MEC7110: Solar Energy Technology

Hours per Semester				Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WEM	WCM	CU
30	15	15	45	100	60	40	3

Course Description

This course introduces students to the fundamentals of solar energy including solar resource assessment, solar photovoltaics and solar thermal energy.

Course Objectives

The objectives of this course are:

- To introduce the basic concepts of solar geometry.
- To give students experience in the design of solar energy systems both photovoltaic and thermal systems.
- To introduce concepts of economic analysis on a proposed solar system.

Learning Outcomes

At the end of this course, a student should be able to:

- Use simulation tools to calculate the energy gain of a solar thermal system
- Analyze the function and characteristics of different types of solar thermal systems
- Size solar heating systems
- Show understanding of the various methods for protecting the system from overheating damage and to be able to choose the most suitable method for a specific application
- Design collector fields

Detailed Course Content

Introduction **(2 Hours)**

- Current and future potential of Solar Energy
- Solar radiation and insolation
- Solar geometry i.e. solar angles
- Radiation on tilted surfaces

Photovoltaics **(4 Hours)**

- Working principle of solar cells
- Types of solar cells, modules and arrays; production of wafers, cells and modules.
- PV Systems Components: Panels, controllers, inverters, batteries, other appliances and balance of system.

PV system engineering **(6 Hours)**

- Sizing, installation, commissioning, maintenance, troubleshooting, possible future technologies
- Applications: Grid connected systems, Solar Home Systems,
- Communication systems, Water pumping systems
- Consumer products, rural electrification systems.

Solar Thermal (8 Hours)

- Solar thermal conversion principles
- Collector and storage energy balance
- Solar thermal collectors, Flat plate collectors, Concentrators, Evacuated tubes collectors.
- Solar Thermal Applications: Water heating, Drying, Cooking, Cooling, electricity: Solar Tower, Trough systems
- Solar thermal power systems
- Evaporative processes

Solar thermal engineering (6 Hours)

- Sizing, installation, commissioning, maintenance, troubleshooting, possible future technologies.

Life cycle and financial analysis (4 Hours)

Mode of delivery

This course will be delivered through lectures, tutorials, exercises, field visits and group projects aimed at solving real life problems.

Method of Assessment

Students will be assessed through assignments, tests, practical work and projects which make up the course work and a final exam at the end of the course as follows:

Course work	40%
Final Exam	60%
Total Mark	100%

References

[1] John A. Duffie and William A. Beckman (1991). Solar Engineering of Thermal Processes (2nd Ed). Willey-Interscience, ISBN-13: 978-0471510567

[2] Stuart R. Wenham, Martin A. Green, Muriel E. Watt and Richard Corkish (2006). Applied Photovoltaics, Centre for Photovoltaic Engineering, Australia

[3] Martin A. Green (1998). Solar Cells: Operating Principles, Technology and System Application, University of New South Wales, Kensington, Australia

[4] Jenny Nelson (2003). The Physics of Solar Cells, Imperial College Press - London, United Kingdom

[5] Tomas Markvart (1994). Solar Electricity (2nd Ed.), John Wiley & Sons, Ltd Chichester, New York, Weinheim, Brisbane, Toronto, Singapore

[6] France Lasnier and Tony Gan Ang (1990). Photovoltaic Engineering Handbook, Adam Hilger, Bristol, New York

[7] Martin A. Green (1995). Silicon Solar Cells: Advanced Principles & Practice Centre for Photovoltaic Devices and Systems University of New South Wales, Kensington, Australia