Universidad Carlos III de Madrid
www.uc3m.es

COURSE: SOLAR ENERGY		
DEGREE: Energy 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	**Ch.1 Solar radiation.** The sun. The solar constant. Definitions: declination, hour, azimuth angle, altitude angle, longitude correction. Solar resource. Beam and Diffuse components.	X			NO	Reading and study Solution of relevant examples.	1.66	4.67
1	2	**Ch 1. Solar radiation (cont)** Evaluation of the incident angle, shadows,		X		NO	- In-class problem solution - Presentation of homework results - Correction of common errors	1.66	

2	3	**Ch 2. Heat Transfer Fundamentals** Natural Convection between Flat Parallel Plates and between Concentric Cylinders. Heat transfer relations for internal flow. E-NTU for Heat exchangers.	X			NO	Reading and study Solution of relevant examples.	1.66	
2	4	**Ch 2. Heat Transfer Fundamentals (cont)** Heat exchagers.		X			- In-class problem solution - Presentation of homework results - Correction of common errors	1.66	
3	5	**Ch 3 Radiation Fundamentals.** Fundamentals of radiation. The electromagnetic spectrum. The Blackbody. Plank's law and Wien's. Stefan-Boltzman equations. Radiation exchange between gray surfaces. Thermal resistance of radiation. Surface radiation measurements. Selective surfaces.	X				Reading and study Solution of relevant examples.	1.66	5
3	6	**Ch 3 Radiation Fundamentals (cont)** Emissive power, irradiation and radiosity.		X		NO	- In-class problem solution - Presentation of homework results - Correction of common errors	1.66	
4	7	**Ch 3. Radiation Fundamentals (cont)** Opaque materials: View Factors. Kirchoff's Law. Insulators. Shields. Rerradianting surfaces.	X			NO	Solution of relevant examples of radiation between surfaces using Kirchoff's Law.	1.66	5
4	8	**Ch 3. Radiation Fundamentals (cont)** Radiation exchange between surfaces.		X		NO	- In-class problem solution - Presentation of homework results - Correcting of common mistakes	1.66	
5	9	**Ch 3. Radiation Fundamentals (cont)** Transmision through glazing. Transmitance-absortance product. Snell's law.	X				Reading and study Solution of relevant examples.		
5	10	**Ch 3. Radiation Fundamentals (cont)** Absorbed radiation on a collector.		X			- In-class problem solution - Presentation of homework results - Correction of common errors		

6	11	**Ch 4. Flat-plate collectors** Description. Energy Balance. Temperature distribution. Overall Heat transfer coefficient. Collector performance.	X			NO	Reading and study: Flat plate collectors	1.66	5
6	12	**Ch 4. Flat-plate collectors** Heat removal factor, F_R and flow factors. Mean fluid and plate temperature. Effective transmitance.		X		NO	- In-class cases analysis and problem solution - Presentation of homework results - Correction of common errors	1.66	
7	13	**Ch 4. Concentrating collectors**	X			NO	Reading and study: Thermodynamic analysis of concentrating collectors.	1.66	7
7	14	**Laboratory session-1. Calculation of solar angles, local/solar time using Matlab**		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	
8	15	**Ch 5. Solar heating. Facilities** Solar heating. Facilities: Design of solar heating systems and service water systems.	X			NO	- In-class problem solution - Correction of common errors Reading and study:	1.66	7
8	16	**Laboratory session-2. Radiation on inclined surfaces using Matlab**		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	
9	17	**QUIZ-1 on Solar Energy.**	X			NO	- In-class evaluation activity	1.66	7
9	18	**Laboratory session-3. Building heating: Modelization of solar facility using Matlab**		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		
10	19	**Ch 5. Solar heating. Facilities (cont.)** Design methods. F-chart Method: Liquids and Air systems. Utilizability	X			NO	Reading and study. Understanding of the concept of thermal stratification. Deduction of the equation of temperature distribution.	1.66	
10	20	**Ch 5. Solar heating. Facilities (cont.)** F-Chart results		X		NO	- In-class problem solution - Presentation of homework results - Correction of common errors	1.66	5
11	21	**Ch. 6 Energy storage** Solar collector outputs and process loads. Energy storage. Water storage. Stratification in storage tanks. Packed bed storage. Storage walls. Phase-change storage.	X			NO	Reading and study. Understanding of the concept of thermal stratification. Deduction of the equation of temperature distribution.	1.66	
11	22	**Ch. 6 Energy storage (cont).** Solution of example cases.		X		NO	- Presentation of homework results - Correction of common mistakes	1.66	5
12	23	**Ch 7. Industrial processes** Desalinization and solar drying	X			NO	Reading and understanding of the thermal behaviour of heat exchangers and their different configurations in industrial processes.	1.66	5
12	24	**Ch 7. Industrial processes (cont)** Desalinization and solar drying		X		NO	In-class problem solution - Presentation of homework results - Correction of common errors	1.66	
13	25	**Ch 8. Photovoltaic systems.** Photovoltaic converters. Semiconductors: pn junction. Photovoltaic effect. Types of PV technology	X			NO	- Reading and study: description and deduction of the principal parameters describing the pv technique.	1.66	7

							- Reading of the guideline and instructions documents		
13	26	**Ch 8. Photovoltaic systems.**		X		NO	In-class problem solution - Presentation of homework results - Correction of common errors	1.66	
14	27	**QUIZ-2 Solar Energy**	X			NO	- In-class evaluation activity	1.66	7
14	28	**Ch 8. Photovoltaic systems (cont.).** Related equipment: batteries, inverters, charge controllers, peak-trackers.		X		NO	Reading and study: Simplifying assumptions and methodologies aimed to solve pv engineering problems. - In-class problem solution - Presentation of homework results	1.66	5
13	29	**Laboratory session-4**						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**