Universidad Carlos III de Madrid	COURSE: Aerospace Propulsion: Complements II		
	DEGREE: Aerospace Engineering	YEAR: 4th	TERM: 2nd

WEEKLY PLANNING

SESSION	WEEK	DESCRIPTION	TYPE		COMMENTS	STUDENT WEEKLY PROGRAMME		
			LECTURE	SEMINAR		DESCRIPTION	CLASS HOURS	HOMEWORK HOURS
1	1	**Introduction to propellers** Basic concepts. Geometry of propellers. Propeller characteristics. Variable-pitch propellers. Propeller charts.	X			Read the corresponding book chapter Study and personal work	1,6	6
2	1	**Momentum Theory** Basic relations. Conclusion. Modified Momentum Theory.	X			Read the corresponding book chapter Study and personal work	1,6	
3	2	**Blade-element Momentum Theory** Blade-element Theory. The two theories combined.	X			Read the corresponding book chapter Study and personal work	1,6	6
4	2	**Exercises on propellers 1**		X		Solve the proposed exercises Study and personal work	1,6	
5	3	**Turboprops 1** Introduction to turboprop engines. Cycle analysis of free-turbine turboprop.	X			Read the corresponding book chapter Study and personal work	1,6	6
6	3	**Exercises on propellers 2**		X		Solve the proposed exercises Study and personal work	1,6	
7	4	**Turboprops 2** Performance of a turboprop.	X			Read the corresponding book chapter Study and personal work	1,6	6
8	4	**Lab Session: Experimental testing of a propeller**		X		Report the proposed lab activities Study and personal work	1,6	
9	5	**Introduction and dimensional analysis 1** Introduction to the subject. Definition of a turbomachine. Different kinds and applications. Main defining variables, dimensions and fluid properties. Units. Dimensional analysis: incompressible flow.	X			Read the corresponding book chapter Study and personal work	1,6	6

10	5	**Dimensional analysis 2** Specific Speed: machine selection. Compressible gas flow relations. Dimensional analysis: compressible flow. Exercises on dimensional analysis		X		Read the corresponding book chapter Study and personal work Solve the proposed exercises	1,6	
11	6	**Turbomachinery Basic Equations 1** Fluid mechanics and thermodynamics equations in integral and differential form. Euler equations for turbomachines. Definition of Rothalpy. Second law of thermodynamics: entropy. Definition of adiabatic / polytropic efficiency. Enthalpy-entropy diagrams.	X			Read the corresponding book chapter Study and personal work	1,6	6
12	6	**Turbomachinery Basic Equations 2** Exercises on Turbomachinery Basic Equations		X		Study and personal work Solve the proposed exercises Prepare Quiz 1	1,6	
13	7	**QUIZ 1 (Propellers + basic equations)** **Axial flow turbines: two-dimensional stage theory 1** Dimensional analysis of a single turbine stage. Thermodynamics of a turbine stage. Total-to-total stage efficiency. Row loss-stage efficiency relation.	X			Read the corresponding book chapter Study and personal work	1,6	6
14	7	**Axial flow turbines: two-dimensional stage theory 2** Velocity triangles, loading and flow parameters, reaction: Repeating stage hypothesis. Reaction. Effect on efficiency. Optimum reaction. Smith chart. Empirical versus reversible.		X		Read the corresponding book chapter Study and personal work	1,6	
15	8	**Axial flow turbines: two-dimensional stage theory 3** Estimation of turbine stage performance. Flow characteristics of a multistage turbine. Stresses in turbine rotor blades. Turbine blade cooling. Detailed design & Design criteria.	X			Read the corresponding book chapter Study and personal work	1,6	6
16	8	**Axial flow turbines: two-dimensional stage theory 4** Exercises on axial flow turbines		X		Study and personal work Solve the proposed exercises	1,6	
17	9	**Axial flow compressors and fans: 2D stage theory 1** Dimensional analysis of a single compressor stage. Thermodynamics of a compressor stage. Total-to-total stage efficiency. Row loss-stage efficiency relation. Velocity triangles, loading and flow parameters, reaction. Repeating stage hypothesis.	X			Read the corresponding book chapter Study and personal work	1,6	6

18	9	**Axial flow compressors and fans: 2D stage theory 2** Loading-Flow coefficient chart. Reaction choice. Lift and Drag in terms of ϕ and ψ. Diffusion Factor and solidity selection. Estimation of compressor pressure ratio and efficiency.		X		Read the corresponding book chapter Study and personal work	1,6	
19	10	**Axial flow compressors and fans: 2D stage theory 3** Simplify off-design performance. Compressor characteristic maps. Stall and surge phenomena.	X			Read the corresponding book chapter Study and personal work	1,6	6
20	10	**Axial flow compressors and fans: 2D stage theory 4** Exercises on Axial Flow Compressors		X		Study and personal work Solve the proposed exercises Prepare quiz 1	1,6	
21	11	**Two-Dimensional Cascades 1** Introduction. Definition of streamsurface, m'-θ plane, blade-to-blade analysis. Cascade nomenclature for compressors and turbines. Cascade kinematics: velocity triangles. Cascade dynamics: forces, momentum. Cascade entalphy and entropy change: loss definitions.	X			Read the corresponding book chapter Study and personal work	1,6	6
22	11	**Two-Dimensional Cascades 2. Compressor** Compressor cascade performance. Compressor characteristics: enthalpy rise, pressure recovery, deflection, deviation and loss. Blade loading: surface velocity distribution, diffusion factor. Compressor cascade correlations: optimum solidity, polar curve. Diffusor efficiency.	X			Read the corresponding book chapter Study and personal work	1,6	
23	12	**Two-Dimensional Cascades 3. Turbine** Turbine cascade performance. Turbine characteristics: turning angle, Zweifel coefficient. Surface velocity distribution: Back Surface Diffusion parameter. Turbine cascade correlations: loss, optimum pitch-chord ratio	X			Read the corresponding book chapter Study and personal work	1,6	6
24	12	**Two-Dimensional Cascades 4** Exercises on Two-Dimensional Cascades		X		Solve the proposed exercises Study and personal work	1,6	
25	13	**Three-dimensional flow in Axial Turbomachines 1** Theory of radial equilibrium. The indirect problem: free-vortex flow, forced-vortex flow, general whirl distribution. The direct problem.	X			Read the corresponding book chapter Study and personal work	1,6	6
26	13	**Three-dimensional flow in Axial Turbomachines 2**	X			Read the corresponding book chapter Study and personal work	1,6	

		Compressible flow through a blade-row. Constant specific mass flow. Actuator disc approach. Blade-row interactions. Computer methods solving through-flow problem.						
27	14	**Three-dimensional flow in Axial Turbomachines 3** Secondary flows. Loss, angles and helicity. Three-dimensional losses. Types and models. CFD analysis. Exercises on Three-Dimensional Flow.		X		Read the corresponding book chapter Study and personal work Solve the proposed exercises Prepare Quiz 2	1,6	6
28	14	**Lab session: Experimental testing of a compressor**		X		Report the proposed lab activities Study and personal work	1,6	
29	15	**QUIZ 2 (Turbines + Compressors + Cascades + 3D flow)**	X				1,6	
						Subtotal 1	**48,33**	**84**
						Sum *(Hours of class plus student homework hours between weeks 1-14)*	132.33	

	15	Tutorials, handing in, etc						5
	16	Assessment						
	17	Assessment					3	9
	18							
		Total *(Total 1 plus student homework hours between weeks 15-18)* 149.33				**Subtotal 2**	**3**	**14**
						Total *(Total 1 plus student homework hours between weeks 15-18)*	149.33	