Universidad Carlos III de Madrid

COURSE: Advanced concepts in Fluid Mechanics		
DEGREE: Bachelor in Mechanical Engineering	YEAR: 4	TERM:

WEEKLY PLANNING

WEEK	SESSION	DESCRIPTION	GROUPS		SPECIAL ROOM FOR SESSION (Computer class room, audio-visual class room)	Inidicate YES/NO If the session needs 2 teachers: Maximum 4 sessions	WEEKLY PROGRAMMING FOR STUDENT		
			LECTURE	SEMINAR			DESCRIPTION	CLASS HOURS	HOMEWORK HOURS Maximum 7 H
1	1	**FLOW KINEMATICS**. Material derivative. Acceleration. Circulation and vorticity. Irrotational flow and velocity potential. Relative motion near a point. Rate-of-strain tensor. Deformation of square and cubic elements.	X			NO		1,5	4
2	2	Solution to a kinematics problem.	X			NO		1,5	
3	3	**CONSERVATION EQUATIONS IN DIFFERENTIAL FORM**. Mass conservation equation in differential form. Stream function. Stress tensor. Navier-Poisson law. Momentum equation in differential form.	X			NO		1,5	4
4	4	Perfect liquids: modified pressure and Bernoulli's equation. Example.	X			NO		1,5	
5	5	Conduction heat transfer. Fourier's law. Prandtl number. Energy equation in differential form. Kinetic and Internal energy equations. Enthalpy and entropy equations.	X			NO		1,5	5
6	6	Navier-Stokes equations. Initial and boundary conditions. Solution to problems in planar, cylindrical and spherical coordinates.	X			NO		1,5	
7	7	**UNIDIRECTIONAL FLOW**. Basic equations, initial and boundary conditions. Steady case: Couette, Hagen-Poiseuille and Poiseuille flows.	X			NO		1,5	4
8	8	Quasi-steady and transient flows. Rayleigh and Stokes problems.	X			NO		1,5	

9	9	**HYDRODYNAMIC LUBRICATION**. Introduction. Bidimensional case: order-of-magnitude analysis. The lubrication effect. Reynolds equation.	X			NO		1,5	5
10	10	Solution of hydrodynamic lubrication problems.	X			SI		1,5	
11	11	**IDEAL FLOW THEORY**. Flow at large Reynolds numbers. Euler equations. Initial and boundary conditions. Potential flow. Frictionless flow in ducts.	X			NO		1,5	5
12	12	**BOUNDARY-LAYER THEORY**. Introduction. Main features of the boundary layer. Equations and boundary conditions.	X			NO		1,5	
13	13	Skin friction. Boundary-layer thickness. Boundary-layer separation. Blasius' solution.	X			NO		1,5	5
14	14	Von Kármán integral boundary-layer equation. Von Kaŕmán-Pohlhausen technique. Examples.	X			NO		1,5	
SUBTOTAL								**21 + 24 = 45**	
15		Tutorials, Handing in, etc				NO		2	2
16-18		Assessment				NO		3	18
TOTAL								**70**	

LABORATORIES CLASSES PROGRAMMING*						
SESSION	**WEEK**	**DESCRIPTION**	**LABORATORY**	**WEEKLY PROGRAMMING FOR STUDENT**		
				DESCRIPTION	**CLASS HOURS**	**HOMEWORK HOURS Maximum 7 H**
1	7	Use of Matlab to analyse the pulsating flow in a pipe (I)	Computer room	- Careful reading of session description prior to entering the lab. - Numerical session in the lab. - Analysis of data	1,5	3,5
2	8	Use of Matlab to analyse the pulsating flow in a pipe (II)	Computer room	- Numerical session in the lab. - Analysis of data - Report writing	1,5	3,5
3	12	Use of Matlab to solve and analyse Blasius' boundary layer (I).	Computer room	- Careful reading of session description prior to entering the lab. - Numerical session in the lab. - Analysis of data	1,5	3,5
4	13	Use of Matlab to solve and analyse Blasius' boundary layer (II).	Computer room	- Numerical session in the lab. - Analysis of data - Report writing	1,5	3,5
TOTAL					**15**	

* 6 hours of complementary laboratories classes in EPS