United States Naval Academy
Mechanical Engineering Department

Catalog Description: EM371 Introduction to Design **Credit:** 3 (2-2-3)
Designation: Required, engineering sciences and design

Fundamentals of mechanical design, with emphasis on the design of pertinent machine elements. Course begins by introducing the fundamentals of static and fatigue failure theories, and from there, addresses the design of basic machine elements such as fasteners, bearings, gearing and shafts. The course also builds on the fundamentals of design introduced in earlier courses by introducing the concepts of customer requirements, specification development, reverse engineering, functional decomposition, and design for assembly/manufacturing.

Prerequisites: EM217-Strength of Materials, EM232-Dynamics
Corequisites: **None**
Textbook: Richard G Budynas and J. Keith Nisbett, *Shigley's Mechanical Engineering Design*, 9th edition, McGraw-Hill, 2017.

Course Director: Professor Stephen M. Graham

Course Content:

No.	Topic or Subtopic	hrs.
1	Review of Mechanics	4
2	Stress Concentrations/Residual Stress	1
3	Static Failure Theories	5
4	Fatigue Failure Theories	8
5	Threaded Fasteners	7
6	Gears	8
7	Rolling-element Bearings	3
8	Shaft design	3
9	Reverse Engineering Design Project	12

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 Outcomes

1. Apply static failure theories to calculate factor of safety against brittle failure, yielding, or buckling.
2. Apply fatigue failure theories to calculate the factor of safety against fatigue failure or the finite fatigue life for (1) zero mean and non-zero mean cyclic loads (2) combined axial, bending and shear loading (3) structures with a stress concentration (4) variable cyclic loading.
3. Design shafts based on static loading, fatigue and deflection considerations.
4. Design and analyze bolted joints for both static and fatigue loading conditions.
5. Select bearings to obtain a particular lifetime considering pertinent design attributes.
6. Analyze simple and planetary spur gear trains to determine reduction ratios and fatigue life for gear tooth bending and contact.
7. Work with a team to reverse engineer a mechanical device or system.

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

Date of Latest Revision: **3**1 October 2017, Professor Stephen M. Graham