Syllabus for ME190-02: Special Topics in ME: Air Breathing Engines

Fall 2015
Instructor: Venkattraman Ayyaswamy

Designation:	Assistant Professor
Catalog Description:	This course will introduce students to the fundamentals of air breathing engines that are an important building block in aircraft propulsion. Starting with the basics of compressible fluid mechanics, the course will discuss the components of a typical engine that is installed on commercial aircraft.
Text Books and Other Required Materials:	No required textbook
Course Objectives/ Student Learning Outcomes:	On successful completion of the course, the students will (i) develop the ability to solve problems involving compressible fluid flows including supersonic flows involving shocks and expansion fans (ii) understand the operation of a basic gas turbine engine (iii) perform cycle analysis and determine performance of propulsion systems including turbojet, turbofan and turboprop configurations. (iv) familiarize themselves with other engine configurations on aircraft including an understanding of the Otto cycle, two-stroke and four-stroke engines.
Program Learning Outcomes:	
Prerequisites by Topic:	
Course Policies:	
Academic Dishonesty Statement:	a. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work. b. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e mail, an e mail attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action. c. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.
Disability Statement:	

	Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.
Topics:	Introduction: A general introduction to air breathing engines with some historical perspective Compressible Flows: Review of thermodynamics; conservation equations (mass, momentum and energy) in integral and engineering forms; Mach number and stagnation state; quasi one-dimensional flow; area-Mach relationship; sonic throat; normal and oblique shocks; expansion fans; Frictionless constant-area duct flows with heat transfer (Rayleigh flow); Adiabatic constant-area duct flow with friction (Fanno flow) Engine Thrust and Performance Parameters: Thrust equation; air breathing engine performance parameters (specific thrust, specific fuel consumption and specific impulse; thermal and propulsive efficiency; engine overall efficiency and some implications on aircraft performance); discussion on engine cut-away figures Gas turbine engine cycle analysis: Gas generator; Component-wise analysis for turbojet engine (inlet, compressor, combustion chamber, turbine, nozzle) and thermal, propulsive efficiency along with performance evaluation; turbojet with after-burner; component-wise analysis for turbofan engine and concept of bypass flow and core flow; component-wise analysis of turboprop; propeller theory (momentum theory and blade element theory). Other engine configurations: Discussion on Otto cycle; four-stroke cycle engines, diesel engines; two-stroke cycle engines; rotary engines and their performance; reciprocating engine on aircraft; electric propulsion concepts.
Class/laboratory Schedule:	TR 4:30 - 5:45 pm
Midterm/Final Exam Schedule:	TBA
Course Calendar:	
Professional Component:	
Assessment/Grading Policy:	Homework: 30% First Mid-term Exam: 20% Course Project/Second Mid-term Exam: 20% Final Exam: 30%
Coordinator:	Venkattraman Ayyaswamy
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Office Hours:	TR 3:30 - 4:30 pm