ME 483: Applied Rocket Design

Course description:	Designing, building, and testing rocket systems.
Number of credits:	3 (1-6)
Course Coordinator:	J. Leachman
Prerequisites by course:	Certification in major.
Textbooks/other materials:	1. G.P. Sutton and O. Biblarz, *Rocket Propulsion Elements*, Wiley, 2010, 8/e. 2. J. Longuski, *Advice to Rocket Scientists: A Career Survival Guide for Scientists and Engineers*, AIAA, 2004.
Course objectives:	Learn how to design, build, and test rocket systems.
Topics covered:	1. Introduction: History and Dichotomy of rocket design 2. Rocket Equation 3. Engine Design 4. Structure and Tankage System Design 5. Auxiliary Systems & Mission Control (AMC) 6. System Integration (SI) 7. Reliability & Safety 8. System Testing
Expected student outcomes:	a. Increased understanding of rocket history and design b. Increased understanding and ability to apply the rocket equation c. Increased understanding of component design d. Increased understanding of safe practices in regards to system testing
Class schedule:	Three 50-minute lecture session per week, for one semester. Labs as needed.
Contribution to meeting the professional component:	Engineering Topics
Relationship of course to program objectives:	Meets: 1. School of MME ME educational objectives: 1, 2, 3 2. School of MME ME program outcomes: (b), (c), (d), (e), (g), (i), (k)
Prepared by:	J. Leachman *Date:* July 31, 2014

Disability Statement: Reasonable accommodations are available for students with a documented disability. If you have a disability and may need accommodations to fully participate in this class, please visit the Disability Resource Center (DRC). All accommodations MUST be approved through the DRC (Washington Building, Room 217). Please stop by or call 509-335-3417 to make an appointment with a disability specialist.

Campus Safety Plan: http://safetyplan.wsu.edu/
University Emergency Management: http://oem.wsu.edu/
WSU Alert Site: http://alert.wsu.edu/

Specifics for Spring 2015

MEETING TIME AND LOCATION: Lecture: M,W,F 2:10-3 pm, MURE 307

INSTRUCTOR: Dr. Jacob Leachman, Office: Sloan 217, Phone: 335-7711, e-mail: jacob.leachman@wsu.edu

TEACHING ASSISTANT(s): Brandt Pedrow, Office: ETRL 221, Phone: 335-5979, e-mail: brandt.pedrow@gmail.com

GRADING: Teams of ~15 students will be formed to work on independent rockets. Each team will be divided further into

sub-teams that are assigned specific sub-components of their rocket that they will present as a design review to the class. Cumulative design reviews are graded at the full team level by external judges/alumni/professionals along with peers/instructor. A standard grade distribution will be applied.

Sub-team Design Reviews (10 % each, 50/50 instructor/peers)	40 %
Cumulative Design Reviews (10 % each, 50/50 instructor/peers)	40 %
Additional homework and attendance	20 %

SCHEDULE: (Subject to change throughout the course)

Day		**Lecture Topic**	**Readings**
Jan 12	**Propulsion Basics**	1. Front matter: Course organization, team assignment, philosophy	
Jan 14		2. Rocket Design: Types and major components	1.1-2
Jan 16		3. Rocket Design: History and applications	1.3
Jan 19		Martin Luther King Jr Day--ALL UNIVERSITY HOLIDAY	
Jan 21		4. Rocket Equation: Impulse, thrust, & exhaust velocity	2.1-3
Jan 23		5. Rocket Equation: energy & efficiencies	2.4-6
Jan 26		6. Nozzle Design: Thermodynamic relations and the ideal rocket nozzle	3.1-3
Jan 28		7. Nozzle Design: Real nozzles and configurations	3.4-6
Jan 30		8. Nozzle Design: Case condition analysis & review	5.1-5
Feb 2	**Engine Design**	9. Fluid Propellant Fundamentals	6.1-10
Feb 4		10. Solid Propellant Fundamentals	12.1-5
Feb 6		11. Hybrid Propellant Fundamentals	16.1-16.5
Feb 9		12. Fluid Propellant Selection	7.1-7
Feb 11		13. Solid Propellant Selection	13.1-7
Feb 13		14. Hybrid Propellant Selection	(TBD)
Feb 16		President's Day—CLASS HOLIDAY	
Feb 18		15. Fluid propellant thrust chamber design	8.1-8
Feb 20		16. Solid propellant motor casing & design	15.1-4
Feb 23		17. Hybrid propellant motor/engine design	(TBD)
Feb 25		18. Fluid turbopump design	10.1-8
Feb 27		19. Propellant combustion and stability (Solid team)	9.1-3, 14.1-4
Mar 2		20. Engine system control & integration (Hybrid team)	11.1-6
Mar 4		21. Selection of rocket propulsion systems (Leachman)	19.1-3
Mar 6		22. Fluid engine design review	
Mar 9		23. Solid motor design review	
Mar 11		24. Hybrid motor design review	
Mar 13		25. (Open)	
Mar16-20		**Spring Break**	
Mar 23	**Auxiliary Systems**	26. Flight vehicles (Leachman)	
Mar 25		27. Safety and testing plans/procedures (Fluid team)	
Mar 27		28. Emergency and recovery systems (Solid team)	
Mar 30		29. Auxiliary structures (Hybrid team)	
Apr 1		30. Recovery and Avionics (Fluid team)	
Apr 3		31. Aerodynamics and internal fuselage design (Solid team)	
Apr 6		32. Recovery and Electronics (Hybrid team)	
Apr 8		33. Testing and System metrics update (Fluid team)	
Apr 9		34. Testing and System metrics update (Solid team)	
Apr 13		35. Testing and System metrics update (Hybrid)	
Apr 15		36. 15 minute pitches, Fluid, Solid, Hybrid	
Apr 17		37. (Traveling)	
Apr 20	**Mission Prep**	38. Testing plan and review (Fluids)	
Apr 22		39. Mission plan and Safety (Solid)	
Apr 24		40. Testing review (Hybrid)	
Apr 27		41. Final Fluid Design Presentation	
Apr 29		42. Final Solid Design Presentation	
May 1		43. Final Hybrid Design Presentation	