COURSE: TRANSPORT PHENOMENA IN BIOMEDICAL ENGINEERING (15547)

DEGREE: BIOMEDICAL ENGINEERING	**YEAR: 2018/2019**	**TERM: 1st Term**

La asignatura tiene 29 sesiones que se distribuyen a lo largo de 14 semanas. Los laboratorios pueden situarse en cualquiera de ellas. Semanalmente el alumnos 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	Introduction to Transport in Biological Systems	X			NO	Introduction to Transport in Biological Systems, The Role of Transport Processes in Biological Systems, Definition of Transport Processes, Relative Importance of Convection and Diffusion. Differential equation solving	1,6	5
1	2	LAB 1 - Fluids (Stoke's law) (G48) and LAB 2- Diffusion (G49)		X	X	NO	Experimental verification of stokes law and experiments to measure diffusion of particles in media	1,6	
2	3	Frames of reference, control volume, velocity, stream lines Conservation relationships and fluid statics. Diffusion vs convection. Peclet Number.	X			NO	Fluid Kinematics, velocity fields, derivation of acceleration. Viscosity and Types of Fluids. Conservation Relations and Boundary Conditions, Fluid Statics (pg. 62-70).	1,6	5
2	4	LAB 2 - Fluids (Stoke's law) (G48) and LAB 1- Diffusion (G49)		X	X	NO	Experimental verification of stokes law and experiments to measure diffusion of particles in media	1,6	

3	5	Stress and momentum balance. Fluids, conservation of mass, conservation of momentum.	X			NO	Conservation Relations and Momentum Balances, Conservation Relations and Boundary Conditions (pg. 55-62)	1,6	5
3	6	Team Work on transport in biological systems in preparation for the Team's presentation		X	X	YES	Prepration of a Lecture (Biology, Physics, and Artificial Organs), One Problem to be solved by the class and two multiple Choice questions (to be included in the final exam)	1,6	
4	7	Surface tension and viscosity. Derivation of Young-Laplace. Laminar and turbulent flow. Pressure driven Flow	X			NO	Surface Tension, Constitutive Relations (pg. 70-79). Laminar and Turbulent Flow (pg. 82-88). Application of momentum balances(pg. 88-97)	1,6	5
4	8	Team Work on transport in biological systems in preparation for the Team's presentation		X	X	YES	Preparation of a Lecture (Biology, Physics, and Artificial Organs), One Problem to be solved by the class and two multiple Choice questions (to be included in the final exam)	1,6	
5	9	Conservation of Momentum in 3D.		X		NO	Conservation Relations for Fluid Transport, Dimensional Analysis, and Scaling (pg. 120-136)	1,6	5
5	10	Team Work on transport in biological systems in preparation for the Team's presentation		X	X	YES	Preparation of a Lecture (Biology, Physics, and Artificial Organs), One Problem to be solved by the class and two multiple Choice questions (to be included in the final exam)	1,6	
6	11	Navier Stokes Equation. Low Reynolds flow around a sphere		X		NO	Differential Form of the Conservation of Linear Momentum and the Navier–Stokes Equations in Three Dimensions (pg. 120-136). Derivation of stoke's drag force for low Reynolds flow around a sphere.	1,6	5
6	12	Team Work on transport in biological systems in preparation for the Team's presentation		X	X	YES	Preparation of a Lecture (Biology, Physics, and Artificial Organs), One Problem to be solved by the class and two multiple Choice questions (to be included in the final exam)	1,6	
7	13	Bernuilli's equation. Overview on fluids.	X			NO	Bernoulli's equation (pg. 177-187). Overview on pressure driven flow, stress, Stoke's equation for Mid Term Exam	1,6	5
7	14	MID TERM EXAM	X			YES	MID TERM EXAM	1,6	
8	15	Matlab applied to Stokes equation and to particle diffusion at different temperatures		X	X	YES	Matlab used to plot in 2D dynamically low Reynolds flow around a sphere. LAB 2 on Diffusion	1,6	5
8	16	Diffusion. Mass Transport – Solute fluxes and diffusion	X			NO	Mass Transport in Biological Systems , Conservation Relations, Constitutive Relations , Diffusion as a Random Walk (pg. 261-275). Estimation of Diffusion Coefficients in Solution (pg. 275-287)	1,6	

9	17	Matlab applied to Stokes equation and to particle diffusion at different temperatures		X	X	YES	Matlab used to plot in 2D dynamically low Reynolds flow around a sphere. LAB 2 on Diffusion	1,6	5
9	18	Matlab used for Monte Carlo simulation to study diffusion. Fick's law. Steady state and unsteady state diffusion in one dimension	X		X	NO	Matlab used for monte carlo simulations to diffusion. Derivation of Fick's law. Steady and Unsteady Diffusion in One Dimension (pg. 288-318). Unsteady Diffusion in One Dimension (pg. 300-318). Fick's Law of Diffusion and Solute Flux, Conservation of Mass for Dilute Solutions (pg. 347-355)	1,6	
10	19	TALK TEAM JOINTS. TALK TEAM CARDIO.	X		X	NO	Presentations of Teams Joints and Cardio.	1,6	5
10	20	The Langevin equation. 1D Diffusion through a multilayer	X			NO	Diffusion and Convection (pg. 370-378). Macroscopic Form of Conservation Relations for Dilute Solutions, Mass Transfer Coefficients , Mass Transfer Across Membranes: Application to Hemodialysis (pg. 378-393)	1,6	
11	21	TALK TEAM VASCULAR . TALK TEAM HEMOGLOBIN		X		NO	Presentations of teams Vascular and Hemoglobin	1,6	5
11	22	1D Diffusion through a multilayer	X			NO	Diffusion through a multilayer, solving problems.	1,6	
12	23	TALK TEAM GI, TALK TEAM GLOMERULUS.		X		NO	Presentations of teams GI and glomerulus.	1,6	5
12	24	Steady and unsteady state conduction		X		NO	Steady and Unsteady Heat Conduction (pg. 778-788)	1,6	
13	25	Convection	X			NO	Convective Heat Transfer (pg. 788-793)	1,6	5
13	26	Green's function for diffusion	X			NO	Derivation of the Green function for cw diffusion.	1,6	
14	27	Steady and unsteady state conduction. Convection		X		NO	Steady and Unsteady Heat Conduction (pg. 778-788). Convective Heat Transfer (pg. 788-793)	1,6	5
14	28	Doubts for Final exam and overview of course	X			NO	Overview of course	1,6	
							Subtotal 1	**44,8**	**70**
							Total 1 *(Hours of class plus student homework hours between weeks 1-14)*	114,8	

15		Tutorials, handing in, etc						12	
16		Assessment						4	
17									

18									
							Subtotal 2	**3**	
		Total 2 *(Hours of class plus student homework hours between weeks 15-18)*						16	

TOTAL *(Total 1 + Total 2. Maximum 180 hours)*	**130,8**