



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 4236 Course Title: Thermal Science Laboratory Number of credits: 2 Contact Period: One three-hour laboratory per week
<b>2. Course Description:</b> English: Experiments and projects in the areas of Thermodynamics, Heat Transfer and Fluid Mechanics. Transducers, sensors and data acquisition systems for the measurement temperature, flow rate and pressure in thermal systems. Spanish: Experimentos y proyectos en las áreas de Termodinámica, Transferencia de Calor y Mecánica de Fluidos. Transductores, sensores, y sistemas de adquisición de datos para la medición de temperatura, caudal y presión en sistemas térmicos.
<b>3. Pre/Co-requisites and other requirements:</b> Prerequisites: INME 4235
<b>4. Course Objectives:</b> Upon successful completion, students will be able to: <ul style="list-style-type: none"><li>• Identify, formulate, and solve experimental thermo-fluids problems by applying fundamental concepts of heat transfer, thermodynamics, and fluid mechanics and using precision measurement devices (1);</li><li>• Characterize experimentally the operation of various equipment where heat transfer and thermodynamic processes take place (6);</li><li>• Use data acquisition systems to collect experimental data and interpret experimental results.</li><li>• Use engineering skills to experimentally validate a thermo-fluid design that meet specified needs (2);</li><li>• Prepare technical reports to communicate the experimental methods, analysis and results for the experiments performed in the laboratory (3);</li><li>• Communicate via oral presentations the experimental methods, analysis and results obtained in the experiments performed in the laboratory (3);</li><li>• Describe how experimental thermofluid mechanics fits into the larger framework of professional engineering (4);</li><li>• Use project management tools such as Gantt charts, Pareto charts, critical path analysis, and action items for planning, prioritizing, and scheduling tasks in a design project work effectively. Work on project teams in both member and leader roles, with team members who may have different backgrounds and technical skill levels (5).</li></ul>
<b>5. Instructional Strategies:</b> <input checked="" type="checkbox"/> conference <input type="checkbox"/> discussion <input type="checkbox"/> computation <input checked="" type="checkbox"/> laboratory  <input type="checkbox"/> seminar with formal presentation <input type="checkbox"/> seminar without formal presentation <input type="checkbox"/> workshop

art workshop practice trip thesis special problems tutoring

research other, please specify:

**6. Minimum or Required Resources Available:**

Laboratory facilities located in L-132.

**7. Course time frame and thematic outline**

General Topics	Contact Hours
Uncertainty Analysis and Error Propagation	3
Convective Heat Transfer (Steady state and transient)	7
Renewable Energy Systems (Solar Cells, Electrolysis, Fuel Cells)	7
Vapor Compression Refrigeration Cycle	7
Heat Exchangers: Concentric tubes, Parallel plates, and Shell and tube	7
Water Tunnel: Internal and External Flow	7
Cooling Tower Performance Evaluation	5
Tests	2
<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	1-3	15-25
<input type="checkbox"/> Final Exam **		
<input checked="" type="checkbox"/> Short Quizzes	0-10	0-25
<input checked="" type="checkbox"/> Oral Reports	0-10	0-25
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	0-1	0-25
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Written Reports Attendance	3-10	0-50 0-25
<b>TOTAL:</b>		<b>100%</b>

\*All evaluation strategies will add to 100%

\*\* In design courses a capstone project may replace the final exam.

**10. Bibliography:**

**Textbook:**

Hanson, J. A. (2017). *Thermal and fluids systems reference manual for the mechanical PE exam*. Belmont, CA: Professional Publications.

A web-based laboratory manual is used.

**Other references:**

- Moran M.J., Shapiro H.N., Boettner D.D., Bailey M.B., (2014) *Fundamentals of Engineering Thermodynamics*, 8<sup>th</sup> ed., John Wiley and Sons, New York, NY.

- Cengel, Y.A and Cimbala, J.M., (2017) Fluid Mechanics: Fundamentals and Applications, 4<sup>th</sup> ed., McGraw Hill Education, New York, NY.
- Cengel, Y.A. and Ghajar, A.J., (2015) Heat and Mass Transfer: Fundamentals and Applications, 5<sup>th</sup> ed., McGraw-Hill Education, New York, NY.
- Beckwith, T.G. and Marangoni, R.D., (1990) Mechanical Measurements, 4<sup>th</sup> ed., Addison Wesley, New York, NY.
- Dally, J.W., Riely, W.F., McConnel, K.G., (1984) Engineering Measurements, Wiley, Hoboken, NJ.
- Holman, J.P., (1978) Experimental Methods for Engineers, 3<sup>rd</sup> ed., McGraw Hill, New York, NY.
- NIST E-handbook of Statistical Method  
<https://www.itl.nist.gov/div898/handbook/index.htm>

**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.