

City Center Campus	School of Industrial Engineering and Design
Program	56DD - Bachelor of Science in Industrial Design Engineering and Product Development 56IM – Bachelor of Science in Mechanical Engineering 56IE – Bachelor of Science in Electrical Engineering 56IA – Bachelor of Science in Industrial Electronics Engineering and Automation 56IQ – Bachelor of Science in Chemical Engineering

Course number and name	
Number	565005082, 565003082, 565002082, 565001082, 565004082
Name	Finite element based simulation model for fluid dynamics
Semester	S8 [(February-June)]

Credits and contact hours	
ECTS Credits	3
Contact hours	30

Coordinator's name	Doce Carrasco, Yolanda Sofia [yolandasofia.doce@upm.es]
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Specific course information	
Description of course content	

List of topics to be covered	
1. Fluid Mechanics <ul style="list-style-type: none"> 1.1. Definition and properties of fluids 1.2. Types of flow 1.3. Equations of Fluid Dynamics 1.4. Turbulence <ul style="list-style-type: none"> 1.4.1. Introduction to turbulence 1.4.2. Turbulent stresses 1.4.3. Reynolds equation 1.4.4. Problem of closing turbulent models 1.5. Method of finite volumes 2. Numerical techniques in Engineering <ul style="list-style-type: none"> 2.1. Introduction to numerical techniques 2.2. Application of the method of finite volumes to 2D and 3D geometry 2.3. From differential equations to a system of algebraic equations: Finite elements and finite volumes 	

2.4. The problem of the non-linearity of the equations 2.5. Iterative method of solving the algebraic system of equations: Convergence of the solution, numerical stability, precision and consistency of the solution 2.6. Structure of a program of finite elements and finite volumes: preprocessing, physical solution and postprocessing 2.7. Types of meshing 3. Validation of a Fluid mechanics- model simulation	
Prerequisites or co-requisites	
None.	
Course category in the program	
__ R (required)	_X_ E (elective) <i>(elective courses may not be offered every year)</i>

Specific goals for the course	
Specific outcomes of instruction	
<ul style="list-style-type: none"> • RA336/ RA315/ RA310/RA292/RA121 - Be able to communicate with English speakers • RA338/ RA312/ RA281/RA274 – Be able to solve fluid mechanics problems • RA334 – Know how to mathematically model a physics problem • RA337/ RA311/ RA313/ RA293/RA273 Understand the physical fluid mechanics problems • RA239 - Be able to plan and organize teamwork and give a short oral presentation. • RA191 - Be able to interpret the results of applying a numerical method. • RA29 – Be familiar with the basic principles of fluid mechanics • RA31 - Be able to apply the principles in practice: calculation of pipes, channels, fluid systems, etc. • RA30 – Be able synthesize and specify the fluid-related phenomena and be proficient in the laws governing fluid behaviour. 	

Bibliography and supplemental materials	
<ul style="list-style-type: none"> – "Introduction to Finite Elements in Engineering" (3rd Edition), Tirupathi R. Chandrupatla, Ashok D. Belegundu – .An Introduction to Computational Fluid Dynamics. The Finite Volume Method . H. K. Versteeg & W. Malalasekera 	

Teaching methodology			
X lectures	_X_ problem solving sessions	__ collaborative actions	_X_ laboratory sessions
Other:	Projects		