.edu/engineering/cas/courses.d/IFEM.d/
2. https://sites.ualberta.ca/~wmoussa/AnsysTutorial/
3. Paleti Srinivas, Sambana Krishna Chaitanya Datti Rajesh Kumar — Finite Element Analysis Using Ansys 11.0, New Delhi, India, 2010, PHI Learning Pvt. Ltd.