



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 6010 Course Title: Advanced Concepts in Fluid Mechanics and Convective Heat Transfer Number of credits: 3 Contact Period: Three hours of lecture per week	
2. Course Description:	
English: Fluid properties, equations of mass, momentum and energy for viscous flows, exact solutions, low and high Reynolds number flows, velocity and thermal boundary layers, flow in tubes, approximate methods, compressible flows, momentum and energy transfer in turbulent flows.	
Spanish: Propiedades de fluido, ecuaciones de masa, momento y energía para flujos viscosos, soluciones exactas, flujos de números de Reynolds bajos y altos, capas límite de velocidad y térmicas, flujo en tubos, métodos aproximados, flujos compresibles, transferencia de momento y energía en flujos turbulentos.	
3. Pre/Co-requisites and other requirements:	
Prerequisites: Authorization of the Director of the Department.	
4. Course Objectives:	
<ul style="list-style-type: none"> • Model and solve problems in fluid flows and convection heat transfer in internal and external flows analytically, semi- analytically and/or numerically. 	
5. Instructional Strategies:	
<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:	
6. Minimum or Required Resources Available:	
None.	
7. Course time frame and thematic outline	
General Topics	Contact Hours
Fluid properties, kinematics of fluids flows, vorticity, dimensional analysis and Pi theorem, dynamic similarity	4
Integral and differential formulations of conservation of mass momentum and energy for viscous flows, boundary conditions, diffusion of vorticity	5

Some exact solutions in two and three dimensional flows, Couette flow, Hagen Poiseuille flow, concentric rotating cylinders, stagnation flow, etc.	5
Flows at very low Reynolds numbers, Stokes flow, high Reynolds number flows, velocity and thermal boundary layers in forced and free convection, Blasius solution, momentum and heat transfer for laminar flow in tubes, Reynolds analogy.	7
Approximate methods, Karman Pohlhausen techniques for velocity and 6 thermal boundary layers, laminar separation and boundary layer suction.	6
Hydrodynamic stability. Introduction to turbulent flows, apparent stresses, eddy diffusivity and viscosity, mixing length theory, turbulent flow in pipes and channels.	4
Introduction to second order boundary layer theory.	4
Fundamentals of turbulence, turbulent events and coherent structures.	7
Examinations	3
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	1-2	40
<input checked="" type="checkbox"/> Final Exam	1	40
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	20
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

- Schlichting, H. and Gersten, K., (2003) Boundary Layer Theory, 8th ed., Springer-Verlag, Berlin, Germany. (**)
- White, F.M., (2011) Viscous Fluid Flow, McGraw Hill, New York, NY.
- Tennekes, H. and Lumley, J.L., (1972) A first course in turbulence, The MIT Press, Cambridge, MA. (**)
- Kays, W.M. and Crawford, M.E., (1993) Convective Heat and Mass Transfer, 3rd ed., McGraw Hill, New York, NY. (**)
- Panton, R.L., (2005) Incompressible Flow, 3rd ed., Wiley, Hoboken, NJ. (**)

** 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