AEEE463 - Thin Solar Films

<table>
<tr><td>Course Title</td><td colspan="5">Thin Solar Films</td></tr>
<tr><td>Course Code</td><td colspan="5">AEEE463</td></tr>
<tr><td>Course Type</td><td colspan="5">Technical Elective</td></tr>
<tr><td>Level</td><td colspan="5">BSc (Level 1)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">3 or 4</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Dr Antonis Papadakis</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3</td><td>Laboratories / week</td><td></td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The aim of the course is to familiarize students with the concepts and the principles underlying the field of Solar Cell Generation, to provide students with deep knowledge of the theories and methodologies related to the properties pn junction photovoltaic generation and to enable students develop the skills required for the analysis and simulation of thin film cells.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">By the end of the course, students must be able to:
1. Explain the basic concepts of solar cell generation.
2. Define the principles of pn junction, depletion region and intrinsic electric field.
3. Explain the principles and fundamentals of photovoltaic generation.
4. Describe 3rd generation solar cells.
5. Examine the basic concepts of thin film solar cells.
6. Analyze using simulation software the effects of fundamental properties on the performance of thin film cells.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">None</td><td colspan="2">Required</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="5">• Photovoltaics Generation: Introduction to photovoltaic generation, Solar radiation, Silicon p–n junction, Photon absorption at the junction, Solar radiation absorption, Maximizing cell efficiency, Solar cell construction, Equivalent circuit of a solar cell, Types and adaptations of photovoltaics, Photovoltaic circuit properties, Applications and systems, Social and environmental aspects.
• Semiconductor Processes of Photovoltaics Technologies: Introduction to the physics of the various photovoltaic technologies: Monocrystalline Silicon, Polycrystalline Silicon, Amorphous Silicon, GaAs, CIGS, CdTe and Multijunction (Tandem) solar cells including generation, recombination, carrier lifetimes, Debye length, energy band gaps, valence,</td></tr>
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	conduction bands, Fermi-Level, p-n junction, depletion region and intrinsic electric field. • **Thin film solar cells:** Introduction and basic concepts of thin film solar cells, Photovoltaic solar energy conversion, Solar energy technologies, Electrochemical deposition of solar energy materials, CdTe solar cells, CIGS solar cells, GaAs solar cells, Effective harvesting of photons, Multi-layer graded bandgap solar cells, Solar cell behaviour in complete darkness, Effects of defects on the solar cell characteristics, and Future directions, Research and development of the above ground braking thin film photovoltaic technologies. • **Simulation of thin films:** Simulation exercises using the PC1D/WXAMPS program to reinforce an understanding of device physics and the different solar cell technologies, Mathematical models used for characterisation of solar cells, Spectral response, Temperature sensitivity, Resistive losses, Current-voltage generation, open-circuit voltages and short-circuit currents.
Teaching Methodology	Students are taught the course through lectures (3 hours per week) in classrooms or lectures theatres, by means of traditional tools or using computer demonstration. Auditory exercises, where examples regarding matter represented at the lectures, are solved and further, questions related to particular open-ended topic issues are compiled by the students and answered, during the lecture or assigned as homework. Topic notes are compiled by students, during the lecture which serve to cover the main issues under consideration and can also be downloaded from the e-learning platform or the lecturer's webpage. Students are also advised to use the subject's textbook or reference books for further reading and practice in solving related exercises. Tutorial problems are also submitted as homework and these are solved during lectures or privately during lecturer's office hours. Furthermore, design projects may be assigned to the students, where literature search is encouraged to identify a specific problem related to some issue, gather relevant scientific information about how others have addressed the problem, implement to implement the design and report the results in written or orally.
Bibliography	**Textbook** • Advances in Thin-Film Solar Cells, 1st Edition, I. M. Dharmadasa, 2012, Pan Stanford Publishing, 9814316075/9789814316071. • The Physics of Solar Cells: Perovskites, Organics, and Photovoltaic Fundamentals 1st Edition, ISBN-13: 978-1138099968, CRC Press, November 2017. • The Physics of Solar Cells, J. Nelson, 2003, Imperial College Press, 1860943497/9781860943492. **References** • Thin Film Solar Cells, K.L. Chopra, S.R. Das, 1983, Springer, 0306411415/978-0306411410. • Renewable Energy Resources, 3rd Edition, John Twidell and Tony Wier, Taylor & Francis, 2015, ISBN: 0419253300/9780419253303.

	• Fundamentals of Renewable Energy Processes, 3rd Edition, Aldo V. da Rosa, 2012, Elsevier Academic Press, 0123972191/9780123972194.
Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 40% and 60%, respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as mid-term written exam, oral exam, quizzes, design assignments, design projects and laboratory experiments. The assessment weight, date and time of each type of continuous assessment is being set at the beginning of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • Assignments 10% • Homework 10% • Mid-Term written exams 40% • Design Project 30% • Quizzes 10% Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constrains and revision timetable. The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in more complex design problems. The above criteria are weighted 30%, 40% and 30%, respectively. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	English