Subject Description Form

Subject Code	AP5021
Subject Title	Renewable Energies and Technologies II: Energy Conversion and Storage
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The objective of this course is to study the operation principles and device fabrication technologies of various types of renewable energy technology, including photovoltaics, thermoelectric and mechanoelectric conversion devices, fuel cells, energy storage devices and system engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) understand, in a broad context, the basic knowledge of energy sustainability and various kinds of energy conversion and storage processes. (b) acknowledge the principles, fabrication and performances of various types of solar cells, including Si solar cells, thin-film and tandem cells, perovskite solar cells, organic photovoltaics. (c) acknowledge solar module, solar photovoltaic system, and power conditioning and control and applications. (d) understand the basic physical/chemical principles behind various kinds of energy conversion and storage devices. (e) have a thorough understanding on the materials issues of the energy conversion and storage devices.
Subject Synopsis/ Indicative Syllabus	**Solar cell design and fabrication**: limitations on energy conversion; Si solar cell design; alternatives to silicon (GaAs, etc.); fabrication process; operation of solar photovoltaic system. **Advanced photovoltaic devices**: thin-film and tandem solar cell technologies; perovskite solar cells; organic photovoltaics. Photovoltaic modules and system: solar module and arrays; energy storage systems. **Other renewable energy technologies:** Thermoelectric conversion devices, Mechanoelectric conversion devices, Fuel cells and some other novel energy conversion devices.

<table>
<tr><td></td><td>Energy Storage and Materials: Electrochemical storage in batteries and supercapacitors.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Lecture: The working principles and materials issues of various kinds of renewable energy technology will be explained, with particular emphasis on the latest applications, including photovoltaics, thermoelectrics, mechanoelectrics, fuel cells, batteries and supercapacitors. Examples will be used to illustrate the concepts and basic physical/chemical principles related to the energy conversion and storage processes delivered in the lecture.

Tutorial: A set of problems and group discussion topics will be arranged in the tutorial classes. Students are encouraged to solve problems before seeking assistance and having solutions.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td></td></tr>
<tr><td>1. Examination</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>2. Continuous assessment</td><td>70%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
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<tr><td>Total</td><td>100%</td><td colspan="6"></td></tr>
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Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Continuous assessment: The continuous assessment includes assignments, presentations and mid-term test which aim at checking the progress of student study throughout the course, assisting them in fulfilling the learning outcomes. Assignments and presentations, in general, are used to reinforce and assess the concepts and skills acquired by the students; and to let them know the level of understanding that they are expected to reach. One mid-term test will be administered during the course of the subject as a means of timely checking of learning progress by referring to the intended learning outcomes, and as a means of checking how effective the students digest and consolidate the materials taught in the class.

Examination: This is a major assessment component of the subject. It is a closed-book examination. The emphasis of assessment is to test the understanding, analysis and problem-solving ability of the students.</td></tr>
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Student Study Effort Expected	Class contact:	
	▪ Lecture	33 Hrs.
	▪ Tutorial	6 Hrs.
	Other student study effort:	
	▪ Self-study	81 Hrs.
	▪	Hrs.
	Total student study effort	120 Hrs.
Reading List and References	P. Jayarama Reddy, "Science and Technology of Photovoltaics", 2nd Edition, CRC Press, (2010). Martin A. Green, "Third Generation Photovoltaics: Advanced Solar Energy Conversion", SpringerLink e-books, (2006). Kathy Lu, Materials in Energy Conversion, Harvesting and Storage, John Wiley & Sons, (2014). Ru-Shi Liu et al., Electrochemical Technologies for Energy Storage and Conversion, Wiley-VCH Verlag & Co. KGaA, (2012). F. Béguin and E. Frackowiak, Supercapacitors, Wiley-VCH Verlag (Form AS 140) 7.2013 3 & Co. KGaA, (2013). Robert A. Huggins, Energy Storage, Springer, (2010).	