

ESM 334 Materials Engineering (Elective)

Course Catalog description:

Practical application of basic material and engineering concepts to fundamental and advanced material utilization. To that end, the course is divided into three sections: (1) "Tough stuff," (2) "Hot stuff," and (3) "Smart stuff." Combined, these address issues of material operation and failure under normal and harsh conditions, high-temperature electrochemical devices (e.g. solid oxide fuel cells), thermal barrier coatings, electro-magnetic devices and shape memory alloys.

4 credits

Pre- or Corequisite(s): ESG332 Materials Science I: Structure and Properties of Materials

Text(s) or other required material:

Richard A. Flinn, Paul K. Trojan, Engineering Materials and Their Applications, 4th ed., 1994, Wiley, ISBN: 0471125083

M. Ashby et al., *Engineering Materials 2*, second edition, Butterworth Heineman

Course learning outcomes:

Case-study based property-process-application relations of materials, Independent literature searching of advanced and modern material topics, In-depth investigation of experimental data.

Topics Covered:

Week 1. Overview of Engineering Materials, Addresses structure, properties and applications and relevance to design and engineering

Week 2. Crystals and Crystal Structure - Review Computer based instruction reviewing bonding and various lattice structures

Week 3. Phases Definitions and examples

Week 4. Phase Diagrams, Control of Structure under Equilibrium Conditions Origin, significance and utility in materials engineering. Study of binary diagrams

Week 5. Non-Equilibrium Structures Equilibrium versus real world situations in materials processing and engineering

Week 6. Mechanical Properties (Effect of Stress on Structure) Computer based instruction of stress strain curves, dislocations etc. Fracture toughness and reliability issues in ceramics. Design implications of structure-property relationships

Week 7. Processing of Metals, Differentiate processing of metals, ceramics and polymers and relevance to design and fabrication

Week 8. Steels and Ferrous Alloys (including examples of applications and utility in design)

Week 9. Non-Ferrous Alloys

Week 10. Ceramics, Overview, Processing, and Applications

Week 11. Polymers, Overview

Week 12. Composites, Overview and Applications

Week 13. Biomaterials

Week 14. Materials Selection and Design. Important aspects of materials in design and engineering of structures and components. Open ended problems addressed in class through question and answer sessions. Explore Construction of Ashby materials selection maps.

Class/ Laboratory Schedule:

ESM	334	Materials Engineering	LEC	1	TUTH	12:50 PM	2:10 PM
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Contribution of Course to meet requirement of Criterion 5:

Engineering Science 20%, Laboratory Experience 0%, Mathematics 20%, Basic Science 20%, General Education 20%, Design Experience 20%

Relationship of course to program outcomes:

Person(s) who prepared this description and date of preparation: