

Academic Year: ( 2024 / 2025 )

Review date: 12-02-2024

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: MARUGAN CRUZ, CAROLINA

Type: Electives ECTS Credits : 6.0

Year : Semester :

**REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)**

Thermal Engineering

**SKILLS AND LEARNING OUTCOMES**

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.

CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.

CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.

CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.

CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.

CG2. Learn new methods and technologies from basic scientific and technical knowledge, and being able to adapt to new situations.

CG3. Solve problems with initiative, decision making, creativity, and communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the engineering activity. Capacity for leadership, innovation and entrepreneurial spirit.

CG4. Solve mathematical, physical, chemical, biological and technological problems that may arise within the framework of the applications of quantum technologies, nanotechnology, biology, micro- and nano-electronics and photonics in various fields of engineering.

CG5. Use the theoretical and practical knowledge acquired in the definition, approach and resolution of problems in the framework of the exercise of their profession.

CG6. Develop new products and services based on the use and exploitation of new technologies related to physical engineering.

CG7. Undertake further specialized studies, both in physics and in the various branches of engineering.

CE6. Solve problems of applied thermodynamics, heat transmission and fluid mechanics in the field of engineering.

CE20. Understand and address the general problems of the field of Energy, as well as the scientific and technological foundations of its generation, conversion, transport and storage.

CT1. Work in multidisciplinary and international teams as well as organize and plan work making the right decisions based on available information, gathering and interpreting relevant data to make judgments and critical thinking within the area of study.

RA1. To have acquired sufficient knowledge and proved a sufficiently deep comprehension of the basic principles, both theoretical and practical, and methodology of the more important fields in science and technology as to be able to work successfully in them.

RA2. To be able, using arguments, strategies and procedures developed by themselves, to apply their knowledge and abilities to the successful solution of complex technological problems that require creating and innovative thinking.

RA3. To be able to search for, collect and interpret relevant information and data to back up their conclusions including, whenever needed, the consideration of any social, scientific and ethical aspects

relevant in their field of study.

RA4. To be able to successfully manage themselves in the complex situations that might arise in their academic or professional fields of study and that might require the development of novel approaches or solutions.

RA6. To be aware of their own shortcomings and formative needs in their field of specialty, and to be able to plan and organize their own training with a high degree of independence.

## OBJECTIVES

By the end of the present course the students will be able to have:

1. - A systematic understanding of the key aspects and concepts of both, solar resource and solar energy systems.
2. -A coherent knowledge of working principles of the systems capable of transforming solar energy into heat or electricity and learning of the newer storage systems and hybridization methods of solar energy with other renewable energy sources.
- 3.- The ability to apply their knowledge and understanding to identify, formulate and solve thermal engineering problems using established methods in thermodynamics and power systems.
- 4.- The ability to apply their knowledge and understanding to develop and realise designs of solar facilities, with/without storage, to produce heat or electricity and to meet specified requirements.
- 5.- The ability to conduct searches of literature, and to use weather data bases and other sources of information.
- 6.- The ability to combine theory and practice to solve energy efficiency problems in solar facilities.
- 7.- Function effectively as an individual and as a member of a team.
- 8.- Recognise the need for, and have the ability to engage in independent, life-long learning.

## DESCRIPTION OF CONTENTS: PROGRAMME

SOLAR RADIATION: Solar angles. Solar radiation. Solar resource.

SOLAR ENERGY COLLECTORS. Flat plate collector. Thermal analysis. Evacuated tube collector.

LOW TEMPERATURE SOLAR ENERGY FACILITIES. Components and f-chart method

THERMOSOLAR POWER. Concentrating collectors for heat production at HIGH temperature

PHOTOVOLTAIC ENERGY. Photovoltaic effect. Semiconductors. Solar cells. Types of PV. i-v curve.

PV APPLICATIONS:PV panels Related equipment: power trackers, inverters, batteries. Efficiency. Stand-alone/Direct-coupled/Grid connected system.

## LEARNING ACTIVITIES AND METHODOLOGY

Lectures, in which the main theory of the course is presented. To facilitate the learning of the theory, a set of class presentations and notes will be delivered to the students together with a reference list of basic text books.

- Practical seminars in class and computer room. These practical sessions will also serve to solve the main practical questions raised by the students about the main processes related to solar energy.

- Visit to a solar power plant. Invited talk of an expert in pv/csp

- All students will solve problems and/or work on projects intended to improve their knowledge and check their learning progression.

- In addition to the questions and problems solved in class, there will be tutorial sessions scheduled at the teacher's office.

## ASSESSMENT SYSTEM

**% end-of-term-examination:** 40

**% of continuous assessment (assignments, laboratory, practicals...):** 60

TVoluntary online exercises and questions: 10 %

Project: 10%

Practical laboratory work: 20% of the final mark

Two partial exams (partial examination): 60% of the final mark.

If a student fails any of the partial examination (grade <5) he/she can do that part in the final exam.

<b>% end-of-term-examination:</b>	40
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	60

Final exam at the end of the semester: 60% of the final mark.

Minimum mark to pass the course: 5/10

#### BASIC BIBLIOGRAPHY

- F.P. INCROPERA & DE WITT FUNDAMENTALS OF HEAT TRANSFER, Willey.
- John A. Duffie, William A. Beckman Solar Engineering of Thermal Processes, Wiley, 2013
- S.A. Kalogirou Solar Energy Engineering: processes and systems, Elsevier.

#### BASIC ELECTRONIC RESOURCES

- Christiana Honsberg and Stuart Bowden . Photovoltaic Education Network: <http://www.pveducation.org/>
- William B. Stine and Michael Geyer . Power from the sun: <http://www.powerfromthesun.net/book.html>