

**United States Naval Academy
Mechanical Engineering Department**

Catalog Description: EM441 Directed Energy: Naval Applications of Lasers

Designation: Elective, engineering major

Credit: 3 (3-0-3)

This course will provide students with an introduction to the use and control of Directed Energy Systems. Topics covered include Propagation of Directed Energy, Atmospheric Effects and Modeling and Simulation of a Directed Energy Beam. In addition, an overview of the technology and analysis needed to understand and design the beam control systems that accomplish acquisition, tracking, and pointing will be discussed. Guest speakers who are experts in these fields will complement the lecture series.

Prerequisites: SM212 – Differential Equations, SP212 General Physics II.

Textbooks: None

Course Director: Cody J. Brownell

Course Content:

No.	Topic or Subtopic	hrs.
1	Introduction	1
2	Maxwell's Equations	6
3	Gaussian Beam Analysis	9
4	Energy Interaction with Matter	6
5	Propagation in a Vacuum - Diffraction	6
6	Absorption and Scattering	6
7	Turbulence	6
8	Project	2
9	Review/Exams	4
10	Guest Lecturers	2

Assessment Methods:

		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

Course Outcomes¹:

1. Use the basic laws of diffraction to describe beam propagation through a vacuum (A,B,C)
2. Use basic equations for absorption and scattering and determine the loss in irradiance due to propagation through a homogeneous medium (A,B,C)
3. Understand and use the wave equation solution to Maxwell's equations (A,B,C)
4. Understand the paraxial approximation to the wave equation solution (A,B,C)
5. Determine the power necessary at an aperture to deliver a specified irradiance at a given range. (A,B,C, D)
6. Understand the basic physics involved in the interaction of a directed energy beam with matter (A,B,C)
7. Understand the basic non-linear effects such as turbulence and thermal blooming on the propagation of a directed energy beam in random media (A,B,C, D)

¹ Numbers in parenthesis refer to the evaluation methods used to assess student performance.

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

Date of Latest Revision: 30 Oct 2017, Cody Brownell