University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Mechanical Engineering
M.S./Ph.D. in Mechanical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INME 6055
Course Title: Radiation and Conduction Heat Transfer
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Discussion and use of methods for the analytical solution of heat conduction and heat radiation problems including Bessel's functions, separation of variables, superposition, and the Laplace transform. Numerical solution of combined heat conduction and radiation problems using the methods of finite difference and discrete ordinates for radiatively participating and non-participating media.

Spanish: Discusión y uso de métodos para la solución analítica de problemas de conducción de calor y radiación de calor, incluyendo las funciones de Bessel, separación de variables, superposición y transformaciones de Laplace. Solución numérica de problemas combinados de radiación y conducción de calor utilizando los métodos de diferencia finita y ordenadas discretas para medios radiativamente participantes y no participantes.

3. Pre/Co-requisites and other requirements:

Pre-requisite: Authorization of the Director of the Department

4. Course Objectives:

- Identify different scenarios of the heat conduction phenomena.
- Apply the mathematical background and techniques involved in the analysis of conduction heat transfer.
- Analyze the radiative transfer of gray and non-gray surfaces.
- Analyze the radiative transfer in participating media.
- Recognize the analysis of multimode heat transfer situations

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

None

7. Course time frame and thematic outline

General Topics	Contact Hours
Radiative properties	3
Radiation heat exchange in blackbodies and in gray bodies	8
The radiative ordinates method	4
The discrete ordinates method	7
Fourier's Law and the heat diffusion equation in rectangular, cylindrical and spherical coordinate systems	9
Steady and unsteady state condition processes in one and multi-dimensions	7
Green's functions	4
Laplace transforms applied to heat conduction problems	3
Total hours: (equivalent to contact period)	**45**

8. Grading System

☒Quantifiable (S/NS) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**1-2**	**40**
☒ **Final Exam**	**1**	**40**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☐ **Projects**		
☐ **Journals**		
☒ **Other, specify: Assignments**	**3-5**	**20**
TOTAL:		**100%**

10. Bibliography:

Textbook:

- Faghri,A., Zhang, Y., Howell, J., (2010) Advanced Heat and Mass Transfer, Global Digital Press, Seattle, WA.

Other References:

- Farmer, R.C., Pike, R.W., Cheng, G.C., Chen, Y., (2009) Computational Transport Phenomena for Engineering Analyses, CRC Press, Boca Raton, FL.
- Patankar, S.V., (1980) Numerical Heat Transfer and Fluid Flow, Taylor & Francis, Oxford, UK. (**)
- Ferziger, J. and Peric, M., (2001) Computational Methods for Dynamics, 3rd ed., Springer, New York, NY.
- Versteeg, H.K., Malalasekera, W., (2007) An Introduction to Computational fluid Dynamics: The Finite Volume Method, 2nd ed., Prentice Hall, Upper Saddle River, NJ.
- Jaluria, Y., (2002) Computational Heat Transfer, 2nd ed., Taylor & Francis, Oxford, UK.
- Hirsch, C., (2002) Numerical Computation of Internal and External Flows, Volume 1: The Fundamentals of Computational Fluid Dynamics, 2nd ed., Butterworth-Heinemann, Oxford, UK.
- Kreith, F., (2001) CRC Handbook of Thermal Engineering, CRC Press, Boca Raton, FL. (*)

* These are classical handbooks
** These books are key classic references and remain as the top books for the subjects covered in the course and there are no up-to-date textbooks to substitute these books.

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