Universidad Carlos III de Madrid

COURSE:	HYDRAULIC MACHINES	
DEGREE: MÁSTER UNIVERSITARIO EN INGENIERÍA INDUSTRIAL PROFESSOR: CÉSAR HUETE RUIZ DE LIRA	ECTS: 3	SEMESTER: 1º

DETAIL TIME-PLANE OF THE CONTENTS

WEEK	SESSION	FULL DESCRIPTION	GROUP (NO APLICA)		SPECIAL ROOM FOR SESSION (Computer class room, audio, …)	WEEKLY PROGRAMMING FOR STUDENT		
						DESCRIPTION	CLASS HOURS	HOMEWORK 7H MAX
1	1	**1. Introduction** 1.1 Definition 1.2 Turbomachinery classification 1.3 Reference frames 2.4 Elements **2. Review of Fluid Mechanics** 2.1 Thermodynamic variables 2.2 Continuity equation 2.3 Linear momentum conservation equation. Hydrostatics. PROBLEM: TANK DISCHARGE				Introduction to hydraulic machines	1.67	2
2	2	2.4 Energy conservation equation 2.5 Application to hydraulic machines 2.6 Pressure loss in pipes PROBLEM: PUMP INSTALLED IN A SIMPLE PIPE SYSTEM FOR WATER SUPPLY				Brief review of the main concepts in fluid mechanics	1.67	3
3	3	**3. One-dimensional theory** 3.1 Goals 3.2 Velocity triangles. Flow rate. 3.3 Momentum gain and loss. Blade angles. PROBLEM FOR PELTON TURBINE				Introduction to idealized hydraulic machines	1.67	4

4	4	3.4 Euler equation. Reaction degree. 3.5 Axial machines. 3.6 Efficiency coefficients. PROBLEM FOR CENTRIPETAL PUMP				Formulation of the specific energy gain.	1.67	4
5	5	3.7 Effect of the blade angle on the reaction degree and the machine performance. PROBLEM FOR KAPLAN TURBINE PROBLEM FOR FRANCIS TURBINE				Problems	1.67	3
6	6	**4. Two-dimensional theory** 4.1 Radial Machines: Constraints for two-dimensional theory Correction relationships 4.2 Axial Machines: Airfoil lift. Radial equilibrium Airfoils array PROBLEM FOR CENTRIPETAL PUMP				Introduction of two-dimensional theory	1.67	4
		ONLINE TEST FOR TOPICS 1-4						5
7	7	**5. Real flow in turbomachines** 5.1 Three-dimensional flow contributions 5.2 Losses due to viscous effects. 5.3 Characteristic curves PROBLE FOR THE OPERATION POINT IN A PUMP COUPLED TO A SIMPLE SISTEM.				Three-dimensional theory and real flow.	1.67	4
8	8	PROBLEM FOR CORROSIVE PIPES PROBLEM FOR EVACUATION SYSTEMS				Problems	1.67	3
		MIDTERM					1.67	7

9	9	**6. Dimensional analysis** 6.1 Dimensional analysis 6.2 Operational variables for hydraulic machines 6.3 Pi Theorem 6.4 Characteristic curves. Similarity 6.5 Specific diameter and specific speed. 6.6 Cordier chart.				Dimensional analysis applied to hydraulic machines. Similarity.	1.67	3
10	10	PROBLEM FOR THE TRANSIENT BEHAVIOUR PUMP DESIGN				Problems	1.67	3
11	11	**7. Cavitation** 7.1 Description 7.2 Cavitation in pumps 7.3 Cavitation in turbines 7.4 Similarity and Thoma parameter. PROBLEM IN ASPIRATOR PUMPS PROBLEM IN TURBINES.				Cavitation. Basic introduction and application to hydraulic systems.	1.67	4
12	12	**8. Hydraulic systems** 8.1 Operational point in complex systems. 8.2 Series-parallel coupling. 8.3 Flow-rate regulation. Stability. 8.4 Pump selection				Complex systems. Operational point and stability.	1.67	4
13	13	PROBLEM IN PUMPING WITH SECURITY VALVE				Problems	1.67	3
14	14	PROBLEM IN PUMPING IN MARS PROBLEM FOR PARALLEL CONFIGURATIONS				Problems	1.67	3
		PRACTICAL PROBLEM (HOMEWORK)						7
TOTAL							25	62