Universidad Carlos III de Madrid
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COURSE: TRANSPORT PHENOMENA IN BIOMEDICAL ENGINEERING (15547)		
DEGREE: BIOMEDICAL ENGINEERING	**YEAR: 2021/2022**	**TERM: 1st Term**

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
	2	LAB 1 - Fluids (Stoke's law) (G48) and LAB 2- Diffusion (G49)		X	LAB	YES	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
	4	LAB 2 - Fluids (Stoke's law) (G48) and LAB 1- Diffusion (G49)		X	LAB	YES	Experimental verification of stokes law and experiments to measure diffusion of particles in media	1,6	
3	5	Team Work on transport in biological systems in preparation for the Team’s presentation.	X			YES	Prepration of a Lecture (Biology, Physics, and Artificial Organs), One Problem to be solved by the class and two	1,6	5

							multiple Choice questions (to be included in the final exam)		
	6	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	
4	7	Team Work on transport in biological systems in preparation for the Team's presentation	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
	8	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	9	Team Work on transport in biological systems in preparation for the Team's presentation	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
	10	Conservation of Momentum in 3D. Navier Stokes Equation		X		NO	Conservation Relations for Fluid Transport, Dimensional Analysis, and Scaling (pg. 120-136). Differential Form of the Conservation of Momentum and Navier–Stokes in 3D (pg. 120-136).	1,6	
6	11	Team Work on transport in biological systems in preparation for the Team's presentation	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
	12	Low Reynolds flow around a sphere		X		NO	Derivation of stoke's drag force for low Reynolds flow around a sphere.	1,6	
7	13	Matlab applied to Stokes equation and to particle diffusion at different temperatures	X			YES	Matlab used to plot in 2D dynamically low Reynolds flow around a sphere. LAB 1 on Fluids	1,6	5
	14	Bernoulli's equation.		X		NO	Bernoulli's equation (pg. 177-187).	1,6	
8	15	Questions regarding Mid Term Exam. Overview of fluids. Matlab transport intro.	X			NO	Overview on pressure driven flow, stress, Stoke's equation for Mid Term Exam . Matlab used for Monte Carlo simulation to study diffusion. Diffusion as a Random Walk (pg. 261-275).	1,6	5
	16	MID TERM EXAM		X		YES	MID TERM EXAM	1,6	
9	17	Matlab used for Monte Carlo simulation to study time-dependent diffusion. Fick's law. Steady state and unsteady state diffusion in one dimension.	X			NO	Steady state and unsteady state diffusion in one dimension Mass Transport in Biological Systems . Diffusion and Convection (pg. 370-378). Conservation Relations for Dilute Solutions, Mass Transfer Coefficients , Mass	1,6	5

							Transfer Across Membranes: Application to Hemodialysis (pg. 378-393)		
	18	Fick's law, conservation relations.		X		YES	Fick's law. Conservation Relations, Constitutive Relations , Estimation of Diffusion Coefficients in Solution (pg. 275-287)	1,6	
10	19	Matlab Analysis of data from LAB 2 Diffusion.	X			YES	Analysis of data from Lab 2, Diffusion.	1,6	5
	20	The Langevin equation.		X		NO	The Langevin equation.	1,6	
11	21	1D Diffusion through a multilayer	X			NO	1D Diffusion through a multilayer	1,6	5
	22	TALK TEAM JOINTS. TALK TEAM CARDIO.		X		NO	VIDEO TEAM JOINTS. VIDEO TEAM CARDIO.	1,6	
12	23	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
	24	TALK TEAM VASCULAR . TALK TEAM HEMOGLOBIN		X		NO	VIDEO TEAM VASCULAR. VIDEO TEAM HEMOGLOBIN.	1,6	
13	25	Green´s function and heat transport	X			NO	Green´s function and heat transport	1,6	5
	26	TALK TEAM GI, TALK TEAM GLOMERULUS.		X		NO	VIDEO TEAM GI. VIDEO TEAM GLOMERULUS.	1,6	
14	27	Doubts for Final exam and overview of course	X			NO	Overview of course	1,6	5
	28	FINAL EXAM		X		YES	FINAL EXAM	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**