



COURSE: Biomechanics of continuum media II: Fluid Mechanics		
DEGREE: Biomedical Engineering	YEAR: 2014-2015	TERM: 2

La asignatura tiene 29 sesiones que se distribuyen a lo largo de 14 semanas. Los laboratorios pueden situarse en cualquiera de ellas. Semanalmente el alumno tendrá dos sesiones, excepto en un caso que serán tres

WEEKLY PLANNING									
WEEK	SESSION	DESCRIPTION	GROUPS (mark X)		SPECIAL ROOM FOR SESSION (Computer class room, audio-visual class room)	Indicate YES/NO If the session needs 2 teachers	WEEKLY PROGRAMMING FOR STUDENT		
			LECTURES	SEMINARS			DESCRIPTION	CLASS HOURS	HOMEWORK HOURS (Max. 7h week)
1	1	Fluid mechanics: principles and applications.	X			NO		1,6	2h
1	2	Solids, liquids and gases. The continuum hypothesis. Density, velocity and internal energy. Local thermodynamic equilibrium. Equations of state.	X			NO	Review thermodynamic concepts seen in Physics II	1,6	
2	3	Uniform flow. Steady flow. Stagnation points. Trajectories. Paths. Streamlines. Substantial derivative. Acceleration. Circulation and vorticity. Irrotational flow. Velocity potential. Stream function.	X			NO	Repeat mathematical derivations at home	1,6	7h
2	4	Solution of problems of flow kinematics (I).		X		NO	Repeat/Do extra exercises at home	1,6	
3	5	Local flow deformation. Strain-rate tensor. Convective flow. Reynolds transport theorem.	X			NO	Repeat mathematical derivations at home	1,6	7h

3	6	Solution of problems of flow kinematics (II).		X		NO	Repeat/Do extra exercises at home. Homework sheet #1: kinematics and coordinate systems.	1,6	
4	7	Continuity equation in integral form. Volume and surface forces. Stress tensor. Navier-Poisson law. Forces and moments on submerged bodies. Momentum equation in integral form.	X			NO	Repeat derivations and apply them to obtain the angular momentum equation (not seen in class)	1,6	7h
4	8	Applications of the continuity and momentum equations in integral form		X		NO	Repeat/Do extra exercises at home	1,6	
5	9	Heat conduction vector. Energy equation in integral form.	X			NO	Repeat mathematical derivations at home	1,6	7h
5	10	Applications of the conservation equations in integral form		X		NO	Repeat/Do extra exercises at home	1,6	
6	11	Navier-Stokes equations. Initial and boundary conditions. Bernoulli's equation.	X			NO	Repeat mathematical derivations at home	1,6	7h
6	12	Applications of Bernoulli equation		X		NO	Repeat/Do extra exercises at home	1,6	7h
7	13	Applications of the conservation equations in differential form	X			NO	Repeat/Do extra exercises at home	1,6	
7	14	Applications of the conservation equations in differential form		X		NO	Repeat/Do extra exercises at home	1,6	7h
8	15	MIDTERM EXAM (From Kinematics to Bernoulli, no Navier-Stokes)	X			YES		1,6	3.5h
8	16	Dimensional analysis. The Pi theorem. Applications.	X			NO	Repeat derivations / exercises at home	1,6	
9	17	Applications of dimensional analysis.		X		NO	Repeat/Do extra exercises at home	1,6	7h
9	18	Nondimensionalization of the Navier-Stokes equations. Dimensionless numbers in fluid mechanics. Applications.	X			NO	Repeat derivations / exercises at home. Homework sheet #2	1,6	
10	19	LAB: Introduction to the numerical solution of the Womersley Flow		X	Computer room	NO	Repeat derivations at home	1,6	7h
10	20	Viscous flow in pipes: Poiseuille flow	X			NO	Repeat derivations at home	1,6	7h
11	21	LAB: Introduction to the numerical solution of the Womersley Flow		X	Computer room	YES	Work on the lab report	1,6	
11	22	Flows with slowly varying cross section. Unsteady effects in viscous flows: Womersley flow		X		NO	Repeat exercises at home	1,6	7h
12	23	LAB: Introduction to the numerical solution of the Womersley Flow		X	Computer room	YES	Work on the lab report	1,6	
12	24	Stokes flow around a sphere: application to cell locomotion		X		NO		1,6	7h

13	25	LAB: Introduction to the numerical solution of the Womersley Flow		X	Computer room	NO	Work on the lab report	1,6	7h
13	26	Non-newtonian fluids in biology and medicine		X		NO	Repeat/Do extra exercises at home	1,6	
14	27	Exercises		X		NO	Repeat/Do extra exercises at home	1,6	3.5h
15	28	Exercises		X		NO	Repeat/Do extra exercises at home	1,6	3.5h
	29	Exercises		X			Repeat/Do extra exercises at home	1,6	3.5h

Subtotal 1

48,33

Total 1 (Hours of class plus student homework hours between weeks 1-14)

15		Tutorials, handing in, etc		X			Additional exercises.		
16		Assessment						3	
17									
18									

Subtotal 2

3

Total 2 (Hours of class plus student homework hours between weeks 15-18)

TOTAL (Total 1 + Total 2. Maximum 180 hours)