Universidad Carlos III de Madrid

COURSE: Fluid Mechanics		
DEGREE: Bachelor in Industrial Technology Engineering	YEAR: 3/4	TERM: 2

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. Example.		X		NO		1,5	4
1	2	Relative motion near a point. Rate-of-strain tensor. Deformation of square and cubic elements. Example.	X			NO		1,5	
2	3	**CONSERVATION EQUATIONS IN DIFFERENTIAL FORM**. Summary of conservation equations in integral form. Mass conservation equation in differential form. Stream function.		X		NO		1,5	4
2	4	Stress tensor. Navier-Poisson law. Momentum equation in differential form.	X			NO		1,5	
3	5	Perfect liquids: modified pressure and Bernoulli's equation. Example.		X		NO		1,5	5
3	6	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	
4	7	Navier-Stokes equations: conservation laws,		X		NO		1,5	4

		equations of state, consitutive equations, initial and boundary conditions.							
4	8	Solution of problems in planar, cylindrical and spherical coordinates. **TAKE-HOME QUIZZ #1**.	X			NO		1,5	
5	9	**UNIDIRECTIONAL FLOW**. Basic equations, initial and boundary conditions. Two-dimensional steady case: Couette and Hagen-Poiseuille flows.		X		NO		1,5	5
5	10	Quasi-steady Couette flow. Unsteady two-dimensional flows. Impulsive flow: Rayleigh problem.	X			SI		1,5	
6	11	Pulsating flow: Stokes and Wommersley problems.		X		NO		1,5	5
6	12	Solution of unidirectional flow problems.	X			NO		1,5	
7	13	**CLASS QUIZZ #1.**		X		NO		1,5	5
7	14	**QUASI-UNIDIRECTIONAL VISCOUS-DOMINATED FLOW**. Basic equations, initial and boundary conditions. Poiseuille flow. Quasi-steady flow in slowly varying ducts.	X			NO		1,5	
8	15	Finite-length effects: entrance region. General solution of quasi-steady flow in ducts.		X		NO		1,5	5
8	16	Solution of quasi-unidirectional flow problems.	X			NO		1,5	
9	17	Solution of quasi-unidirectional flow problems. **TAKE-HOME QUIZZ #2**.		X		NO		1,5	6
9	18	**HYDRODYNAMIC LUBRICATION**. Introduction. Bidimensional case: order-of-magnitude analysis. The lubrication effect.	X			NO		1,5	
10	19	Reynolds lubrication equation.		X		NO		1,5	4
10	20	Solution of hydrodynamic lubrication problems.	X			NO		1,5	
11	21	Solution of hydrodynamic lubrication problems.		X		NO		1,5	4
11	22	**CLASS QUIZZ #2.**	X			NO		1,5	
12	23	**IDEAL FLOW THEORY**. Flow at large Reynolds numbers. Euler equations. Initial and boundary conditions. Potential flow.		X		NO		1,5	6
12	24	Frictionless flow in ducts. Solution to ideal flow problems.	X			NO		1,5	
13	25	**BOUNDARY-LAYER THEORY**. Introduction. Main features of the boundary layer. Equations and boundary conditions.		X		NO		1,5	5
13	26	Skin friction. Boundary-layer thickness. Boundary-layer separation. Blasius' solution.	X			NO		1,5	
14	27	Von Kármán integral boundary-layer equation. Von Karmán-Pohlhausen technique. Examples.		X		NO		1,5	6
14	28	Thwaites method. Thermal boundary layer. Examples. **TAKE-HOME QUIZZ #3**.	X			NO		1,5	
SUBTOTAL								**42 + 68 = 110**	
15		Tutorials, Handing in, etc				NO		2	2
16-18		Assessment				NO		3	18
TOTAL									**135**

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