Universidad Carlos III de Madrid
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COURSE: THERMAL ENGINEERING		
DEGREE: Aerospace Engineering	YEAR: 2nd	TERM: 2nd

The course has 29 sessions distributed in 14 weeks. The laboratory sessions are included in these sessions. The students have 2 sessions per week, excepting in one week in which they have 3 sessions.

WEEKLY SCHEDULE

WEEK	SESSION	CONTENTS 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 SCHEDULE FOR STUDENT		
			LECTURES	SEMINARS			DESCRIPTION	IN CLASS HOURS	HOME-WORK HOURS (Max. 7h week)
1	1	**1.- Review of thermodynamics and closed system analysis.** Definitions. First and Second Law of Thermodynamics for closed systems.		x		NO	Reading and study of First and Second Law of Thermodynamics applied to common closed Systems in Engineering. Solution of relevant examples. - In-class problem solution	1.66	4.67
2	2	**2.- Thermodynamic properties.** Evaluation of properties-I: usage of properties tables and diagrams.	x			NO	Reading and study: ideal substance models and their application to the calculation of thermodynamic properties. Solution of relevant examples.	1.66	
2	3	**Thermodynamic properties (cont.).** Evaluation of properties-II: ideal substance models.		x		NO	- In-class problem solution	1.66	5

							- Presentation of homework results - Correction of common errors		
3	4	**3.- Control Volume analysis.** Control Volume Analysis. First and Second Law of Thermodynamics applied to the analysis of steady state Systems.	x			NO	Reading and study: First and Second Law of Thermodynamics applied to common control volumes in Engineering.	1.66	
3	5	**Control Volume analysis (cont.).** Description and analysis of control volume systems: nozzles, pumps, compressors, turbines, heat exchangers and valves.	X			NO	Analysis of relevant cases of control volume Systems using different substance models.	1.66	5
3	6	**Control Volume analysis (const.).** Thermodynamic process analysis. Isentropic efficiencies of turbines, compressors, pumps, nozzles and diffusers.		X		NO	- In-class problem solution - Presentation of homework results - Correction of common errors	1.66	
4	7	**4.-Thermodynamic analysis of gas turbines.** Brayton Cycle: description and main parameters	X			NO	Reading and study: Thermodynamic analysis of gas turbine cycles (Brayton)	1.66	5
4	8	**Thermodynamic analysis of gas turbines (cont.).** Solution of Brayton cycles		X		NO	- In-class problem solution - Presentation of homework results - Correction of common errors	1.66	
5	9	**5.- Thermodynamic analysis of internal combustion engines.** Otto, Diesel and Dual cycles: description, main parameters and solution of exercises.	X			NO	Reading and study: Analysis of thermodynamic cycles for internal combustion engines. - In-class problem solution - Correction of common errors	1.66	7
5	10	**Laboratory session-1: Thermodynamic analysis of gas turbines using CyclePad**		X	Computer room	NO	- Reading of the guideline and instructions documents - Participation into the practical session and data acquisition - Results analysis and critical evaluation. - Preparation of the report	1.66	
6	11	**6.- Introduction to propulsion.** Main propulsion systems. Integral momentum equation. Thrust and specific impulse. Required energy. Propulsive efficiency.	X			NO	Reading and study: Classification of propulsion systems in aerospace engineering. Elements present in the propulsion systems. Mass and momentum conservation analysis. Propulsion performance parameters.	1.66	5

6	12	**Introduction to propulsion (cont.).** Gas turbines for aircraft propulsion: turbojet, turbofan and turboprop. Constitutive elements and thermodynamic cycles. Example cases.		X		NO	- In-class cases analysis and problem solution - Presentation of homework results - Correction of common errors	1.66	
7	13	**QUIZ-1 on Engineering Thermodynamics and Propulsion Cycles.** (The exact date of the exam will be confirmed during the course)	X			NO	- Review of theoretical and practical concepts - In-class evaluation activity	1.66	7
7	14	**7.- Introduction to Heat Transfer.** Fundamental laws. Thermal properties of matter. Differential equation of conduction.		X		NO	Reading and study: description and comparative analysis of the modes of heat transfer. - In-class problem solution - Correction of common errors	1.66	
8	15	**8.- One-dimensional steady state heat transfer.** One-dimensional conduction. Steady state conduction between flat surfaces. Steady state one-dimensional conduction in cylindrical and spherical geometries. Thermal resistances. Application of thermal resistances to one-dimensional conduction. Insulation.	X			NO	Reading and study. Deduction of the differential equation of one-dimensional conduction. Application of the differential equation of conduction to different one-dimensional problems. Understanding of the concept of thermal resistances in thermal circuits. Critical insulation radius.	1.66	5
8	16	**One-dimensional steady state heat transfer (cont.).** Conduction with heat sources. Flat plates and cylinders with generation. Solution of example cases.		X		NO	Deduction and interpretation of the temperature solution with uniform heat generation. - In-class problem solution - Presentation of homework results - Correction of common errors	1.66	
9	17	**9.- Extended surfaces.** Fins. Thermal analysis of fins. Performance parameters of fins.	X			NO	Reading and study: formulation and simplification of the fin differential equation. Fins of uniform section. Performance parameters of fins. Annular fins. Finned surfaces.	1.66	5
9	18	**Extended surfaces (cont.) .** Example problems.		X		NO	- In-class problem solution - Presentation of homework results	1.66	

							- Correction of common errors		
10	19	**10.- Transient conduction of heat.** Lumped capacity method. One-dimensional transient conduction	X			NO	Reading and study: deduction of the general equation of the lumped capacity method for transient problems. Analysis of different transient conduction problems. - In-class problem solution - Correction of common errors	1.66	7
10	20	**Laboratory session-2: Thermal analysis of two-dimensional fins using ANSYS Fluent.**		X	Computer room	NO	- Reading of the guideline and instructions documents - Participation into the practical session and data acquisition - Results analysis and critical evaluation. - Preparation of the report	1.66	
11	21	**11.- Convection heat transfer.** Dimensionless parameters. External flow convection. Internal flow convection. Analytical and empirical relationships.	X			NO	Reading and study: major parameters describing the transfer of heat by convection in both external and internal configurations	1.66	5
11	22	**Convection heat transfer (cont.).** Solution of convection heat transfer cases.		X		NO	- In-class problem solution - Presentation of homework results - Correction of common errors	1.66	
12	23	**Laboratory session-3: External forced convection over a flat plate: numerical experiments using ANSYS Fluent.**		x	Computer room	NO	- Reading of the guideline and instructions documents - Participation into the practical session and data acquisition - Results analysis and critical evaluation. - Preparation of the report	1.66	5
13	24	**12.- Heat Exchangers.** Types of heat exchangers and definitions. NTU-epsilon method.	X			NO	Reading and understanding of the thermal behaviour of heat exchangers and their different configurations.	1.66	7
13	25	**Heat Exchangers (cont.).** Analysis and design of heat exchangers.		X		NO	- In-class problem solution - Presentation of homework results - Correction of common errors	1.66	

14	26	**13.- Radiation heat transfer.** Fundamentals. Black body and grey surfaces. Thermal resistance of radiation.	X			NO	Reading and study: description and deduction of the principal parameters describing the transfer of heat by radiation.	1.66	7
14	27	**Radiation heat transfer (cont.).** Problems solution using thermal resistances. Application to relevant examples in aerospace engineering.		X		NO	Reading and study: Simplifying assumptions and methodologies aimed to solve thermal engineering problems. - In-class problem solution - Presentation of homework results - Correction of common errors	1.66	
15	28	**QUIZ-2 on Heat Transfer.** (The exact date of the exam will be confirmed during the course)	X			NO	- Review of theoretical and practical concepts - In-class evaluation activity	1.66	5
-	29	**Laboratory session-4: Thermo-hydrodynamic analysis of duct flows using ANSYS Fluent.**		x	Computer room	NO	- Reading of the guideline and instructions documents - Participation into the practical session and data acquisition - Results analysis and critical evaluation. - Preparation of the report	1.66	5
							Subtotal 1	**48.3**	**85.7**
							Total 1 *(Hours of class plus student homework hours between weeks 1-14)*	133	

15		Tutorials, handing in, etc						7	
16		Assessment						3	7
17									
18									
							Subtotal 2	**3**	**14**
							Total 2 *(Hours of class plus student homework hours between weeks 15-18)*	17	

TOTAL *(Total 1 + Total 2. Maximum 180 hours)*	**150**