

**EM313 Materials Science United States Naval Academy  
Mechanical Engineering Department**

**Catalog Description:** EM313 Materials Science

**Credit:** 4 (3-2-4)

**Designation:** Required, engineering sciences

An introductory course in physical and mechanical properties of engineering design materials, ceramics and plastics, their structures, use in engineering applications and failure phenomena. All laboratory projects are structured to provide strong physical illustrations for the topics covered in the lectures.

**Prerequisites:** None

**Corequisites:** None

**Textbooks:** Fundamentals of Materials Science and Engineering: An Integrated Approach, 3rd Edition, William D. Callister, David G. Rethwisch

**Course Director:** Prof. Angela Moran

**Course Content:**

| <b>No.</b> | <b>Topic or Subtopic</b>  | <b>hrs.</b> |
|------------|---|-------------|
| 1          | Materials Selection   | 1           |
| 2          | Atomic Bonding  | 2           |
| 3          | Crystal Structure   | 3           |
| 4          | Defects/Microscopy  | 2           |
| 5          | Diffusion   | 2           |
| 6          | Mechanical Properties   | 4           |
| 7          | Strengthening/Annealing   | 3           |
| 8          | Fracture/Fatigue/Creep/Fractography/Impact Testing                              | 4           |
| 9          | NDE   | 2           |
| 10         | Solidification, Casting and Welding   | 4           |
| 11         | Phase Diagrams, Phase Transformations, Nucleation and Growth, Thermal Processes | 10          |
| 12         | Other Alloys  | 2           |
| 13         | Ceramics  | 2           |
| 14         | Composites  | 3           |
| 15         | Polymers  | 2           |
| 16         | Corrosion and Wear  | 2           |
| 17         | Fabrication and Processing  | 4           |
| 18         | Materials Selection in Design   | 3           |

**Assessment Methods:**

|                              | YES | NO |
|------------------------------|-----|----|
| A. Quizzes                   | X   |    |
| B. Homework                  | X   |    |
| C. Exams                     | X   |    |
| D. Laboratory reports        | X   |    |
| E. Oral presentation         | X   |    |
| F. Design reports/notebooks  |     | X  |
| G. Prototypes/demonstrations | X   |    |
| H. Projects                  | X   |    |
| I. Other evaluation tools    |     |    |

**Course Outcomes<sup>1</sup>:**

1. Explain the relationship between the microstructure of engineering materials and the mechanical and physical properties of these materials. (A,B,C,D)
2. Demonstrate some of the common laboratory tools used to characterize the structures of engineering materials.( D,G,H)
3. List various mechanical properties of engineering materials that can influence material selection decisions and explain the various testing methods for evaluating these properties. (A,B,C,D,G)
4. Describe and recognize various types of material failure. (A,B,C,D,G,H)
5. Explain how thermal and mechanical processing influence and control the structures and properties of engineering materials and use conceptual tools to make predictions of processing effects. (A,B,C,D,G)
6. Describe how the environment can influence the properties of engineering materials. (A,B,C,D,G,H)

<sup>1</sup> Letters in parenthesis refer to the assessment methods listed in the previous section.

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

**Date of Latest Revision:** 24 APR 2010, Prof. Angela Moran