Faculty of Mechanical Engineering / MECHANICAL ENGINEERING / NUMERICAL METTHODS IN ENERGETICS

Course:	NUMERICAL METTHODS IN ENERGETICS			
Course ID	**Course status**	**Semester**	**ECTS credits**	**Lessons** (Lessons+Exercises+Laboratory)
12211	Mandatory	3	5	2+2+0
Programs	MECHANICAL ENGINEERING			
Prerequisites	Mathematics			
Aims	introduction to the Control Volume method for the discretization of transport equations of fluid mechanics and heat propagation.			
Learning outcomes	The student is expected to: 1. Understands the basic equations that describe transport phenomena (heat and mass transfer); 2. Distinguishes and interprets different types of partial differential equations; 3. Understands the principles of numerical methods (FDM, FEM, CVM) with which partial diff. convert equations into algebraic ones; 4. Discuss the mechanisms and methods of solving systems of algebraic equations, the problem of nonlinearity and iterative solving of systems of equations; 5. Interprets the stationary and non-stationary diffusion equation; 6. Understands and interprets the discretization of the transport equation with convection; 7. Understand and explain the discretization of the moment equation for describing the fluid flow process; 8. Understands how the SIMPLE, SIMPLER and SIMPLEC algorithms work.			
Lecturer / Teaching assistant	Prof. Dr Igor Vušanović, Mr. Boris Hrnčić			
Methodology	Lectures, exercises, work on the computer, preparation of seminar papers			
Plan and program of work				
Preparing week	Preparation and registration of the semester			
I week lectures	Basic concept of fluid flow. Conservation laws. Simplified mathematical models.			
I week exercises				
II week lectures	Mathematical classification of partial differential equations.			
II week exercises				
III week lectures	Introduction to numerical methods. Numerical grids.			
III week exercises				
IV week lectures	Methods of discretization of basic equations. FEM, FDM, CV methods.			
IV week exercises				
V week lectures	First colloquium			
V week exercises				
VI week lectures	Solving systems of algebraic equations. Direct methods. Iterative methods. Stability of the solution.			
VI week exercises				
VII week lectures	Diffusion equation. Boundary conditions. Unsteady conduction. Discretization schemes.			
VII week exercises				
VIII week lectures	Diffusion equation in cylindrical - axial coordinated. Interpolation of diffusion coefficients. Linearization of source terms. Relaxation.			
VIII week exercises				
IX week lectures	Convection. Discretization of the transport equation. Discretization schemes. False diffusion and dispersion.			
IX week exercises				
X week lectures	Second colloquium			
X week exercises				
XI week lectures	Unsteady convection. Discretization schemes. Error analysis. Higher order schemes.			
XI week exercises				
XII week lectures	Discretization of the moment equation. Collocated numerical grid and its characteristics. Solving of			

	the pressure field.
XII week exercises	
XIII week lectures	SIMPLE method. Pressure correction equation. Reference pressure and the problem of incompressibility.
XIII week exercises	
XIV week lectures	SIMPLER algorithm. SIMPLEC algorithm.
XIV week exercises	
XV week lectures	Relaxations for SIMPLE, SIMPLER and SIMPLEC algorithm.
XV week exercises	
Student workload	Per week : 3 credits x 40/30 = 4 hours Structure: 2 hours of lectures 2 hours of exercises

Per week	**Per semester**
5 credits x 40/30=6 hours and 40 minuts 2 sat(a) theoretical classes 0 sat(a) practical classes 2 excercises **2 hour(s) i 40 minuts** of independent work, including consultations	Classes and final exam: **6 hour(s) i 40 minuts x 16 =106 hour(s) i 40 minuts** Necessary preparation before the beginning of the semester (administration, registration, certification): **6 hour(s) i 40 minuts x 2 =13 hour(s) i 20 minuts** Total workload for the subject: **5 x 30=150 hour(s)** Additional work for exam preparation in the preparing exam period, including taking the remedial exam from 0 to 30 hours (remaining time from the first two items to the total load for the item) **30 hour(s) i 0 minuts** Workload structure: **106 hour(s) i 40 minuts (cources), 13 hour(s) i 20 minuts (preparation), 30 hour(s) i 0 minuts (additional work)**
Student obligations	Students are required to attend classes, perform all home works, and do all colloquiums
Consultations	every working day from 10 a.m. to 12 p.m
Literature	Literatura: [1] I. Vušanović : Numeričke metode u Energetici, Skripta, Mašinski fakultet, Podgorica, 2004. [2] S. Patankar Numerical Heat Transfer & Fluid flow, Hemisphere NY, 1980
Examination methods	Forms of knowledge testing and assessment: homework 15 points, Three colloquiums 30 points Class attendance 5 points Final exam 50 points.
Special remarks	
Comment	

Grade:	F	E	D	C	B	A
Number of points	less than 50 points	greater than or equal to 50 points and less than 60 points	greater than or equal to 60 points and less than 70 points	greater than or equal to 70 points and less than 80 points	greater than or equal to 80 points and less than 90 points	greater than or equal to 90 points