

MeEn 331

ENGINEERING MATERIALS & SELECTION

A 'Required Course' in Mechanical Engineering Program

2002-2004 Course Description: MeEn 331 Engineering Materials & Selection – (Credit, 3 Hours) (Lecture, 3 hours, Lab. 2 hours). Theory of equipment and techniques used in materials testing and characterization, hot and cold working of metals, alloys and alloying elements in steels, advanced materials, materials selection, and failure analysis, powder metallurgy, heat treatment, corrosion, and the joining of metals. Individual/team projects will be assigned. **Prerequisites: MeEn 227, MeEn 330**

Textbook: *Materials Science and Engineering: An Introduction*, by William D. Callister, Jr., 6th Edition, John Wiley and Sons, Inc, 2002.

Lecture: M W F 9:00-9:50 AM, in Room No. 151, Pinchback Engineering Building

Laboratory: W 2:00-3:50 PM; in Room No. 107, Engineering West Building

Course Coordinator: Dr. Ravinder M. Diwan, Professor
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References:

1. *Materials Selection in Mechanical Design*, by: M.F. Ashby, 2nd Edition, Butterworth-Heinemann, Oxford, 1999.
2. *Engineering Materials and Their Applications*, by: R. A. Flinn and P. K. Trojan, 4th Edition, Houghton Mifflin Company, Boston, 1990.
3. *Metals Handbook*, American Society for Materials ASM, 9th and 10th Editions, ASM International, Materials Park, Ohio.

Course Topic

1. Materials Mechanical Properties and Behavior (Chapter 6) Sections 6.1-6.12
2. Strengthening Mechanisms (Chapter 7) Sections 7.4-7.13
3. Fracture, Fatigue, Fracture Mechanics (Chapter 8) Sections 8.1-8.17
4. Viscoelastic deformation of Polymers (Chapter 15) Sections 15.3-15.7
5. Phase Transformations, Behavior of Steels (Chapter 10) Sections 10.1-10.9
6. Applications, Processing of Alloys (Chapter 11), Sections 11.1-11.9
7. Composite Materials (Chapter 16), Sections 16.1-16. 16.15
8. Corrosion and Degradation of Materials (Chapter 17), Sections 17.2-17.10
9. Materials Selection Principles and Applications (Chapter 6, 8 and Reference Sections)
10. Case Studies and Materials Assignments

Laboratory Assignments: (Lab. 2 hrs/ week)

1. Metallographic Analyses
2. Hardness Testing - hardness/structure/heat treatment
3. Heat Treatment of Steels
4. Tensile Testing
5. Hardenability Test
6. Impact Testing
7. Materials Failure Analysis Assignments
8. Materials Selection Assignments

Prerequisite by Topic:

1. MeEn227: Strength of Materials
Understanding of fundamentals of strength of materials including simple stress and strain, shear stress, stress concentration, failure theories, impact loads and residual stress.
2. MeEn 330: Material Science and Engineering
Materials science principles including atomic structure and interatomic bonding, crystallographic structure, x-ray diffraction, crystallographic imperfections, and diffusion.

Course Objectives:

1. To develop in students knowledge and skills related to the theory and techniques used in materials mechanical properties testing and processing.
2. To develop in students knowledge and skills required for failure analysis of materials in service.
3. To develop in students knowledge and skills to analyze potential materials concepts and problems including polymers, alloys and composites and their effects in materials processing and applications
4. To develop in students knowledge and skills required to analyze material properties as well as material failures for appropriate material selection for selected applications.

COURSE ASSESSMENT:

Course Objective	Intended Educational Outcomes	Means of Assessment	Criteria of Success	Program Edu. Objectives/ ABET (a-k, Me1-Me6)
<p>Objective 1: To develop a clear understanding of the theory and techniques used in materials processing.</p>	<p>1.1 Students will become familiar with standard materials processing procedures, including deformation and thermal processing.</p> <p>1.2 Students will demonstrate an understanding of micromechanical processes that occur during materials processing and control material behavior.</p> <p>1.3 Students will demonstrate understanding of how materials processing affects materials properties.</p> <p>1.4 Students will demonstrate an ability to analyze strengthening by strain hardening, solid solution, precipitation hardening, and grain size reduction.</p>	<p>1. Locally developed exams and quizzes</p> <p>2. Course opinion survey</p> <p>3. DCE course score</p> <p>4. BKS Competencies Evaluation</p>	<p>1- 85% passing rate</p> <p>2- 90% positive response</p> <p>3- 70% passing rate</p> <p>4- 80% will achieve critical level of performance (CLP)</p>	<p>Edu. Objective: 1, 2, 3</p> <p>ABET: a, c, e, g, and, k</p>
<p>Objective 2: To develop a clear understanding of forensic and failure analysis of materials in service.</p>	<p>2.1 Students will learn characteristics of typical materials failures and mechanisms of failure.</p> <p>2.2 Students will demonstrate an ability to analyze material failures and determine modes and/or mechanisms of failure.</p> <p>2.3 Students will demonstrate the ability to perform calculations in fracture mechanics pertaining to problems of material failure, and fracture toughness concepts.</p> <p>2.4 Students will learn about cyclic stresses, fatigue and crack initiation and propagation in fatigue..</p>	<p>1. Locally developed exams and quizzes</p> <p>2. Course opinion survey</p> <p>3. DCE course score</p> <p>4. BKS Competencies Evaluation</p>	<p>1- 85% passing rate</p> <p>2- 90% positive response</p> <p>3- 70% passing rate</p> <p>4- 80% will achieve critical level of performance (CLP)</p>	<p>Edu. Objective: 1, 2, 3</p> <p>ABET: a, c, e, g, k, Me1, and Me4 l</p>
<p>Objective 3: To develop an understanding of potential material problem areas and how they affect component design and materials processing.</p>	<p>3.1 Students will demonstrate an understanding of potential materials problems and testing and processing with laboratory exercises and group assignments.</p>	<p>1. Locally developed exams and quizzes</p> <p>2. Course opinion survey</p> <p>3. DCE course score</p> <p>4. BKS Competencies Evaluation</p>	<p>1- 85% passing rate</p> <p>2- 90% positive response</p> <p>3- 70% passing rate</p> <p>4- 80% will achieve critical level of performance (CLP)</p>	<p>Edu. Objective: 1, 2, 3</p> <p>ABET: a, c, e, g, and k</p>
<p>Objective 4: To learn how to use and analyze material properties as well as material failures for appropriate material selection for mechanical engineering systems.</p>	<p>4.1 Students will demonstrate the ability to examine materials properties for proper materials selection for engineering components/applications.</p> <p>4.2 Students will demonstrate the ability to consider potential materials problems in materials selection and to determine appropriate methods to eliminate failures.</p> <p>4.3 Students will demonstrate an ability to analyze materials failures through case studies and determine appropriate methods to rectify problems and/or identify steps that would prevent the problem.</p>	<p>1. Locally developed exams and quizzes</p> <p>2. Course opinion survey</p> <p>3. DCE course score</p> <p>4. BKS Competencies Evaluation</p>	<p>1- 85% passing rate</p> <p>2- 90% positive response</p> <p>3- 70% passing rate</p> <p>4- 80% will achieve critical level of performance (CLP)</p>	<p>Edu. Objective: 1, 2, 3</p> <p>ABET: a, b, c, e</p>

ABET Category Content (as estimated by faculty member who prepared this course description):

Engineering Science: 2.5 credits or 83%
 Engineering Design: 0.5 credit or 17%

Prepared by: Ravinder M. Diwan

Date: 01/28/ 2003