EM300 Principles of Propulsion

United States Naval Academy
Mechanical Engineering Department

Catalog Description: EM300 Principles of Propulsion **Credit:** 4 (3-2-4)
Designation: Required, core for non-engineering majors

A study of naval engineering systems, including the principles of energy conversion and the basic operation of steam, gas turbine and internal combustion power plants, fluids, hydraulics, heat exchanger, air conditioning, and refrigeration.

Prerequisites: SP211 – General Physics I

Textbooks: EM300, Naval Engineering: Propulsion and Auxiliary Systems, Course Notes (ISBN# 978-0-8400-0267-9), *Required*

Course Director: CDR K. J. Leeds, P.E.

Course Content:

No.	Topic or Subtopic	hrs.
1	Introduction	1
2	Fundamentals of Thermodynamics	4
3	Fluid Flow and Centrifugal Pumps	5
4	Hydraulics	1
5	Gas Power Cycles	8
6	Gas Turbines	10
7	Steam Properties and Steam Power Cycles	8
8	Heat Transfer	3
9	Refrigeration	4
10	Desalination	1
11	Review	3
	Laboratory Exercises	14

Assessment Methods *(Use capital letters)***:**

		YES	NO
A	Quizzes	X	
B	Homework	X	
C	Exams	X	
D	Laboratory Reports	X	
E	Oral Presentations		X
F	Design Reports/Notebooks		X
G	Prototypes/Demonstrations	X	
H	Projects		X
I	Other		X

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Course Outcomes[1]

1. Effectively convert from one system of units to another. Use the unique units and ranges found on pressure gages in Naval systems. Use the unit analysis method to verify solution is in desired units. (A,B,C,D)
2. Interpret basic system and equipment schematics for fluid flows, thermodynamic processes, and/or basic feedback control signals. (A,B,C,D)
3. Use Bernoulli's Equation to solve pipe fluid flow problems. Determine major and minor system head losses. (A,B,C,D)
4. Apply dynamic Pump Affinity Laws to determine the change in volumetric flow rate, pump head, and power required with changes in pump configuration and speed for variable displacement and fixed displacement pumps. (A,B,C)
5. Identify the basic components of Reciprocating Engines and describe the Otto and Diesel cycle. Use Ideal Gas Law relationships to determine cycle parameters, performance, and efficiency. (A,B,C,D,G)
6. Describe the Brayton (a.k.a. Gas Turbine) cycle. Use *Air Tables* to determine cycle parameters, performance, and efficiency. (A,B,C,D,G)
7. Describe the Rankine (a.k.a. Steam) cycle, both conventional and nuclear variants. Use *Steam Tables* to determine cycle parameters, performance, and efficiency. (A,B,C,D)
8. Describe how Vapor Compression refrigeration plants operate. Use pressure-enthalpy (p-h) charts to determine cycle parameters and performance, including coefficient of performance (COP). (A,B,C,D,G)
9. Describe how ventilation systems cool air. Use a Psychrometric chart to determine air properties. (A,B,C)
10. Describe the construction of common heat exchangers. Use heat transfer relations to determine transfer of heat between different systems. Understand the source and effect of fouling on heat exchanger performance. (A,B,C,D,G)

[1] Letters in parenthesis refer to the assessment methods listed in the previous section.

	Course Outcomes									
Program Outcomes	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(a)	X	X	X	X	X	X	X	X	X	X
(b)										
(c)										
(d)										
(e)	X	X	X	X	X	X	X	X	X	X
(f)										
(g)										
(h)										
(i)										
(j)										
(k)		X	X		X	X	X	X		X

Date of Latest Revision: 17 MAY 2010, CDR K. J. Leeds, P.E.