AUBURN UNIVERSITY
SAMUEL GINN
COLLEGE OF ENGINEERING
AEROSPACE

Special Topics: Rocket Propulsion I

AERO 4970/7970 **Course Outline** **Semester 2014**

Lecturer: Joseph C. (Joe) Majdalani, Ph.D.
Lecture Location: TBD
Lecture Times: TBD
Office Hours: TBD

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Grader: TBD
Textbook: Notes

Textbook: Sutton, George P. and Biblarz, Oscar, *Rocket Propulsion Elements*, 7th or 8th ed., Wiley, New York, 2001. ISBN 0471326429.

References:

1. Zucrow, M. J., *Aircraft and Missile Propulsion*, Wiley, New York, 1958.
2. Bowman, N. J., *The Handbook of Rockets and Guided Missiles*, 1st ed., Perastadion Press, Chicago, 1957.
3. Breuer, W. B., *Race to the Moon : America's Duel with the Soviets*, Praeger, Westport, Conneticut, 1993.
4. Feodosiev, V. I., and Siniarev, G. I. B., *Introduction to Rocket Technology*, Academic Press, New York, 1959.
5. Frank, R. G., and Zimmerman, W. F., *Materials for Rockets and Missiles*, MacMillan, New York, 1959.
6. Kit, B., and Evered, D. S., *Rocket Propellant Handbook*, MacMillan, New York, 1960.
7. Kolk, W. R., *Modern Flight Dynamics, Prentice-Hall Space Technology Series.*, Prentice-Hall, Englewood Cliffs, N.J., 1961.
8. Ley, W., *Rockets, Missiles, and Space Travel*, Viking Press, New York, 1958.
9. Neufeld, M. J., *The Rocket and the Reich : Peenemünde and the Coming of the Ballistic Missile Era*, Free Press, New York, 1995.
10. Nikolaev, B. A., *Thermodynamic Assessment of Rocket Engines*, Pergamon Press, Oxford, New York, 1963.
11. Roy, G. D., *Advances in Chemical Propulsion : Science to Technology, Environmental and Energy Engineering Series*, CRC Press, Boca Raton, FL, 2002.
12. Wilkins, R. L., *Theoretical Evaluation of Chemical Propellants, Prentice-Hall International Series in Space Technology*, Prentice-Hall, Englewood Cliffs, N. J., 1963.
13. Williamson, M., *Dictionary of Space Technology*, A. Hilger, Bristol, England, 1990.

14. Wulforst, H., *The Rocketmakers*, 1st ed., Orion Books, New York, 1990.

Objectives: Analysis of propulsion systems using chemical rocket engines. Liquid and solid chemical rocket engines, nozzle theory, component analysis, and flight performance.

Grading and Exams:		
	Homework and Design Problems	30%
	Two 1-hour examinations	30%
	One 2-hour final examination	30%
	Attendance and class demeanor	10%
	Total	100%

A higher score on the final exam replaces one of the two 1-hour exams.

Contributions to the Professional Component:

Engineering Science: 85%. Engineering Design: 15%.

Relationship of Course to Mechanical Engineering Program Objectives:

This course aims at the partial fulfillment of the following Program Objectives:

1. Develop the creative and critical thinking skills essential in identifying, structuring, and solving complex problems.
2. Firmly ground students in the fundamentals of mathematics, the basic sciences, and the engineering sciences necessary to pursue a successful career in mechanical engineering.
3. Develop graduates who can communicate effectively in written and graphical forms.
4. Provide open-ended challenges for the design of mechanical and thermal systems.
5. Instill an attitude that learning is a lifelong process.

Relationship of Course to ABET Criteria:

a) Ability to apply knowledge of mathematics, science, and engineering.
e) Ability to identify, formulate and solve engineering problems.
i) Recognition of the need for, and an ability to engage in life-long learning.

Catalog Data: Rocket propulsion fundamentals; thermodynamics of non-reacting and chemically reacting ideal gases, rocket nozzle design; ideal rocket performance parameters; rocket heat transfer; chemistry of propellants; liquid rocket engine systems; ground testing; introduction to solid propellant rockets.

AERO 4970/7970 Special Topics: Rocket Propulsion I (Tentative)

Lecture		Date	Topics		Text
1	August	18	Introduction	*Week 1*	
2		23	Classification	*Week 2*	1.1–1.3
3		25	Classification		1.1–1.3
4	August	30	Definitions & Fundamentals	*Week 3*	2.1–2.5
5	September	1	Nozzle Theory		3.1–3.2
	September	6	NO CLASS–Labor Day Holiday	*Week 4*	
6		8	Thrust Coefficient		3.4
7		13	Back Pressure	*Week 5*	3.5
8		15	Variable Area Nozzles		3.6–3.9
9		20	Heat Transfer	*Week 6*	4.1–4.3
10		22	Steady-state Heat Transfer		4.4–4.5
11		27	Flight Performance	*Week 7*	5.1–5.3
12		29	Multiple-stage Vehicles		5.4
13	October	4	EXAM I	*Week 8*	IN CLASS
		6	NO CLASS–Fall Break		
14		11	Propellant Performance	*Week 9*	6.1–6.3
15		13	Chemical Reactions		6.4
16		18	Thermochemical Calculations	*Week 10*	6.4
17		20	Liquid Propellant Rockets		7.1–7.3
18		25	Liquid Propellant Rockets	*Week 11*	7.1–7.3
19		27	Auxiliary Systems		7.4–7.7
20	November	1	Combustion Properties	*Week 12*	8.1–8.4
21		3	Combustion of Liquid Propellant		9.1–9.2
22		8	Combustion Instabilities	*Week 13*	9.3
23		10	Liquid Rocket Systems		10.1–10.9
24		15	Liquid Rocket Systems	*Week 14*	10.1–10.9
		17	NO CLASS—Thanksgiving		
25		22	EXAM II	*Week 15*	IN CLASS
26		24	Solid Rocket Systems		11.1–11.2
27		29	Grain Configurations	*Week 16*	11.3–11.4
	December	1	NO CLASS–Study Period		
28		6	FINAL EXAM (TBD)	*Week 17*	IN CLASS