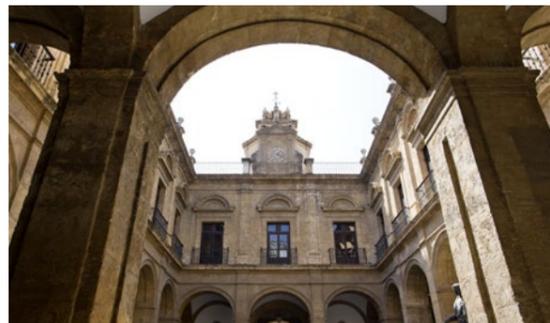


Solar Power Technologies

| SUNDAY | |
|--------------------|--|
| ARRIVAL IN SEVILLA | |
| MONDAY | |
| 8.00 - 8:30 | BREAKFAST |
| 9.30 - 10.00 | Welcome & Opening |
| 10.00 - 11.00 | Lecture 1: Fundamentals of solar radiation |
| 11.00 - 11:30 | COFFEE BREAK |
| 11.30 - 13.30 | Lecture 2: Low solar thermal systems |
| 13.30 - 15.00 | LUNCH TIME |
| 15.00 - 17.30 | Technical Visit US solar facilities: Meteorological station, Flat plate test benches, Dish Stirling, Fresnel solar field, CSPV heliostat |
| TUESDAY | |
| 8.00 - 8:30 | BREAKFAST |
| 9.30 - 11.00 | Lecture 3 - Part 1: Photovoltaic Solar Power systems: Off-grid installations |
| 11.00 - 11:30 | COFFEE BREAK |
| 11.30 - 13.30 | Lecture 3 - Part 2: Photovoltaic Solar Power systems: Grid-connected installations |
| 13.30 - 15.00 | LUNCH TIME |
| 15.00 - 18.30 | Technical Visit: PV facility: PV plant in operation |
| 20.00 - 21.00 | Night Tour of Sevilla- Unesco World Heritage City |
| WEDNESDAY | |
| 8.00 - 8:30 | BREAKFAST |
| 9.30 - 11.00 | Lecture 4 - Part 1: CSTP technologies: Key components and technology variants of solar thermal plants |
| 11.00 - 11:30 | COFFEE BREAK |
| 11.30 - 13.30 | Lecture 4 - Part 2: CSTP technologies: Thermal Energy Storage |
| 13.30 - 15.00 | LUNCH TIME |
| 15.00 - 18.30 | Technical Visit: Central receiver and/or parabolic trough solar plant in operation |
| THURSDAY | |
| 8.00 - 8:30 | BREAKFAST |
| 9.30 - 11.00 | Lecture 4 - Part 3: CSTP technologies: Introduction to the operation of CSTP plants |
| 11.00 - 11:30 | COFFEE BREAK |
| 11.30 - 13.30 | Lecture 4 - Part 4: CSTP technologies: Economics of CSTP projects |
| 13.30 - 15.00 | LUNCH TIME |
| 15.00 - 17.30 | Lecture 5: Software for Solar projects: Practical examples |
| 17.30 - 18.00 | Closing/Diploma delivery |
| 20.00 - 21.00 | Social Dinner |
| FRIDAY | |
| 7.00 - 20.00 | Technical Visit: Plataforma Solar de Almería (PSA) solar facilities |

UNIVERSITY OF SEVILLE



The University of Seville considers research to be the work of creating, developing and updating scientific, technical, artistic and cultural criteria. Research activity is carried out in the heart of the Departments, University Institutes, and Research Centres, and is supported by public and private funding. The University has a strong commitment to socio-economic development of the Seville area, and therefore carries out intense transfer of knowledge and technology to society and its economic fabric.

- ▶ Campus of International Excellence, the US reference of Research, Development and Innovation (R&D).
- ▶ More than 400 research groups, almost 4,500 researchers and close to 7,500 yearly scientific publications with international impact.
- ▶ Technology transfer; knowledge management, collaboration with the economy.
- ▶ The spirit of enterprise and professional scope, introducing you to the business world. More than 9,000 students doing internships in more than 3,500 businesses.
- ▶ The University ranks third in Spain as far as number of patents generated on a national level, and is the founder of many Technology-Based Businesses.

CONTACT US:

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OBJECTIVES

This course will allow the students to broaden their knowledge in the basics of solar energy and the key technologies for generating electricity with solar energy.

TOPICS

- ▶ Solar radiation
- ▶ Low solar thermal systems
- ▶ Photovoltaic Solar Power (PV)
- ▶ Concentrating Solar Thermal Power (CSTP) systems

EXPECTED LEARNING OUTCOMES

After completion of the course, the student should be able to:

- ▶ Understand the relevant characteristics of solar radiation for solar energy applications
- ▶ Understand the physical principles and the engineering basis for the conversion of solar radiation into electricity using different technologies
- ▶ Identify the different technology variants and components associated to PV and CSTP technologies
- ▶ Understand the economic and financial aspects of solar power projects
- ▶ Perform basic design and techno-economic analysis of PV and CSTP power plants

PROGRAMME

The growing demand for electricity, coupled with the depletion of fossil fuels and the impact of greenhouse gases have encouraged the development of cheap and reliable electric energy with renewable sources. In this respect, solar energy is probably the most promising sustainable solution that can truly meet the long-term energy expectations.

The course is meant for students/professionals of the renewable energy sector with a specific interest in solar power generation. The content of this course comprises from theoretical and technical matters to challenges and new developments in designs.

The participants will have the opportunity to know first-hand the operation of solar power plants in the five scheduled visits to a PV power plant, various CSP power plants, including a one-day visit to the Plataforma Solar de Almería (PSA) and a last generation meteorological station.

CONTENTS

- ▼ **Fundamentals of solar radiation for energy applications**
 - Measurement and modelling of solar radiation
 - Solar resource characterization
 - Solar radiation forecasting for solar power plants
- ▼ **PV and low solar thermal power systems**
 - Off-grid installations
 - Grid-connected installations
 - Economics of PV systems
 - Solar thermal systems for heating and cooling
- ▼ **CSTP technologies**
 - Key components of solar thermal plants
 - Technology variants
 - Thermal Energy Storage
 - Introduction to the operation of CSTP plants
 - Economics of CSTP projects



THE EXPERTS



Manuel A. Silva Pérez – PhD

Director of solar projects of the Research Group Thermodynamics and Renewable Energy (GTER). He has been scientific Advisor of CTAER (Advanced Technology Centre for Renewable Energy), member of the Scientific and Technical Committee of ESTELA (European Solar Thermal Electricity industry association) and author of books and scientific articles on solar energy. He has participated with different levels of responsibility in a large number of national and international R&D projects and consulting activities in collaboration with the industry leading companies and prominent R&D institutions.

Isidoro Lillo Bravo – PhD

He has been director of the Center for New Energy Technologies (CENTER 1995-2010), member of the Evaluation Committee for Research Projects CICYT (Ministry of Education and Science, 1999-2004) and evaluator of research projects at the national Energy Program. Today, he is the project director of testing equipment lines, low-temperature solar energy analysis and photovoltaic panels of the research group, through which works and runs, together with numerous companies and institutions, projects of research and technological development. He is the author of several books and articles, as well as a patent in the field of photovoltaics.



Sara Moreno Tejera – PhD

She is member of the committee for standardization of the Spanish Association for the Standardization and Certification (AENOR) since 2010. She has experience in solar radiation modeling and solar resource assessment for CSP plants in all its stages and has participated in a number of R&D projects aimed in the development of solar technologies. She has published several contributions in international scientific journals and conferences in this field.

Miguel Larrañeta Gómez-Caminero – M.Sc.

His work deals mainly with the topic of solar resource assessment for solar energy projects, where he has ample experience from his participation in R&D projects and technical assistances for commercial plants. In 2013, he won the YEAR (Young European Associated Researchers) Award. He is also a member of the expert groups of the International Energy Agency and has already published his work in international scientific journals and conferences.



Elena Pérez Aparicio -M.Sc.

She is a member of the Solar Concentra technology platform from where she promotes and develops the medium range CSP technologies for industrial processes. She has an ample experience in CSP simulation programs and has participated in many consultancy projects as well as in several R&D projects for the CSP development.