



University of Puerto Rico  
Mayagüez Campus  
College of Engineering  
Department of Mechanical Engineering  
Bachelor of Science in Mechanical Engineering



### Course Syllabus

<b>1. General Information:</b>	
Alpha-numeric codification: INME 5007 Course Title: Solar Energy Applications Number of credits: 3 Contact Period: Three hours of lecture per week	
<b>2. Course Description:</b>	
English: Fundamentals of solar radiation, its measurement, and methods of estimation. Selected topics on heat transfer relevant to systems design applications of solar energy such as flat plate and focusing collectors, energy storage systems, heating and cooling systems, power systems, and distillation processes.	
Spanish: Fundamentos de la radiación solar, su medición y métodos de estimación. Temas seleccionados sobre transferencia de calor relevantes para aplicaciones de diseño de sistemas de energía solar, como placas planas y colectores de enfoque, sistemas de almacenamiento de energía, sistemas de calefacción y refrigeración, sistemas de potencia y procesos de destilación.	
<b>3. Pre/Co-requisites and other requirements:</b>	
Prerequisites: INME 4015 or INQU 4001 or Authorization of the Director of the Department	
<b>4. Course Objectives:</b>	
<ul style="list-style-type: none"> <li>● Explain the relationship between solar radiation, its measurement, and methods of estimation</li> <li>● Apply heat transfer equations in solar systems</li> <li>● Design an efficient system using flat plate and focusing collectors, energy storage systems, heating and cooling systems, power systems, and distillation processes.</li> </ul>	
<b>5. Instructional Strategies:</b>	
<input checked="" type="checkbox"/> conference <input type="checkbox"/> discussion <input type="checkbox"/> computation <input type="checkbox"/> laboratory  <input type="checkbox"/> seminar with formal presentation <input type="checkbox"/> seminar without formal presentation <input type="checkbox"/> workshop  <input type="checkbox"/> art workshop <input type="checkbox"/> practice <input type="checkbox"/> trip <input type="checkbox"/> thesis <input type="checkbox"/> special problems <input type="checkbox"/> tutoring  <input type="checkbox"/> research <input type="checkbox"/> other, please specify:	
<b>6. Minimum or Required Resources Available:</b>	
Computational resources available at the Mechanical Engineering Department CADLab.	
<b>7. Course time frame and thematic outline</b>	
<b>General Topics</b>	<b>Contact Hours</b>
Introduction; discuss class schedule; energy vs work; 6 forms of energy; energy; energy units; fuels for US electricity supply; conventional power plants; calculating CO <sub>2</sub> emission and energy content from fossil fuels	4

Basic electricity; conductors vs semiconductors vs insulators; Ohm's law; resistors and diodes; basic circuit concepts (series vs parallel, current, voltage and power); introduce solar cell and solar module as circuit	4
Operation of PV cells; pn junction physics; how light generates current flow; cells and modules; effect of temperature and light intensity	4
Rating cell and module performance (STC vs reality); motion of the sun; cloudiness; effect of angle, time of day, variability of sunlight; trackers; rating power vs energy	4
Solar cells: Si crystal growth, wafering, fabrication of Si solar cell; methods to make Si cheaper (mc-Si vs c-Si); advanced Si designs; Solar grade Si; Si supply limitations	4
Thin film solar cells; advantages and disadvantages vs Si; production technology; transferring lab results to manufacturing; relative costs and performance; very large scale manufacturing	4
Environmental issues (toxic mats); worldwide availability of materials for non-Si PV; energy payback times; recycling hazardous PV mats; worldwide view of applications, industry players, national status	4
Stand-alone PV systems: components; system sizing; batteries; AC vs DC efficiency; loss-of-load probability; hybrid (diesel/PV)	4
Grid tied; utility scale; distributed generation; utility experience with large scale PV in Southwest; grid support, peak power matching; electrical and architectural aspects of BIPV	4
Solar thermal-to-electric systems: parabolic trough and solar power tower collectors. Collectors, heat transfer fluid, various concentrating schemes. Stirling engine. Storage Compare to PV	5
Examinations	4
<b>Total hours: (equivalent to contact period)</b>	<b>45</b>

### 8. Grading System

Quantifiable (letters)  Not Quantifiable

### 9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2-3	50
<input checked="" type="checkbox"/> Final Exam	1	25
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	25
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
<b>TOTAL:</b>		<b>100%</b>

**10. Bibliography:****Textbook:**

Duffie, J.A. and Beckman, W.A., (2013) *Solar Engineering of Thermal Processes*, 4<sup>th</sup> ed., Wiley, New York, NY.

**11. Law 51: The Comprehensive Educational Services Act for People with Disabilities:**

States that after identifying with the instructor and the institution, the student with disabilities will receive reasonable accommodation in their courses and evaluations. For more information, contact the Department of Counseling and Psychological services at the Office of the Dean of Students (Office DE 21) or call 787-265-3864 or 787-832-4040 x 3772, 2040 and 3864.

**12. Academic Integrity**

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR Students General Bylaws (Board of Trustees Certification 13, 2009-2010) states that academic dishonesty includes, but is not limited to: fraudulent actions; obtaining grades or academic degrees by false or fraudulent simulations; copying the whole or part of the academic work of another person; plagiarizing totally or partially the work of another person; copying all or part of another person answers to the questions of an oral or written exam by taking or getting someone else to take the exam on his/her behalf; as well as enabling and facilitating another person to perform the aforementioned behavior. Any of these behaviors will be subject to disciplinary action in accordance with the disciplinary procedure laid down in the UPR Students General Bylaws.—

**13. Certification 06-43 of the Academic Senate**

"The academic guidelines for offering online courses," defines: Traditional face-to-face courses are those that have less than 25% of the course's regular contact hours via the Internet. Therefore, a three-credit course will be considered "face to face" if, of the 45 hours of regular contact, 11 or less are taught via the Internet. According to certification 06-43 of the Academic Senate, a course may include up to 25% of its total contact hours via the Internet. The objective of this is so that all professors have this alternative in the case of any unscheduled eventuality.

**14. Sexual Harassment: Certification 130-2014-2015 states:**

Sexual harassment in the workplace and in the study environment is an illegal and discriminatory act and is against the best interests of the University of Puerto Rico. All persons who understand they have been subject to acts of sexual harassment at the University of Puerto Rico may file a complaint and request that the institution investigate, where necessary, and assume the corresponding action by the university authorities. If the complainant is a student, he or she must refer his or her complaint to the Office of the Student Ombudsperson or that of the Dean of Students.

*Revised: February, 2019*