

SE 2 Structural Materials

Designation : Required Course for AE

Catalog Data :

SE 2 Structural Materials (4)

Structure of engineering materials (metals, ceramics, concrete, composites) tailored to produce desired properties and response in structural components and systems. Mechanical tests, elasticity, plastic deformation, fracture, toughness, creep and fatigue. Selection based on performance requirements/applications.

Prerequisites: Chem 6A, Phys 2A

Textbook, Other Required Material: Foundations of Materials Science and Engineering, William F. Smith and Javed Hashemi. 4th Edition, McGraw Hill.

Class/Laboratory Schedule: Class: Mondays and Wednesdays 7:30 am – 8:50 am, i.e. a total of 3 hours of class-room instruction per week Laboratory: Fridays, equivalent of one hour per group.

Course Objectives

(Numbers in parentheses relate to MAE Program Outcomes)

- a. To provide a general introduction to classes of structural materials, their performance attributes, and structural response under common load regimes (1a, 2b).
- b. To provide a thorough understanding of the basic principles of materials selection as required in a variety of applications (1a, 3c, 5e, AE12).
- c. To teach students to identify design/service requirements and how to relate those needs to engineering performance attributes and hence to the selection of appropriate materials (1a, 3c, 5e, AE12)

Topics Covered

1. Motivation and need for differentiation and selection
2. Classes of materials and basic differences
3. Atomic Bonding and structure
4. Defects and Imperfections
5. Mechanical properties and failure
6. Selection based on strength and stiffness
7. Selection based on fatigue and/or toughness
8. Selection based on creep
9. Selection based on service temperature
10. Selection based on durability
11. Design characteristics, safety factors, design responsibility
12. Materials selection case studies

Method of Assessment and Evaluation

1. Weekly homework assignments including short essay type questions and questions designed to build problem formulation and solving skills (10%)
2. Pop quizzes based on material covered in class (15%)

3. Laboratory exercises and projects based on testing and characterization of materials to be submitted as structured reports (15%)
4. Mid-terms, including questions aimed at materials selection, design, and analysis (15% each, i.e a total of 30%)
5. Final (30%)

Relationship of Course to Program Outcomes

The course is structured to provide a thorough understanding of materials and their performance attributes while building on aspects of Structural Engineering already introduced in SE1. The course contents enable the development of the student's ability to apply principles of mathematics, physics and chemistry through the discipline of materials science to structural components, assemblies and systems (a,e). The structure of the course requires students to begin to identify, formulate and solve engineering problems through the correspondence of material performance attributes to application and design requirements (e, c). The laboratory exercises and project emphasize functioning in teams, whereas the assignments, project and reports build skills in written and verbal communication. The aspects of professional responsibility and ethics are emphasized through discussions, exercises and case studies relating to real world applications and the implications of materials selection and design choices (f).

Contribution of Course to Professional Component:

The course provides the basis for the design component while simultaneously exposing students to a multi-disciplinary environment and the impact of engineering choices on design. It provides the basis for breadth in the applications of the students' knowledge to aerospace, civil, mechanical and naval/offshore structures.

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